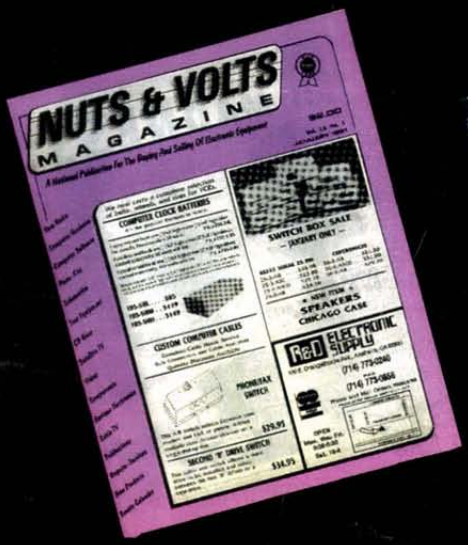
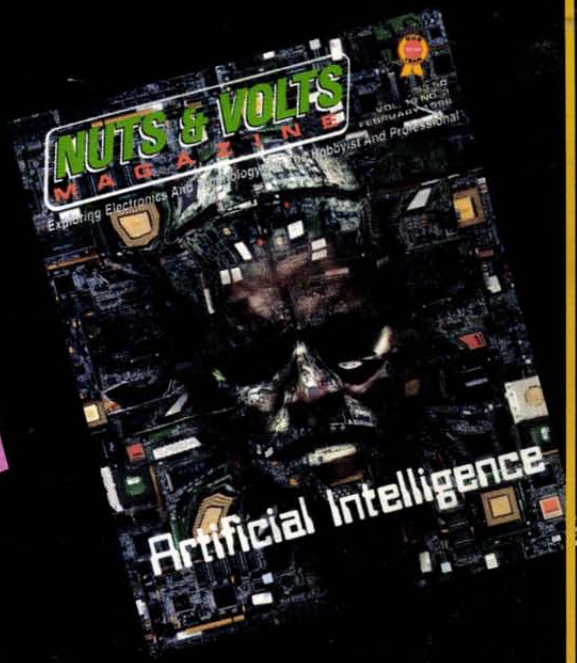
Nuts & Volts

Exploring Electronics And Technology For The Hobbyist And Professional

January 1999 Vol. 20 No. 1





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- 4 DIMM RAM sockets, parity or non-parity, ECC, EDO, FP
- On-board 2 x IDE, 2 x 16550 Serial ports, 1 parallel port
- New, 90-day warranty (CPU not included)

HSC# 80437 **$49.95**

- ATX style Midtower case, fits above motherboard
- "Netpower" logo on front, never used, 90-day warranty

HSC# 17517 **$29.95**

Fujitsu 1 GB Drives

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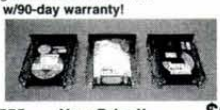
- Tested good and DOS formatted
- Used - **w/90-day warranty!**



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- Supports up to 384MB memory (72-pin SIMMs)
- Comes with instruction book, I/O Cables & bracket
- New in box, 90-day warranty

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- ***W6-LI "Lightning"*** dual CPU board has 4 PCI, 2 ISA slots
- Dual Processor motherboard, can use 1 or 2 CPU chips
- Comes with **one** tested 150 MHz CPU installed
- Voltage Regulator Module for second CPU included
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- These handsome hardshell cases were used to carry a laptop-computer estimating system (laptop not included)
- They were used with a Compaq LTE laptop, and provided a SCSI port for a CD-ROM drive with battery back-up
- Large Nicad pack has 10 Sanyo Cadnica cells.
- Built-in 19VDC power supply for battery charging
- Tiny piggy-back PC board seems to be a SCSI interface
- Case measures 18" x 14" x 7", with several compartments
- SCSI II to CEN50 SCSI cable, many great parts inside!
- Buy either the whole assembly, or just the parts you want!
- Not guaranteed to function with laptops -- for parts only!

HSC#17180 Complete Laptop Case **$29.95**
HSC#17182 Empty Hardshell Case **$15.00**
HSC#17181 Nicad Pack, 12.5VDC, 5AH **$17.50**
HSC#17179 SCSI II Cable, 1 ft. long **$12.50**

Video-hacker Dream!

- Logitech Videoman Video-conference camera & interface
- These units were sold with Hewlett Packard S-700 workstations for videoconference capability
- We do not have technical data, software or manuals
- All we have is cameras with stand, and SCSI-II interface
- The camera is on a weighted stand that extends from 13" tall to over 20" tall, and has a stereo microphone
- Color camera is digital output only (not NTSC) as far as we can tell -- but who knows?
- Interface box has two SCSI-II ports on back, and a DC power input (we do not have the adapter), and on the front it has a mic. out jack, composite video out (BNC), and the connector for the camera cable.
- Note: HP and Logitech will provide no information on these

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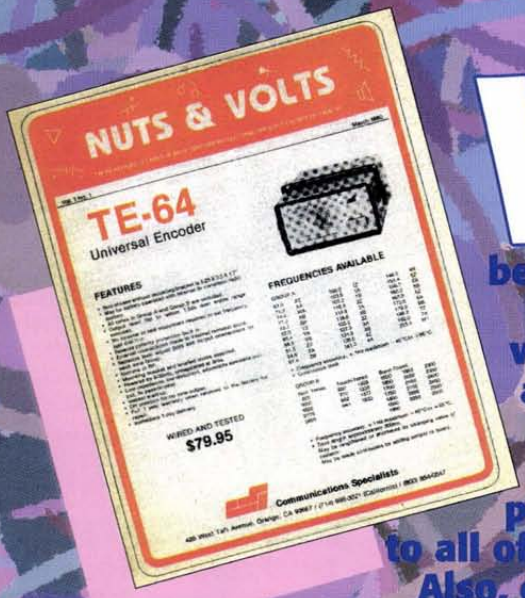
Write in 82 on Reader Service Card.

It's our 20th year, and we're ready to ...

CELEBRATE



We're looking forward to a stellar year in 1999, and we hope you'll be a part of it. We'll be implementing a lot of new programs this year for both the magazine and the website, plus we'll be giving existing features a face-lift.

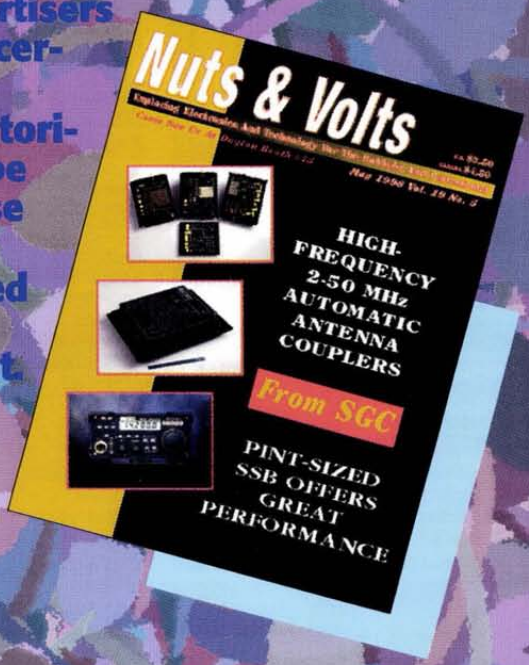
For example, our website will be undergoing various changes over the next several months, and we will be offering things like a subscriber-only section, an extensive search engine for our index of articles, an electronics chat-room, plus we plan on having links from our website to all of our display advertisers.

Also, each month we will be having a prize drawing in which paid subscribers are automatically entered (see page 64). Prizes are provided by our display advertisers and will include both merchandise and gift certificates.

Plus, we will be starting up some new editorial and reader-interactive features, so we'll be on the look-out for new contributors to these sections. And, we'll be having some special "20th Year" promotional offers, so stay tuned for those.

We hope you'll be a part of the excitement. As we head toward the millenium, it will be increasingly important to stay on the cutting edge.

And that edge is where *Nuts & Volts* plans to be!!



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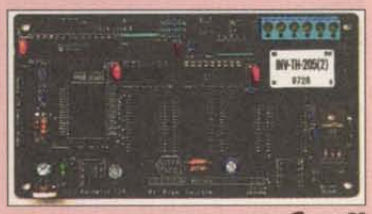

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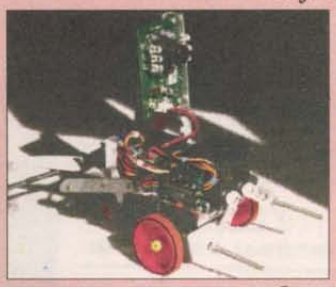

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YOUR HOTTEST TOOL MAY BE ICE!
Been drooling over the thought of owning your own In Circuit Emulation tool? Here's one for under $130.00!

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INEXPENSIVE DIGITAL TIMER
Never ruin another circuit board again with this handy device that shuts off the exposure time automatically.

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Three convenient sizes of graphic LCD displays offer complete display solutions for most embedded and PC applications.

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Your Hottest Tool May Be *ICE* !!

by Tim Deagan KC5QFG

To a professional microcontroller developer, few tools are as useful as In Circuit Emulation, or ICE. The ability to test code while connected to the hardware it will run is a tremendous time-saver. Traditionally, ICEs can cost $10,000.00 and up. Hobbyists on a micro-budget may drool at the thought of owning one, but that's about all.

Even though the PIC world has brought ICE prices down, $500.00 is still considered low-cost. Nevertheless, an ICE exists that you can buy today, for under $130.00! It's the PIC ICE II from Leading Edge Technology Ltd.

Operating from Malta (yes, the island in the Mediterranean), Leading Edge is not well known in the United States. They have one distributor in the UK — Crownhill Associates. Yet other than the web sites of those companies, there is almost no information to be found about the PIC ICE II. Still, the information you can find is very enticing!

First and foremost is the price, £59.95 (GBP) + £6.50 (GBP) shipping. In November '98, that came out to $112.51 (US)! Even with big fluctuations in the exchange rate, that's an incredible price.

But what do you get for one-fifth the price of any other ICE? The web site lists an impressive feature set:

- Emulates all 18 and 28 pin PICs.
- Works from a standard printer port.
- On board four-channel A/D with A3 ref or VCC ref and a conversion rate of 17µS.
- OSC2 output.
- RTCC input.
- Text Editor, Assembler, Disassembler, and Simulator/Tracer.
- Single step, Go with Breakpoints, Change any register at any time, and Go without Breakpoint.
- A speed command in the editor assembler allows fine tuning, (measure OSC2 output for real-world speed calculations).
- Full 12-month guarantee.

Let's look at these features, all of which are true, but perhaps not in the way you might expect ...

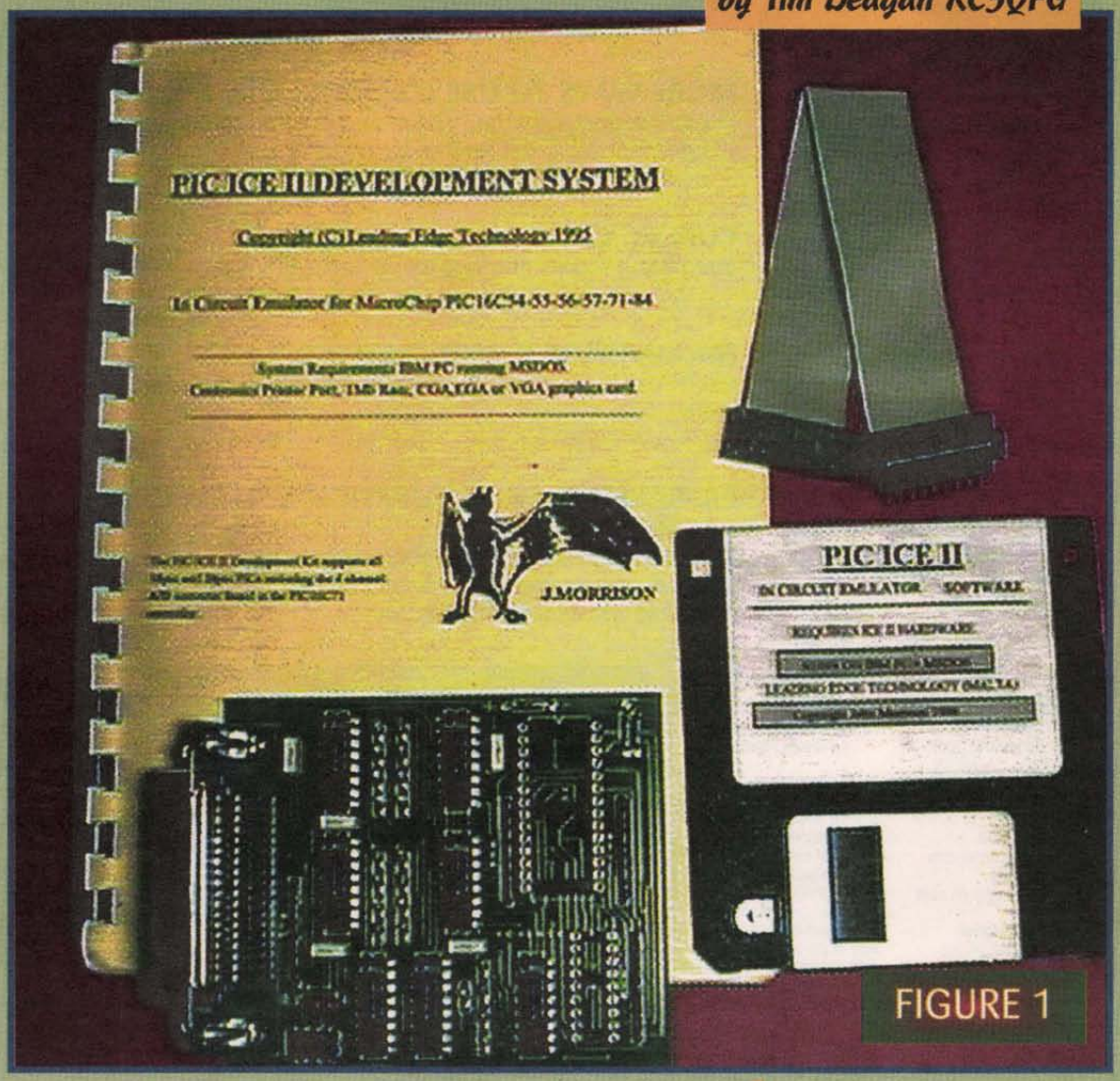

FIGURE 1

The Components

International delivery of the PIC ICE II took three weeks. When it arrived, the envelope contained a manual, printed circuit board, 18-pin ribbon cable, and a floppy disk.

The manual consists of six front-sided pages of ICE information and three schematics for PIC circuits. Like many technical product documents, 'terse' would be an accurate description. While all the information needed to successfully use the PIC ICE II is provided, it may take a few reads through to figure this out. Luckily, the brevity makes it easy to reread a number of times.

The printed circuit board has a standard female Centronics plug for connection to a parallel port. Two DIP sockets — an 18-pin and a 28-pin — allow connection through a ribbon cable to the test circuit. These ribbon cables have male DIP connectors on each end, allowing you to plug into the sockets where your PIC would go. The ribbon cable for the 18-pin was included, but the 28-pin cable was missing. Surprisingly enough, none of the major supply houses (Mouser, Digi-Key, JDR, Jameco) carry 28-pin DIP ribbon cable headers or pre-made cables. Somewhere this part, or its components, is available for a couple of bucks. But without it, the ICE is not usable for emulating the 28-pin PICs. Leading Edge has been E-Mailed about the cable omission, but had not replied as of this writing.

The diskette contains the main program in two versions: DEV54 for the 12-bit PICs and DEV71 for the 14-bit PICs. OBJ2BIN is included to convert a standard (Intel INHX8M) Hex file to the binary image format the software uses. Some test, conversion, and assembly examples are also included.

Using the PIC ICE II

The first thing that will slow down a lot of users is the speed. The PIC ICE II does not use a bond-out chip, i.e., a PIC with extra circuitry to return information about the processor internals. Instead, the PIC ICE II is a software simulator that extends its I/O out the parallel port. This design is quite clever and accounts for the low cost of the unit. However, it also means that the PIC ICE II runs at a speed dependent on the computer to which it is attached. This gives it a max speed of 7.12 KHz on a 16-MHz 386SX and 15.52 KHz on a 100-MHz 486.

The manual suggests using a

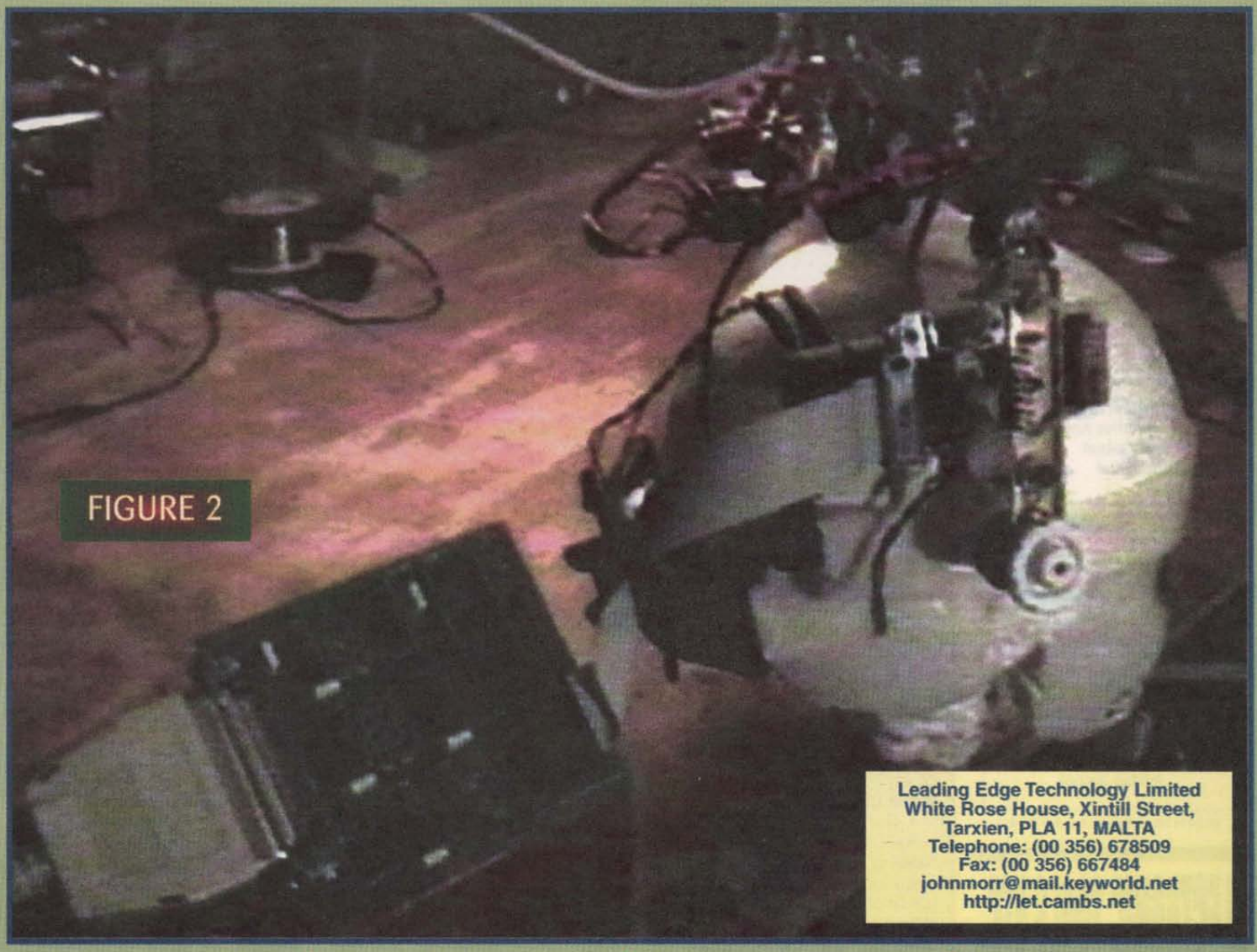

FIGURE 2

Leading Edge Technology Limited
White Rose House, Xintill Street,
Tarxien, PLA 11, MALTA
Telephone: (00 356) 678509
Fax: (00 356) 667484
johnmorr@mail.keyworld.net
http://let.cambs.net

stand-alone printer port card and adjusting the port clock speed in BIOS if available, but it's unlikely that even 1 MHz is attainable. This alone will dissuade many potential buyers. Nevertheless, it's worth pausing for a moment and thinking about what this really impacts. It means that real-time and serial port applications are tricky, if not completely impossible. Any timing-dependent project will take a lot of thought. The OSC2 does output at 1/4 the clock speed and software allows you to modify (slow down) the 'clock,' so synchronization is not completely out of the question.

Power is another area to note. The PIC ICE II is powered by the circuit under test. Any difference between the VCC in your circuit and the VCC from your parallel port can cause problems. Since parallel ports use a VCC of 5V, your circuit must provide 5V. The documentation goes on to note that 5.5V or 3.6V will not work. Many PICs have operating ranges that allow operating voltages of other than 5V. These circuits are not candidates for the PIC ICE II.

With a few exceptions, PIC microcontrollers can source either 20 or 25mA and sink 25mA per I/O pin. When used as outputs, the PIC ICE II sources 15-20mA per pin, but can only sink 2mA. Greater sink currents are achieved by adding pull-down resistors to the test circuit. This is described as a feature, not a bug, to keep novice users from damaging the PIC ICE II by port contention. Warning that it will void the warranty, directions are given on how to replace specific diodes with shunts and achieve greater sink currents. Using the I/O pins as inputs requires pull-up resistors tied to 5V to achieve a logic level 1.

```
Line : 00009      Char: 01    Memory : 01051    PIC-DEV16C71/84 Version 5.06
F1 Help  Esc quit.      lights71.asm              (C) John Morrison 1994/5.

:-------------
:  - Running
:  Demo for P
:  LEDS conne
:  Use 3mm Le
:-------------
rtcc
porta
portb
time_temp
wait_counter
:

begin
```

```
ADDLW  (W+k)->W                MOVLW k->w
ADDWF  (W+f)->d                MOVF f->d
ANDLW  (W & k)->W              MOVWF W->f
ANDWF  (W & f)->d              NOP no op
BCF  bit clr f.b               OPTION W->Option
BSF bit set f.b                RETFIE Tos->Pc.gie
BTFSC skip if f(b)=0           RETLW  k->W.Tos->pc
BTFSS skip if f(b)=1           RETURN Tos->pc
CALL addr                      RLF  Left shift f
CLRF 00->f                     RRF  Right shift f
CLRW 00->W                     SLEEP Tired?
CLRWDT 00->wdt                 SUBLW (k-W)->W
COMF  /f.d                     SUBWF (f-w)->d
DECF (f-1)->d                  SWAPF  f.d
DECFSZ (f-1)->d. skip if 00    TRIS  f
GOTO addr                      XORLW (W xor k)->W
INCF (f+1)->d                  XORWF (W xor f)->d
INCFSZ (f+1)->d. skip if 00    ------------------
IORLW (W or k)->W              : jc.jnc.jz.jnz.jmp
IORWF (W or f)->d              :------------------
```

FIGURE 3

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```
0000 3000 begin     movlw  00          File  Bin      Hex : File  Bin      Hex
0001 1683           bsf        03,5    00 00000000 00   : 18 00000000 00
0002 0085           movwf      porta   01 00000001 01   : 19 00000000 00
0003 0086           movwf      portb   02 00000011 03   : 1A 00000000 00
0004 1283           bcf        03,5    03 00111000 38   : 1B 00000000 00
0005 3040           movlw  040         04 00000000 00   : 1C 00000000 00
0006 0086           movwf      portb   05 00000000 00   : 1D 00000000 00
0007 0085           movwf      porta   06 11111111 FF   : 1E 00000000 00
0008 201F right     call       wait    07 00000000 00   : 1F 00000000 00
0009 0C86           rrf        portb   08 00000000 00   : 20 00000000 00
000A 1C03           btfss      03,0    09 00000000 00   : 21 00000000 00
000B 2808           jmp        right   0A 00000000 00   : 22 00000000 00
000C 0D86           rlf        portb   0B 00000100 04   : 23 00000000 00
000D 201F left      call       wait    0C 00000000 00   : 24 00000000 00
000E 0D86           rlf        portb   0D 00000000 00   : 25 00000000 00
000F 1C03           btfss      03,0    0E 00000000 00   : 26 00000000 00
0010 280D           jmp        left    0F 00000000 00   : 27 00000000 00
0011 0C86           rrf        portb   10 00000000 00   : 28 00000000 00
0012 0A85           incf       porta   11 00000000 00   : 29 00000000 00
0013 1D03           btfss      03,2    12 00000000 00   : 2A 00000000 00
0014 2808           jmp        right   13 00000000 00   : 2B 00000000 00
0015 3005           movlw  05          14 00000000 00   : 2C 00000000 00
Status : P1 P0 To Pd Z  Dc C    Option  15 00000000 00   : 2D 00000000 00
         0  1  1  1  0  0  0    '101000'  16 00000000 00   : 2E 00000000 00
WrkR:00000000 P0  Int:0 00000 0:1:0 111111  17 00000000 00   : 2F 00000000 00
```

FIGURE 4

The analog-to-digital converter performs as advertised, working the same as it would on a 16C71. Voltage reference is either VCC or the voltage on the A3 pin. According to the datasheet, a 16C71 can have a minimum conversion time of 2mS. The PIC ICE II can convert with a minimum time of 17mS.

The software is DOS-based, running under DOS versions 3-6.2. Starting up, the text editor is the first window. Users can write assembly language programs (Microchip mnemonics) and then run them in the Trace window. Previously saved files can be opened and edited as well. The commands for editing are somewhat obscure. A full range of features (i.e., cut and paste, search, delete line) exist, but constant referral to the manual is necessary. Little things like the home key always taking you to the top of the file instead of the beginning of the line are frustrating at first. While it does claim to cover all 18- and 28-pin PICs, the software was all written before 1996. The bottom line is that any program using the 16C84 or 16C54 instruction sets is supported.

Somewhat more challenging is the implementation of the assembler directives and formatting. Hex values require a leading zero (0FA) rather than a zero-x (0xFA) or trailing h (0Fah.) Instructions must be preceded on a line by either a space or a tab, equations must not. In addition, many assemblers refer to registers in the second code page with an address like 0x86 (TRISB). This is not legal in the PIC ICE II assembler. Addresses in the second code page require switching the code page bit and then referring to that address as 0x06.

While all of these are minor annoyances, no piece of assembler code that I had previously written or acquired elsewhere would assemble without some modification. It wouldn't take much to write a PERL script or QBASIC program that would convert the files, but it's not out there at the moment. A brief line in the manual states "We recommend using the internal text editor."

However, this does not mean integration is impossible. The software has the capacity to import a binary image file created elsewhere. This allows the internal disassembler to rebuild the source in a manner it is happy with. The down side is that there is no provision for importing symbol tables. Symbols can be added manually, and saved with the disassembled .asm file. Stock listings of standard EQU statements can be block-imported in the text editor as well; more opportunities for a utility that would strip and reformat symbols from a .lst or symbol file.

The real core of the product is the Trace screen. Usage is straightforward, you can change registers, single step, step over, run to a breakpoint, or run continuously. Symbols replace hex values in the assembler listing, so code maintains some readability. It's really exciting to watch internal registers change as your hardware interacts with the code. RISC code is easy to follow in this environment, since the changes per instruction are relatively small. The software does not provide any trace buffers or history features.

A list file from an assembler or compiler becomes tremendously valuable when running imported code. Code produced using the OBJ2BIN utility occasionally gets corrupted in the first couple of bytes. Careful comparison of the addresses of code routines helps in catching this quickly. Listings also preserve comments that do not show up in the Trace screen, making code more understandable. It's also worth noting that having an ICE doesn't lessen the value or importance of pure software simulation as a first step.

Tool or Toy?

We've covered a lot of ground, identified a number of caveats about the product, and hopefully started some thinking about the PIC ICE II. For myself, I went through stages with the product. First, excitement and curiosity about what I might get for this really low price. Then, after it arrived, I went through a stage of frustration. It took some time to understand how to use the ICE in relation to the other tools in my environment. I went back to basics, plugging the ICE into a breadboard with LEDs and simple circuits, and just experimented.

That's when the fun started. I began to play and get comfortable with the software. After a couple more attempts to import code, I managed to get a working system. I'm now positively excited about the PIC ICE II. Sure, the software could be brought up to date with a host of improvements, but the basic functionality is all there. It's worth considering that if you bought a parallel port extension card with a programmable oscillator, multiple digital I/O lines, and four A/D channels for about $100.00, it would be a reasonable deal. Toss in an integrated PIC emulator, disassembler and assembler and, even if you can't use it on every project, it's still a very cost-effective addition to your toolbox. The PIC ICE II is solid value for the money, opening up the ability to test code in-circuit to the hobbyist on a budget. **NV**

The U.S. Government always knows exactly what time it is...do you?

New clock from Arcron uses radio signals from the U.S. Atomic Clock in Colorado to display the precise time, within a billionth of a second.

by Jake Prine

These days, timing is everything. Between meetings and appointments, deadlines and conference calls, my schedule requires that I know the time down to the minute. Even on weekends, I've got Little League games to coach, shows to tape and planes to catch. If I'm late, I'm sunk. The problem is that it's hard to be prompt if my clocks aren't correct. Even digital clocks can be inaccurate. Power outages, dead batteries, time changes...any of these can cause a clock to be inaccurate. The next thing you know, you're strolling into that important conference...an hour late. Now there's no need to worry, because advanced radio technology has produced a clock which gets the time directly from the U.S. Atomic Clock in Fort Collins, Colorado, the standard for time-keeping the world over. The Atomic Clock by Arcron is the most accurate, reliable and convenient timepiece you can buy.

Desktop Alarm Clock

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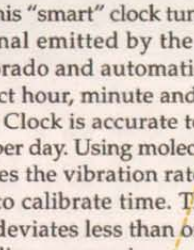

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The desk clock's display features the exact time (in hours, minutes and seconds), month and date, or you can choose to display any two U.S. or world time zones. It features a sleek, European design, and, at only eight ounces, is the perfect travel clock. It also has dual alarms, perfect for couples, and one-touch illumination for nighttime viewing.

The handsome wall clock comes with temperature and humidity gauges. After you install the batteries, watch the hands spin at 20 times their normal rate, until the clock has adjusted to the precise time. Both the executive desktop and the wall model have an internal antenna for superior reception sensitivity, without unattractive wires.

Every morning at 1:00 a.m., this "smart" clock tunes in to the radio time signal emitted by the U.S. Atomic Clock in Colorado and automatically resets itself to the exact hour, minute and second. The U.S. Atomic Clock is accurate to ten billionths of a second per day.

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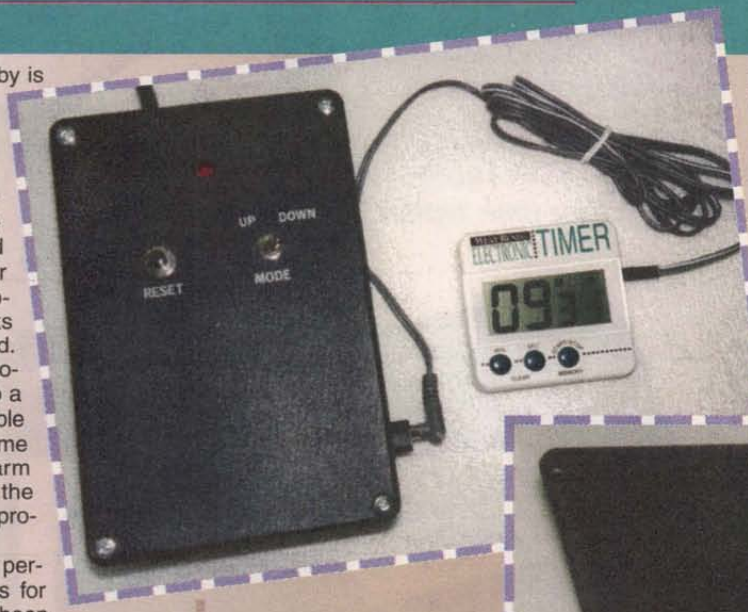
INEXPENSIVE DIGITAL TIMER

by Raymond C. Buck



Anyone whose hobby is electronics will probably decide at some point to make a circuit board for one of their projects. Or, if their projects use EPROM parts, they will need to erase the parts as their software undergoes development. Each of these tasks needs to be accurately timed. Usually you will plug the exposure frame or UV eraser into a wall socket and set an audible alarm for the length of time required. When the alarm sounds, you can unplug the device from the wall and proceed with the next step.

This is the way I have performed these two operations for years. However, there have been times when I was distracted and failed to hear the alarm go off. This results in overexposure of the circuit board. There is no harm done in the case of the EPROM other than shortening the life of the UV bulb.

I had been planning for a long time to build a timer that would automatically remove power at the end of the timing cycle. However, I never seemed to have enough time to design the circuit board with the display and write the necessary software for the microcontroller.

One weekend I was shopping at Walmart and happened to pass through the kitchen appliance area. I noticed a digital timer that cost less than $10.00. I began to wonder if I could somehow use it as part of my timer project. So, I purchased one and brought it home to do some testing.

I opened the timer case and connected the piezo speaker leads to an oscilloscope and set the alarm off. The output was a slightly modified sinewave of around 2.5 volts. This was more than enough output voltage to use in the timer project. I just needed to develop the interface circuit between the digital timer and the AC line circuit.

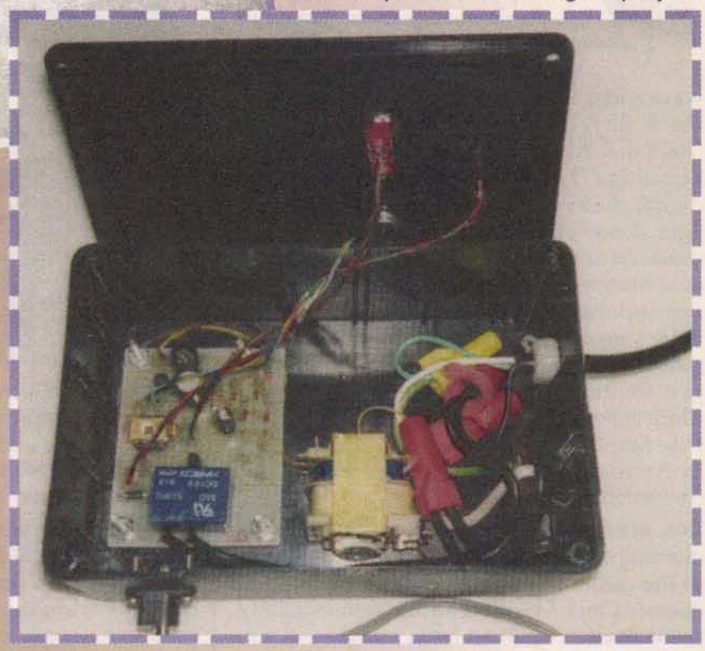


Figure 1 shows the final circuit design. As you can see, the circuit uses only a handful of components and is very simple. The heart of the design is the Microchip PIC 12C508 microcontroller. This is a complete microcontroller in an eight-pin DIP package. It has 512 bytes of user programmable memory and a total of six I/O lines. It operates at 4 MHz using a built-in oscillator and is perfect for this type of application. I started the original design using discrete components. However, when I got up to about a dozen parts and three ICs, I knew there had to be a better way.

That is when I decided to let the PIC make all of the logical decisions. You can purchase the preprogrammed PIC from the source shown in the parts list. If you prefer to program your own part, the source code and hex code listings are available from the *Nuts & Volts* website. The file name is timer.exe and it is a self-extracting executable. Copy the file to a separate directory and run it from the DOS prompt to extract the code listings.

The operation of the circuit is easy to understand. Diodes D1-D4 rectify the 2.5 volt AC signal from the digital timer. Capacitor C2 provides a slight amount of filtering to produce a DC voltage which is detected by pin 4 of IC1. Resistor R2 is used to pull the DC voltage rapidly to ground when the AC voltage (beeping) is removed. This allows you to initiate a timing period as short as two seconds.

Pin 5 of IC1 drives R3 which turns on Q1 and operates relay RL1 to apply power to the device that is plugged into J1. The AC voltage from T1 is rectified by bridge rectifier BR1. This

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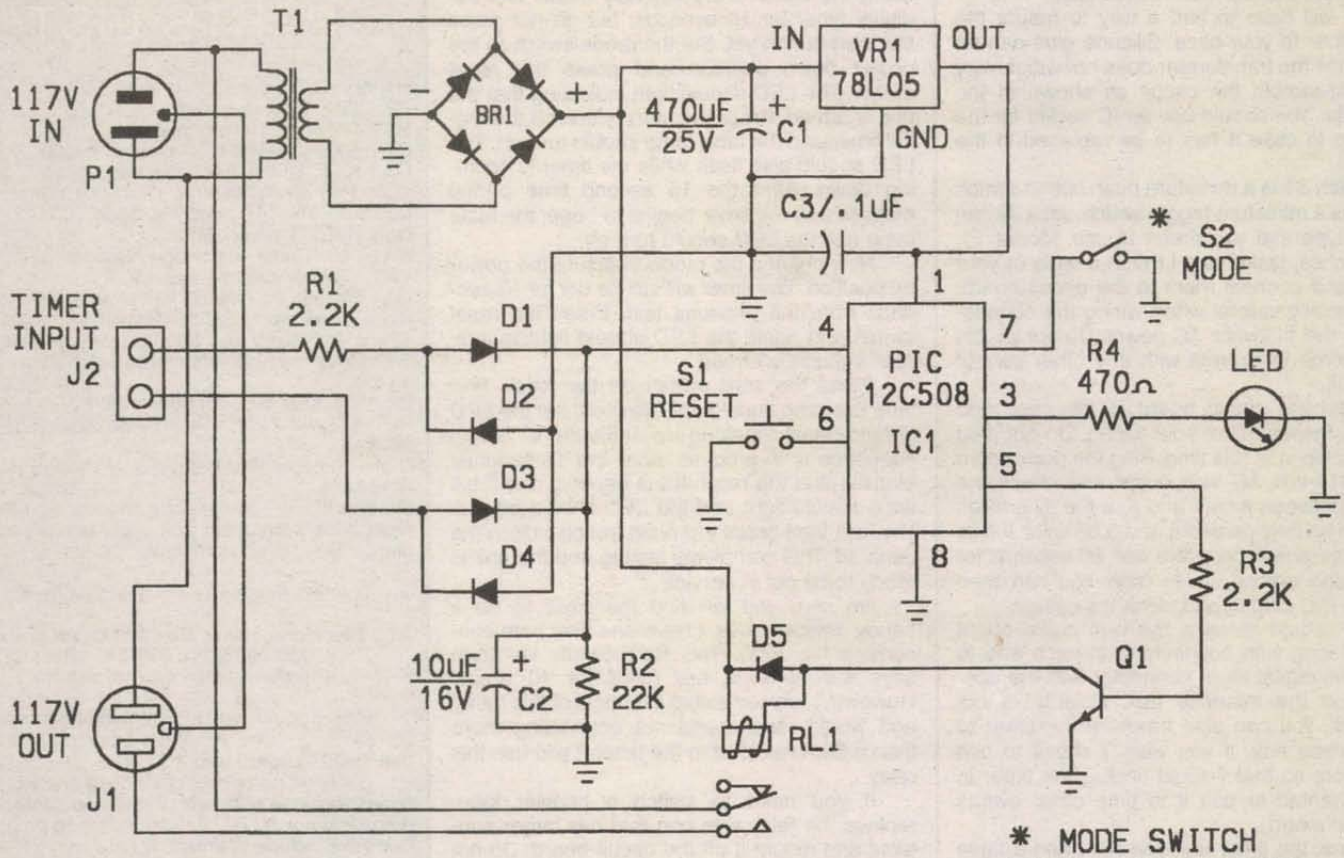


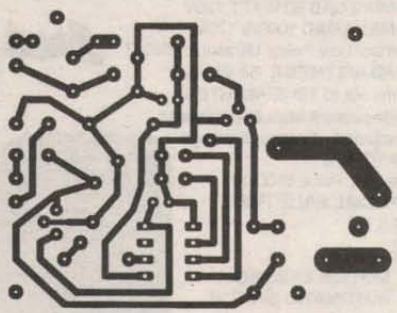
FIGURE 1

voltage is smoothed by C1 and applied to the five-volt regulator VR1 to supply power for IC1.

The timer can operate in two different modes. It can be used to power a device up or to power it down when the timing period elapses. In the power down mode, pressing the start button on the digital timer applies power to the device and power is automatically removed when the timing period is over. When used in the power up mode, power is applied when the timing period expires and you have to manually power the device down by pressing the reset button. The digital timer from Walmart has a maximum timing period of 99 minutes and 59 seconds.

Figure 2 shows the PCB layout looking through the board from the component side. Figure 3 shows the component layout. The circuit is simple enough to build using perfboard construction if you don't want to make the PCB. The board layout matches the RadioShack relay specified in the parts list.

FIGURE 2



Begin construction by modifying the digital timer. Remove the back cover from the timer. Solder two six-inch pieces of 30-gauge insulated wire to the piezo speaker terminals. Route them through the speaker opening on the back of the timer and reassemble the timer. Cut the wires so that about two inches remain and connect them to a two position .100" Molex type KK series female connector. Glue the connector to the back of the timer so that it is even with the edge of the timer. You can use any type of miniature connector that you happen to have on hand. The Molex type is convenient because its rectangular plastic body is easy to glue to the timer case.

Transformer T1 should be a 9- or 10-volt transformer. Do not use a 12-volt transformer as the DC voltage will be excessive for the relay. Any transformer with a 100 mA rating or greater will be sufficient. If you can't find a suitable chassis mount transformer, purchase a 12-VDC wall transformer. Break the case open

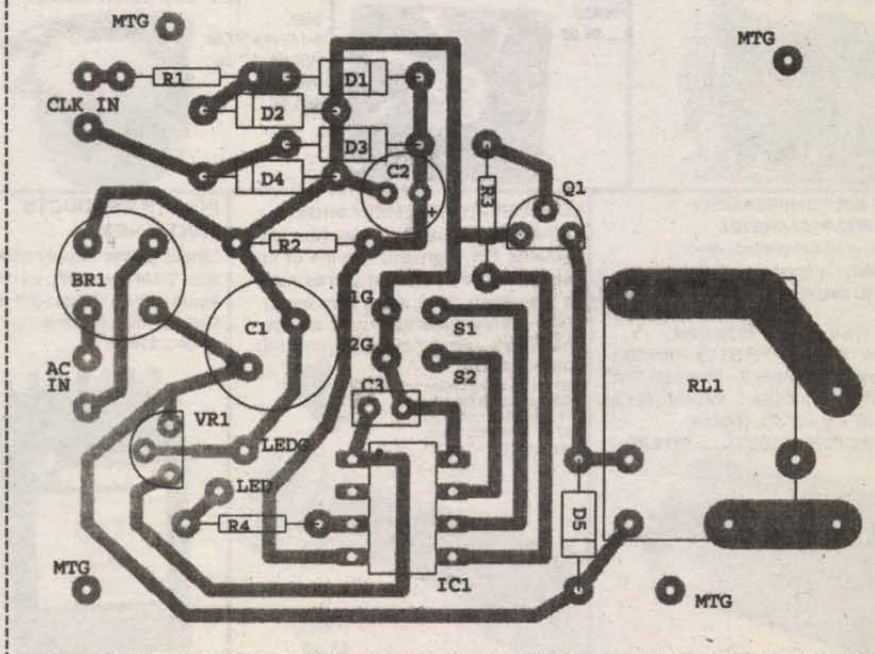


FIGURE 3

and use the transformer that is inside.

You will have to find a way to mount the transformer to your case. Silicone glue can be used since the transformer does not weigh very much. Assemble the circuit as shown in the schematic. You should use an IC socket for the PIC chip in case it has to be replaced in the future.

Switch S1 is a miniature push button switch and S2 is a miniature toggle switch. Jack J2 can be any type that you prefer to use. Mount T1, the switches, jacks, and LED in a case of your choice and connect them to the circuit board. Be especially careful when wiring the connections for the 117 volts AC power. Do not let this wiring come in contact with any other part of the circuit.

Mount the circuit board in the case and carefully inspect all of your wiring. Do not plug the PIC chip in at this time. Plug the power cord into a 117-volt AC wall outlet and check the voltage between pins 1 and 8 of the IC socket. It should be between 4.85 and 5.25 volts. If it is, unplug the power cord and wait 30 seconds for the voltage across C1 to drop. You can then plug the PIC chip in and close the case.

You should make a two-wire cable about two feet long with connectors on each end to match the digital timer connector and the connector on the interface box. Polarity is not important. You can also hardwire the timer to the interface box, if you wish. I chose to use connectors so that I could unplug the timer in case I wanted to use it to time other events using the alarm.

To test the timer unit you will need a table lamp. Turn the lamp on and plug it into J1. Plug the line cord from the timer unit into the AC wall outlet. Connect the digital timer to the timer unit using the cable you previously made. Set the digital timer for 15 seconds, but do not press the start button yet. Set the mode switch to the power down position and press the reset switch. The LED should light indicating that the unit is armed. Press the start button on the digital timer and the table lamp should turn on. The LED should also flash while the timer is counting down. After the 15 second time period elapses and the timer begins to beep, the table lamp and the LED should turn off.

Now change the mode switch to the power up position. The timer will still be set for 15 seconds from the previous test. Press the reset switch and again the LED should light to indicate the unit is armed.

Press the start switch on the timer. This time the lamp should not come on, but the LED should start flashing to indicate a timing sequence is in process. After the 15 seconds elapses and the timer starts beeping, the table lamp should light and the LED should go out. You can then press the reset switch to turn the lamp off. This completes testing and the unit is ready to be put in service.

I'm sure you will find the timer to be a handy device to use. I have one final note concerning the relay. The RadioShack literature says the contacts are rated for 10 amps. However, I am somewhat skeptical of this rating and would recommend not connecting more than a 500-watt load to the timer if you use this relay.

If you need to switch a heavier load, replace the relay with one that has larger contacts and mount it off the circuit board. Do not use a relay with a coil resistance of less than 120 ohms or you may exceed the power rating of Q1. **NV**

PARTS LIST

R1, R3 - 2.2K, 1/4 watt resistor.
R2 - 22K, 1/4 watt resistor.
R4 - 470 ohm, 1/4 watt resistor.
C1 - 470uF, 25-volt electrolytic capacitor.
C2 - 10uF, 16-volt electrolytic capacitor.
C3 - .1uF, 25-volt ceramic disc capacitor.
D1 - D4 - 1N4148 switching diode.
D5 - 1N4003 silicon diode.
BR1 - 50, 1 amp volt bridge rectifier.
VR1 - 78L05 voltage regulator.
Q1 - 2N3904 or 2N4400 NPN transistor.
IC1 - Microchip 12C508/P04 microcontroller.
T1 - 9 VAC or 10 VAC transformer (see text).
S1 - Miniature N.O. miniature push button switch.
S2 - Miniature SPST toggle switch.
RL1 - 12-volt SPDT relay (RadioShack 275-248).
Digital Timer - West Bend model #40035 (Walmart).
Misc.: LED, AC power cord, chassis mount AC receptacle, timer input jack, eight-pin IC socket, plastic case, misc. hardware.

The following parts are available from:

ATC Electronics, P.O. Box 43033, Phoenix, AZ 85080-3033; Ph. 602-516-2926; http://www.atcelectronics.com

Preprogrammed 12C508 microcontroller $3.50 12-volt relay with three amp contacts that matches PC board layout $1.50.

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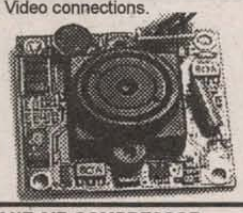

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Model # 3110KL-04W-B17
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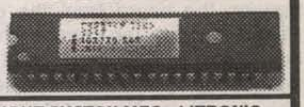

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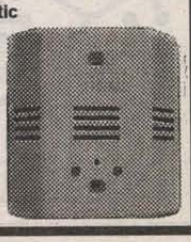

Write in 34 on Reader Service Card.

reader FeedBack

An otherwise good article by Gerald Roylance was somewhat marred by his incorrect reference to the derivation of the 'N' connector nomenclature (page 96, Dec. '98 *NEV*).

You may inform your readers that the 'N' in 'N' connector stands for Neill. This is the name of the guy who invented this popular threaded and high-performance RF connector. A similar, but bayonet-style connector, the 'C' connector, was invented by a fellow named Concelman. Their joint efforts yielded the familiar TNC (threaded Neill-Concelman) and the BNC (bayonet Neill-Concelman) connectors.

To the best of my knowledge, these gentlemen both worked for Bell Labs.

The following was extracted liberally from various, mostly RSGB sources...

Up to the 1930s, the lead-in feed between the antenna and the rig was constructed by parallel wires with spreaders and binding posts. When the first RF coaxial cable was marketed, the UHF connectors PL259 were introduced.

During WW2, RADAR sets required a better connector than the PL259 then in popular use, and two designs followed. The first was to make a connector look like a piece of 50 ohm cable as near as possible and this was designed by Mr. Paul Neill at the Bell Laboratories and known as the type 'N' connector.

A Mr. Carl Concelman, apparently also of the Bell Telephone Laboratories, however realized that there was a small bit of inductance where the center pins of the N connector meet. By changing the position of the dielectric used to fill the connector, he was able to introduce some reactive cancellation, and this type 'C' connector allows it to be used well into the GHz range. Shortly after this, Neill and Concelman co-operated on the design of a miniature bayonet locking connector. This combined Neill's mechanical design with Concelman's reactive dielectric and his twist-on "bayonet style" locking ring. The Bayonet Neill Concelman (BNC) connector had arrived.

Later, for some airborne use, they produced a threaded version, the Threaded Neill Concelman (TNC). For precision microwave use, a series of sub-miniature connectors were developed 'A', 'B,' and 'C.' Of these, the 'A' type — or Sub-Miniature A (SMA) — is most popular.

Steve Jackson
Technical Editor
Home Automator Magazine

First, thanks for including my circuit tip in the November '98 issue of *NEV* magazine on page 32 in the Q & A column.

Unfortunately, several additions have been added to the original schematic that I submitted to you, resulting in two major problems.

First, the text no longer agrees very well with the schematic shown.

Specifically, the voltage supply circuitry in the upper left was not on the original, and so is not described in the text, and its purpose in the ckt is not clear. And, in fact, I cannot even find a MAX1021-5 listed anywhere in the databooks. Had I put a regulator in my ckt, I would have used a cheap 78L05 instead of an expensive Maxim part anyway.

My original intent, as described in the text, was that the +5V for the ckt would come from the processor board on which the ckt was built, and the ckt would then draw no local power when not connected to a host PC.

I guess some of this confusion probably stems from my text saying "the circuit 'steals' its power from the host serial port", whereas it should more appropriately said "... 'steals' its negative voltage ...".

Second, and much worse, is the addition of the DB9 connector to my original scematic. It is located on the WRONG side of the circuit!

As described in the text, the TxD and RxD lines go to the host serial port, while the TD and RD lines (originally labelled Tc and Rc) go to the local CPU. This has caused a lot of confusion with some people who have E-Mailed me about the ckt.

So I think we need to publish some kind of correction to straighten things out. Other than this, thanks for publishing the circuit.

Best regards,

Dan Michaels
Oricom Technologies

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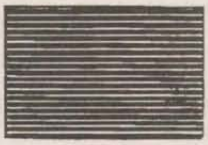
Size 12 x 18



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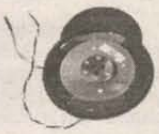
COLOR WHEEL ASSEMBLY



5 Volt, 3-phase disc-drive motor powers a 4-quadrant color wheel. A reflective silver strip is positioned on the wheel which is used for timing with a printed circuit mounted sensor. Unit is metal and black in color. The wheel diameter is 4-1/4". Overall assembly sz: 1-1/4" x 4-3/4" x 6". The sensor cable (3 leads) is approx 9-1/2" long. Excellent condition. Shpg wt 1 lb.
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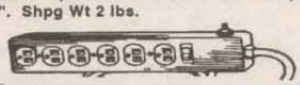

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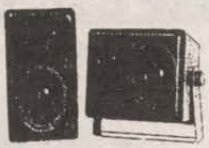
TM98COM3183 ---------- $17.95



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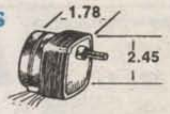

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ELECTRONICS Q & A

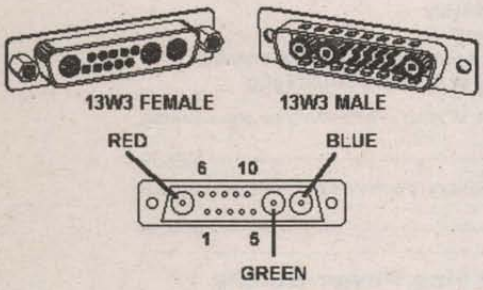
With TJ Byers

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

Sun To PC Monitor

Q. Recently I bought a used Sun Sparc 2 computer. It's complete except that I didn't buy a monitor for it. I have a Sony Multiscan 17sf II, which I use for my IBM PC compatible that I'd like to connect to the Sun system. Can you advise me on how to do this?

Howard Lee
via Internet



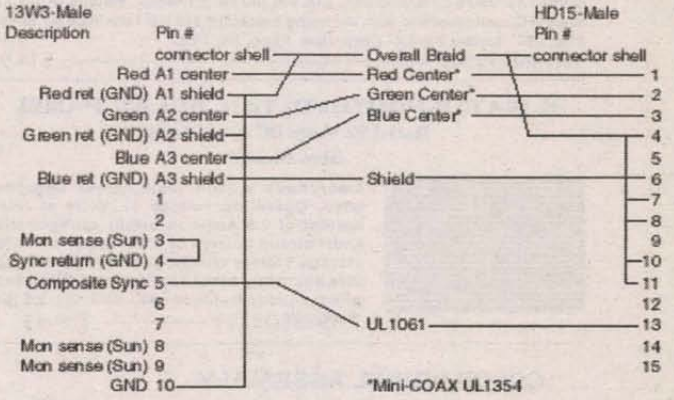
A. *This isn't a big problem if your Sparc's graphics card uses a standard 13W3 connector. The 13W3 is an unusual connector combining a 10-pin D-shell with three analog video conductors.*

Sun Sparc 13W3 Connector

Pin	Function
1	GND*
2	Vertical sync*
3	Sense #2
4	Sense GND
5	Composite sync
6	Horizontal sync*
7	GND*
8	Sense #1
9	Sense #0
10	Composite GND

** Considered obsolete, may not be connected.*

You can buy ready-made adapter cables from ***Sun Cables (732-435-1484; http://www.sun-cables.com)*** *and* ***System Integrators (1-800-547-2349; http://www.si87.com)*** *for about $30.00. Or, you can make your own using the schematic below. While the "perfect" interface calls for mini coax cables (usually of the orange-covered variety) for the video interfaces, you can use twisted pairs if you keep the cable length to six inches, or so.*



For those readers who don't have the Sony monitor mentioned (or its equivalent), be aware that the Sony Multiscan 17sf II supports separate sync, composite sync, and sync-on-green, as do many PnP (Plug-n-Play) monitors. Check your monitor's specs before trying this patch. Otherwise, it won't work without further signal processing.

CPU "Upgrade" Conversion Adapters

Q. I have a 486 GIO-VT2 motherboard made by FIC, and I'm looking for an adapter (daughterboard?) that drops the voltage from 5 volts to 3.3 volts. Do you know of any such device or have any ideas that might be helpful?

Jim Madden
via Internet

A. *Ah, you want to upgrade the CPU, but the new processor needs a 3.3-volt source. Bear in mind that it needs a 5-volt source, too, so you can't simply change the whole system over to 3.3 volts. Fortunately, all you need is a CPU adapter socket made by* ***Aries Electronics (http://www.arleselec.com)****, which is available from* ***Digi-Key (1-800-344-4539; http://www.digikey.com)****. The CPU adapter contains a 3.3-volt voltage regulator that powers the two (or four) 3.3-volt pins of the new CPU and passes the 5-volt source to their original destinations. To make the upgrade, simply remove the old CPU, plug in the adapter, then install the new CPU according to its instructions. These adapters will even let you plug surface-mount CPU chips into a*

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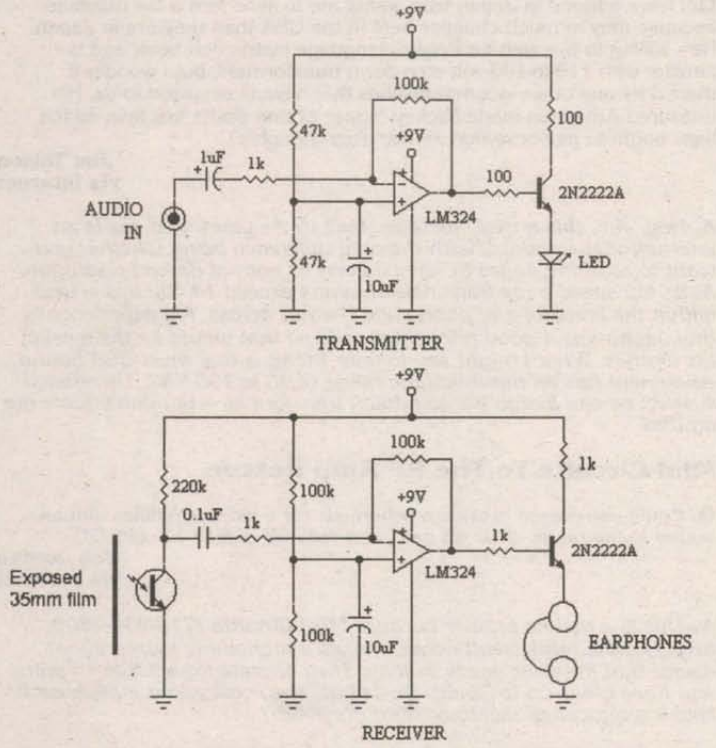
Wireless

Q. I'm looking for a device that will broadcast the sound from my TV to my earphones so that I alone can hear the sound. Can you help me?

Bob Miskowic
via Internet

***A.** Sure! You can find what you're looking for from UnWired. The model you want is 3000IR, which is an infrared wireless headphone for private television listening. They sell for $29.99 and can be found at Target stores, Fry's Electronics, J&R Computer, or directly from the company at their web site (**http://www.laral.com/unwired**). Now, if you'd like to make your own wireless IR link, play with the circuit below.*



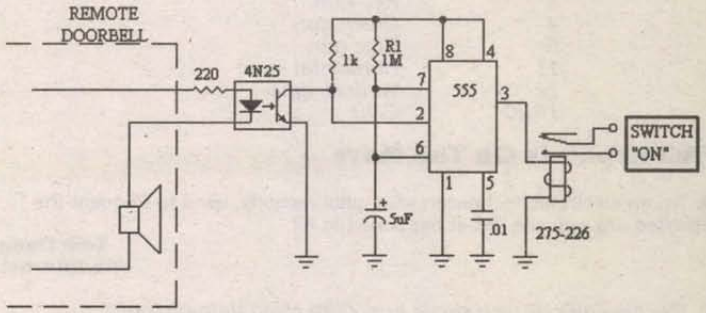
*As you can see, it's divided into a transmitter and a receiver (what else?). Both circuits are basically identical, with an op amp driving either the LED transmitter or receiver earphones. The gain of the amplifier is set at 100 (this is determined by the ratio of the 1K input resistor to the 100K feedback resistor). Notice that the op amp's non-inverting input (+) is tied to a resistor divider (47K for the transmitter and 100K for the receiver) to permit unipolar (one battery) operation. For best performance, the LED and phototransistor should be matched. I used RadioShack's 276-142 optical pair and was able to receive up to 30 feet away. However, overhead lights tend to swamp the phototransistor and fluorescence create a 60-Hz buzz. The solution is to place a piece of exposed 35mm film over the phototransistor; it blocks the visible light while letting the infrared emissions pass freely. Want to have more fun? Play with the RF data modules from **Abacom Technologies (416-236-3858; http://www.abacom-tech.com)**. See their ad on page 59. They are AM transmitters and receivers operating in the 418 MHz range which sell for about $25.00 total and don't have the ambient light shortcomings of the IR devices.*

Push My Button

Q. I have a 5000 EXL gasoline generator with a button-actuated battery starter. Do you know how to convert it so that it will start unattended? Do you also know of a source that sells parts or will convert it to run off LP (propane)/natural gas (methane)?

Howard Epstein
via Internet

***A.** Well, the remote starter is easy; the LP conversion harder. You are aware that you can buy remote devices that can start automobiles via remote control, aren't you? Check out Pep Boys or similar auto parts house in your local phone book. However, this is a DIY (do-it-yourself) magazine, isn't it, so let me take a shot at it. To start the generator remotely, I'd use a remote doorbell that you can buy from Radio-Shack or any hardware store. Then I'd do something like this.*



The one thing these remotes have in common is that they activate a buzzer or a speaker when the button is pressed. We will use this signal to engage a starter relay by inserting an optical coupler in series with the speaker leads. I'm assuming your starter battery is 12 volts. When the "bell" rings, the 4N25's LED lights which, in turn, triggers the 555 monostable circuit. The values selected are for about a one second crank time. Repeated pushing of the "doorbell" will crank the starter one more time. The cranking time is controlled by the 1M and 5 uF capacitor; i.e., increasing the 5 uF cap to 10 uF will result in a two second "starter." I've built this circuit and it may need some fine tuning. For example, the polarity of the 4N25 LED may have to be reversed, and the cranking time depends on your generator and its tune-up. As for unattended starting, I don't recommend it, although it's easily done using a mechanical timer you can buy from any hardware store. My concern is that gasoline and nonchalance don't go together. Finally, the LP and/or natural gas conversion: Don't do it yourself! First, you need a new carburetor, plus a new fuel tank. Only a professional can provide both. Again, don't try it yourself unless you've set a track record at the Daytona. Check the Yellow Pages under "propane" or call your local gas company (as in PG&E). Expect to pay about $500-$1500 for the conversion.

Out With The Old Monitor, In With The New

Q. I have an old Amiga (Commodore 1084S-P) monitor that I haven't used for quite some time. Now I'm making an IBM clone for my kids and

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would like to make use of this monitor. Is there any way I could drive this monitor from a VGA or SVGA video card? I may have a clouded memory, but I always thought it was a pretty good monitor, capable of displaying 16 million colors. Any information on the conversion (if it can be done) or plug pinouts would be appreciated.

Harry
via Internet

A. Yeah, back in those days this was an incredible monitor – because it was the first of the analog monitors and could display 16 million colors as opposed to IBM's digital limit of 64 colors. Unfortunately, the horizontal scan rate of this monitor is fixed at 15.75 KHz – the same as that of a color TV. (Its companion computer was designed to work with a TV, too, which explains the scan rate.) Bottom line: it won't work with VGA. My suggestion is to buy an NEC Multisync C400 14-inch monitor from Egghead Online (http://www.egghead.com) for just $99.99 (Egghead has surplus monitors for as little as $79.00, too). Now before the letters from Amiga aficionados come pouring in, here's the pinout of the monitor.

Amiga 500, 1000, 2200, 2500, 3000, 3500, 4000 Video Pinout

Pin	Function
3	Red gun
4	Green gun
5	Blue gun
11	Horizontal sync
12	Vertical sync
16-20	GND

FAQ Repair Is On The Move

Q. I'm an electronic technician who, until recently, used to frequent the repairfaq.org web site. What happened to it?

Tom Dang
via Internet

A. The new official web site is http://ftp.cised.unina.it/pub/electronics/REPAIR. The original site has changed to http://www.repairfaq.org/~filipg, V2.60 (10/5/97), which spotlights Samuel M. Goldwasser's "Notes on Troubleshooting and Repair of ..." series of comprehensive repair guides for consumer electronics equipment and other household devices. There is also a great deal of other information of interest to the electronics hobbyist, experimenter, technician, and engineer – and the official FAQ (frequently-asked questions) of the sci.electronics.repair newsgroup.

Unfortunately, several portions of the http://www.repairfaq.org/~filipg site are being phased out – so download the files now. The best way to do this is to bring up the HTML text on the screen, highlight it using the mouse, copy it using Edit Copy or the keyboard Alt, E, C command, and paste (Alt, E, P) it into a blank word processor page, then save it. I use Winword 6.0 (Windows Word 6.0). If you need a schematic, take a screen shot using SnagIt, Paint Shop Pro, or similar screen-capture utility. This site won't last long, and it's not being updated, so time is of the essence.

Fax Machines In Japan

Q. I have a friend in Japan who wants me to send him a fax machine because they're much cheaper here in the USA than they are in Japan. He's willing to live with an English-language instruction book and is familiar with 110-to-100-volt step-down transformers, but I wonder if there'd be any other incompatibilities that haven't occurred to us. His treasured American-made Mickey Mouse phone works just fine, so the lines ought to be somewhat similar. Any thoughts?

Jim Tolson
via Internet

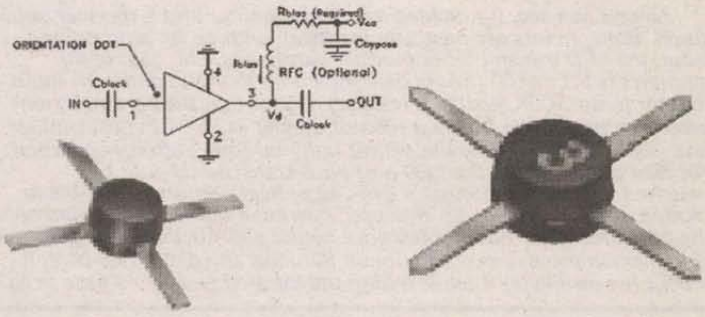
A. Hey, Jim, this a trick question, isn't it? As you know, fax is an international standard, with the only difference being whether you want to send the pages in fine (slower) or normal (faster) resolution. At its top speed a fax transmission won't exceed 14,400 bps – well within the limits of any phone line I've run across. My experience is that Japan has a good phone network, so that would be the least of his worries. What I might say to your friend is that most USA-bound equipment has an input voltage range of 90 to 130 VAC. Therefore, I suspect he can forego the stepdown transformer – but don't quote me on that.

Mini-Circuits To The RF Amp Rescue

Q. Could you please provide a schematic for a video amplifier with an output in the range of 10 dB gain, and runs off of 5 to 12 volts DC?

Bob Jordan
via Internet

*A. This is a real no-brainer because **Mini-Circuits (718-934-4500; http://www.minicircuits.com)** makes a monolithic four-terminal device that fits your needs exactly. They operate from 3.5 to 15 volts, and have gains up to 26 dB. Best of all, they cost about a buck each! Here's a typical application using the MAR-7.*



MAR MAV

This device sells for $1.05, requires just five volts, has a bandwidth of 8 GHz, and a gain of 13.5 dB. The Mini-Circuits MAR and ERA series of amplifiers are monolithic devices using gallium arsenide HBT (heterojunction bipolar transistor) technology. The internal circuit configuration is a Darlington pair, embedded in a resistor network. The resistors determine the DC operating point of the transistors, and provide feedback to set RF gain, bandwidth, and input and output impedance to optimum values.

Blocking capacitors are needed at the input and output ports. They should be of a type having low ESR (effective series resistance), and should have reactance low enough not to affect insertion loss or VSWR adversely at low frequency. The blocking capacitors must be free of parasitic (parallel) resonance up to the highest operating frequency. Use of a bypass capacitor at the connection to the DC supply is advised to prevent stray coupling to other signal processing components.

But this is just one of many Mini-Circuits RF amplifiers. Check them out – they'll be happy to send you their RF/IF Designer's Handbook (for free) which is jam-packed with data sheets, tips, and design information. (Damn, I hate it when I have to be this terse. A

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feature article would be better, but only to a select few. Still check it out, and gather what you can.)

Great Web Sites To Visit

WinFiles.com (http://www.winfiles.com), formerly known as Window95.com, is the premier site on the web devoted exclusively to Windows 3.1, Windows 95, Windows 98, Windows NT, and Windows CE with great 32-bit shareware, drivers, tips, and information. Need an updated driver for your mouse? You'll find it here. Worried about Y2K? No sweat, there's a library of BIOS upgrades as well. There's a wealth of other information at this site, too. Cobsys Computers "Windows 95 Tips & Tricks" has all the dirt you'll ever want on Windows 95. FREE access to over 200 Tips & Tricks, listed in seven different categories, plus "System Optimization" Scott Wainner's incredible site with every performance and system optimization trick, hardware and software, you could ever hope to find!

Need datasheets on new and obsolete ICs? Look no further than QuestLink (http://www.questlink.com). This site has links to every major semiconductor vendor, including some rather obscure ones like Peregrine Semiconductor. In addition to tons of datasheets and more than 4,000 application notes there's a semiconductor supermarket where you can buy ICs one at a time! Better yet, the minimum purchase is just $10.00. While targeted at the design engineer, it's an excellent source of parts for the hobbyist with a opening bid much lower than the $25.00 minimum imposed by Digi-Key, Newark, et. al.

In the meantime, what evidence did the dinosaurs leave behind besides bones? Find out here http://www.emory.edu/GEOSCIENCE/HTML/Dinotraces.htm. I think dinos are cool, and I have a really neat dino CD called "Eyewitness Virtual Reality Hunter Dinosaur Hunter" that "pits your wits against the past." Trust me, it's fun. Contact DK Multimedia at http://www.dk.com for a free romp.

Finally, check out the Modem Speed Test Page at http://www.toast.net/~leslie/testpage.htm. It will tell you whether or not your old POTS (Plain Old Telephone System) phone lines and modem can carry on a 56K conversation with our — soon to be new — revised web site (http://www.nutsvolts.com).

Have a Happy New Year!
TJ Byers
Q & A Editor

MAILBAG

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

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

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

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

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

Gerald Roylance
Mountain View, CA

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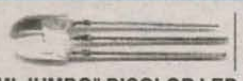

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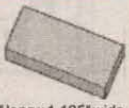

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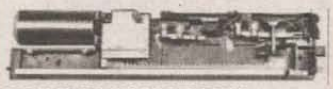

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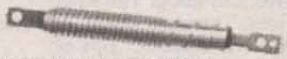

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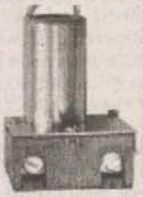

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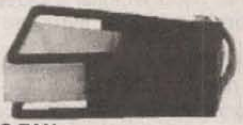

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Some Interesting Circuits

by Joseph J. Carr

Whether you are building a radio receiver for general shortwave reception, or the IF section of a radio astronomy set-up, you will be interested in the circuits discussed this month. One is a "universal" IF amplifier that can be used at any of the standard frequencies, and the other is a logarithmic amplifier. But more of that later. The IF amplifier can also be used for an RF amplifier at some frequencies.

Universal IF Amplifier

An IF amplifier is used in superheterodyne receivers to perform most of the amplification and selectivity functions. Typically, IF gains run in the 60 to 90 dB range, depending on the receiver design.

The IF amplifier in Figure 1 is based on the popular MC-1350P integrated circuit. This chip is easily available through any of the major mail order parts houses, and many small ones. It has been popularized in amateur radio technical articles aimed at the QRP (low power) crowd by Doug DeMaw's books and articles. It is basically a variation on the LM-1490 type of circuit, but is a little easier to apply in my opinion.

If you have difficulty locating MC-1350P devices, the exact same chip is available in the service replacement lines such as ECG and NTE. These parts lines are sold at local electronics parts distributors, and are intended for the service repair shop trade. I used actual MC-1350P chips in one version, and NTE-746 (same as ECG-746) chips in the other, without any difference in performance. The NTE and ECG chips are actually purchased from the sources of the original devices, and then renumbered.

The circuit is shown in Figure 1. Two MC-1350P devices in cascade are used. Each device has a differential input (pins 4 and 6). These pins are connected to the link windings on IF transformers (e.g,. T2 at device U1 and T3 at U2). In both cases, one of the input pins is grounded for AC (i.e., RF and IF) signals through a bypass capacitor (C2 and C4).

In the past, I've had difficulties applying the MC-1350P devices when two were used in cascade. The problem is that these are high-gain chips, and any coupling at all will cause oscillation. I've built several real good MC-1350P oscillators ... the problem is that I was building IF amplifiers. The problem is basically solved by two tactics that I'd ignored in the past. This time, I reversed the connections to the input terminals on the two devices. Note that pin 4 is bypassed to ground on U1, while on U2 it is pin 6. The other tactic is to use different value resistors at pin 5.

Pin 5 on the MC-1350P device is the gain control pin. It is used to provide either manual gain control (MGC) or automatic gain control (AGC). The voltage applied to this pin should be between +3 volts and +9 volts, with the highest gain being at +3 volts and nearly zero gain at +9 volts.

The outputs of the MC-1350P are connected to the primaries of T3 and T4. Each output circuit has a resistor (R2 and R5) across the transformer winding. The transformers used are standard "transistor radio" IF transformers. I used the Mouser 42IF123 (10.7 MHz) devices. However, almost any other IF transformer can be used as well. In one version, I used Toko 455 KHz IF transformers purchased from Digi-Key, and in another 455 KHz transformers of unknown origin from another source.

The DC power is applied to the MC-1350P devices though pins 1 and 2, which are connected together. Bypass capacitors C3 and C5 are used to decouple the DC power lines, and thereby prevent oscillation. All of the bypass capacitors (C2, C3, C4, and C5) should be mounted as close to the bodies of U1 and U2 as possible. They can be disk ceramic devices, or some of the newer dielectric capacitors, provided of course that they are rated for operation at the frequency you select. Most capacitors will work to 10.7 MHz, but if you go to 50 MHz or so, some capacitor types might show too much reactance (disk ceramic devices work fine at those frequencies, however).

The DC power supply should be regulated at some voltage between +9 VDC and +12 VDC. More gain can be obtained at +12 VDC, but I used +10 VDC with good results. In each power line there is a 100-ohm resistor (R3 and R6), which helps provide some isolation between the two devices. Feedback via the power line is one source of oscillation in high-frequency circuits.

The DC power line is decoupled by two capacitors. C7 is a 0.1 µF capacitor, and is used to decouple high frequencies that either get in through the regulator, or try to couple from chip to chip via the DC power line (which is why they are called "decoupling" capacitors). The other capacitor (C8) is a 10 µF to 100 µF device used to smooth out any variations in the DC power or to decouple low frequencies that the 0.1 µF doesn't take out effectively.

The RF/IF input circuit deserves some comment. I elected to use a double-tuned arrangement. This type of circuit is of a category that is coupled via a mutual reactance. Various versions of this type of circuit are known (see my book *Secrets of RF Circuit Design* — available through Amazon Books), but I elected to use the version that uses a capacitive reactance (C1) at the "hot" end of the L-C tank circuits. Because I am using standard IF transformers, I coupled the tuned sides through the capacitor. Coupling in and out of the network is provided by the transformer coupling links.

Construction of the circuit is made easier if you use a printed circuit board (PCB). Figure 2A shows a reproducible PCB pattern that you can use to build this circuit, while Figure 2B shows the component layout labels. This PCB contains all com-

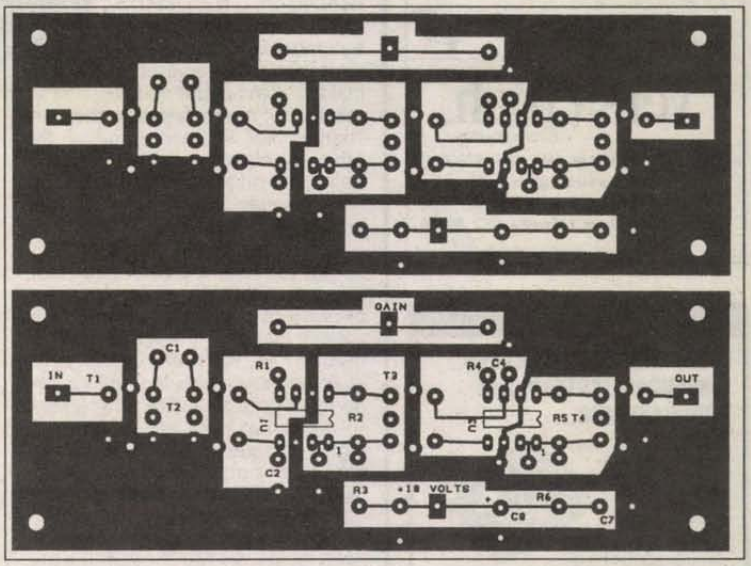

Figure 2a & b.

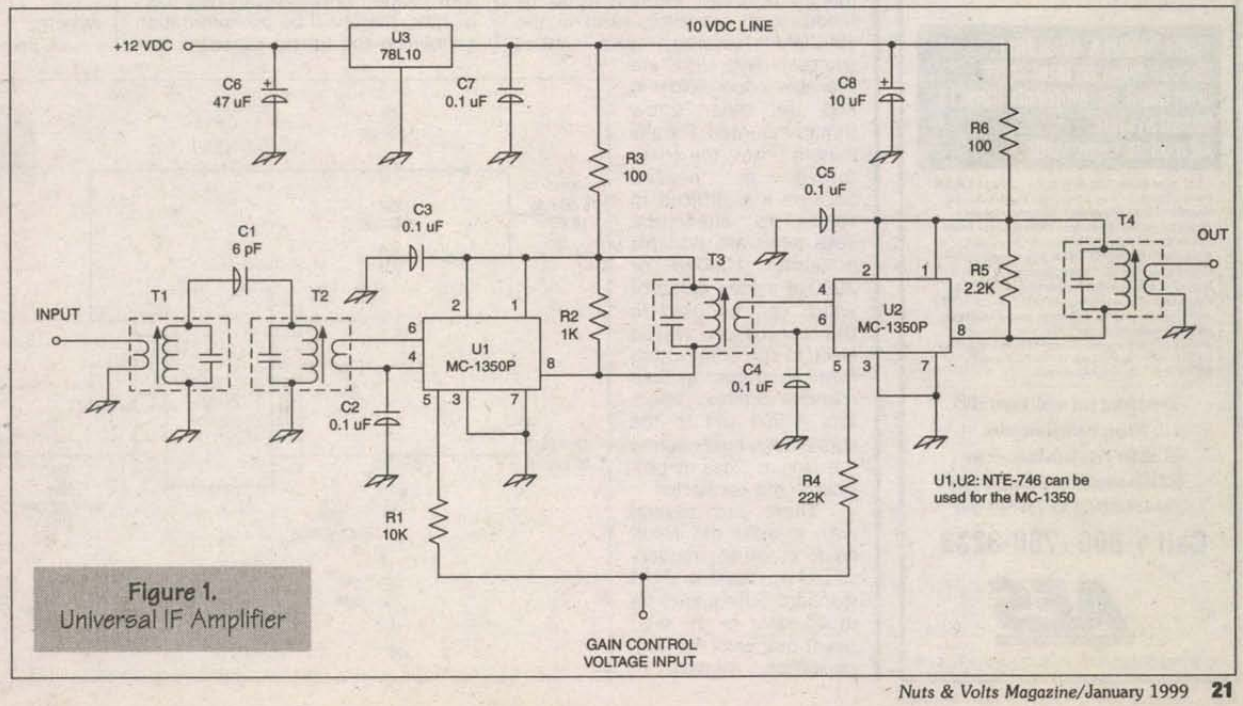

Figure 1.
Universal IF Amplifier

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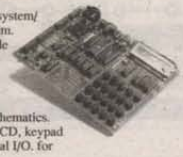

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ponents in Figure 1 except the voltage regulator (U3) and C6, which will be off-board or elsewhere in the system. If you don't wish to etch your own printed circuit board, then use the guy I had make mine: FAR Circuits (18N640 Field Court, Dundee, IL 60118). Send Fred a copy of Figure 2A so that he can identify it in his files. He has a lot of my designs on file, so may find it perplexing to figure out just which one you mean. Judging from FAR's rates, I suspect that about $7.00 ought to buy this board, but you might want to check with them for current pricing.

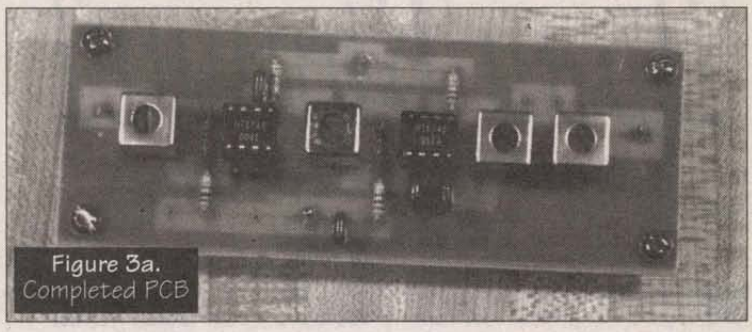

Figure 3a. Completed PCB

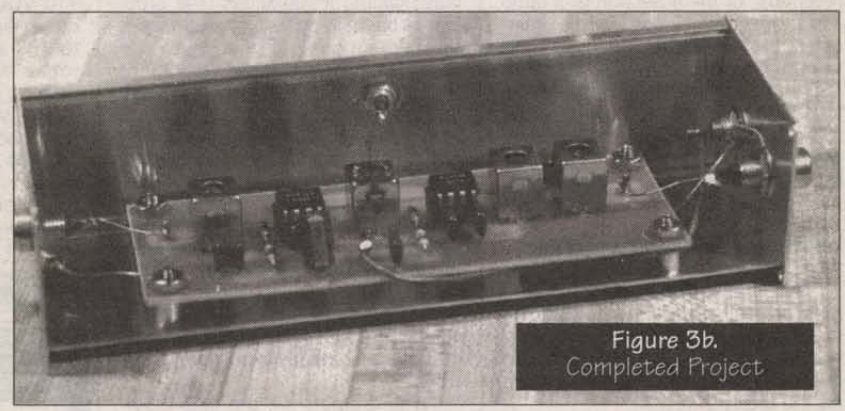

Figure 3b. Completed Project

Figure 3 shows two views of the completed project. The view in Figure 3A is the printed circuit board (Figure 2A) with components assembled. (Note: This photo was taken before C8 was installed.) The box shown in Figure 3B is one of the SB "Lab" series made by SESCOM, Inc. (2100 Ward Drive, Henderson, NV 89015-4249). This company makes a number of really interesting boxes for RF and other builders. I've bought quite a number of them because they are "tighter" for RF than some of the other aluminum and steel construction boxes on the market ... and that means better shielding (which is all important in RF work).

The connectors for input and output can be any coaxial connector. I used RCA phono connectors because of space constraints in the project that this IF amplifier will be used in. At 10.7 MHz, the loss of RCA phono connectors (which are normally used at audio) is negligible, so ought not pose any problem. At higher frequencies, I recommend BNC connectors, SMC connectors, or SO-239 "UHF" connectors (if you've got lots of room!).

The power and gain control connections are bought through the aluminum box wall through 1000 pF feedthrough capacitors (also in the SESCOM catalog, plus other sources). Two kinds are available: one solder-in and the other screw thread mounted. For aluminum boxes, the screw thread is needed because it is difficult to solder to aluminum. Both types are available in either 1000-pF or 2000-pF values, either of which can be used in this application. If you elect to use some other form of connector, then add disk ceramic capacitors (0.001 µF) to the connector, right across the pins as close as possible to the connector.

There are several ways to make this circuit work at other frequencies. If you want to use a standard IF frequency up to 45 MHz or so, then select one with the configuration shown in Figure 1 (these are standard).

If you want to make the circuit operate in the HF band on a frequency other than 10.7 MHz, then it's possible to use the 10.7 MHz transformer. If the desired frequency is less than 10.7 MHz, then add a small value fixed or trimmer capacitor in parallel with the tuned winding. It will add to the built-in capacitance, reducing the resonant frequency. I don't know how low you can go, but I've had good results at the 40-meter amateur band (7-7.3 MHz) using additional capacitance across a 10.7 MHz IF transformer.

On frequencies higher than 10.7 MHz, you must take some more drastic action. Take one of the transformers, and turn it over so that you can see the pins. In the middle of the bottom header, between the two rows of pins, there will be an indentation containing the tuning capacitor. It is a small tubular ceramic capacitor (you may need a magnifying glass to see it well if your eyes are like mine). If it is color coded, then you can obtain the value using your knowledge of the standard color code. Take a small screwdriver and crush the capacitor. Yeah, you read it right: crush the capacitor. Clean out all of the debris to prevent shorts at a later time. You now have an untuned transformer with an inductance right around 2 µH (I measured values between 1.8 µH and 2.6 µH using the inductance function of my DMM). Using this information, you can calculate the required capacitance using:

$$C = \frac{2.53 \times 10^{10}}{f^2 L_{\mu H}} \text{ picofarads}$$

where:

C is the capacitance in pico-

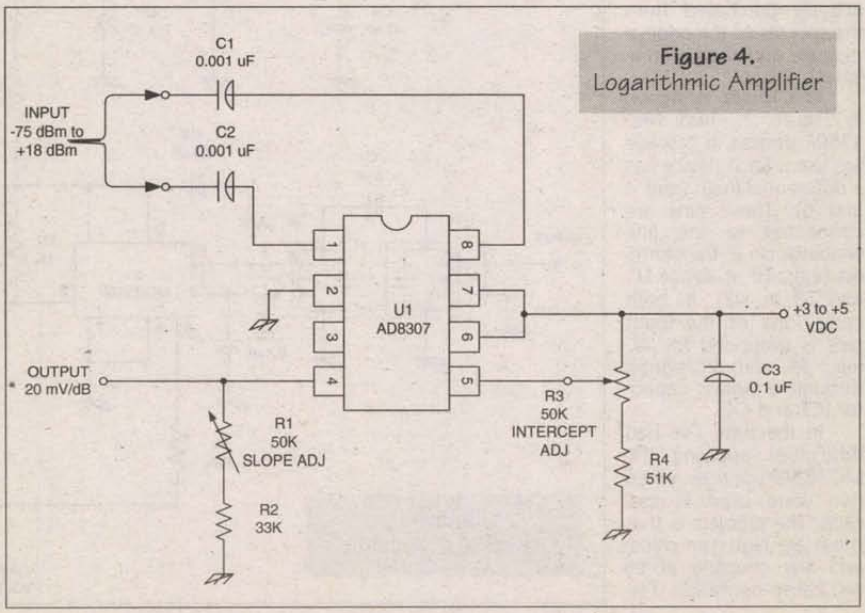

Figure 4. Logarithmic Amplifier

farads

f is the desired frequency in Kilohertz (KHz)

LμH is the inductance in microhenrys

Equation (1) is based on the standard L-C resonance equation, solved for C, and with all constants and conversion factors rolled into the numerator. If you know the capacitance that must be used, and need to calculate the inductance, then swap the L and C terms in Equation (1).

If the original capacitor was marked as to value or was color-coded, then you can calculate the approximate capacitance needed by taking the ratio of the old frequency to the new frequency, and then square it. The square of the frequency ratio is the capacitance ratio, so multiply the old capacitance by the square of the frequency ratio to find the new value. For example, suppose a 110 pF capacitor is used for 10.7 MHz, and you want to make a 20.5 MHz coil. The ratio is $(10.7\ MHz/20.5\ MHz)^2 = 0.272$. The new capacitance will be about 0.272 x 110 pF = 30 pF.

For other frequencies, you might consider using homebrew toroid inductors. The PCB pattern of Figure 2A can still be used, but you will have to run the wires from the toroid core coils to the correct holes.

A variation on the theme is to make the circuit wideband. This can be done for a wide portion of the HF spectrum by removing the capacitors from the transformers, and not replacing them with some other capacitor.

In the example above, I used a frequency of 20.5 MHz (i.e., 20,500 KHz) to make the calculation. The reason is simple: it is a prime radioscience observing frequency for finding natural radio signals from Jupiter (see my book *RadioScience Observing Volume 1*). It is possible to build a tuned radio frequency (TRF) receiver for that frequency using this circuit, but re-tuned to 20.5 MHz.

Logarithmic RF/IF Amplifier

A logarithmic amplifier produces an output signal that is proportional to the logarithm of the input signal. There are a number of applications for these amplifiers. Some of them take advantage of the range compression that takes place, making it easier to get a large dynamic range. In other cases, log amps are used to convert linear signal levels to the logarithmic decibel (dB) scale. The AD8307 log amp (Figure 4) will fit a lot of these uses, including radioscience observing receivers. It has a 92 dB dynamic range from -75 dBm to +17 dBm, and operates over the range DC to 500 MHz with ± 1 dB linearity. It produces a slope of 25 mV/dB and an intercept of -84 dBm, but this can be trimmed to other values using the SLOPE ADJ and INTERCEPT ADJ potentiometers shown in Figure 4. The DC power requirements are +2.7 VDC to 5 VDC at 7.5 mA.

If you want to see the entire spec sheet for the AD8307, then go to the Analog Devices web site (http://www.analog.com). The data sheet is available in *.PDF format, so you will need Adobe Acrobat Reader to display and print it. The device can be purchased for around $18.00 from Newark Electronics and other Analog Devices distributors.

RadioScience Observing

Amateur scientists can often make contributions to "real science" by careful recordkeeping and observation. One of the more popular amateur science activities is radioscience observing (judging from my mail and E-Mail it is also very popular with *Nuts & Volts* readers). At one time, amateur radio operators and shortwave listeners kept log books as standard practice, but that habit seems to have fallen away in recent years. But there is a real good reason to do so if you are a radioscience observer.

Here's the reason. On August 27, 1998 at about 1022 UTC (GMT to us old guys), the earth was struck by a very large burst of gamma rays. It appears to have initiated from a neutron "magnestar" star (catalog number SGR 1900+14). Solar detectors on the sun-lit side of earth missed the event, so data is lacking. According to a report in *Popular Communications*, a researcher at the National Radio Astronomy Observatory (NRAO) is looking for any data from people who were monitoring the radio bands on Thursday morning (0322 PDT or 0622 EDT), August 27th, 1998. Send reports via E-Mail to Mr. Paul Harden at pharden@nrao.edu. Include your location (latitude and longitude if you know it), the station that you were listening to, and the frequency. This was an extremely rare natural event, and the scientists have a lot less data than they need!

Note: If, like many radioscience observers, you have paper strip charts or computer records of signal strengths, you might want to offer them to the scientists.

I first heard of this event from my E-Mail. I subscribe to the Public Seismic Network list server. The first indication of an event was a fellow who was trying to get his instruments working, but found them pegged to full-scale. A number of "helpful" suggestions on circuit and local interference causes were offered. Pretty soon, however, a number of E-Mail messages were submitted to the list server indicating a lot of sites saw the same pegged condition. Later that day, a television news report told the story of the August event. **NV**

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HP 5328A, Counter, 500MHz ... $350
HP 5334A, Counter, 100MHz, Opt. 010 Oven ... $600
HP 5340A, Counter, 18GHz (noxie) ... $700
HP 5345, Counter, 500MHz ... $450
HP 5345A, Counter, 500MHz, HP-IB ... $650
HP 59307A, VHF Switch ... $125
HP 6104A, Precision Power Supply, 20V @ 3A, 20-40V @ 1A (metered) ... $175
HP 6112A, Power Supply, 40V @ .5A (metered) ... $175
HP 6116A, Power Supply, 0-100V @ 200mA (metered) ... $125
HP 6202B, Power Supply, 40V @ .75A (metered) ... $175
HP 6203B, Power Supply, 7.5V @ 3A (metered) ... $175
HP 6205B, Power Supply (dual), 0-40V @ .3A, 0-20V @ 8A (metered) ... $225
HP 6206B, Power Supply, 0-60V @ 1A (metered) ... $250
HP 6253A, Power Supply (dual), 0-25V @ 3A (metered) ... $225
HP 6260B, Power Supply, 10V @ 100A (metered) ... $400
HP 6265B, Power Supply, 40V @ 3A (metered) ... $250
HP 6266A, Power Supply, 40V @ 6A (metered) ... $250
HP 6289A, Power Supply, 0-40V @ 1.5A (metered) ... $225
HP 6294A, Power Supply, 0-60V @ 1A (metered) ... $275
HP 8011A, Pulse Generator, .1Hz-20MHz ... $175
HP 8013B, Pulse Generator, 1Hz-50MHz ... $275
HP 8015A, Pulse Generator, .1Hz-50MHz 30V ... $425
HP 8091A, Rate Generator (1GHz) w/8092A Delay Generator (1GHz) w/8093A Output Amp w/15401A & 15400A ... $2,000
HP 8165A, Programmable Sig Source, 1milliHz-50MHz ... $950
HP 8180A, Data Generator ... $425
HP 8410B, Network Analyzer Mainframe ... $275
HP 8414A, Polar Display ... $225
HP 8443A, Tracking Generator, 1KHz-110MHz ... $325
HP 8444A, Tracking Generator for 141T System, .5-1300MHz ... $750
HP 8445B, Auto Preselector, 1.8-18GHz ... $550
HP 8553B, RF Plug-in (for 140 Series Mainframes), 1KHz-110MHz ... $425
HP 8553L, RF Plug-in (for 140 Mainframes), use with 8552A, 1KHz-110MHz ... $125
HP 8601A, Sweeper Generator, .1-110MHz ... $425
HP 8614A, Signal Generator, 800-2400MHz, AM/FM Leveled ... $475
HP 8616A, Signal Generator UHF, 1.8-4.5GHz, +10-126dB, AM/FM ... $475
HP 86242D, RF Plug-in, 5.9-9.0GHz ... $350
HP 8640B, Signal Generator, .5-1050MHz, Opt. 002/001 or 003 ... $1,800
HP 8640B, Signal Generator, .5-512MHz, Opt 001 or 003 ... $950
HP 8743A, Reflection Test Set, 2-12.4GHz ... $475
HP 8901A, Modulation Analyzer ... $1,000
HP 59303A, D/A Converter ... $175
HP 59501A, HP-IB Isolated D/A Converter ... $125
Huntron Tracker 2000, w/410 Switcher (nice) ... $1,000
Kepco ATE15-50M, Power Supply, 0-15V @ 50A (metered) ... $650
Kepco ATE55-5M, Power Supply, 55V @ 5A ... $425
Kepco BVP100-4M, Bi-Polar Power Supply, 0-100V @ 4A (metered) ... $520
Kepco JQE 36-15MVPT, Power Supply, 0-36 @ 15A (metered) ... $275
Kepco JQE 36-3MVPT, Power Supply, 0-36 @ 3A (metered) ... $175
Krohn-Hite 3202R, Dual Channel Tunable Filter, 20Hz-2MHz, High Pass, Low Pass Band Reject ... $275
Polorad SPNH, Signal Generator, 20Hz-20KHz ... $450
Polorad SPNL, Signal Generator, 1Hz-600KHz ... $350
Racal Dana 9303, True RMS RF Level Meter ... $550
Rockland 1022F, Dual Hi/Lo Filter ... $150
Rockland 5100, Synthesizer, DC-2MHz, .001 Hz Resolution ... $325
Sencore SC61, Scope (100MHz) w/New Probes, Dual Trace ... $750
Sencore SC61, Scope (100MHz) w/o Probes, Dual Trace ... $500
Sencore SC3100, Waveform Analyzer (like new) ... $1,900
Sencore TVA92, TV Video Analyzer ... $1,100
Sorenson DCR-80-5A, Power Supply, 80V @ 5A (metered) ... $475
SRL 112B, PLO/PRF Synthesizer ... $125
Tek DC503, Plug-in Counter Universal, 100MHz ... $150
Tek DM501A, Plug-in DMM, 4-1/2 Digit ... $175
Tek DM502, Plug-in DMM, 4-1/2 Digit ... $150
Tek FG501, Plug-in Function Generator, .001Hz-1MHz ... $175
Tek FG504, Plug-in Function Generator, .001Hz-40MHz ... $450
Tek PG501, Plug-in Pulse Generator, 5Hz-50MHz ... $175
Tek PS501-1, Plug-in Power Supply ... $150
Tek PS503A, Plug-in Power Supply Triple ... $175
Tek OIG-502, Plug-in Optical Impulse Generator (unused) ... $950
Tek T922, Scope (15MHz), Dual Trace, nice ... $175
Tek TM503, Power Module, 3 Slot ... $125
Tek TM504, Power Module, 4 Slot ... $150
Tek TM506, Power Module, 6 Slot ... $200
Tek TWD120, Digitizer ... $675
Tek 7A16A, Plug-in (225MHz), Single Trace Amp ... $100
Tek 7A18, Plug-in (75MHz), Dual Trace Amp ... $75
Tek 7A19, Plug-in (600MHz), Single Trace Amp ... $150
Tek 7A26, Plug-in (200MHz), Dual Trace Amp ... $150
Tek 7B50A, Plug-in (150MHz), Time Base ... $100
Tek 7B53A, Plug-in (100MHz), Dual Time Base ... $125
Tek 7B70, Plug-in (200MHz), Time Base ... $75
Tek 7B80, Plug-in (400MHz), Delayed Time Base ... $150
Tek 7B92A, Plug-in (500MHz), Dual Time Base ... $200
Tek 7D11, Plug-in Digital Delay ... $175
Tek 7D13, Plug-in DMM 3-1/2 Digit ... $125
Tek 7D15, Plug-in Counter/Timer, DC-225MHz ... $225
Tek 7L18, 1.5-60GHz Spectrum Analyzer ... $1,700
Tek 7S11, Plug-in Sampling Unit ... $175
Tek 134, Current Probe Amp ... $100
Tek 453, Scope (60MHz), Dual Trace ... $175
Tek 465, Scope (100MHz), Dual Trace ... $425
Tek 465B, Scope (100MHz), Dual Trace ... $475
Tek 466, Scope (100MHz storage), Dual Trace ... $575
Tek 475, Scope (200MHz), Dual Trace ... $475
Tek 475A, Scope (250MHz), Dual Trace ... $625
Tek 475/DM44, Scope (200MHz), Dual Trace w/DMM ... $575
Tek 485, Scope (350MHz), Dual Trace ... $850
Tek 520A, NTSC Vectorscope ... $575
Tek 2213, Scope (60MHz), Dual Trace ... $375
Tek 2215, Scope (60MHz) Dual Trace ... $450
Tek 2235, Scope (100MHz) Dual Trace ... $650
Tek 2236, Scope (100MHz) w/Counter/Timer/DMM ... $800
Tek 2336, Scope (100MHz) Dual Trace ... $650
Tek 2445, Scope (150MHz), 4-Channel Cursor Readout ... $1,700
Tek 2465, Scope (300MHz), 4-Channel Cursor Readout ... $2,400
Tek 7104, Scope (1GHz), Dual Trace ... $1,750
Tek 7603, Scope Mainframe (100MHz) ... $200
Tek 7704A, Scope Mainframe (250MHz) ... $200
Tek 7854, Scope (400MHz), Dual Beam w/Waveform Calculator ... $625
Tek 7904, Scope Mainframe (500MHz) ... $275
Wavetek 145, Pulse/Function Generator, .0001-20MHz ... $350
Wavetek 185, Lin Log Sweep Generator, .0001Hz-5MHz ... $425
Wavetek 288, Synthesized Function Generator, 20Hz-20MHz (unused) ... $950
Wavetek 3000, Signal Generator, 1-520MHz ... $525
Wavetek FG3B, Sweep/Function Generator .2Hz-100KHz (unused) ... $375

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MCM AUDIO SELECT™

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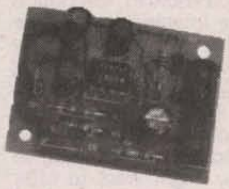
CEBEK



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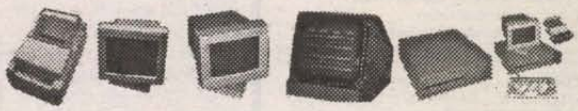

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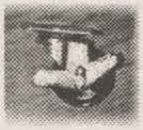
486 SX 25 CPU
4MB On board
2 ISA Slots
IDE, FD, 2 COM, 1 LPT & 512K VGA
UPGRADABLE to DX2/66



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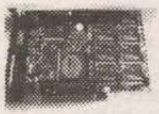

3D Accelerated Video Card for Windows 95/NT
See Web for more details

3D Sound Cushion

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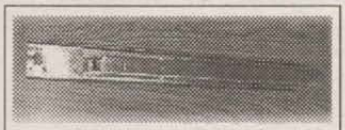

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Small DC Motor w/gear box & Wheel

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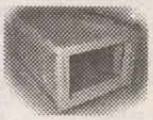

5.25" Closed HH $29.
5.25" Open HH .$35.
5.25" Open FH ..$45.
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3.5" Lunchbox ..$19.
All cases have two 50 pin centronics connectors.

Small 105V 40 RPM Motor. 2.7W

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$9.95

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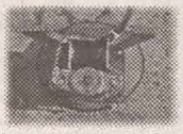

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27256 /27512	$1.50
1Meg	$2.50
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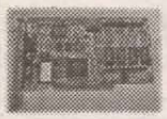

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Events

JANUARY 1999

CALENDAR

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

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

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

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

JANUARY 2

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

TN - MORRISTOWN - Hamfest & Computer Show. Talley Ward Recreation Bldg. Talk-in: 147.303+ & 53.030-. Lakeway ARC, Perry Hensley N4PH, 423-828-4848. E-Mail: n4ph@juno.com. Kemp Lawson KF4AGB, 423-587-3320. E-Mail: kemplawson@aol.com. Web: www.usit.net/mfawbush/larc.html

JANUARY 9

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

CO - LOVELAND - Superfest. Larimer County Fairgrounds, 700 Railroad Ave. 9am-3pm. VE Exams. Talk-in: 145.115- or 146.85-. Northern CO ARC, Jeanene Gage N0YHY, 970-351-7327 or 970-352-5304

NE - KEARNEY - Hamfest. Midway ARC, Bob Mayo KB0YTO, 308-236-7320

NY - MARATHON - Hamfest. Skyline ARC, Patrick Dunn KC2BQZ, 315-468-5909

SC - GREENWOOD - Hamfest & Computer Show. Greenwood Civic Center, 1610 Hwy. 72 E. 9am-5pm. FCC exams. Talk-in: 147.165+ (open) alternate: 146.52 simplex. Greenwood ARS, Frank Kolar WA9FWO, 864-229-5639. Web: http://www.w4gwd.org

WI - WAUKESHA - Hamfest. Waukesha County Expo Center Forum. 8am-2pm. West Allis RAC, Phil Gural W9NAW, 414-425-3649

JANUARY 9-10

FL - FT. MYERS - Hamfest. Sat: 9am-3pm, Sun: 9am-2pm. Talk-in: 146.880. Ft. Meyers ARC, Colleen Sammons KQ4TR, 941-936-1431. E-Mail: csammons@juno.com

JANUARY 10

IN - SOUTH BEND - Hamfest. The Century Center, US 33 N. at Jefferson Blvd. 8am-3pm. Talk-in: 145.290-. Michiana Valley Hamfest Assn., Bob Denniston KA9WNR, M-F 7-10pm EST. 219-291-0252

FL - LANTANA - Flea Market. Next to Pizza Hut, 6170 S. Congress Ave. 7am-12pm. Talk-in: 146.67. The Major Armstrong FM Assn., Jeff Beals WA4AW, 561-586-5120. Al West W4SDC, 561-641-8244

MI - FLINT - Hamfest. AR & Youth, Clay KF8UI, 810-233-7889. E-Mail: clay@iavbbs.com

MO - ST. JOSEPH - Hamfest. Ramada Inn, I-29 @ Frederick Ave. 8am-3pm. Talk-in: 146.85 and 444.925. Missouri Valley ARC & Ray Clay ARC, John Winkler WB0VRA, 816-424-6484. Gaylen Pearson, E-Mail: WB0W@IBM.Net

JANUARY 13

PA - PHILADELPHIA - Auction. Phil-Mont Mobile RC, Russ Stafford W3CH, 610-631-3401 Ext 902. Web: http://www.phil-mont.org

JANUARY 16

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

LA - HAMMOND - Hamfest. University Center, University Dr. Southeast Louisiana ARC, Jack Stang N5XVJ, 504-542-7605. E-Mail: jstang@i-55.com. Ned Shipman KC5IHR, 504-796-0177. E-Mail: kc5ihr@internet.com Web: http://www.i-55.com/~creolepb/selarchamfest.html

MI - FLINT - Hamfest. AR and Youth, Clay Hewitt KF8UI, 810-233-7889. E-Mail: clay@iavbbs.com

MO - ST. JOSEPH - Hamfest. Missouri Valley ARC & Ray-Clay ARC, John Winkler WB0VRA, 816-424-6484. E-Mail: WB0W@IBM.Net

OH - MIDDLETOWN - Hamfest. Dial Radio Club, Hank Greeb N8XX, 513-385-8363. E-Mail: 72277.706@compuserve.com Web: http://w3.one.net/~rkuns/swohdigi.html

JANUARY 17

MI - HAZEL PARK - Hamfest. Hazel Park High School, 23400 Hughes St. 8am-2pm. Talk-in: 146.64 (-). Hazel Park ARC, Tom Austin N8TMQ, Tom Krausnick WC9F. HPARC, POB 368, Hazel Park, MI 48030.

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

OH - NELSONVILLE - Hamfest. Sunday Creek AR Federation, Russ Ellis N8MWK, 740-767-2226 or 740-797-4166. E-Mail: SCARF@hocking.edu

VA - RICHMOND - Hamfest. The Showplace, 3000 Mechanicsville Tpke. 8:30am-3:30pm. Talk-in: 146.88 repeater. RATS, Jim Clark N3JJF, 804-739-2269 ext. 3378. Web: http://frostfest.rats.net

JANUARY 23

NC - WINSTON-SALEM - FirstFest. Dixie Classic Fairgrounds, Home & Garden Bldg. 8am-1pm. Talk-in: 146.64 MHz. Forsyth ARC, Inc., Tom Gallagher N4IOZ, 336-723-7388. E-Mail: n4ioz@ibm.net Web: http://www.rbdc.com/~kq4lo/farc.htm Web: http://members.xoom.com/w4nc/

TN - GALLATIN - Hamfest. Civic Center, off Hwy. 31E. 8am-2pm. VE Exams. Talk-in: 147.90/.30 tone 114.8. Tennessee Valley AR Network, Bill Ferrell N4SSB, 615-451-5992

JANUARY 24

IL - VILLA PARK - Hamfest. Odeum Expo Center. 8am-2pm. VE Exams. Talk-in: 145.390-. Wheaton Comm. RAs, Donald Motz N9NYX, 630-665-7757. E-Mail: donlin@xnet.com http://www.w9ccu.org: Pat Byrne K9JAU, 630-545-9950. E-Mail: k9jau@juno.com

OH - DOVER - Hamfest. Tusco ARC, Howard Blind KD8KF, 330-364-5258

JANUARY 29-30

MS - JACKSON - Hamfest. Jackson ARC, Ron Brown AB5WF, 601-956-1448 or 601-982-0101. E-Mail: ab5wf@juno.com Web: http://www.jxnarc.org

JANUARY 30

AL - GREENVILLE - Hamfest. Butler & Pike County RACES, Jerry McCullough KE4ERO, 334-382-7644. E-Mail: w4mpq@alaweb.com

FL - ARCADIA - Hamfest. DeSoto ARC, Doug Christ KN4YT, 941-494-5070 or 941-993-4834. E-Mail: kn4yt@cyberstreet.com

MO - NEVADA - Hamfest. Nevada ARC, Dennis Kimrey. E-Mail: dkimrey@ipa.net E-Mail: k0cb@ipa.net Web: http://www.users2.ipa.net/~dkimrey

NM - ALBUQUERQUE - Albuquerque Winter Tailgate Swapfest, Tom Ellis K5TEE, 505-291-8122. E-Mail: k5tee@qsl.net

NY - LOCKPORT - Auction. Lockport ARA, Albert Gritzmacher AE2T, 716-433-3396. E-Mail: lockportara@juno.com Web: http://hamgate1.sunyerie.edu/~lara/auction.html

JANUARY 31

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

MD - ODENTON - Hamfest. Maryland Mobileers ARC, Bill Ziegler KA6TYY, 410-987-2384. E-Mail: ka6tyy@juno.com. Bill Hampton N3WGM, 410-766-2199. E-Mail: diamondb@space4less.com Web: http://www.space4less.com/usr/mmarc

COMPUTER SHOWS

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

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

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

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

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

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

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

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

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

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

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

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Events CALENDAR

FEBRUARY 1999

FEBRUARY 1

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

FEBRUARY 6

AR - WEST MEMPHIS - Hamfest. Eugene Woods Civic Center, 212 W. Polk. 9am-4pm. VE Exams. Talk-in: 147.150+, 444.775+. Dixie AR Group, Kellye Farris KB5RCE, 870-732-8724.
E-Mail: kb5rce@media-two.com
E-Mail: dixiefest@media-two.com
Web: http://www.media-two.com/DARG
CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
IA - MONTOUR - Hamfest. Jerry Morrison N0LEM, 515-484-6036. E-Mail: N0LEM@W0CXX-1.IA.USA.NA E-Mail: lmonster@pcpartner.net
KS - MOUND CITY - Hamfest. Mine Creek ARC, Bill VanKirk W0PT, 913-795-2080.
E-Mail: bvkirk@kanza.net
SC - NORTH CHARLESTON - Hamfest. Stall High School. 8:30am-4pm.VE Exams. Charleston ARS, Jenny Myers WA4NGV, 843-747-2324.
E-Mail: brycemyers@aol.com
E-Mail: wa4usn@amsat.org

FEBRUARY 6-7

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

FEBRUARY 7

OH - LORAIN - Hamfest. Northern Ohio ARS, Mike Willemin W8EU, 440-324-4574
PA - LATROBE - Hamfest. American Legion, 1811 Ligonier St. 8am-1pm. Talk-in: 145.150 (-600). Chestnut Ridge ARC, William Demosky K3AFS, 724-539-1552

FEBRUARY 12-13-14

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

FEBRUARY 13

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves
MA - MARLBOROUGH - Hamfest. Marlborough Middle School, Rt. 85. 10am-2pm. Algonquin ARC, Ann Weldon KA1PON, 508-481-4988
MI - NEGAUNEE - Swap & Shop. Township Hall. Talk-in: 147.27. Hiawatha ARA, Bob Serfas N8PKN, 906-226-9782. John Veight N8RSE, 906-228-9417
NY - WESTFIELD - Hamfest. Westfield Exempt Volunteer Fireman's Assn., 75 Bourne St. 8am-3pm. Talk-in: 145.350 (-). Chautauqua County RAs, Eric Kroon N2PCQ, 716-595-3220.
E-Mail: ekroon@netsync.net
PA - OBERLIN - Hamfest. Oberlin Fire Co., Fire Hall. VE Exams. Talk-in: 146.76. HRAC 717-939-4825. E-Mail: n3njb@juno.com

FEBRUARY 14

IL - ROCK ISLAND - Hamfest. QCCA Expo Center, 2621 4th Ave. Talk-in: W0BXR 146.28/.88 and 146.04/.64. Davenport ARC, Kent Williams K9UQI, 309-796-0718, 4-9pm only. E-Mail: k9uqi@arcsupport.com E-Mail: k9uqi@netexpress.net Web: http://www.arcsupport.com/drac
OH - MANSFIELD - Mid*Winter Hamfest & Computer Show. Richland County Fairgrounds. Talk-in: call W8WE on 146.34/94. InterCity ARC, Inc., Pat Ackerman N8YOB, 419-589-7133 after 2pm EST.

FEBRUARY 20

AR - RUSSELLVILLE - Hamfest. AR River Valley AR Foundation, Margaret Alexander KC5MCS, 501-968-7270. E-Mail: ealexand@cswnet.com
CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
FL - BROOKSVILLE - Hamfest. Spring Hill VFW Post 10209, Spring Hill Dr. between US 41 & Mariner Blvd. Talk-in: 146.715. Hernando County ARA, Ralph Wilson AF4FC, 352-754-9653. Jim Angello KE4SZP, 352-688-5214.
E-Mail: jangello@fiber-net.com
Web: www.fiber-net.com/pub/hcara/index.htm
MN - BLAINE - Hamfest. Robbinsdale ARC, Jerry Dorf N0FWG, or Harriet Johanson 612-537-1722.
E-Mail: jerryd@skypoint.com
OR - RICKREALL - Hamfest. Polk County Fairgrounds, 520 S. Pacific Hwy. W. Talk-in: 146.86-. Salem Repeater Assn. and Oregon Coast Emergency Repeater, Evan Burroughs N7IFJ, 503-585-5924 before 8pm.
E-Mail: n7ifj@teleport.com
Web: http://sra.goldcom.com/sraflyer.htm
TX - SMITHVILLE - Hamfest. Bastrop County ARC, Lynn Fisk K5LYN, RR 2 Box 198B, Smithville, TX 78957-9551

FEBRUARY 21

MI - FARMINGTON HILLS - Swap 'n Shop. William M. Costick Activities Center, 28600 Eleven Mile Rd. 8am-3pm. Talk-in: 145.350-repeater and 146.52 simplex. Livonia ARCs, 734-261-5486. E-Mail: swap@larc.mi.org
Web: www.larc.mi.org
NC - ELKIN - Hamfest. Briarpatch & Foothills ARCs, Jimmy Holbrook KB4GKI, 336-957-3820.
E-Mail: kb4gki@aol.com Web: http://members.aol.com/kb4ghi/kb4gki.html
NY - FREEPORT - Hamfest. Armory, 63 Babylon Tnpk. 8:30am-1pm. Talk-in: 146.850 (136.5 PL). LIMARC, 516-520-9311. E-Mail: hamfest@limarc.org Web: http://www.limarc.org

FEBRUARY 27

GA - DALTON - Hamfest. Dalton ARC, James Jordan K4FLG, 706-278-0630 evenings
KY - CAVE CITY - Hamfest. Mammoth Cave ARC, 502-651-2363. E-Mail: lbrumett@glasgow-ky.com Web: http://www.scrtc.blue.net/mcarc
ND - BISMARCK/MANDAN - Hamfest. Central Dakota ARC, Dennis Murphy K0GRM, 701-258-6747. Web: http://www.qsl.net/cdarc
VT - MILTON - Hamfest and Convention. Milton High School, Rt. 7. 8am-3pm. Talk-in: 145.15-. RAs of Northern VT, Mitch Stern W1SJ, 802-879-6589. E-Mail: w1sj@vbimail.champlain.edu
Web: http://www.ranv.together.com

FEBRUARY 27-28

OH - CINCINNATI - Convention. Cincinnati Gardens, Exhibition Center. Great Lakes Div.

Continued on page 67

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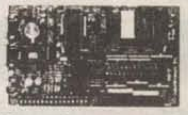

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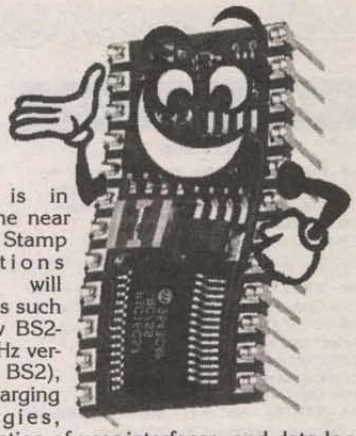
STAMP APPLICATIONS

by Lon Glazner



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

Back To The Basics (Stamps, That Is)!

So here I am, sitting down at the computer, and asking myself, "What do people want to know about BASIC Stamps?" More importantly, "What do I have to share?"

At Solutions Cubed, we handle all aspects of embedded control design. In other words, I've got technical experience. But technical know-how does not a good article make.

Like most engineers, I spend an inordinate amount of time perusing dry engineering manuals. While informative, I think most of us can agree that data sheets are a far cry from good literature. I think the real power in BASIC Stamps is derived from the way they allow us to interact with technology. This interaction is what I hope to explore.

The first time I completed serial communication between a microcontroller and a computer, I felt like I had cracked some secret code. Yeah, so the secret code was well-documented and everyone else already knew it, I felt a sense of accomplishment anyway. I still find myself thinking "This is pretty cool!" when I see MY data splashing across a computer screen.

BASIC Stamps can be many things to many people. To the inexperienced, they allow a successful foray into the world of embedded control. To the experienced engineer, they are a powerful tool in an ever-expanding tool box.

It is my hope that experienced BASIC Stamp users will find good technical information in my upcoming columns. It is my desire that a number of beginners will experience the sense of accomplishment that understanding technology has brought to me.

Why does the Stamp Applications column exist? Probably because BASIC Stamps are being used by students, teachers, hobbyists, and engineers worldwide. In an educational setting, they can provide months of discussion and learning. To a hobbyist, they may represent a home-lighting solution, or a tachometer for the hot-rod in the garage. As an engineer, I often use them to test various aspects of my electronic designs.

The BASIC Stamp is a powerful and ubiquitous design tool. They're also inexpensive, well-documented, and Parallax provides excellent technical support.

Designing with BASIC Stamps can be described as 50% software and 50% hardware. At times, it will seem like there is an additional 50% that revolves around figuring which part just evaporated in a cloud of smoke, and why.

Certain design techniques help to reduce guesswork and allow the designer to foresee potential problems. These techniques will be the meat and potatoes of my future articles.

What is in store for the near future? My Stamp Applications columns will cover topics such as the new BS2-SX (a 50MHz version of the BS2), battery charging technologies, implementation of user interfaces, and data logging. We'll also get into testing techniques for BASIC Stamp based systems.

I'm looking forward to writing this column and hope that you will find something worthwhile in the pages to come. See you next month! NV

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

CONTACT:

Lon Glazner – Partner
Solutions Cubed
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Newsbytes

Announcing the Steganos Contest – Keep Your Secrets a Secret and Win!

Washington, DC - CenturionSoft announced a contest to promote their new security utility Steganos. Steganos – for Windows, 95,98 and NT – is a utility that not only provides a high 2048 bit level of encryption but also allows the user to hide their encrypted data in normal looking image, sound, and text files.

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To enter the Steganos contest one needs only to go to the CenturionSoft website – **http://www.centurionsoft.com** - and follow the instructions for downloading both the free 30-day evaluation copy of Steganos and the contest image. The contest image contains a secret message on how to enter the contest which can be unhidden and decrypted using Steganos.

Prizes will be awarded weekly beginning December 15th, 1998. The grand prize will be awarded on March 31st, 1999. Prizes include a round-trip ticket to Europe, a color TV, and free copies of Steganos. For complete terms and conditions, please see the CenturionSoft website.

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Steganos, which began shipping on September 30th, 1998, has an estimated street price of $39.95.

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More Ways To Use Low-Cost Digital Meters

by John Sharp

Traditionally, digital panel meters have been sort of a premium item. They're accurate and easy to read, but they tend to be fairly expensive, with prices starting at about $40.00 in single quantities. Recently, a series of parts imported from China has changed that situation dramatically. You can now buy a single 3-1/2 digit job with LCD display for under $10.00! That's cheaper than all but the very crudest analog movements.

There's not much clue as to who actually built these meters; the packaging is simply marked "C & C Digital Panel Meter," with a part number PM-128. Nonetheless, they work pretty well. The display is reasonably sized and, though not backlit, very readable in typical room lighting or outdoors. The accuracy and stability are plenty adequate for most applications; certainly better than even fairly expensive analog meters. So, what's the catch?

The Problem

To help clarify the problem, let's first look at how these meters work. They're based on a clone of the classic Intersil ICL7106 integrated circuit, which is a complete analog-to-digital converter with LCD display drivers. When fed with 'split' positive and negative power supplies as shown in Figure 1, it will measure a signal of 0V to + or -200mV whose common or ground is the same as the power supply ground. However, the chip was primarily intended for handheld, battery-operated multimeters. It internally generates a 'common' level that's about 2.8V below the positive supply voltage. For battery operation, the signal common line is tied to this internal common, as shown in Figure 2. That's what the designers of these panel meters have done.

So, if you run the panel meter from an isolated source like a battery, and measure a voltage that has no connection to the power source, it works fine. If you use the meter wholly within an instrument or device, though, you'll usually be measuring signals in the same circuit that powers the meter.

Most often, the voltages you want to measure will be referenced to ground. But if you feed the meter with, say, +10V on the positive supply input and circuit ground on the negative, the signal input common will need to be at about +7.2V. That's why the vendors have started putting notes in their ads like "Cannot measure own power source" or "meter power must be isolated."

What can you do about this? One solution might be to modify the meter so that you can use the circuit in Figure 1. In practice, this means ripping the thing apart and doing a whole bunch of trace cutting and jumpering. If that's not enough to stop you, consider that disassembling the plastic housing from the circuit board pops the LCD display module loose; those of you who have tried to reinstall an LCD with conductive elastomeric connectors after they've picked up some dust or skin oils need no further warning.

Fortunately, there's a couple of other fairly simple solutions. You can power the meter with a ground referenced supply and then shift the signal voltage to where the meter wants it; or you can power the meter from an isolated supply so that it doesn't care where the signal is.

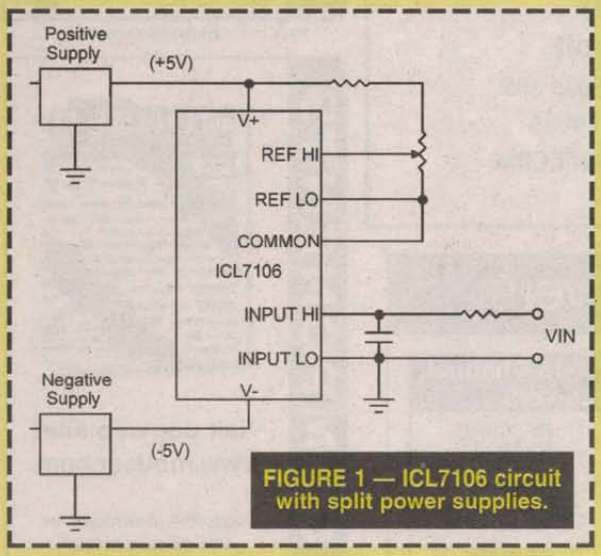


FIGURE 1 — ICL7106 circuit with split power supplies.

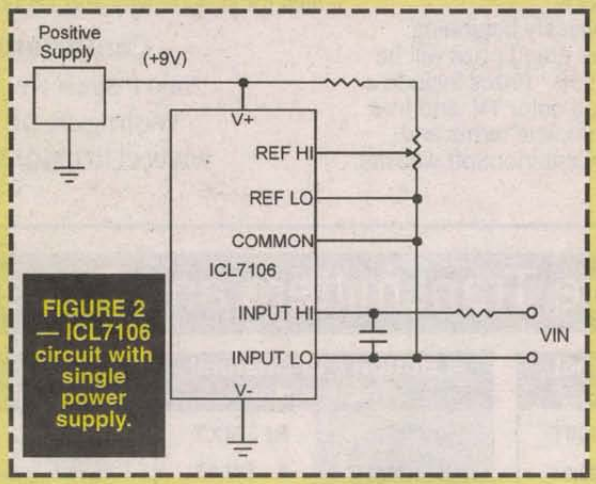


FIGURE 2 — ICL7106 circuit with single power supply.

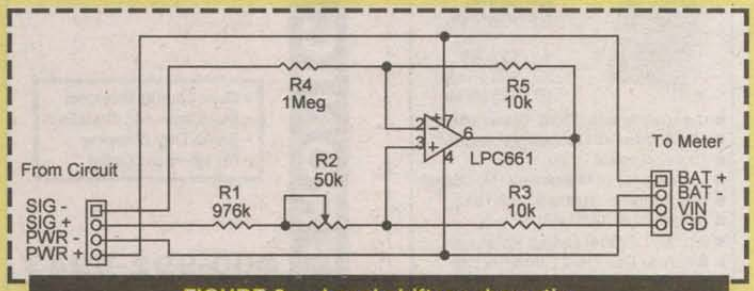


FIGURE 3 — Level shifter schematic.

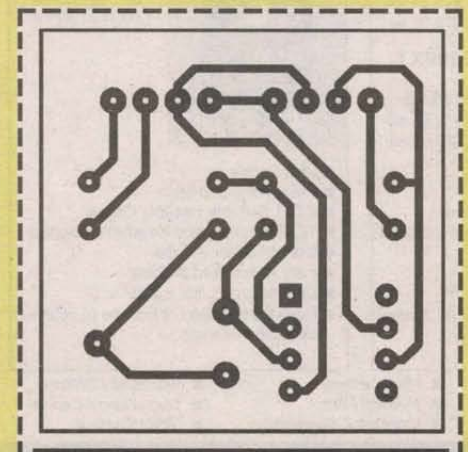


FIGURE 4 — Level shifter PC artwork.

Circuit #1: Level shifter

Figure 3 shows a circuit that allows the panel meter to measure a voltage in relation to its own supply ground. The opamp is configured as a differential amplifier with a gain of 0.01 (1/100), which scales a 20V signal referenced to circuit ground down to a 200mV signal referenced to the meter's common input. Note that even though the meter and opamp are both powered from +7 to +12 volts, the measured voltage can be ±20V.

Differential amplifiers (and their kin — instrumentation amplifiers) are often used to pick up a relatively small signal that's 'riding' on a higher voltage that may be fluctuating or noisy. The idea is to amplify the signal between the inputs without

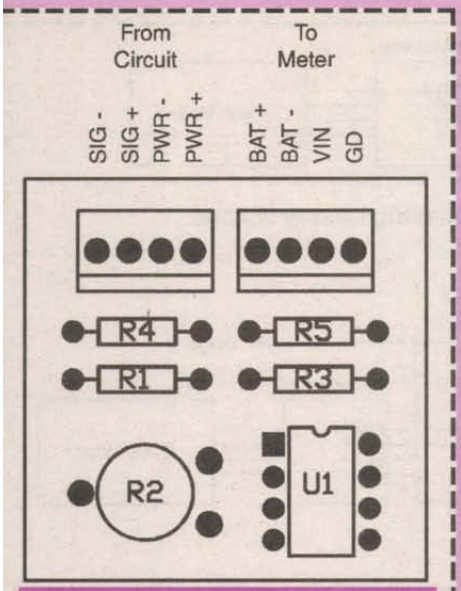


FIGURE 5 — Component layout for level shifter board.

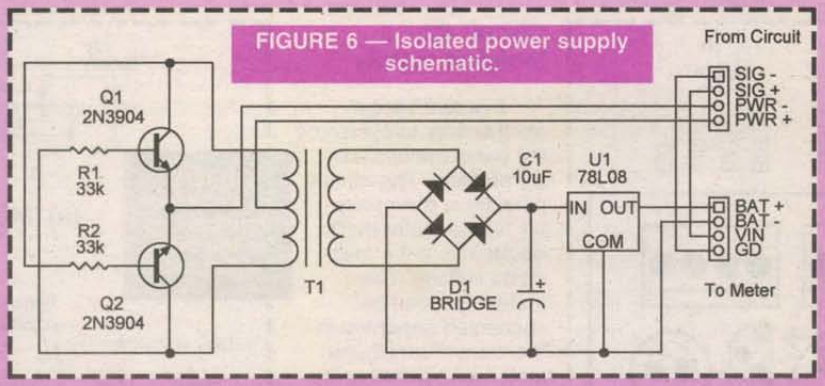


FIGURE 6 — Isolated power supply schematic.

amplifying the voltage to ground that's common to both inputs. They have a reputation as a 'high performance' type of circuit, requiring parts with tight tolerances and low drift and usually still needing careful tweaking.

The application here is a lot less demanding for two reasons. One is that instead of amplifying a small signal, we're attenuating a larger one. The second reason is that while the signal is offset from the meter input level, that offset changes very little.

So, this scheme will work fine for fairly large voltage ranges (2V or more) that have a fixed reference, like circuit ground. Examples would be monitoring the battery voltage in a portable instrument, or tracking the output voltage of a variable power supply (see sample connections in Figure 9). It won't work well at all for small voltages whose reference changes. For example, to measure the current of your variable supply, you'd put a shunt resistor on the output, as in Figure 9(c). The voltage across the shunt will only be a couple of hundred millivolts at most, but the voltage from the shunt to ground will vary from zero to 10s of volts. For this kind of measurement, check out the 'isolated supply' trick later in this article.

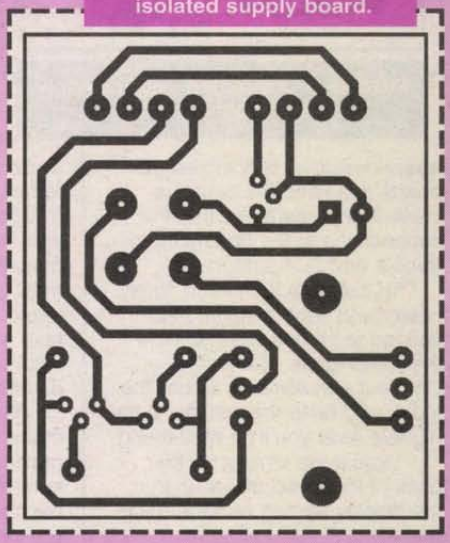
The LPC661 opamp works well in this circuit for several reasons. One is that it will operate with very low supply voltage, so we can feed it from the meter's power supply. It also draws very little supply current, so this circuit is great for battery-operated equipment. Finally, this opamp's inputs take extremely low current, so we can use high value resistors to avoid loading the circuit we're measuring.

Use 1% resistors for R1, R3, R4, and R5. A single turn trimmer is fine for R2. The values shown are for a 20V full scale input range; you can scale that up to 200V by making R3 and R5 1 Kohm resistors, or down to 2V by using 100K parts.

Figure 4 is the artwork for a single-sided printed circuit board. It's reproduced at twice normal size so you can copy or scan with better resolution; reduce it 50% when printing to toner-transfer material or to a transparency for photoresist processes. To check on the accuracy of your copier, printer, or scanner, the board outline is 1.25" square. Note that the pattern appears as if you are looking down through the PC board from the component (top) side; the final copper pattern, seen looking at the bottom of the board, will be a mirror image of this. This image orientation is required for the toner-transfer process (i.e., you can't get it backwards).

If you use a photoresist, though, be sure that the side of the transparency with the image on it is against the board during the exposure. Figure 5 shows the top side component placement. If you're laying out your own PC

FIGURE 7 — Printed circuit artwork for isolated supply board.



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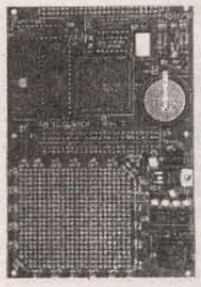

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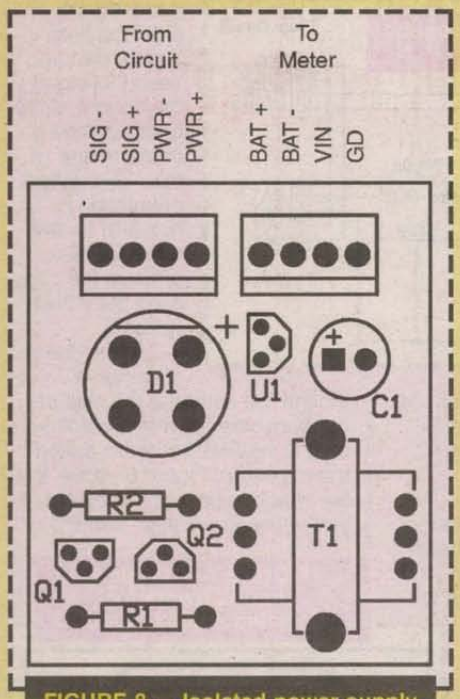

FIGURE 8 — Isolated power supply component layout.

board design or building on perfboard, just keep the resistors close to the opamp so that the connections to the opamp inputs (pins 2 and 3) are short.

To calibrate the circuit, apply power and set the signal input voltage to zero. Adjust R2 until the panel meter reads zero. Connect a multimeter across the input, and raise the voltage to the highest level you'll be measuring.

Adjust the trimpot on the back of the panel meter so that the display agrees with the multimeter.

Circuit #2: Isolated supply

Figure 6 shows another way to overcome the panel meter's supply problem. This circuit provides a power supply for the meter that's isolated from the measured voltage. The meter input can be connected anywhere in the 'parent' circuit; the meter will behave as if powered by its own battery. This is especially useful when you're switching the meter input to various parts of the circuit, for example using the same panel meter to display both voltage and current.

The circuit is a simple DC-to-DC converter. The transistors form a multivibrator that creates a squarewave of several hundred Hertz, which passes through an inexpensive audio frequency coupling transformer to a rectifier and filter. This is followed by a low power voltage regulator IC that keeps the output constant and removes most of the remaining noise and ripple. The circuit as shown will take a power input from 7 to 12 volts and put out a clean, isolated 8 volts for the meter.

We can get away with this crude approach because the meter needs only very modest current, less than 1 mA. You can buy ready-made DC-DC converters that are smaller, more efficient, and handle more power. Unfortunately, their cost starts at around $10.00 each. The parts for this circuit should run less than a third of that.

T1 is simply the cheapest 600-ohm coupling transformer I could find. Most anything similar you can dig up should function. C1 should be a tantalum electrolytic since they work a little better at high frequencies than the aluminum capacitors. If you have two meters to run, a dual secondary (600:600/600) transformer with a bridge, capacitor, and regulator on each output will keep them both isolated.

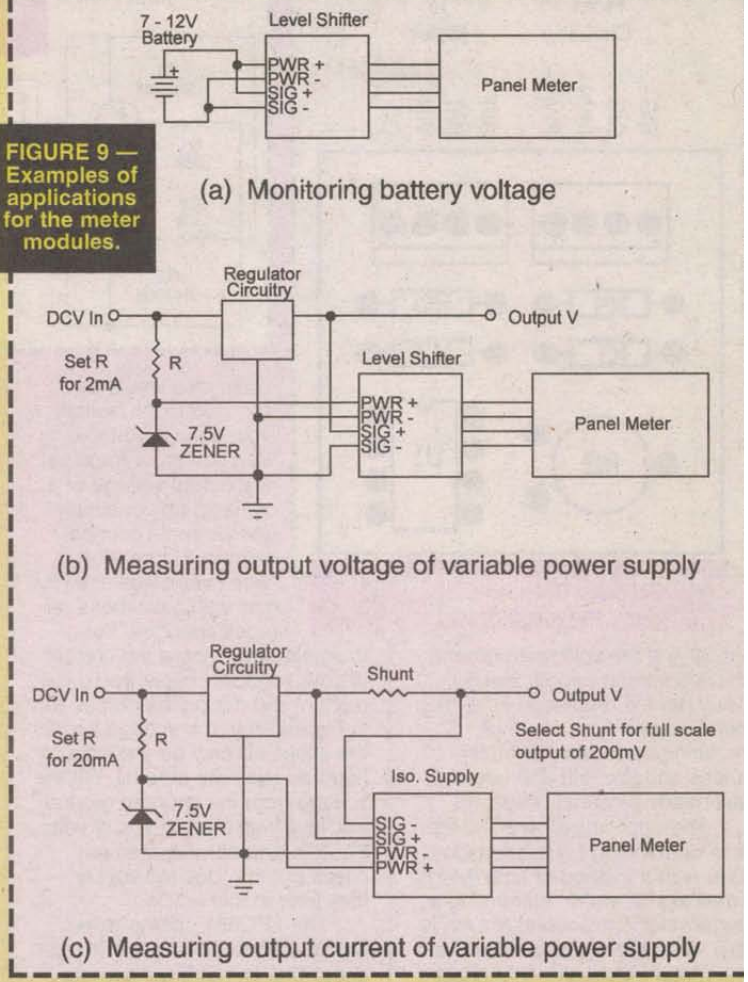

FIGURE 9 — Examples of applications for the meter modules.

Figure 7 is the printed circuit board artwork. As for the level shift circuit, it's reproduced at twice normal size. The actual board outline is 1.25" by 1.5". Figure 8 shows the top side component placement. Layout isn't critical in this circuit. The location and wiring of the input and output connectors is identical to the level shift board.

When you first power up the module, double check the output voltage under load to make sure it's at approximately 8 volts. Note that the circuit simply passes the measured signal through the board. If you are using the meter's 200mV range, no further calibration is necessary (assuming the panel meter was correctly adjusted at the factory).

If you need a higher range (2V, 20V, or 200V), follow the instructions packed with the meter to create a simple resistive divider on the meter board. Set

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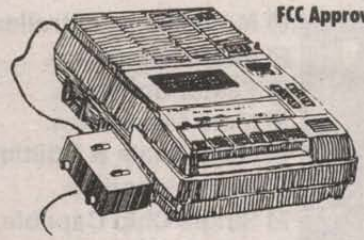

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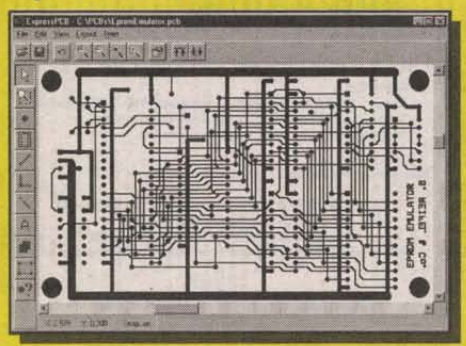

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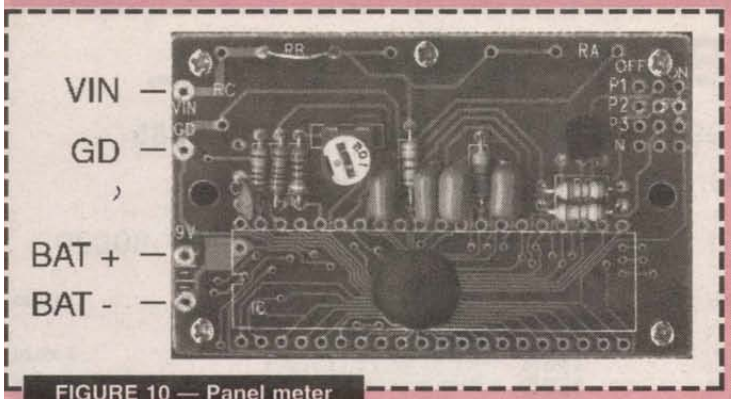

FIGURE 10 — Panel meter connections.

the voltage to be measured near its maximum level and monitor it with a multimeter. Adjust the trimpot on the back of the panel meter so that the display agrees with the multimeter. The panel meter doesn't require any calibration for the zero input condition.

Conclusion

As you can probably tell from the tone of this article, I tend to like things that are cheap and simple, but do the job, and that pretty well describes these imported panel meters. I hope the ideas shown here will help you use them in your own projects.

Perhaps on your next one, you can skip scrounging around the surplus bins for an electromechanical antique and design in a nifty digital readout instead!

NV

Parts List for Panel Meter Modules

Level Shift Circuit

R1 -	976 Kohm, 1/4 watt, 1% tol.
R2 -	50 Kohm, horizontal trimpot (most 8mm open-frame trimmers fit)
R3,R5 -	10 Kohm, 1/4 watt, 1% tol. (for 20V full scale input; use 1 Kohm for 200V, 100 Kohm for 2V)
R4 -	1 Megohm, 1/4 watt, 1% tol.
U1 -	National Semiconductor LPC661 opamp IC, DIP pkg. (Digi-Key P/N LPC661IN-ND)

Isolated Supply Circuit

C1 -	10uF, 25V, tantalum electrolytic, radial lead
D1 -	1.5 Amp, 50V or higher, bridge rectifier
Q1,Q2 -	2N3904 transistor, TO-92 plastic case
R1,R2 -	33 Kohm, 1/4 watt, 5% tol.
T1 -	600:600 ohm audio transformer (Mouser P/N 42TL016)
U1 -	LM78L08 type 8V regulator IC (Mouser P/N 513-NJM78L08A)

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Contact pins for housing - Molex P/N 08-50-0114

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OSCILLOSCOPES & ACCESSORIES

TO 100 MHz

TEK SC502 15 MHz Dual Trace Oscilloscope, TM500 series — $ 375.00

ABOVE 100 MHz

TEK 2465 300 MHz 4-channel Oscilloscope — $ 2,500.00
TEK 7104 1 GHz Oscilloscope, with 7A29, 7A29-04, 7B10, 7B15 — $ 4,500.00
TEK 7844 400 MHz Dual Beam Oscilloscope with 7A24,7A26,7B80,7B85 — $ 900.00
TEK 7904 500 MHz Oscilloscope, with 7A24, 7A26, 7B80, 7B85 — $ 900.00
TEK 7A42 4-Channel Logic Triggered Vertical Amplifier — $ 500.00

PROBES

HP 1122A Probe Power Supply — $ 150.00
TEK 1101 Accessory Power Supply, for FET probes — $ 200.00
TEK P6046 100 MHz Differential Probe — $ 750.00
TEK P6150 9 GHz 10X/ 3 GHz 1X 50 Ohm Probe, SMA(m) output — $ 400.00
TEK P6201 900 MHz 1X/10X/100X FET Probe — $ 450.00
TEK P6202A 500 MHz 10X FET Probe — $ 300.00
TEK P6203 1 GHz 10X Active Probe, for 11000 series — $ 375.00
TEK P6701-opt.02 O/E Converter, 450-1050 nm/0-1 mW: DC-700 MHz, ST conn. — $ 175.00

CALIBRATION

TEK SG503 Level Generator, 250 kHz-250 MHz, TM500 series — $ 600.00

WAVEFORM GENERATORS

FUNCTION

HP 3310A 5 MHz Function Generator — $ 250.00
HP 3310B 5 MHz Function Generator, monocycle & var.phase trigger — $ 325.00
HP 3312A 13 MHz Function Generator — $ 600.00
HP 3325A 21 MHz Synthesized Function Generator, HPIB — $ 1,000.00
HP 3325A-002 21 MHz Function Generator, high voltage output option — $ 1,500.00
HP 8165A-002,003 Prog. Signal Source, 1 mHz-50 MHz, log sweep, rear out — $ 1,750.00
TEK AWG5102 Arb.Waveform Gen., 20 MS/s,12 bits,50ppm synthesis <1MHz — $ 900.00
TEK AWG5105-opt.02 Arbitrary Waveform Generator, dual channel option — $ 1,250.00
TEK DD501 Digital Delay & Burst Gen., for function & pulse gen's — $ 275.00
TEK FG501 1 MHz Function Generator, TM500 series — $ 225.00
TEK FG502 11 MHz Function Generator — $ 300.00
TEK FG503 3 MHz Function Generator, TM500 series — $ 250.00
TEK RG501 Ramp Generator, TM500 series — $ 225.00
WAVETEK 185 5 MHz Lin/Log Sweep/Function Generator — $ 300.00
WAVETEK 288 20 MHz Synthesized Function Generator, GPIB — $ 750.00

PULSE

BERKELEY NUCLEONICS 7085B Digital Delay Generator, 0-100 mS, 1 nS res.,5 Hz-5 MHz — $ 750.00
HP 8007B 100 MHz Pulse Generator — $ 650.00
HP 8012B 50 MHz Pulse Generator, variable transition time — $ 600.00
HP 8015A-002 50 MHz Dual Output Pulse Generator, gated burst option — $ 750.00
HP 8080A/81A/83A/84A 300 MHz Word Generator — $ 800.00
HP 8080A/91A/92A/93A 1 GHz Single Channel Pulse Generator — $ 950.00
HP 8111A 20 MHz Pulse / Function Generator — $ 1,000.00
HP 8115A 50 MHz Dual Channel Pulse Generator, HPIB — $ 2,750.00
TEK PG502 250 MHz Pulse Generator, Tr<1nS, TM500 series — $ 600.00
TEK PG505 100 kHz Pulse Generator, 80 V peak, TM500 series — $ 275.00
TEK PG508 50 MHz Pulse Generator, TM500 series — $ 500.00
WAVETEK 802 50 MHz Pulse Generator — $ 300.00

VOLTAGE & CURRENT

VOLTMETERS

FLUKE 845AR High Impedance Voltmeter / Null Detector — $ 400.00
HP 3456A 6-1/2 Digit Voltmeter — $ 700.00
HP 3478A 5-1/2 digit Multimeter, HPIB — $ 700.00
KEITHLEY 181 6-1/2 digit Nanovoltmeter, 10 nV sensitivity, GPIB — $ 900.00
SOLARTRON 7081 8-1/2 digit Voltmeter — $ 3,250.00
TEK DM501A 4-1/2 digit Multimeter, TM500 series plug-in — $ 225.00

CALIBRATION

FLUKE 510A AC Reference Standard, 10 VRMS, 0-10 mA — $ 450.00
FLUKE 515A Portable Calibrator, DC/AC/Ohms, line & battery power — $ 900.00
FLUKE 5220A Transconductance Amplifier, DC-5 kHz, 0-20 A — $ 3,000.00
FLUKE 720A 7-decade Kelvin-Varley Voltage Divider — $ 1,250.00
FLUKE 731B DC Reference Standard — $ 400.00
FLUKE 732A DC Voltage Standard — $ 1,750.00
HOLT 11 AC Thermal Converter Set, 0.5-1200 V, 20 Hz-30 MHz — $ 1,000.00
VALHALLA 2703 AC Volt.Std., 0-120V/10 Hz-100 kHz;120-1200V/10 Hz-1 kHz — $ 1,750.00

VOLTAGE SOURCES

HP 6115A Precision Dual Range Power Supply, 50V 0.8A / 100V 0.4A — $ 850.00
KEITHLEY 228 Programmable Voltage/Current Source — $ 2,500.00

CURRENT METERS & SOURCES

HP 4140B Picoammeter / DC Voltage Source, without test fixture — $ 2,000.00
HP 6177C DC Current Source, to 50V, 500mA — $ 500.00
HP 6181C DC Current Source, to 100 V, 250 mA — $ 500.00
HP 6186C DC Current Source, to 300V, 100mA — $ 750.00
KEITHLEY 225 Current Source, 0.1 uA-100 mA, 10-100 V compliance — $ 500.00
KEITHLEY 227 Current Source, 1 uA-1 A, 0-50 V compliance — $ 800.00
KEITHLEY 261 Picoampere Source — $ 375.00
TEK A6303 Current Probe, DC-15 MHz, 100 A max.,for use with AM503 — $ 1,000.00
TEK AM503/A6302/TM501 AC/DC Current Probe System — $ 1,000.00
TEK CT-5 -opt.05 High Current Transformer for P6021/A6302, to 1000AMeter, 2-2000 uH — $ 300.00 / $ 550.00

IMPEDANCE & COMPONENT TEST

L.C.R.

BOONTON 62AD 1 MHz Inductance
BOONTON 72BD 1 MHz Capacitance Meter, 3-1/2 digit display — $ 650.00
GR 1689-M 5 digit LCR Meter, 12 Hz-100 kHz — $ 1,900.00
HP 4262A-101 3-1/2 digit LCR Meter, 120 Hz/ 1 kHz/ 10 kHz test, HPIB — $ 1,750.00
HP 4275A-001 5-1/2 digit LCR Meter, 10 kHz-10 MHz, 0-35 V int. bias — $ 5,000.00

STANDARDS

E.S.I. DB62-11K 6-Decade Resistor, 0-11,111.10 Ohms, 0.01 Ohm res. — $ 300.00
E.S.I. SR1010 Resistance Transfer Standards, 1 Ohm-100 K/step — $ 550.00
E.S.I. SR1050-1M Resistance Transfer Standard, 1 Megohm/step — $ 2,000.00
GR 1404-A 1000 pF Reference Standard Capacitor — $ 700.00
GR 1406 Standard Air Capacitors, GR900 connector, 0.1% acc. — $ 375.00
GR 1432-U 4-Decade Resistor, 0-111.10 Ohms, 0.01 Ohm resolution — $ 100.00
GR 1433-G 7-Decade Resistor, 0-1.111, 110 Megohms, 0.1 Ohm res. — $ 275.00
GR 1433-J 4-Decade Resistor, 0-11,110 Ohms, 1 Ohm resolution — $ 150.00
GR 1433-K 4-Decade Resistor, 0-1,110 Ohms, 0.1 Ohm resolution — $ 150.00
GR 1433-L 4-Decade Resistor, 0-111,100 Ohms, 10 Ohms resolution — $ 150.00
GR 1433-N 5-Decade Resistor, 0-11,111 Ohms, 0.1 Ohm resolution — $ 200.00
GR 1433-X 6-Decade Resistor, to 111,111.0 Ohms, 0.1 Ohm res. — $ 250.00
GR 1482-series Standard Inductors — $ 200.00
VALHALLA 2724A Programmable Resistance Standard, 0-11 Gigaohms, GPIB — $ 1,250.00

HI & LO RESISTANCE

HP 4328A Milliohmeter — $ 1,200.00

CURVE TRACERS

TEK 577D1/177 Storage Curve Tracer, with standard test fixture — $ 2,250.00
TEK 577D2/177 Curve Tracer, with standard test fixture — $ 1,850.00

T.D.R.

TEK 1502-opt.04 Time Domain Reflectometer, 0-2,000 feet, chart recorder — $ 1,400.00
TEK 1503-opt.04 Time Domain Reflectometer, 0-50,000 feet,chart recorder — $ 1,400.00

POWER SUPPLIES

SINGLE OUTPUT

HP 6002A-001 0-60 V/ 0-10 A/ 200 Watts max. Autoranging Power Supply — $ 750.00
HP 6011A Autoranging 0-20 V 0-120 A Power Supply, 1000 W max — $ 1,400.00
HP 6200B Dual Range Supply, 0-20 V 0-1.5 A/ 0-40 V 0-750 mA CVCC — $ 200.00
HP 6201B 0-20 V 0-1.5 A CV/CC Power Supply — $ 175.00
HP 6207B 0-160 V 0-200 mA CV/CC Power Supply — $ 200.00
HP 6256B 0-10 V 0-20 A CV/CC Power Supply — $ 300.00
HP 6260B-027 0-10 V 0-100 A CV/CC Power Supply; 208 VAC line — $ 675.00
HP 6261B-027 0-20 V 0-50 A CV/CC Power Supply; 208 VAC line — $ 675.00
HP 6263B 0-20 V 0-10 A CV/CC Power Supply — $ 400.00
HP 6266B 0-40 V 0-5 A CV/CC Power Supply — $ 400.00
HP 6267B 0-40 V 0-10 A CV/CC Power Supply — $ 500.00
HP 6269B-028 0-40 V 0-50 A CV/CC Power Supply; 230 VAC line — $ 900.00
HP 6271B 0-60 V 0-3 A CV/CC Power Supply — $ 400.00
HP 6281A 0-7.5 V 0-5 A CV/CC Power Supply — $ 175.00
HP 6284A 0-20 V 0-3 A CV/CC Power Supply — $ 200.00
HP 6299A 0-100 V 0-750 mA CV/CC Power Supply — $ 200.00
HP 6384A 4.0-5.5 V at 8 A CV/CL Power Supply — $ 125.00
HP 6434B 0-40 V 0-25 A CV/CC Power Supply — $ 800.00
HP 6443B 0-120 V 0-2.5 A CV/CC Power Supply — $ 450.00
KEPCO ABC-1500M 0-1500 V 10 mA CV/CL Power Supply — $ 125.00
KEPCO ATE 36-30M 0-36 V 0-30 A CV/CC Power Supply — $ 900.00
KEPCO ATE 36-8M 0-36 V 0-8 A CV/CC Power Supply — $ 375.00
SORENSEN DCR 20-25B 0-20 V 0-25 A CV/CC Power Supply — $ 550.00
SORENSON DCR 40-40B 0-40 V 0-40 A CV/CC Power Supply — $ 700.00
SORENSON DCR 600-0.75B 0-600 V 0-750 mA CV/CC Power Supply — $ 600.00
SORENSON SRL 20-12 0-20 V 0-12 A CV/CC Power Supply — $ 400.00
SORENSON SRL 60-8 0-60 V 0-8 A CV/CC Power Supply — $ 600.00
TEK PS501-1 Power Supply, 0-20 V, 2 mV res., 400 mA, TM500 series — $ 175.00

MULTIPLE OUTPUT

HP 6205C Dual Output Supply, 0-40 V 300 mA or 0-20 V 600 mA — $ 300.00
HP 6227B Dual 0-25 V 0-2 A CV/CC Power Supply — $ 500.00
HP 6228B Dual 0-50 V 0-1 A CV/CC Power Supply — $ 450.00
HP 6236B Triple Output Supply, to +/-20 V 0.5 A & 0-6 V 2.5 A — $ 375.00
HP 6237B Triple Output Supply, to +/-20 V 0.5 A & 0-18 V 1 A — $ 375.00
HP 6253A Dual 0-20 V 0-3 A CV/CC Power Supply — $ 500.00
HP 6255A Dual 0-40 V 0-1.5 A CV/CC Power Supply — $ 500.00
LAMBDA LPT-7202-FM Triple Output Power Supply — $ 450.00
TEK PS5010 Programmable Triple Power Supply, TM5000 series — $ 750.00
TEK PS503A Dual Power Supply, TM500 series — $ 200.00

MISCELLANEOUS

ACME PS2L-500 Programmable Load, 0-75 V / 0-75 A / 500 Watts max. — $ 400.00
ELGAR 1751B/461 AC Power Source, 0-135 VAC, 1750 Watts, fixed freq.osc. — $ 2,000.00
HP 59501B HPIB Isolated DAC/Power Supply Programmer — $ 175.00
HP 6825A Bipolar Power Supply/ Amplifier, +/- 20 V 2 A — $ 800.00
HP 6827A Bipolar Power Supply/ Amplifier, +/-100 V 0.5 A — $ 800.00
KEPCO BOP 20-20M Bipolar Op Amp/ Power Supply, to 20 V 20 A — $ 675.00
KEPCO BOP 36-5M Bipolar Op Amp/Power Supply, to 36 V 5 A — $ 400.00
KEPCO BOP 50-2M Bipolar Op Amp/Power Supply, to 50 V 2 A — $ 400.00
TRANSISTOR DEVICES DAL-50-15-100 Programmable Load, 0-50 V, 0-15 A, 100 Watts max. — $ 200.00

TIME & FREQUENCY

UNIVERSAL COUNTERS

HP 5315A-001 100 MHz/100 nS Universal Counter, TCXO reference option — $ 450.00
HP 5315B 100 MHz/ 100 nS Universal Counter — $ 500.00
HP 5316A 100 MHz/100 nS Universal Counter, HPIB — $ 600.00
HP 5316A-001,003 100 MHz/ 100 nS Univ. Counter, HPIB, TCXO, 1 GHz C-ch. — $ 750.00
HP 5316B 100 MHz/ 100 nS Universal Counter, HPIB — $ 750.00
HP 5334A 100 MHz Universal Counter, HPIB — $ 200.00
HP 5334A-010,030,050 100 MHz Univ. Counter; OCXO, DVM, 1.3 GHz C-ch., rear in — $ 750.00
HP 5334B-010,060 100 MHz Universal Counter, HPIB, OCXO — $ 250.00
HP 5335A 200 MHz Universal / Statistical Counter — $ 500.00
TEK DC5004 Programmable 100 MHz/100nS Counter/Timer, TM5000 series — $ 250.00
TEK DC5009 Programmable 135 MHz Univ. Counter/Timer, TM5000 series — $ 400.00
TEK DC5010 350 MHz / 3.125 nS Universal Counter, TM5000 series — $ 1,200.00
TEK DC503A 125 MHz/100 nS Universal Counter, TM500 series — $ 275.00
TEK DC509 135 MHz/ 10 nS Universal Counter, TM500 series — $ 275.00
\5315A-003 100 MHz/100 nS Univ. Counter, 1 GHz C-channel option — $ 550.00

FREQUENCY COUNTERS

EIP 575 18 GHz Source Locking Counter, GPIB — $ 1,500.00
FLUKE 7220A-010,131,351 1.3 GHz Counter; battery power, OCXO, and res. mult. — $ 500.00
HP 5340A 18 GHz Frequency Counter — $ 450.00
HP 5342A 18 GHz Frequency Counter — $ 500.00
HP 5342A-001,011 18 GHz Frequency Counter, OCXO reference & HPIB — $ 600.00
HP 5342A-003 18 GHz Freq.Counter, +22 dBm,-20 dBm dynamic range — $ 600.00
HP 5342A-01,04,05 24 GHz Frequency Counter, OCXO, DAC — $ 650.00
HP 5343A-001 26.5 GHz Frequency Counter, OCXO reference — $ 3,500.00
HP 5345A/5355A/5356B 26.5 GHz CW/Pulse Frequency Counter — $ 4,000.00
HP 5384A 225 MHz Frequency Counter, HPIB — $ 500.00
TEK DP501 1.3 GHz Prescaler, divide by 16, TM500 series — $ 225.00

STANDARDS

HP 105B Quartz Oscillator, 0.1/ 1.0/ 5.0 MHz, battery power — $ 1,500.00
HP 5087A-4,11,01x8,12x4 Dist. Amp., eight 5 MHz outputs, four 10 MHz outputs — $ 1,500.00
HP 5087A-opt.033 Distribution Amplifier; 12 outputs at 10 MHz — $ 1,750.00

AUDIO & BASEBAND

SPECTRUM ANALYSIS

HP 3586C Selective Level Meter, 50 Hz-32.5 MHz, 50 & 75 ohms — $ 1,500.00
TEK 7L5/L3/R7603 Spectrum Analyzer, 20 Hz-5 MHz, 10 Hz min. res.,w/frame — $ 1,500.00

DISORTION ANALYZERS

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

RMS VOLTMETERS

FLUKE 8920A True RMS Voltmeter, 180 uV-700 V, 10 Hz-20 MHz — $ 450.00
FLUKE 8922A True RMS Voltmeter, 180 uV-700 V, 2 Hz-11 MHz — $ 450.00

OSCILLATORS

HP 209A Sine/Square Wave Generator, 4 Hz-2 MHz, 5 VRMS max. — $ 225.00

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HP 3336C Synthesizer/ Level Generator, 10 Hz-21 MHz ..... $ 1,400.00
TEK SG5010 Programmable Oscillator, 10 Hz-163.8 kHz ..... $ 2,750.00
TEK SG502 Sine/Square Osc., ... $ 200.00
5 Hz-500 kHz, 70 dB step atten.,TM500

RF & MICROWAVE

SPECTRUM ANALYZERS

HP 3575A-001 Phase-Gain Meter, ... $ 850.00
1 Hz-13 MHz, dual display option
HP 461A Amplifier, 20/40 dB, ... $ 125.00
1 kHz-150 MHz, 0.5 V/50 Ohms
KROHN-HITE 3103 High/Low Pass Filter, ... $ 350.00
10 Hz-3 MHz, 24 dB/octave
KROHN-HITE 3202 Dual HP/LP/BP/BR ..... $ 450.00
Filter, 20 Hz-2 MHz, 24 dB/octave
KROHN-HITE 3342R Dual HP/LP Filter, ... $ 900.00
0.001 Hz-99.9 kHz, 48 dB/octave
KROHN-HITE 3750 LP/HP/BP/BR Filter, ... $ 600.00
0.02 Hz-20 kHz, 6/12/18/24 dB/oct.
KROHN-HITE DCA-10R 10 Watt Amplifier, ... $ 450.00
20 dB gain, DC-1 MHz, 600-1000 Ohms
ROCKLAND 852 Dual Highpass/ ..... $ 1,000.00
Lowpass Filter, 0.1 Hz-111 kHz
TEK AM502 Differential Amplifier, ... $ 475.00
0.1 Hz-1 MHz, TM500 series
HP 11517A/18A/19A/20A Mixer Set, ... $ 600.00
12.4-40.0 GHz, for HP 8555A/8569A
HP 11970A WR28 Harmonic Mixer, 26.5-40 GHz ..... $ 1,100.00
HP 11970K WR42 Harmonic Mixer, 18.0-26.5 GHz ..... $ 1,100.00
HP 11970Q WR22 Harmonic Mixer, 33-50 GHz ..... $ 1,400.00
HP 11970U WR19 Harmonic Mixer, 40-60 GHz ..... $ 1,400.00
HP 8444A-059 Tracking Generator, ... $ 1,250.00
0.5-1500 MHz, for 8554,8568,etc.
HP 853A-001 Spectrum Analyzer Display, ... $ 1,250.00
bench/rack mount config.
HP 8565A-100 Spectrum Analyzer, ... $ 4,500.00
10 MHz-22 GHz, 100 Hz min. res.
HP 8566B Spectrum An., ... $ 25,000.00
100 Hz-22 GHz, HP calibration certificate
HP 8569B Spectrum Analyzer, ... $ 7,500.00
10 MHz-22 GHz, 100 Hz min.res.bw.
TEK 7L14-039/7603 Spectrum Analyzer, ... $ 2,500.00
1 kHz-2.5 GHz, 30 Hz min. res. bw.
TEK TR502 Tracking Generator, ... $ 950.00
0.1-1800 MHz, for Tek 7L12/13/14
TEK TR503 Tracking Generator, ... $ 850.00
0.1-1800 MHz, for 492/4/5/6
TEK WM782V WR15 Harmonic Mixer, 50-75 GHz ..... $ 1,500.00

NETWORK ANALYZERS

HP 08748-60010 8748A Reference Plane ..... $ 3
Extension Cables (set of 6)
HP 08748-60011 8748A-H26 ..... $ 250.00
Reference Plane Extension Cables (set of 3)
HP 35676A Reflection/Transmission ..... $ 1,000.00
Test Kit, 5 Hz-200 MHz
HP 8405A Vector Voltmeter, 1-1000 MHz ..... $ 450.00
HP 85020A Directional Bridge, ... $ 650.00
10-4300 MHz, N(f) test port
HP 85021A Directional Bridge, ... $ 1,000.00
0.01-18 GHz, APC7 test port
HP 85021C Directional Bridge, ... $ 1,000.00
0.01-18 GHz, N(f) test port
HP 8502A-H26 Reflection/ ..... $ 600.00
Transmission Test Set, 4-2600 MHz
HP 85044A Reflection/Transmission ..... $ 1,500.00
Test Set, 300 kHz-3 GHz
HP 85046A S-Parameter Test Set, ... $ 3,750.00
300 kHz-3 GHz, for HP 8753A/B/C
HP 8753A Network Analyzer, 300 kHz-3 GHz ..... $ 7,500.00
HP 8756A Scalar Network Analyzer ..... $ 2,500.00
HP R85026A WR28 Detector, ... $ 1,200.00
26.5-40 GHz, for HP 8757 series

SIGNAL GENERATORS

FLUKE 6060A Synthesized Signal Gen., ... $ 2,500.00
0.1-1050 MHz, 10 Hz res., GPIB
FLUKE 6060A/AN Synthesized Signal ..... $ 1,750.00
Gen.,10 kHz-520 MHz, 10 Hz res.,GPIB
FLUKE 6062A Synthesized Signal Gen., ... $ 5,000.00
0.1-2100 MHz, 10 Hz res., GPIB
GIGATRONICS 1018 Synthesized ..... $ 4,500.00
Signal Gen., 50 MHz-18 GHz, 1 MHz res.
GIGATRONICS 600/10-18 Synthesized ..... $ 2,500.00
Source, 10-18 GHz, 1 MHz res., GPIB
GIGATRONICS 600/6-12 Synthesized Source, ... $ 2,500.00
6-12 GHz, 1 kHz res., GPIB
GIGATRONICS 875/50 Levelled ..... $ 2,500.00
Multiplier, x4, 50.0-75.0 GHz output, -3 dBm
GIGATRONICS 875/86 Levelled ..... $ 3,750.00
Multiplier, 26.5-40.0 & 50.0-75.0 GHz outputs
GIGATRONICS 900/2-8 Synthesized Signal/ ..... $ 2,500.00
Sweep Gen., 2-8 GHz, 1 MHz res.,GPIB
HP 11720A Pulse Modulator, 2-18 GHz, 80 dB on/off ratio ..... $ 450.00
HP 85100V Frequency Mult., ... $ 3,750.00
10-15 GHz in / 50-75 GHz out >0 dBm
HP 8640B-001 Signal Generator, ... $ 1,000.00
0.5-512 MHz, AM, FM, var. audio osc.
HP 8640B-002,003 Signal Gen., ... $ 1,750.00
0.5-1024 MHz, AM, FM, reverse power prot.
HP 8656B-001 Synth. Signal Gen., ... $ 2,500.00
0.1-990 MHz, 10 Hz res., OCXO ref.
HP 8657A-002 Signal Generator, 0.1-1040 MHz, 10 Hz res., HPIB ... $ 3,250.00
HP 8660C/86602B-002 Synth. Sig. Gen., ... $ 3,000.00
1-1300 MHz, FM / Phase mod. w/86635A
HP 8660C/86603A-002 Synthesizer, ... $ 4,250.00
1-2600 MHz, FM / Phase Mod., w/86635A
HP 8672A Synthesized Signal Generator, 2-18 GHz ..... $ 6,000.00
HP 8673G-004,008 Synth. CW Signal ..... $ 12,500.00
Generator, 2-26 GHz, >+8 dBm output
HP 8684B Signal Generator, ... $ 3,500.00
5.4-12.5 GHz, AM, WBFM, Pulse

SWEEP GENERATORS

HP 8350A/83545A-002 Sweep Oscillator, ... $ 4,000.00
5.9-12.4 GHz, 70 dB step attenuator
HP 83545A RF Plug-in, 5.9-12.4 GHz, +17 dBm levelled ..... $ 1,750.00
HP 8601A Generator/Sweeper, 0.1-110 MHz, +20 dBm levelled ..... $ 400.00
HP 8620C Sweep Oscillator Frame ..... $ 550.00
HP 86222B-002 RF Plug-in, 10-2400 MHz, ... $ 1,500.00
+13 dBm levelled, 70 dB atten.
HP 86230B RF Plug-in, 1.8-4.2 GHz, +10 dBm unlevelled ..... $ 400.00
HP 86235A-001,002 RF Plug-in, ... $ 600.00
1.7-4.3 GHz, +14 dBm levelled, 70 dB atten.
HP 86240C RF Plug-in, 3.6-8.6 GHz, +16 dBm levelled ..... $ 700.00
HP 86241A-001 RF Plug-in, ... $ 300.00
3.2-6.5 GHz, +8 dBm levelled
HP 86242D-004,008 RF Plug-In, ... $ 300.00
5.9-9.0 GHz, +10 dBm levelled
HP 86250D RF Plug-in, 8.0-12.4 GHz, +10 dBm levelled ..... $ 500.00
HP 86260A RF Plug-in, 12.0-18.0 GHz, +10 dBm unlevelled ..... $ 500.00
HP 86260A-H04 RF Plug-in, ... $ 500.00
10.0-15.0 GHz, +10 dBm unlevelled
HP 86290A RF Plug-in, 2.0-18.0 GHz, +7 dBm levelled ..... $ 1,750.00
WAVETEK 962 Sweep Generator, ... $ 1,250.00
1.0-4.0 GHz, markers, +12 dBm unlvld.
WILTRON 6619A Sweep Generator, ... $ 1,500.00
2-8 GHz, +10 dBm levelled

POWER METERS

ANRITSU MA72B Power Sensor, ... $ 200.00
-20 to +20 dBm, 0.01-18 GHz
ANRITSU MP-81B/ML-83A Power Meter, ... $ 2,500.00
75-110 GHz (WR10), -20 to +20 dBm
BOONTON 4200-01A,03/&-4A x2 Dual ..... $ 1,500.00
Channel Microwattmeter, w/(2) 1 MHz-7 GHz sensors
BOONTON 42B/41-4B Analog Power Meter, ... $ 375.00
with 1 MHz-12 GHz sensor
BOONTON 42B/41-4E Analog Power Meter, ... $ 500.00
with 1 MHz-18 GHz sensor
GENERAL MICROWAVE 476/4240A ..... $ 300.00
Power Meter & Sensor, 0.01-18 GHz, -35 to +10 dBm
HP 435B/8482B Power Meter, ... $ 1,800.00
0 to +43 dBm, 100 kHz-4.2 GHz
HP 435B/8482H Power Meter, ... $ 950.00
0.1-4200 MHz, -10 to +34 dBm
HP 8477A Power Meter Calibrator, for HP 432 series ..... $ 500.00
HP K486A WR42 Thermistor Mount, ... $ 350.00
18.0-26.5 GHz, for 432 series
HP Q8486A Power Sensor, ... $ 1,500.00
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AMATEUR ROBOTICS NOTEBOOK

by Robert Nansel

Though it's barely past Thanksgiving as I write this, it will be January by the time you read this column, so Happy New Year to all you gearheads out there. Even if you didn't get that digital storage scope you've been lusting after, 1999 is going to be a great year for building robots.

This month, I was going to show how to use the DonTronics DT101 SIMMStick as a high-performance brain for Breadbot, but I got to thinking about the New Year and what I want to accomplish in robotics in 1999, and I decided to postpone the actual brain transplant in favor of outlining some of those larger goals. Also, I didn't want to present yet another version of Breadbot's figure-eight test software (only this time in PIC assembler). I want to actually make Breadbot do something worth doing, and that's going to take some real work. Which left me in a quandary: what should Breadbot do?

As any mobile robot builder will say, it should be, well, mobile. But mobile in an interesting way.

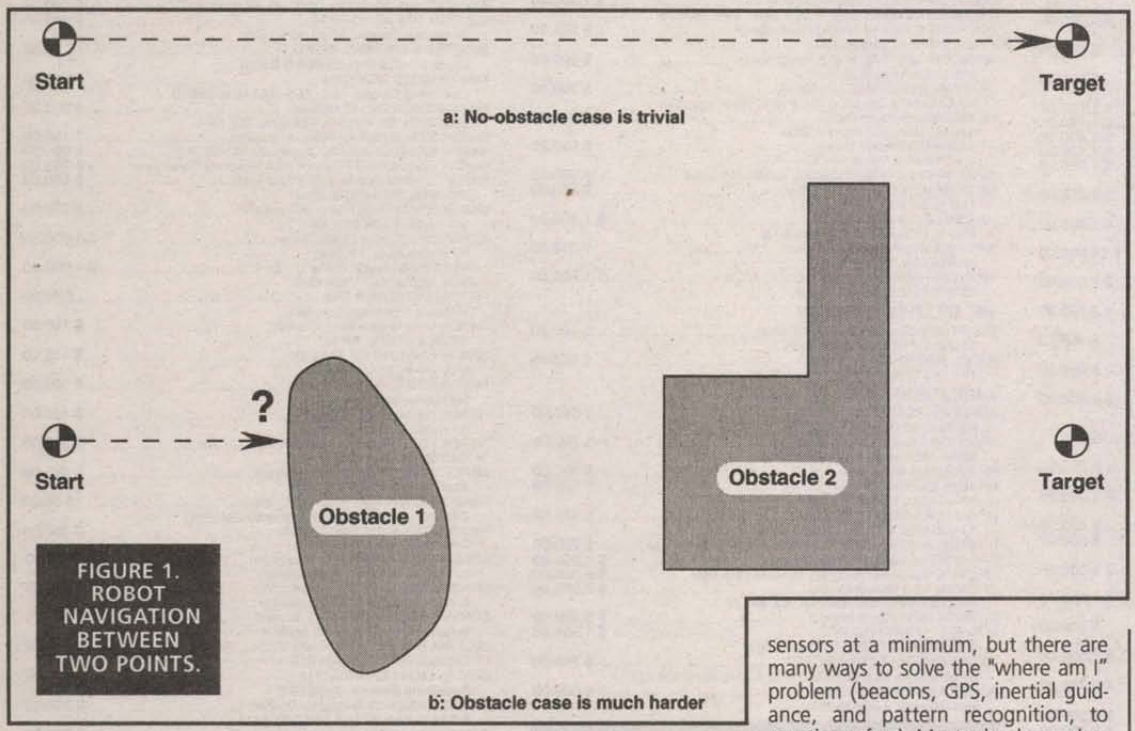

FIGURE 1. ROBOT NAVIGATION BETWEEN TWO POINTS.

Where am I?

A robot's whole reason for being is to autonomously go from point A to point B, and it is this ability that ultimately separates RC toys from true mobile robots. In its current form, Breadbot doesn't do this very well because it doesn't have feedback to tell it how straight it's steering or what distance it has traveled. So, one goal for the coming year is to explore ways to make Breadbot and its descendants go in straight lines.

This will require wheel encoder sensors at a minimum, but there are many ways to solve the "where am I" problem (beacons, GPS, inertial guidance, and pattern recognition, to mention a few). Most wheel encoders are optical, but this month I'll touch on one new part that will give optical encoders a real run for their money (more on this later).

Just going from point A to point B isn't all that interesting in and of itself, though. When there can be obstacles in the path between A and B, when the robot has to do obstacle avoidance and navigation, things become really interesting. The problem is so complex that even people sometimes have problems solving it, and very few amateur roboticists even attempt it with their machines. Call it hubris, but this year I'm going to give it a shot.

Is there Software in that Land?

Another area that I want to work on is development tools. So far, I've avoided the issue with the various incarnations of Breadbot; PBASIC provided a convenient – if not exactly high power – development environment, and that was that.

Now as I'm venturing into the land of assembly language, I know that, although I am comfortable with assembly language, many of you out there won't be. Assembly language, for all its speed, is not the ideal language to illustrate the general principles of AI programming; with the availability of good compilers for embedded processors, using a high-level language such as C makes sense for all programming but the lowest-level I/O.

I've used Forth and, while I admire its lean, elegant style and power, most people find Forth code nearly impossible to read. C and its offspring – like it or not – are what the majority of folks are most comfortable programming in. C can be pretty obtuse, too, of course, but good programming practices can alleviate most of that.

Get Real Time

Another area that I want to investigate in the coming months is the use of a Real Time Operating System (RTOS) to simplify the task of writing the code more complex robots will require. Robots are inherently multi-

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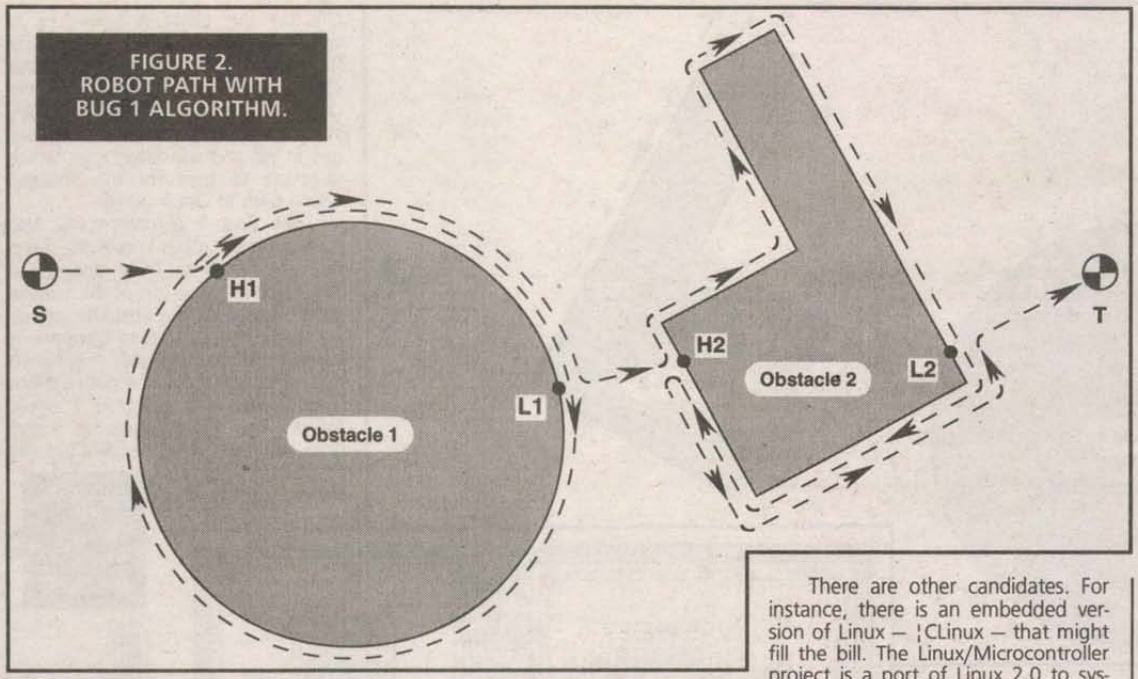

FIGURE 2.
ROBOT PATH WITH
BUG 1 ALGORITHM.

tasking creatures since motion control, sensing, and planning must occur simultaneously while the robot is in motion. The idea is to incorporate reflex actions that can be triggered by certain conditions – say, bumping into a wall – without having to explicitly code every possible exception (which would be mostly impossible in any case).

There are hundreds of RTOS systems out there for every processor you can imagine. Most are expensive, proprietary systems that aren't of much interest to amateur robot builders, but there are a number of free systems around. One I'm looking at is ¦C/OS (pronounced "micro-see OS") by Jean Labrosse. This is a portable, ROMable, scalable, preemptive real-time, multitasking kernel for microprocessors and microcontrollers. The RTOS is described in Labrosse's book *¦C/OS, The Real-Time Kernel* which also includes a diskette with all the source code. ¦C/OS manages up to 63 user tasks, and its performance is comparable with many commercially available kernels. Because ¦C/OS was designed from the outset to be as processor-independent as possible, it's written in C with an absolute minimum of assembly language. Altogether, it seems ideal for hacking into a robot OS.

Labrosse has just published a new book with a new version of ¦C/OS called (of course) *¦C/OS-II*. I haven't seen this book yet, but it's available for $69.95 hard cover, with disk (560 pp, 8" x 10", ISBN 0-87930-543-6). I think I'll wait for the paperback version. The latest version of the original ¦C/OS source code – V1.11 – is available for free download from his website (see sidebar).

There are other candidates. For instance, there is an embedded version of Linux – ¦CLinux – that might fill the bill. The Linux/Microcontroller project is a port of Linux 2.0 to systems without a Memory Management Unit. There's even a version that runs on the 3Com PalmPilot, which would make a dandy robot controller. The nice thing about this RTOS is that it's all published under the GNU Public License, as are all the development tools. That means they are free. I haven't looked at this port yet, so I'll let y'all know how it looks in coming months. One thing for sure, though, is this one won't run on a PIC.

Finally, this year I want to look into networking processors together to make sophisticated robots. There are many network technologies to choose from (I2C, CAN-Bus, USB, etc.), but I want to concentrate on the network software architecture first. I favor a publish/subscribe architecture where any processor node that has data to announce "publishes" it to the network without explicitly addressing it to any particular node, in turn, any node that needs certain data will send a "subscribe" notice to the network, informing any nodes that publish that information. This makes for a robust, easy-to-program system since neither publisher nor subscriber nodes need be aware of each other.

Bug Algorithms

What is the simplest possible algorithm for a mobile robot to autonomously navigate from a starting point S to a target point T? If there are no obstacles between S and T, the obvious solution is for the robot to follow the straight line segment connecting the two points. Even though the robot may use position feedback (say, from wheel shaft encoders), this approach is fundamentally open loop because no allowance is made for obstacles.

A more interesting – and useful – problem to solve, then, would allow arbitrary obstacles to exist between S and T. Because the mechanical elements needed for planar mobility are well understood and can be considered "off-the-shelf" items, the question really boils down to "what are the simplest sensing schemes and motion control algorithms required to deal with arbitrary obstacles between S and T?"

For any robot navigating in a domain with unknown obstacles, the simplest sensor is the bumper contact sensor. There are many electromechanical possibilities for bumper sensing. As proof of the utility of bumpers, consider that every animal in nature has some form of tactile collision sense, even those animals that possess incomparably more sophisticated senses such as vision or sonar. Some animals – insects in particular – have almost no other sense than the tactile sense. Assuming we can build

BUG 1 & 2 algorithms:
Lumelsky, V. J. and Stepanov, A. A. "Path-Planning Strategies for a Point Mobile Automaton Moving amidst Unkown Obstacles of Arbitrary Shape." Algorithmica, 1987, pp 403-430.

¦CLinux web page:
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As always, if you have suggestions for improving Breadbot, if you've built a Breadbot, or if you have questions or comments about amateur robotics topics, you can reach me at:

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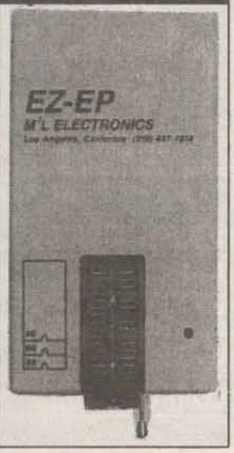

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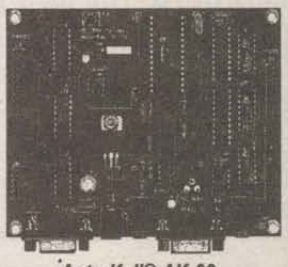

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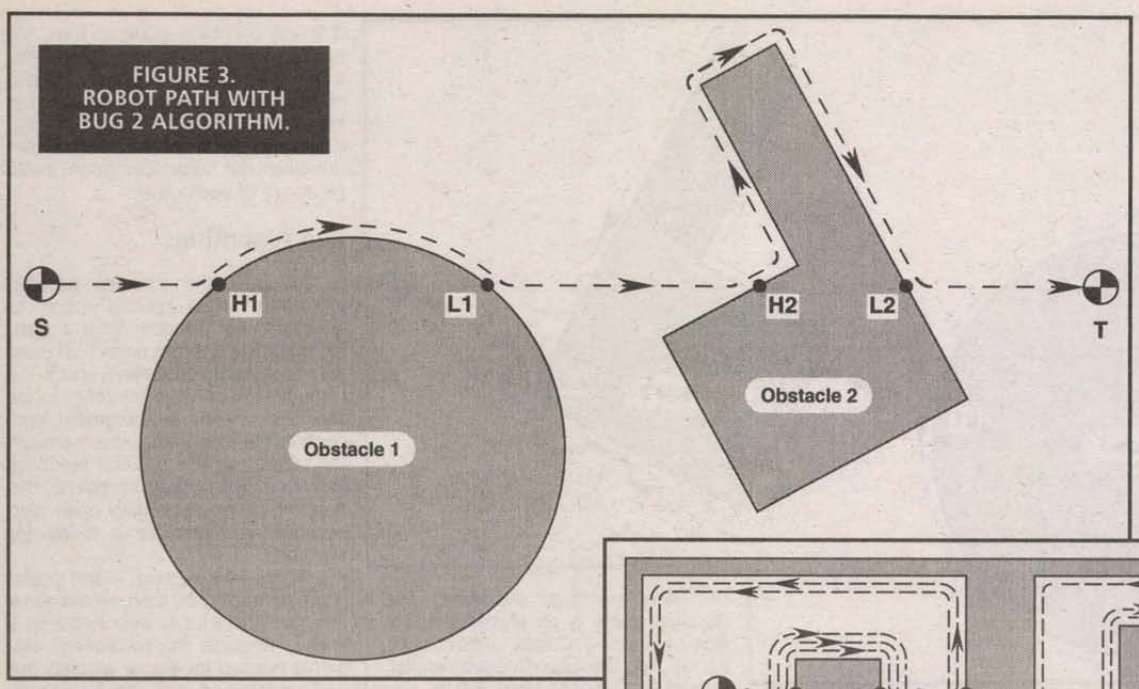

FIGURE 3.
ROBOT PATH WITH BUG 2 ALGORITHM.

suitable bumpers, can we program a robot "bug" using bumper sensors to successfully negotiate unknown obstacles?

In short, yes. Two simple algorithms created over a decade ago by Vladimir Lumelsky satisfy the obstacle avoidance needs of a robot attempting to travel from any initial position to any target position regardless of the obstacles in between. These algorithms are called, appropriately enough, BUG 1 and BUG 2. If a path exists, these algorithms will find it, and though the path won't necessarily be optimum, it will usually be good enough.

Assuming no prior knowledge of the obstacles that might be in its way, a robot with only bumpers for sensors can deal with an obstacle only by running into it and then attempting to skirt around it. Without knowledge of the obstacle's shape or size, the robot has no way of knowing which way to turn is the "best," so an arbitrary direction to turn must be chosen.

To keep things simple, pick one direction and stick with it. This preferred direction is called the "local direction." If the robot always turns left when it bumps into an obstacle, then it is using a "left local direction" rule. Where the robot first hits an obstacle is designated a "hit point" and where the robot leaves the obstacle to continue on toward the target is called a "leave point." Now that the terminology is out of the way, let's look at the Bug algorithms.

BUG 1

1. From point Li-1 (with L0 = S), move toward T along the straight line segment (S,T) until one of the following happens:

(a) T is reached; flag success and exit.

(b) An obstacle is encountered and a new hit point Hi is defined; go to step 2.

2. Using the accepted local direction, follow the obstacle boundary. If during this process T is reached, flag success and exit. While traversing the boundary, store the coordinates of the current point Qm located the closest to T. After traversing the whole boundary (and returning to Hi), define a new leave point Li=Qm and go to step 3.

3. If the straight line segment between Li and T crosses the obstacle at point Li, stop because the target is completely enclosed by the obstacle and is thus unreachable; flag failure and exit. Otherwise, follow the shorter path along the boundary back to Li, set i=i+1, and go to step 1.

The Bug 1 algorithm should be executed at every point along a continuous path. The procedure can be implemented with only three registers: R1, R2, and R3 to store intermediate information between hit points. When a new hit point is reached, all three are reset to zero. R1 holds the current X, Y coordinates of the point Qm on the obstacle boundary at which the distance to T is a minimum; R2 integrates the length of the obstacle boundary starting at Hi; R3 integrates the length of the boundary starting at Qm. The smaller of the values in R2 and R3 determines which direction to turn for the shortest return path to Qm from Hi.

The Bug 1 algorithm will also function if the robot knows the direction and range to T. By storing the minimum distance Dm of the current point instead of the absolute coordinates, the robot can then compare its current distance to T with that stored in R1. Figure 2 shows the path a robot programmed with the BUG 1 would follow. The robot begins at S and goes straight toward T until it hits the first obstacle at H1. Arbitrarily, this robot is a left local direction robot, which means that it turns left each time it encounters an obstacle. Following the BUG 1 algorithm, it circumnavigates Obstacle 1, all the while keeping track of how far around the perimeter it has come, how far it currently is from T, and how far it has come from Qm, the most recent closest point to T.

Once it reaches H1, it then compares the total perimeter distance with the distance travelled since the point Qm (L1) is closest to T. In this case, the shortest distance between H1 to L1 is in the clockwise direction, so the robot continues on its path around the obstacle until it reaches L1, then it makes another attempt to

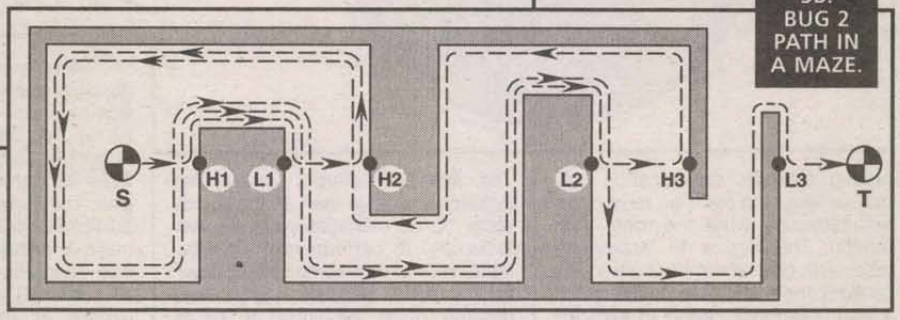

FIGURE 3B.
BUG 2 PATH IN A MAZE.

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go straight toward T.

If obstacle 2 were not in the way, it would be home free, but it collides with the second obstacle at H2 and the whole process repeats. In this case, however, once the robot has circumnavigated the obstacle perimeter, the shorter distance from H2 to L2 is in the counterclockwise direction, so the robot turns around to go that way. Once at L2, it again resumes a straight line path toward T, which it will reach with no further difficulty.

In the worst case, the robot will have to travel 1.5 times the perimeter of each obstacle before resuming its travel toward the target point. This may seem wasteful, but BUG 1 assumes no prior knowledge about the obstacles that might be encountered. BUG 1 could work very well in conjunction with a separate algorithm that creates an occupancy grid map of the environment so that the next time a particular obstacle is encountered, a more efficient route around it can be picked (but that's a topic for another column).

A less conservative algorithm would not require a complete circumnavigation of every obstacle. For simple, mostly convex obstacles, BUG 2 can usually produce more efficient paths than BUG 1 (see Figure 3).

BUG 2

1. From point Li-1 (with L0 = S), move toward T along the straight line segment (S,T) until one of the following happens:

(a) T is reached; flag success and exit.

(b) An obstacle is encountered and a new hit point Hi is defined; go to step 2.

2. Using the accepted local direction, follow the obstacle boundary until:

(a) T is reached; flag success and exit.

(b) The robot crosses line segment (S,T) at Qm where the distance Dq from Qm to T is less than the distance from Hi to T, and the line segment (Qm,T) does not cross the current obstacle at the point Qm. Define leave point Li=Qm, set i=i+1, and go to step 1.

(c) The robot completes the boundary traversal and returns to Hi without having defined the next leave point Li; flag failure and exit because the obstacle boundary completely encloses T.

Again, I've arbitrarily chosen a left local direction for the robot. Notice how much shorter the path is for the robot when it encounters the first obstacle at H1. Even a right local direction robot, which would follow the perimeter of obstacle 1 in a counterclockwise direction, would still have a shorter total path than the BUG 1 algorithm could produce. With the second obstacle, it's a toss-up which direction would be better, but either would still be shorter than the BUG 1 path.

Both the BUG 1 and BUG 2 algorithms are guaranteed to find a path if one exists, though it's important to remember that the path may be quite long. Bug 2 is a bit less conservative than Bug 1 and will often give shorter total paths, but note that Bug 2 is especially poor at handling mazes (see Figure 3b). Both algorithms are at their best when dealing with simple convex obstacles. Both algorithms put a premium on the robot knowing where it is and how far it has come, so accurate odometry and straight-line motion control are essential.

What's all this Navigation stuff?

This takes us right to the leading edge of robotics and beyond. Rather than attempt to formulate some all-inclusive (and impractical) definition of the autonomous navigation problem, I'll break it down into a hierarchy of subproblems (see Figure 4).

There is no one "navigation problem" just as there is no one "problem of driving to LA." For a robot driving to Los Angeles, there are a variety of problems to be overcome in different phases and at different scales.

In order for a robot to find its way from a start position to a target position, it must plan the path to take and it does this by using a software agent called a Path Planner. If the robot starts in Seattle, the path plan it would use to get to LA could be "drive south on Interstate 5 until you get to LA." Driving from Boston, the plan would be slightly more complicated: "Go west on I90 until you reach Seattle; at Seattle go south on I5 until you reach LA."

These are both examples of global path planning. By global, I don't mean paths must be a thousand miles long to qualify, but that the Planner agent is concerned only with the "big picture." Details about freeway entrances and exits, traffic signals, detours, and scenery along the way are not the concern of Planner.

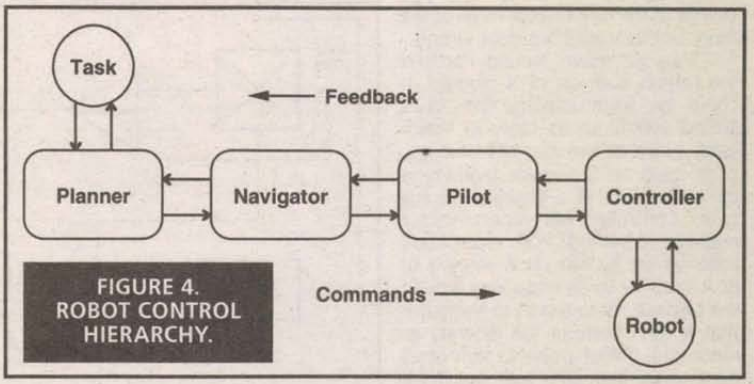

FIGURE 4. ROBOT CONTROL HIERARCHY.

The path plan itself must be executed by a Navigator Agent. The Navigator is responsible for two things. The first is translating the vague path plans Planner cooks up into detailed itineraries. I'll get to the second of the Navigator's duties later.

To translate Planner's plans into viable itineraries, Navigator must be able to do some planning of its own, though of a more local nature. Local plans deal with the immediately perceivable environment and unfold sequentially.

How far is LA?

Our Bostonian robot on the road to LA would have a local planning area as far as it could see, which might be as little as half a block in downtown Boston, or as much as 20 miles to the horizon in South Dakota. A robot exploring the asteroid belt would still be doing local path planning as long as those paths remain within the range of its radar, the limits of its perception. Local planning for a robot with nothing but bumpers for sensors (as with the Lumelsky Bugs) would operate within the area defined by the reach of those bumpers.

Navigator decomposes the global path plan into a series of local path plans. Navigator would translate the Seattle/LA drive into something like "drive one mile west on Northgate Way, turn right at the southbound I5 entrance, merge into traffic, drive south; every 350 miles or so stop to gas up and charge batteries, until you reach LA."

Navigator will turn this itinerary over to another agent called Pilot to do the actual driving. Pilot is responsible for generating and executing point-to-point trajectories, for local obstacle avoidance, and for sensing "free space" (that is the safe zone for the robot to move within). The Navigator's itinerary is still a fairly general plan, reflecting perhaps that our robot has never been further south than Portland, but it's enough for Pilot to do its job.

Pilot assumes the robot is ideal, that it accepts drive and steer commands, and returns position and heading without error. Real robots come in a variety of mechanical configurations, so a lower-level agent is needed to translate Pilot's universal robot commands into the actual actuator velocities and positions. This agent is known as Controller. Controller isolates the rest of the command chain from the specific details of making the robot perform as commanded. Pilot gives commands and Controller makes it so. Controller is in

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charge of the robot's actions all of the time. Unless something goes wrong.

Suppose down around Portland the robot's path on I5 is blocked. It could be from construction or a stalled vehicle in its lane, in which case, a lane or two may still be open, or it could be the whole highway is closed because of a landslide. In any case, Controller will report sensor readings deviating from acceptable limits as set by Pilot. It is the job of Pilot to either try to find a way around the obstacle, or to report to Navigator that it can't perform the itinerary as requested. If Pilot is able to shift lanes on its own, then all is well. But if the obstacle is more extensive (the landslide), then Pilot will report failure to Navigator.

At this point, Navigator must adjust its itinerary. Navigator might be able to choose another route visible locally, perhaps following detour signs. This is the second capability Navigator should have, that of mapping its surroundings, determining position, and recognizing features of interest. Of all robotics AI topics, this is the most difficult and in need of the most research because this is where idealized planning collides with the real world.

Supposing Navigator fails to find an alternate local route, then Navigator must, in turn, report failure to Planner. Planner would then create a new global path plan that takes the new obstacle into consideration (perhaps it would divert to I405).

The Chain of Command

At each level in the hierarchy from Planner to Navigator to Pilot to Controller, commands from the agent above and status information from the agent below control the behavior of that particular agent. There are many fine algorithms available to implement Planner, as well as Pilot and Controller.

The BUG 1 and BUG 2 algorithms address the purely local problem of obstacle avoidance; they are therefore properly Pilot-level algorithms. The general autonomous navigation problem involves issues of sensor processing, local path planning, position resolution, and error recovery, which are all the domain of Navigator.

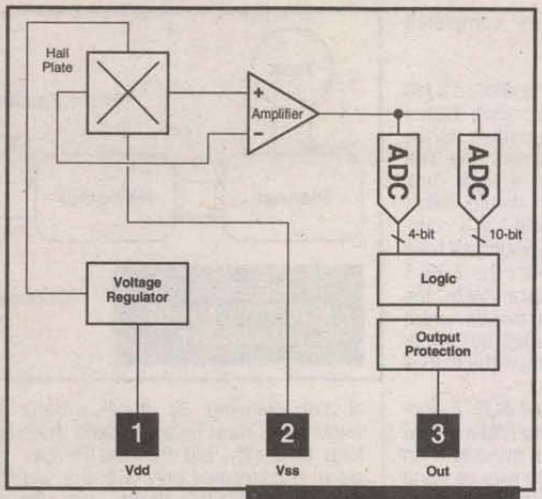

FIGURE 5. MLX90217 HALL-EFFECT GEAR TOOTH SENSOR.

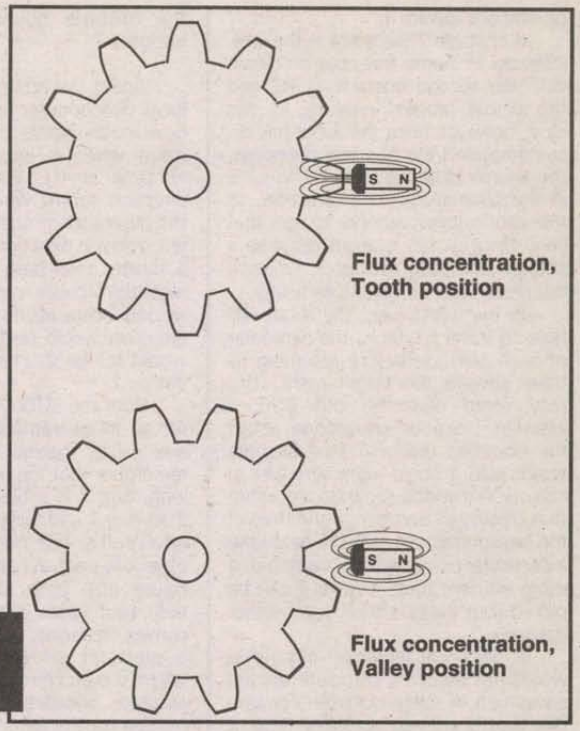

FIGURE 6. HALL-EFFECT GEAR TOOTH SENSOR.

Navigator is the tough nut to crack. Creating software that can perform all the functions required of the Navigator agent is an on-going research problem in universities around the world. My goal for this year is to demonstrate some of the simpler algorithms already out there.

Another Turn of the Wheel

Okay, I'm just about out of space, but I promised I would talk about an alternative to optical encoders. The "part of the month" is the Melexis MLX90217, a Hall-Effect gear tooth Sensor (Figures 5 and 6).

The MLX90217 is a digital output gear tooth position sensor designed for automotive camshaft sensing, as well as sensing gear teeth. It's designed to be used with a bias magnet as shown in Figure 6 with the south pole facing the back of the sensor (if you put the magnet the other way, the part goes into a special test mode).

The nifty thing about this part is that it has an on-chip 10-bit A/D converter and logic that acts as a digital sample and hold. A separate four-bit converter provides a fixed amount of hysteresis. The output will turn ON after the magnetic flux has reached its peak and has decreased by the amount equal to the hysteresis; likewise, the output will turn OFF after the flux has reached a minimum and increased by the hysteresis amount. This makes for a nice, clean signal even when individual gear tooth profiles are worn, a sort of Schmitt Trigger for magnetic flux.

This baby comes in a three-pin, TO-92-size package (a bit slimmer, actually), and will run from a wide voltage supply range, 3.5 to 24V. At 12V, it draws 3 mA. The bandwidth of the chip is 15 KHz. How would you use this chip? Well, the output gear on one popular Dayton gear motor is a 67-tooth steel gear. There's plenty of space inside the metal gear box to put a couple of these sensors, along with their bias magnets and, with a little logic or software, they would provide 67 x 4 = 268 counts per revolution, along with direction information. This would be a very rugged setup, one I intend to try soon. The MLX90217 is $5.13 each in 10 pc. quantities, and $2.33 each in 100 pc. quantities, three weeks ARO from the factory.

Next Time

I'll get back to that promised SIMMStick brain transplant, try out simple encoders for Breadbot's wheels, and review a new robot kit. Until then, keep your soldering irons warm. This is going to be a heckuva year. **NV**

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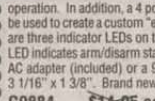

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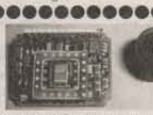

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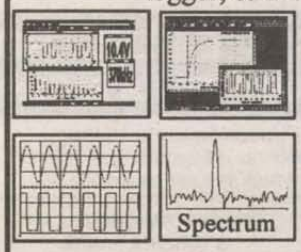

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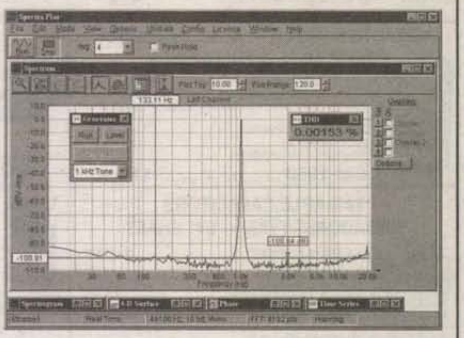

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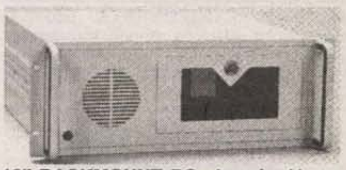

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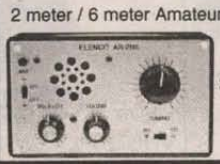

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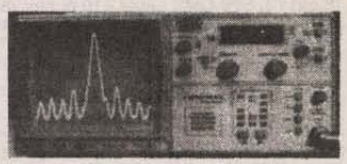

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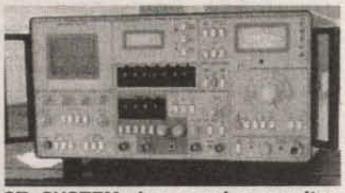

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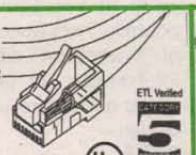

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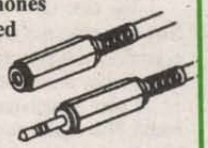

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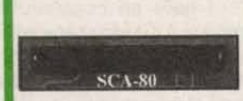

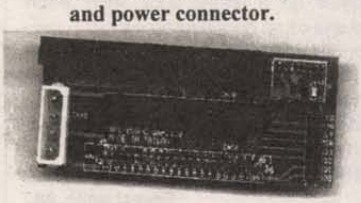

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1992 **Ken Delahoussaye**
via Internet

I have used a 33.6 modem for some time and when I received a call while online, it would hang me up and allow the call to come through (I have call waiting). Now that I have a 56K modem, it no longer allows the calls to come through and I am missing important phone calls. Please let me know if you have any ideas how I can still get my calls through. Please don't tell me I need another line.

1993 **Bill Ulster**
via Internet

I would like to see a schematic for a simple UPS which uses power MOSFETs in its output stages. I have several which are not repairable due to the lack of a schematic and, which I might convert to a useable unit with a schematic.

1994 **C. Mills**
via Internet

I have a Galaxy 2100 transceiver that when the frequency counter is on, a tone is heard on the speaker. It's not very loud, but I would like to get rid of it. How do I go about doing this?

1995 **Herman Atkinson**
Venus, TX

Is there a simple circuit to detect 60 Hz and light an LED? And also, add another LED to light before 60 Hz, and go out at 60 Hz? And another LED to light at 62 Hz with the others off?

1996 **Henry Van Zee**
Stevens, PA

I need to find information concerning a magnetic force field that could lift approximately 100 lbs., if possible. I am working on a new type of "Hover-Cam" design. I also need information on anti-gravity that I might be able to use for this same design.

1997 **Don Camman**
Cameron, MO

I think I understand the cause of ghosts on TV pictures. But what causes vertical dark and light bands on some channels? Can anything be done about them?

The two UHF channels (28 and 34) are plagued by bands, share a common tower, and are about 10 miles away across flat urban terrain.

I use a high-gain antenna on a rotor. The signal strength seems satisfactory, but the bands are quite annoying. Any suggestions?

1998 **Paul Tucker**
Columbus, OH

I am okay with a single timer, but I can't figure out how to make a three-stage timer. I want to use the timer on a traffic light. Also, each stage must be adjustable from 5 seconds to 30 seconds, approximately.

The problem I have is how do I make the end of one timing cycle start the next, and then at the end of the third cycle start all over again?

1999 **Ray Samples**
Fayetteville, NC

I have been using a Magnavox MC3510-AL01 monitor system, CCTV system for about two years now. When mounting one of the cameras, I bumped it hard and a solder joint must of broke inside the camera's picture tube. It left a crooked line on the screen.

I would like to replace the picture tube in the camera, but Magnavox does not supply parts for this camera. So, I would like to get a replacement tube. The number on the tube is Matsushita-4848. Can anyone tell me what replacement tube will work and where I can get one?

19910 **Furman Hendrickson**
Washington Crossing, PA

I have an analog device AD2038 digital temperature meter for which I would like to have the pinout.

There is a description of this device in the 1987 ad, short form selecting guide.

I ordered some sensors for it several years ago, but both the ad and their distributor disclaimed any technical information. Through experimentation, I have discovered some information, but a pinout would be much simpler.

19911 **Kenneth Keck**
Via Internet

I want to build a light display using 100 lamps or LEDs, 10 columns x 10 rows. The display is sort of like the lights you would see on a Ferris wheel with endless patterns and designs.

I repair pinball machines for a living and the machines have a Materix display, except the Materix system is embedded with a switch Materix and EPROMs.

Is there anything simpler to build or is my imagination expecting too much?

19912 **Ray Samples**
Fayetteville, NC

I have on occasion, a need to make a 1/2 inch tape with my video equipment. What I need are the pinouts to construct an adapter to go from 14-pin female to 10-pin male, both EIAJ.

19913 **Matthew Augugliaro**
Smiths Creek, MI

I'm trying to find a way to use a BASIC Stamp and display, or laptop to communicate with my Jeep Cherokee's onboard computers. This way I can tie into the data stream to check all of the engine diagnostics. Any ideas?

19914 **Joe**
Via Internet

I heard that it was possible and inexpensive to make an adapter so that an oscilloscope would act like a Huntron Tracker.

A Huntron Tracker is a device that gives the waveform of a component such as a diode curve or a capacitor and resistor.

I used one for testing components to see if they are failing or noisey, etc.

19915 **Joe Farley**
Via Internet

I just bought a new CMOS camera for my RC car and I'm now stuck with the dilemma of finding a good compact video transmitter.

I have seen some transmitters

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

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

on the market, but I need something that can go further than 1,000 feet.

Does anyone know of any kits or circuit schematics out there for a black and white (audio would be nice) video transmitter? The smaller and less power, the better.

19916 **Gregg**
Via Internet

I am looking for a circuit that would enable one to switch between a regular PC mouse (i.e., Microsoft or Logitech typical mouse), and a PC touchpad mouse (i.e., Cirque glidepoint control).

I believe the complication comes from either the software or initialization of the hardware.

19917 **Derek Koonce**
San Jose, CA

ANSWERS

ANSWER TO #12988 - DEC. 1998

Use a 74193 or 74LS193 four-bit up-down counter to count down. You did not specify whether your preset of 2-12 is a constant or changeable.

The starting number is wired to the DCBA inputs with an optional 10K resistor to +5V on each input, which is then unconnected for a binary 1 or shorted to ground by a switch for a binary 0.

You will need to supply a pulse on the DOWN pin for each count. If this is to come from a switch, you must debounce it. Use a 7404 hex inverter and a SPDT switch.

7404 Wiring: +5V to pin 14 (power) ground to pin 7 and switch common (ground of inverter and logic 0 input). Connect pin 2 (notA) to pin 3 (inputB) and to normally closed SPDT switch section. Connect pin 4 (notB) to DOWN of 7493 (clock pulse out) and pin 1 (inputA) and normally open switch.

7493 Pinout: Inputs: D,C,B,A initial count = 9,10,1,15

LOAD counter=11
CLEAR=14
DOWN=4
UP=5
Power: +5V=16
GND=8
Outputs: BORROW=13
CLEAR=14
CARRY=12
D,B,C,A outputs={7,6,2,3}

7493 Wiring: +5V to pins 5 and 16 (no UP counting, and supply voltage). Ground to 8 and 14 and through four switches to {9, 10, 1, 15} (ground, no clear, initial count). Connect pin 11 to 13 (to reload each count down past 0, or a momentary switch from ground to pin 11) to manually load your count. Connect your trigger (high to low edge) to pin 4 (clock down count). Output the end of count on pin 13 (borrow out from counter after 0 count). Leave output counts D, C, B, A={pins 7, 6, 2, 3} unconnected.

The input count can be four DIP switches or a rotary HEX thumb wheel switch with the common tied to ground and the four outputs tied to inputs DCBA.

Example: ground C and B to load 1001 binary. This will take nine pluses of down to count to 0 and one more to trigger the borrow for a count of 10.

Barry Cole
Sunnyvale, CA

ANSWER TO #129823 - DEC. 1998

You don't need to bypass the monitor at all — the motherboard doesn't need to have a monitor attached.

The keyboard is checked during the POST (Power On Self Test), so you will need to have a 'keyboard' attached.

Vetra Systems sells a "Phantom Keyboard" that "Allows PC boot-up and operation without keyboard." It's a small plug that replaces the keyboard plug at the motherboard connector.

Vetra Systems is at 275-J Marcus Blvd., Hauppage, NY 11787; **516-434-3185** FAX **516-434-3516**. E-Mail: **vetra@mail.idt.net**

Carlos Hidalgo
Hauppage, NY

ANSWER TO #129819 - DEC. 1998

Check out the ad on page 47 of Dec. '98 *Nuts & Volts*. This vendor (Pikul & Assoc.) carries two inexpensive monitor adapters that may do

ANSWERS TO #129821 - DEC. 1998

HiJaak Pro from Inset Systems, supports a Dr. Halo .CUT format — created with Dr. Halo III. Uses run length compression to store images with 256 colors (eight bit).

CUT images store color palette information in a separate palette file with a .PAL extension. It also supports Lotus. .PIC format — I don't know if that's any relation to the Dr. Halo .PIC format.

Inset Systems is at 71 Commerce Dr., Brookfield, CT 06804; **203-740-2400** FAX **203-775-5634**.

HiJaak Pro should be available from software retailers.

Carlos Hidalgo
Brookfield, CT

ANSWERS TO #129821 - DEC. 1998

I have located two programs which I have used for graphic format conversion. Both of these claim to convert Dr. Halo II files to many formats (actually from many formats to many formats). However, both refer to .CUT files not the .PIC which you mention.

Can you resave them in .cut? If you can display the file in your Dr. Halo program, perhaps you can use a screen capture program to get a new format.

1. icovert.zip (short for I convert.com — version 1.49 — 1988) is an old DOS program available on http://www.filepile.com/nc/start. I have used this program to convert many odd file formats. You must use the "setver" DOS command to set the version to 3.3 or lower as the program does not recognize later versions.

2. Graphic Workshop Professional Version 2.0A Copyright 1998 by Alchemy Mindworks, Inc. — **http://www.mindworkshop.com/alchemy/alchemy.html**. I have used this program slightly, only to test a few conversions. There is a registration fee (after you try it and like it) of $40.00. This program also has screen capture ability, but I have not used it.

Bob Rutledge
via Internet

ANSWERS TO #129821 - DEC. 1998

Graphic Workshop, by Alchemy Mindworks, Inc., will read and convert Dr. Halo images to just about any other common format. The program is available for evaluation or purchase at **http://www.mindworkshop.com**. HiJaak PRO by Quarterdeck Corp. is another excellent converter, but it's a little pricey compared to Graphic Workshop, and is probably overkill for your needs.

Scott Miller
via Internet

ANSWERS TO #129821 - DEC. 1998

The Dr. Halo format is probably the same as Lotus .PIC format. PIC was used by Lotus to display graphs in their 1-2-3 spreadsheet, and many programs adopted the file format for simple pictures. David C. Kay and John R. Levine describe the format in their book, *Graphics File Formats*, McGraw Hill 1992.

A current version of Lotus may offer some form of conversion, but I don't know. Excel 97 claims to read these files if they belong to a set of Lotus files, but it will not convert them.

The documentation for Corel Draw 7 claims to read and write these files, but the program disagrees. Corel may have removed the filter because the .PIC extension conflicts with the extension commonly used for Macintosh PICT files. Corel Draw 8 may have ironed this out, but we are getting pricey.

An old version, Corel Draw 4, does read these files and will output the converted file in almost any format you want. If you can find a copy, it will be cheap. The program was bundled with some video cards for a while, and I've seen copies for $40.00.

Lotus PIC is a simple vector format file, so when you convert the files, you should convert them to another vector format. A Windows metafile can do vectors. If you convert the file to a bitmap file (BMP, PCX, or TIF), then you've turned the lines and text into pixels. Bitmap files are larger than vector files, and they are more difficult to edit.

Gerald Roylance
Mountain View, CA

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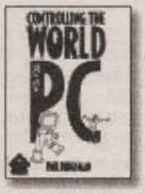

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John McMichael
Laramie, WY

ANSWER TO #129813 - DEC. 1998

The stripes in the new currency are used as a measure against counterfeiting. These stripes cannot be scanned from outside your home to see how much money you have in your possession.

Mark Hanz
Houston, TX

ANSWER TO #129812 - DEC. 1998

The adapter you need to connect your video camera to a TV can be purchased at RadioShack. It is called a video RF modulator (cat. #15-1283) and is priced at $29.99. This unit will convert the line-level video from your video camera to TV channel 3 or 4.

Depending on the plug style on your camera's video output cord, you may also need to buy an adapter to connect to the video RF modulator. RadioShack should also have such an adapter if you need one.

John McMichael
Laramie, WY

ANSWER TO #129811 - DEC. 1998

Although you should follow the manufacturer's recommendations for charging batteries, you do not have to be a fanatic. Understanding what's going on will show the reasoning behind charging profiles and how and why they may be modified.

For reference, I recommend a book by Gates Energy Products, *Rechargeable Batteries Applications Handbook*, Butterworth-Heinemann 1992.

There is also T. R. Crompton, *Battery Reference Book, Second Edition*, Society of Automotive Engineers, 1996.

Batteries are recharged by running a current through them. The larger the current, the more quickly the battery will reach full charge. Battery design determines how large

ANSWERS TO #129820 - DEC. 1998

The "Apple II Emulator Resources Guide" found at: **http://www.faqs.org/faqs/apple2/emulators-faq/part1/** is the best resource for Apple II emulator and interface information.

I am not sure if it's possible to directly connect an Apple II drive to a PC, because PC drives and Apple drives use different encoding techniques. There are a number of methods available to transfer the information from an Apple II diskette to a ROM image for use with an emulator.

It is possible to transfer disk images "on the fly," in which an Apple II will simultaneously create and send images via null-modem cable to a host computer. The easiest method for creating disk images on the Apple II and transferring them to the PC is by using "Ap222PC" by Clay Chang (found at **ftp://ftp.apple.asimov.net/pub/apple_utility/ap2222pc.zip**. AP2222PC will transfer disk and sequential text files between the PC and Apple using the Apple game I/O port and a PC parallel port.

In-depth details of all facts of Apple II emulators can be found in the above listed resource guide.

Joe Grand

ANSWERS TO #129820 - DEC. 1998

Mr. Reynolds indicated that he wants to interface an Apple II floppy drive directly to his PC to create disk images, but I believe there is a much simpler way. Why not just interface the entire Apple II computer to your PC to transfer the disks and create images?

I will assume that you have access to an Apple II with floppy drive and serial port. I believe the //c and //gs came with a serial port already installed, and controller cards for others models are readily available from several sources.

You can connect your Apple II and PC together with a null modem cable, and run some free software to transfer disks.

Check out **http://geta.life.uiuc.edu/~badger/files/adt120.zip** (Apple Disk Transfer 1.20) for the software needed to create/transfer the disk images. The program is well documented and even contains pinouts for the null modem cable, in case you need to construct one.

According to the program documentation, the program will create 140K disk images that are compatible with the ap12em Apple emulator. Overall, this solution should be less costly and time consuming than designing and constructing an interface to the floppy drive itself.

It's nice to see people still supporting such a great computer. For additional Apple II references, take a look at **http://geta.life.uiuc.edu/~badger/apple2.html** and **http://www.apple2.org**.

Jason Plumb
Lubbock, TX

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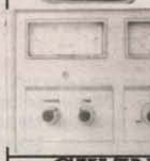

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the charging current may be — and for how long.

The major limitation occurs when the battery is recharged but is still receiving a recharge current — the condition is called overcharge.

Near full charge in modern sealed batteries, the charging current produces oxygen at the positive plate, and this oxygen increases the pressure inside the cell. Ideally, this oxygen migrates to the negative electrode where it harmlessly recombines with some extra cadmium hydroxide.

The recombination releases the heat that makes the cell temperature rise, and this heat balances the electrical energy of the charging current. The migrating oxygen allows a battery to handle some overcharge current, but how much overcharge current depends on the cell design. If the overcharge current is too large, then the pressure becomes too high and the cell vents through a safety valve. Venting causes a sealed cell to lose capacity and shortens its life. Consequently, cells should not be overcharged beyond their design specifications.

There are three common battery types: standard charge, quick charge, and fast charge.

The capacity of a battery is rated in ampere-hours, and the charging rates are commonly specified as a fraction of C, which is the battery capacity divided by one hour.

A D-size battery might have a 4 ampere-hour rating. The standard charge rate is 0.1 C, so it should be recharged at 400mA (or less). The charging process isn't perfect, so it takes about 14 hours to recharge a battery at the 0.1 C rate — about 40% longer than expected. The battery should not be damaged by a 0.1 C overcharge that lasts for days.

Quick charge batteries can be charged at up to 0.33 C, so they reach full charge within four to five hours.

Although the cell is designed to withstand this high rate, it should not be left on the charger indefinitely.

For example, my Black and Decker drill wants the charge stopped after five hours.

Some chargers will use the quick charge rate for a few hours and then switch to rate less than 0.1 C. Such a charger will not damage a cell that is left in the charger.

Fast charge cells can be charged at rates as high as 4C, so they can recharge a battery in 20 minutes, but the charging current must be reduced before the cell is fully charged.

To fast charge a cell, you need a charger that senses when the cell nears full charge and adjusts its charging rate. The charger can tell it is near full charge when the battery temperature rises.

Many batteries are trickle charged (0.05 to 0.1 C) to keep them fully charged during long periods of inactivity.

Gerald Roylance
Mountain View, CA

ANSWER TO #12984 - DEC. 1998

The GP1U52X IR receiver is manufactured by Sharp, and is also sold by RadioShack as part #276-0137. You can find a copy of the data sheet at **http://support.tandy.com/support_supplies/17533.htm**.

Also, if you're trying to build transmitter and detector circuits with this device, you may find the following URLs useful: **http://www.wirz.com/tutorial/IR/index.html** and **http://www.seattlerobotics.org/guide/infrared.html**.

Another good source for IR circuits in general is **http://godot.tuniv.szczecin.pl/~mjaskula/tomi/opto.html**

Mark Winters
Orem, UT

ANSWER TO #12981 - DEC. 1998

I don't know where you can get a copy of IDE, but getting the USB spec is very easy — you can download the spec from www.usb.org.

Gerald Roylance
Mountain View, CA

ANSWER TO #12982 - DEC. 1998

Everyone should connect a pair of VU meters to his stereo system!

When my brother and I were in our teens, we saved up our money until we could afford to do it. It must have done something good, because we both became broadcast engineers.

A quick check of the 1969 Allied Electronics catalog shows a 4.5" Simpson "Wide-Vue" VU meter for $32.10 ... pretty pricey in terms of 1969 allowance dollars!

If you have a pair of true VU meters, consider yourself lucky.

Nowadays, these have been largely replaced by DC voltmeter movements that are driven by an electronic buffer circuit. A true VU meter is typically a 200-microampere D'Arsonval movement, with an internal resistance of 3900 ohms. A fullwave diode bridge inside the meter case converts the audio (AC) into DC to drive the meter. The meter is intended to be used to measure a 600-ohm audio circuit.

Of course, a diode will not conduct below a certain threshold voltage, and as the meter diodes switch between non-conduction and conduction, this slightly changes the amount of current that the meter draws from that 600-ohm audio line, and introduces a slight amount of distortion to the sound. To reduce this distortion, the standard 3900-ohm VU meter was intended to be used with a 3600-ohm series resistance, bringing the total resistance to 7500 ohms.

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With this series resistance, the meter would read zero VU, or 100%, with 1.228 vRMS (+4 dBm) applied.

A further need for the series resistance is so that the meter will have the proper ballistic characteristics ... when a signal is applied, the needle will rise at the proper rate, and will come to rest without excessive overshoot and "bouncing around."

A standard VU meter has been designed to have proper ballistics when fed through that 3600-ohm resistance, and if you change or eliminate that resistance, the ballistics will suffer.

How do you connect the VU meter to the speaker wiring of your stereo system? The simplest hook-up is to connect one terminal of the meter to the "common" speaker terminal, and connect the other meter terminal, through a 3600-ohm series resistor, to one channel's "hot" speaker terminal. Connected that way, the meter will read zero VU when 1.228 VRMS is present across the speaker. If you assume your speaker has an eight-ohm impedance, that will actually be a power level of 188 mW. P = E^2/R; (1.228)^2/8 = 0.188 W.

That's pretty quiet, by most listeners' standards.

In fact, this measurement will be only approximate, for two reasons.

First, a VU meter reads accurately only with a steady-state sinewave input. With a complex waveform, such as music or speech, the meter indicates somewhere between the average and peak values of the waveform.

Second, the impedance of the loudspeaker varies with frequency. So even if the meter is measuring a steady sinusoidal tone, you would need to know the speaker's actual impedance at that frequency, and then re-calculate the actual power delivered.

Unless you listen at exceedingly low audio levels, you'll probably want to add some attenuation to your meter circuit.

For ballistic reasons, always keep that 3600-ohm resistance in series with the meter, and connect the attenuation between the loudspeaker terminals and the resistance.

Continued on page 63

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OTHER TEST equipment Racal Dana 9303 true RMS level meter with head as new, $375; Fluke 8921A true RMS voltmeter, $300; Philips PM 6654 high resolution programmable timer counter, $350; Wavetek 178 programmable waveform synthesizer, $825. Psitech Plus, 707-745-4804, www.psitech-plus.com.

HP 8640B, 001,002,003, manual, $1,195; HP 8660A/86602A/86633B, $1,695; **TEK** 465M, $349; **Wavetek** 1001A, $149; **HP 334A**, $100; **TEK** AM 502, $100; **HP 6006A**, $149; **HP 8620C**, 5.9-9GHz, $249; **TEK** 7844, opt. 3,22,78, $139. Technologies West, 541-267-6064.

HP 54602B 4 ch. 150MHz digital oscilloscope, opt 5 (enhanced video trigger), benchlink module/software (RS232 out), training kit probes, transferable HP warranty til 9/99, normally priced at $5,000, sale price as new at $2,500. Sorenson DCR-115B DC PS, 0-20V, 0-115A, CVCC, dual meter 220 input, $800. 201-796-1405.

CESIUM/RUBIDIUM repairs, free estimates. 13 Tektronix catalogs 1967, 70s, most 80s, $120; GR1412BC capacitance decade, $100; Fluke clamp on ammeter 80I-410, $50; Rubidium modules, $425; Quartz modules, $175-$250. Corby Dawson, 805-736-0288.

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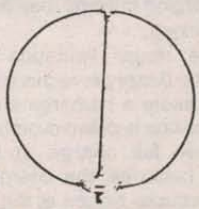

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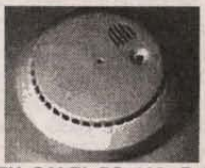

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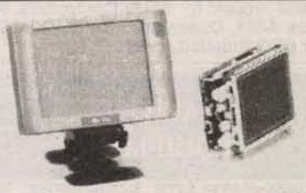

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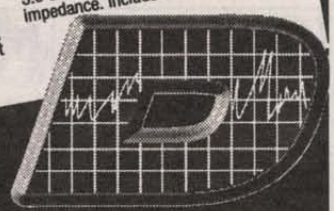

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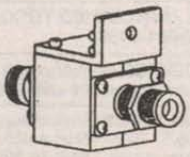

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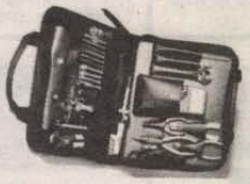

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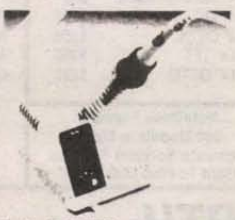

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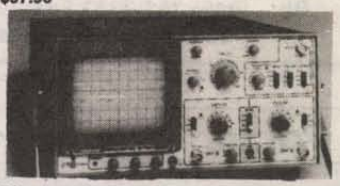

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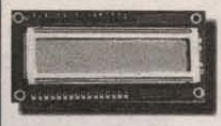

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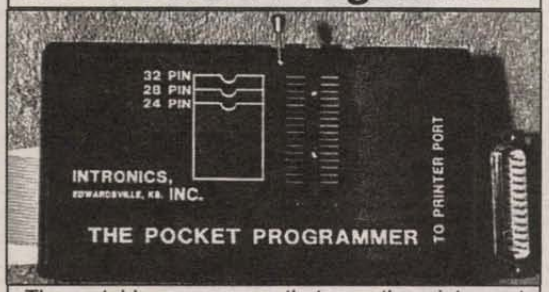

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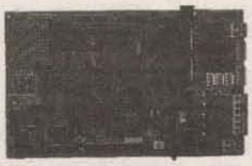

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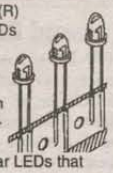

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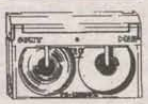

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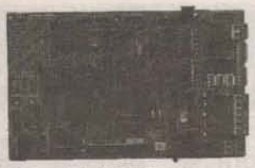

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ELECTRONIC KITS, projects and supplies for prototyping, designing or hobby. Call 1-888-GO-4-KITS for catalogs or send $3 to Quality Kits, 49 McMichael St., Kingston, ON., K7M 1M8. **http://www.qkits.com**

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

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Transmits color or B&W with fantastic quality - almost like a direct wired connection to any TV tuned to cable channel 59. Crystal controlled for no frequency drift with performance that equals law enforcement models that cost hundreds more! Basic 20 mW model transmits up to 300' while the high power 100 mW unit goes up to 1/4 mile. Audio units include sound using a sensitive built-in mike that will hear a whisper 15 feet away! Units run on 9 volts and hook-up to most any CCD camera. Any of our cameras have been tested to mate perfectly with our Cubes and work great. Fully assembled - just hook-up power and you're on the air!

C-2000, Basic Video Transmitter Cube.....$89.95
C-3000, Basic Video and Audio Transmitter Cube.....$149.95
C-2001, High Power Video Transmitter Cube.....$179.95
C-3001, High Power Video and Audio Transmitter Cube.....$229.95

Super Pro FM Stereo Radio Transmitter

A truly professional frequency synthesized FM Stereo transmitter station in one easy to use, handsome cabinet. Most radio stations require a whole equipment rack to hold all the features we've packed into the FM-100. Set frequency easily with the Up/Down freq buttons and the big LED digital display. Plus there's input low pass filtering that gives great sound no matter what the source (no more squeals or swishing sounds from cheap CD player inputs!) Peak limiters for maximum 'punch' in your audio - without over modulation, LED bargraph meters for easy setting of audio levels and a built-in mixer with mike and line level inputs. Churches, drive-ins, schools and colleges find the FM-100 to be the answer to their transmitting needs, you will too. No one offers all these features at this price! Kit includes cabinet, whip antenna and 120 VAC supply.

We also offer a high power export version of the FM-100 that's fully assembled with one watt of RF power, for miles of program coverage. The export version can only be shipped outside the USA, or within the US if accompanied by a signed statement that the unit will be exported.

FM-100, Professional FM Stereo Transmitter Kit.....$299.95
FM-100WT, Fully Wired High Power FM Transmitter.....$429.95

AM Band Radio Transmitter

Ramsey AM radio transmitters operate in the standard AM broadcast band and are easily set to any clear channel in your area. Our AM-25, 'pro' version, fully synthesized transmitter features easy frequency setting DIP switches for stable, no-drift frequency control, while being jumper setable for higher power output where regulations allow. The entry-level AM-1 uses a tunable transmit oscillator and runs the maximum 100 milliwatts of power. No FCC license is required, expected range is up to 1/4 mile depending upon antenna and conditions. Transmitters accept standard line-level inputs from tape decks, CD players or mike mixers, and run on 12 volts DC. The Pro AM-25 comes complete with AC power adapter, matching case set and bottom loaded wire antenna. Our entry-level AM-1 has an available matching case and knob set for a finished, professional look.

AM-25, Professional AM Transmitter Kit.....$129.95
AM-1, Entry level AM Radio Transmitter Kit.....$29.95
CAM, Matching Case Set for AM-1.....$14.95

CCD Video Cameras

If you're looking for a good quality CCD board camera, stop right here! Our cameras use top quality Japanese Class 'A' CCD arrays with over 440 line line resolution, not the off-spec arrays that are found on many other cameras. You see, the Japanese suppliers grade the CCDs at manufacture and some manufacturers end up with the off-grade chips due to either cost constraints or lack of buying 'clout'. Also, a new strain of CMOS single chip cameras are entering the market, those units have about 1/2 the resolution and draw over twice the current that these cameras do - don't be fooled! Our cameras have nice clean fields and excellent light sensitivity, you'll really see the difference, and if you want to see in the dark, the black & white models are super IR (Infra-Red) sensitive. Our IR-1 Illuminator kit is invisible to the human eye, but lights the scene like a flashlight at night! Color camera has Auto White Balance, Auto Gain, Back Light Compensation and DSP! Available with Wide-angle (80°) or super slim Pin-hole style lens. They run on 9 VDC and produce standard 1 volt p-p video. Add one of our transmitter units for wireless transmission to any TV set, or add our IB-1 Interface board for audio sound pick-up and super easy direct wire hook-up connection to any Video monitor, VCR or TV with video/audio input jacks. Cameras fully assembled, including pre-wired connector.

CCDWA-2, B&W CCD Camera, wide-angle lens.....$99.95
CCDPH-2, B&W CCD Camera, slim fit pin-hole len.....$99.95
CCDPH-2, Color CCD Camera, wide-angle lens.....$149.95
IR-1, IR Illuminator Kit for B&W cameras.....$24.95
IB-1, Interface Board Kit.....$24.95

FM Stereo Radio Transmitters

Microprocessor controlled for easy frequency programming using DIP switches, no drift, your signal is rock solid all the time - just like the commercial stations. Audio quality is excellent, connect to the line output of any CD player, tape deck or mike mixer and you're on-the-air. Foreign buyers will appreciate the high power output capability of the FM-25; many Caribbean folks use a single FM-25 to cover the whole island! New, improved, clean and hum-free runs on either 12 VDC or 120 VAC. Kit comes complete with case set, whip antenna, 120 VAC power adapter - easy one evening assembly.

FM-25, Synthesized FM Stereo Transmitter Kit.....$129.95

A lower cost alternative to our high performance transmitters. Offers great value, tunable over the 88-108 MHz FM broadcast band, plenty of power and our manual goes into great detail outlining aspects of antennas, transmitting range and the FCC rules and regulations. Connects to any cassette deck, CD player or mixer and you're on-the-air, you'll be amazed at the exceptional audio quality! Runs on internal 9V battery or external power from 5 to 15 VDC. Add our matching case and whip antenna set for a nice finished look.

FM-10A, Tunable FM Stereo Transmitter Kit.....$34.95
CFM, Matching Case and Antenna Set.....$14.95
AC12-5, 12 Volt DC Wall Plug Adapter.....$9.95

RF Power Booster

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

LPA-1, Power Booster Amplifier Kit.....$39.95
CLPA, Matching Case Set for LPA-1 Kit.....$14.95
LPA-1WT, Fully Wired LPA-1 with Case.....$99.95

Treasure Finder Kit

Search for buried treasure at the beach, backyard or park. This professional quality kit can detect metal at a depth of up to 6 inches. Easy to use, just listen for the change in tone as you 'sweep' the unit across the surface - the larger the tone change - the larger the object. Has built-in speaker or earphone connection, runs on standard 9 volt battery. Complete kit includes handsome case, rugged PVC handle assembly that 'breaks down' for easy transportation and shielded Faraday search coil. Easy one evening assembly. This nifty kit will literally pay for itself! That guy in the picture looks like he found something - what do you think it is - gold, silver, Rogaine, Viagra? You'll have fun with this kit.

TF-1, Treasure Finder Kit.....$39.95

Binocular Special

We came across these nice binoculars in an importers close-out deal. Not some cheap in-line lens jobs, these beauties have roof prisms, a super nice rubber armored housing over light weight aluminum. 10 x 25 power with fully coated optics. Includes lens cleaner cloth, neck lanyard and nice carry case. For extra demanding use in bright sun, choose the EX module with ruby coated Objective lens. First quality at a close-out price! We've seen the exact same units with the 'Bushnell' name on them being sold for $30 more!

BNO-1, Binoculars and case.....$24.95
BNO-1EX, Ruby Coated Lens Binoculars and case.....$29.95

Speech Descrambler

Decode all that gibberish! This is the popular descrambler / scrambler that you've read about in all the Scanner and Electronic magazines. Speech inversion technology is used, which is compatible with most cordless phones and many police department systems, hook it up to your scanner speaker terminals and you're in business. Easily configured for any use: mike, line level and speaker output/inputs are provided. Also communicate in total privacy over telephone or radio, full duplex operation - scramble and unscramble at the same time. Easy to build, all complex circuitry contained in new custom ASIC chip for clear, clean audio. Runs on 9 to 15VDC. Our matching case set adds a professional look to your kit.

SS-70A, Speech Descrambler/Scrambler Kit.....$39.95
CSS, Custom Matching Case and Knob Set.....$14.95
SS-70AWT, Fully Wired SS-70A with Case.....$79.95
AC12-5, 12 Volt DC Wall Plug Adapter.....$9.95

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Stock #TE9805 **$295.00**

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HEWLETT PACKARD, Model 4328A. Designed to measure very low resistances. Measurement range 1m ohm to 100 ohms. Resolution 20 u ohms. Analog meter readout. Ideal for measuring contact resistance of switches or relays. This unit is also useful for measuring the resistivity of semiconductor devices. (Requires special 4 terminal probes which are not supplied, but probably are available from Hewlett Packard.) Power input: 115–230 VAC 48–66 Hz, 5 VA max. Dimensions: 5-1/8" wide x 11-1/2" deep x 6-1/2" high.
Stock #TE9812 **$200.00**

3-1/2 DIGIT DIGITAL MULTIMETER
FLUKE, Model 8000A. LED readout. Classic digital multimeter. Ideal companion to our Stock #TE9800 counter. Measures AC/DC volts/milliamps plus ohms. Input range 0–200 mV to 1200 volts, 0–200 UA to 2000 mA. 0 to 2000 K ohms. Portable unit with carrying handle which also can be used as a tilt stand. Input impedance 10 meg ohms. Max. input voltage 1200 VDC or rms. Accuracy DC volts 0.1% of input +1 digit. AC volts 0.5% of input +2 digits 45 Hz to 10 KHz. Input power 115 VAC 50 to 400 Hz 5 watts. Dimen.: 8-1/2" wide x 12" deep (including carrying handle) x 2-1/2" high.
Stock #TE9801 **$75.00**

200,000 COUNT DIGITAL MULTIMETER, FLUKE, Model 8800A. LED readout. 6-digit, autoranging multimeter. Basic accuracy ±.005%. 15 ranges DC volts: ±200 mv to ±1200 in 5 ranges accuracy ±.008% or better. AC volts: 2 VAC to 1200 VAC in 4 ranges. Accuracy ±1% or better depending on frequency and range. Resistance 200 ohm to 20 meg ohms in 6 ranges. Accuracy ±.02 or better. Input impedance: 1000 meg ohms or more on DC ranges, 2 meg ohms on AC ranges. Has complete overload protection and isolated inputs. Power input 110/230 VAC 50/60 Hz 8 watts. Built-in carrying handle that also acts as a tilt-up base. Dimensions: 3-1/2" high x 9" wide x 12-1/2" deep.
Stock #TE9815 **$100.00**

3600 RPM DC MOTOR WITH OPTICAL ENCODER PACIFIC SCIENTIFIC, #4VM82-004-4. 30 volts nom. input voltage. Permanent magnet, reversible servo motor. Has Hewlett Packard optical encoder. Ball bearings. No load speed at 30 VDC input is 4600 rpm. No load current 0.75 amp at 60 oz-in load rpm is 3600, current is approx. 6.6 amps. Torque constant is 9.1 oz-in per amp. Rotor inertia 0.0007 oz-in-sec^2. Terminal resistance 0.89 ohm. Optical encoder is similar to "HEDS 6000" series. Encoder has 1024 counts per revolution, two channel quadrature output. Outputs are TTL compatible. Encoder requires 5 VDC input at less than 50 mA input current. Dual shafts: front shaft is 3/8" dia. x 3/4" long. This shaft is tapped on the end 8X32 tpi. Rear shaft is 1/4" dia. x 7/16" long. This shaft has dual flats that measure approx 3/16" across. Motor has four 8X32 tpi tapped mounting holes on front. A 3-3/16" dia. centering pilot is also provided on the front face. Dimensions: 4" dia. x 5-1/2" long (excluding shafts.)
Stock #DCME9850 **$79.50**

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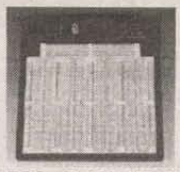

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WIRELESS DOORBELL! Includes battery-operated transmitter and receiver. 200 FT ranges. Plans for interfacing external hardware. $26.95 + $3 S&H. Pine Valley Technologies, Inc. W4117 Pine Valley Rd., Belleville, WI 53508. 608-424-3836.

NEW: SOLAR electric helium helicopter airship. Plans for 200 lb. 1 pilot version, $100. Plans for radio-controlled model, $50. Rose Aircraft, POB 7589, Chula Vista, CA 91912.

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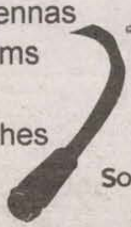

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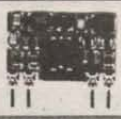
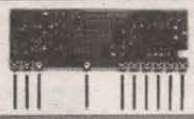

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- Auto TX/RX changeover

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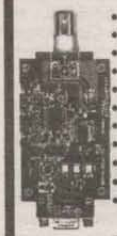

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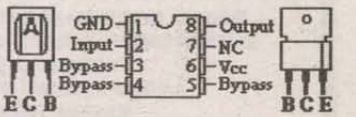

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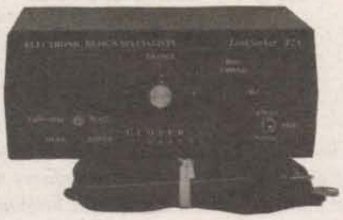

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TECH FORUM

Continued from page 49

One solution would be a simple potentiometer. I'd suggest a value of 1000 ohms. If you assume you have eight-ohm speakers, and you're powering them with 100 watts, that means there's 28.28 volts across the speaker terminals. P = E^2/R; so E = (P*R)^.5; so (100W * 8 ohms)^.5 = 28.28 volts. Now calculate the amount of power drawn by the 1000-ohm pot: again P = E^2/R, so (28.28)^2/1000 = 0.8 watts. That means you'll need at least a one-watt pot, and a higher power rating would be even safer.

Connect two identical circuits, one for each channel, as follows: Connect the speaker "common" terminal to the counter-clockwise end of the potentiometer, and also to one side of the VU meter. Connect the speaker "hot" terminal to the clockwise end of the potentiometer.

Connect the center terminal of the potentiometer to one end of the 3600-ohm resistor (1/2 watt is fine for the resistor's power rating).

Connect the other end of the resistor to the remaining terminal of the VU meter.

If you want attenuators that are calibrated, I suggest you look through the surplus catalogs. From time to time, you'll find someone selling stepped attenuators, with values typically 1 dB or 10 dB per step. These are usually 600-ohm impedance. Be sure the attenuator's power rating is high enough, as shown above. Or, using Ohm's Law, you could build your own custom attenuator using 1% resistors and a two-gang rotary switch.

Greg Miller
gemiller@commedge.com

ANSWER TO #11982 - NOV. 1998

Either some jumpers were changed or the sound card was removed from the computer before it was sold. Windows knew about the card and can't find it, so it gives you an error message.

You may try re-installing the software for the card. From the Control Panel, click on the Add New Hardware icon and follow the on-screen directions. If the card is there Windows should find it. If it needs a disk it should tell you.

You may also want to check under Control Panel | System | Device Manager to see what the computer thinks is in your machine. Click on the Sound, Video and Game Devices icon then right click on each subsystem. Check the properties table that appears. Make sure that the hardware is selected and that there are no conflicts. Anything with a yellow question mark for an icon needs some attention.

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Write in 132 on Reader Service Card.

TECH FORUM

Often removing the offending device driver then running Find Hardware again will fix these sort of problems. If that doesn't help either buy a sound card or ask your seller what happened. Before you go back to the seller, though, open up the box and check for yourself to save some embarrassment.

Dave Sarraf

ANSWER TO #129814 - DEC. 1998

This timer is ideally implemented in a small microcontroller such as a PIC. The only components needed are a PIC, a crystal (try a 32,768Hz watch xtal), switch, and output device!

The program is so short, it can be written in assembler, BASIC, FORTH, or C. Sample pseudo code follows:

```
DO
{ WaitForSwitch
  For i:=1 to 20
    {
      Wait1Minute
      For cnt:=1 to 20
      {
        if(cnt<=i) BEEP1 else
BEEP0
      WaitHalfSec
      BEEP0
      WaitHalfSec
    }
  }
```

Wait1Minute and WaitHalfSec are simple decrement loops based on precomputed constants loaded into a variable or register, and being counted down to zero. BEEP1 and BEEP0 turn an output bit on or off. The 20 second creep can be avoided by reducing the minute count by 20 seconds, and always outputting 20 beeps of which the first count writes 1 (ON, OFF) and the remaining write 0 (OFF, OFF). This method allows extremely accurate timing, easy to change the rules, and minimum parts count!

Barry Cole
Sunnyvale, CA

ANSWER TO #12987 - DEC. 1998

I have played around with high voltage a lot, and since I do neon work, I have access to many high-voltage transformers.

Building ion generators is fairly easy. Basically, all you need is a high-voltage transformer, rheostat, and an ion grid.

The rheostat controls the input of the transformer and the output of the transformer goes to the ion grid.

The ion grid is easily made. I used a 6" x 6" x 1/8" piece of plate-glass and epoxied mesh wire 4" x 4" to

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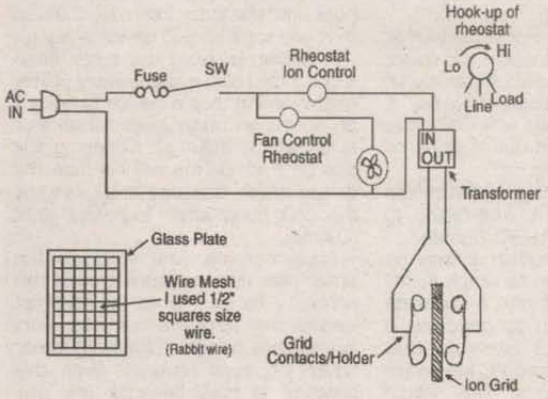
TECH FORUM

each side of the glass.

Epoxy is applied to each corner of the mesh wire on both sides of the glass.



You can make some sort of a insulated stand to hold the ion grid. I built a box and added a 8" computer fan and Heppa filter. The unit has two controls: One for the ion control and one for the fan speed, plus and off/on switch and fuse.

Ray Samples
Fayetteville, NC

ANSWERS TO #129815 - DEC. 1998

The PC timer chips have three counters. The count registers are at I/O ports 40h, 41h, and 42h, respectively. The Control Word is written to port 43h.

The timers are assigned as: Timer 0 — IRQ0 (timer tick); Timer 1 — DRAM refresh; Timer 2 — speaker control.

Loading a countdown value to one of the registers must be done in conformance with the Read/Load format already established for that timer. This format is set in the Control Word.

In attempting to control the speaker, three steps should occur: **1)** Set the Control Word: Output B6h to port 43h. (This selects counter 2 (bits 7 & 6), establishes the counter value as 16-bit LSB then MSB order (bits 5 & 4), sets timer Mode 3 (squarewave) (bits 3-1), and sets the counter to count in binary vs. BCD (bit 0)). **2)** Load the desired countdown value to port 42h, least-significant byte followed by most-significant byte. **3)** Enable the speaker by setting bits 1 & 0 at port 61h, WITHOUT CHANGING THE OTHER SIX BITS AT THIS PORT ADDRESS. (Input port 61h, OR the value with 3, then Output back to 61h).

The output frequency will be 1.193182 MHz divided by the countdown value loaded into the timer's register. To get an output freq of about 10 KHz, use a countdown of 119 (decimal).

If you want interrupts to occur at this rate, you could use a special purpose card which has a pigtail to interface with the speaker connector, and use that signal to pulse another one of the, IRQ lines available on the peripheral connector. You would have to install your own interrupt handling routine to service that IRQ. In this event, you would probably want to use timer Mode 2 (Control Word bits 2 & 1 set to 1 & 0, respectively).

Another way to change the interrupt rate would be to change the setting of the timer 0 countdown value, but this is involved. You would probably want to install your own IRQ0 interrupt handler to service each interrupt, calling the default IRQ0 handler at the standard "timer tick" rate, about every 54 milliseconds. I'd suggest using assembly language, to keep your IRQ0 handler code as tight as possible.

Larry Mistretta
Sunnyvale, CA

Continued on next page

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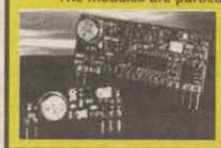

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The TX2 and RX2 radio transmitter and receiver pair enable the simple implementation of a data link at up to 40kbit/s at distances up to 75m in-building and 300m open ground. Both modules combine full screening with extensive internal filtering to ensure EMC compliance by minimizing spurious radiations and susceptibilities. The TX2 and RX2 modules will suit one-to-one and multinode wireless links in applications including car and building security, EPOS and inventory tracking, remote industrial process monitoring, and computer networking.

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RPC — $99.00 ea.

The RPC module is an intelligent transceiver which enables a radio network link to be simply implemented between a number of digital devices. The module combines an RF circuit with processor-intensive low-level packet formatting and recovery functionality, requiring only a simple antenna and 5V supply to operate with a microcontroller or a PC.

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BIM — $69.00 ea.

The BiM module integrates a low-power UHF FM transmitter and matching superhet receiver together with data recovery and TX/RX change over circuits to provide a low-cost solution to implementing a bi-directional short-range radio data link.

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27C64-15	2.99	2.84	2.56
27256-15	4.79	4.55	4.10
27C256-15	2.99	2.84	2.56
27512-25	3.09	2.94	2.65
27C512-25	2.99	2.84	2.56
27C010-15	3.79	3.60	3.24
27C020-15	4.49	4.27	3.84
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TECH FORUM

ANSWERS TO #129815 - DEC. 1998

The 8253 timer is quite useful, but hard to program unless you know some computer architecture or have had some digital electronics experience. I'll briefly go over how the 8253 is used in a PC before going on to how to program it.

The PC real-time clock runs at 1.19318 million Hz. However, to fit the value in a 16-bit number, the 8253 is used to "step down" the counter to a 16-bit value (max of 65535). The result is the 18.2 Hz rate, or approx. 55 ms interval.

The 8253 has four "channels," but 0, 1, and 3 are used by the system (real-time clock, memory refresh, and system timeout detection, respectively), so only channel 2 is available for use, and that is usually hooked up to the speaker.

The 8253 actually has SIX different modes of operation, but for PC purposes, "mode 3" is sufficient. In "mode 3," the "latch register" is loaded with a number, which counts DOWN to 0 on every clock pulse. When the counter hits 0, the output turns on for one clock cycle, and the counter reloads the original value and starts over.

To control the timer, you need to send a one-byte command to the "command register", which is on the PC at port 0043h. Then you load the latch register with the value you selected. Once the timer gets the second value, the countdown starts.

The command register is programmed as follows:

```
bit 0: 0 if binary, 1 if BCD
1-3: timer mode, 0-5 <<<-- use 3
4-5: operation type
00 = move counter into latch
01 = read/write high byte only
10 = read/write low byte only
11 = read/write high byte, then low byte <<<-- use this 6-7: which channel to set (0-3) <<<-- use 2
```

Channel 2's latch is at port 0042h. To set the timer to operate at 0.1ms, you need to determine the latch counter value by dividing 1190000 by the frequency. 0.1 ms is 10000 Hz, so the value you need is 119. Let's declare that ... unsigned latchval=199; you will also need to turn off the link between the timer and the speaker. You do that by turning off the last two bits of command port B at 0061h, so you need outp(0x61,inp(0x61) & 252); // turn off sound.

Then we initialize the command register. The bits we need are 10110110b, or 182. outp(ox43,182); // init cmd register

To output 199 in two parts, we'll separate the lower and upper by using AND $FF and shift right eight times. As 199 is less than 2^8 you can use only the lower byte, but I wrote it this way to be "compatible."

```
outp(0x42,latchval & 0xFF); // send low byte value
outp(0x42,latchval >> 8); // send high byte value
```

And you are done!

Don't forget the reset the timer when you're done ... 1190000/18.2 = 65385 (approx).

To relink channel 2 to speaker, reinitialize with: outp(0x61,inp(0x61)|3);

Kasey Chang
San Francisco, CA

ANSWERS TO #129815 - DEC. 1998

Unless you modify the PC hardware, the only timer that can generate an interrupt is timer 0. The XT BIOS sets up timer 0 with this code:

```
mov al,36h  ;mode 3, lsb then msb, squarewave
out 43h,al
mov ax,0000  ;preset = 65536
out 40h,al
mov al,ah  ;now send msb
 out 40h,al
```

Note that it takes three output instructions to complete this preset operation, the first is the mode control byte and then this is followed by the two bytes you have just told the 8253 that you were going to send, first the low byte of the preset value, and then the high byte of the preset value. You cannot just output a new preset value, you must go through the full fandango. The value 0000 is effectively 65,536 because it loads a 16-bit counter that first counts down and then looks to see where it is.

The interrupt rate is int rate = 1,193,180/preset so with preset = 65536 we get 18.206 interrupts per second.

You have asked for an interrupt every 100 microseconds, or 10,000 interrupts per second. The preset required would then be preset = 1,193,180/int rate or = 119.

You should have set INT 1Ch at location 0000:0070 to point to your own interrupt handler; when you quit you should restore that vector to its original value.

The time-of-day and the floppy disk motor timeout will be messed up while you have timer 0 running at your own rate, so you should also restore the original 8253 preset value.

Alas there's more. Whether you can actually get in and out of 10,000 interrupts per second and still do anything else, is a question you may explore the hard way.

That's the theory. For a somewhat more thorough discussion you might want to consult Michael Abrash: *Zen of Assembly Language, Volume 1, Knowledge*. Foresman and Company, 1990. Of course it's out of print, so you'll have to look around.

For discussion of the hardware see Lewis C. Eggebrecht: *Interfacing to the IBM PC. Sams*, 1990. Sameo.

As a practical matter, it may be easier in the long run to simply install an expansion board with a separate 8253 timer set up to generate a completely separate interrupt that stays clear of the basic PC hardware and BIOS operations. This would appear to be particularly true where you are interfacing "various sensors/transducers ..."

For example, **Circuit Specialists 1-800-528-1417** has a $46.00 I/O Prototype Development Card that comes in kit form and includes the 8253, 8255, and address decode circuits already built in. This is the kind of project that may cause you to learn why Steve Ciarcia once said, "solder is my favorite language."

Jack Dennon
Warrenton, OR

ANSWERS TO #129815 - DEC. 1998

The simple answer is do not change the timer interrupt rate. There is a lot of black magic that happens with timer interrupts, and you need to understand the impact that any changes have.

Furthermore, it is generally a bad idea to issue thousands of interrupts per second.

It takes time to service interrupts, and a lot of interrupts will bring a system to its knees.

For fast data rates, you should use buffered transfers and DMA. Keep the interrupts below 1,000 per second.

Under MS/DOS, you can change the interrupt rate, but you risk screwing up the operating system or a device driver. Device drivers will often hook onto the timer interrupt chain so they can tell if an I/O device is hung.

A driver, knowing the timer interrupts (ticks) occur about every 55ms, might decide that a device is hung if an operation takes longer than four ticks (about 200ms). Changing the tick time to 0.1ms will confuse the device driver, because it will assume the I/O hung after four fast ticks (0.4ms).

Programmers who increase the timer rate need to work around this problem, so they write an interrupt handler that fields the fast ticks; every 55ms that handler chains to other timer interrupt routines. Even this practice is risky because any program that hooks into the timer interrupt chain later gets the fast tick rate.

Under Windows, what happens is mysterious. Your outportb() subroutine calls manipulate a virtual timer chip (not the real one on the motherboard, but a software simulation), and then Windows may or may not change the settings on the real chip.

Under Windows you must also take special steps to page lock your interrupt routine or callback, and that requires a fair bit of Windows knowledge.

Using the Windows APIs can be even more disconcerting. Windows allows you to schedule a timer message every millisecond — but it doesn't promise to give you every one of them! Ask for 1ms messages and you may get one only every 55ms — and even then you may not get one if the system is busy doing something else.

Leave the timer interrupt alone and use the serial port for collecting the samples. Use the operating system's drivers for accessing the serial port so you don't have to write the interrupt routine. The operating system drivers will make full use of hardware FIFOs, system buffers, and ring 0 interrupt routines.

Gerald Roylance
Mountain View, CA

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Events CALENDAR

Continued from page 27

Conv., William Tittle KA8LAY, 513-661-1861. E-Mail: gldivconvention@juno.com

FEBRUARY 28

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

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

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

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

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

VA - ANNANDALE - Hamfest. Vienna Wireless Society, Mike Toia K3MT, 703-757-5021. E-Mail: k3mt@erols.com Web: http://www.erols.com/k3mt/vws

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

MARCH 1999

MARCH 5-6-7

NE - NORFOLK - State Convention. Fred Wiebelhaus N0VLX, 402-379-1929. E-Mail: dfwiebel@sufia.net Web: http://members.aol.com/davidri0xbn/evarc.html

MARCH 6

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

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

MARCH 6-7

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

MARCH 7

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

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

MARCH 13

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

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

FL - EAST ENGLEWOOD - Hamfest. Englewood ARS, J.R. House K9HUY, 941-475-3005. Web: http://www.flnet.com/~crosby/ears/index.html

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

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

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

ND - WEST FARGO - Hamfest. Red River Radio Amateurs, Mark Kerkvliet KG0FR, 701-282-4716. E-Mail: mbkerk@worldnet.att.net Web: http://www.rrra.org/

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

MARCH 13-14

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

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

MARCH 14

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

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

OH - CONNEAUT - Hamfest. Conneaut ARC, Jack Marttila KA8TUU, 440-593-3353

MARCH 19-20

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

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

OK - TULSA - OK State Convention. Green Country Hamfest Assn., Merlin Griffin WB5OSM, 918-622-2277. E-Mail: info@GreenCountryHamfestorg Web: http://www.GreenCountryHamfest.org

MARCH 20

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

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

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

MARCH 20-21

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

MARCH 21

NC - KINSTON - Down East Hamfest. Lenoir

Continued on page 77

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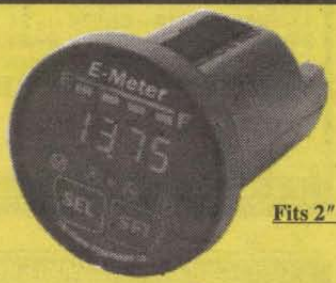

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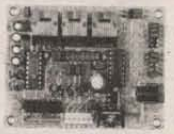

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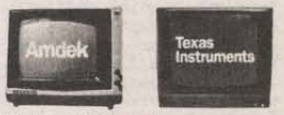

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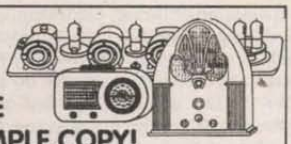

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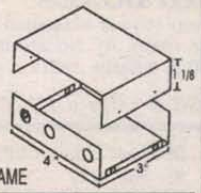

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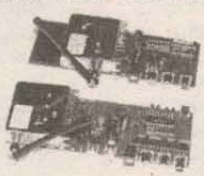

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Don Lancaster's

RESOURCE BIN

number eighty four

A look at some medical electronics.

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

Be certain to frequently check out my new *Guru's Lair* web site at (where else?) www.tinaja.com.

Some Medical Electronics Topics

This month, I thought I'd round up a bunch of resources which seem to relate to medical electronics in one way or another. But first, an obvious big disclaimer: Please do not consider what follows to be medical advice in any way, shape, or form. Do not base any critical decisions upon anything said or suggested here. At least not without careful further research.

Working with medical electronics has major hassles. Typical electronics suppliers flat out refuse to allow their components to get used in life critical applications. There's untold zillions of regulations. You might easily end up illegally practicing medicine.

The market is strictly by, for, and of big bucks and long term insiders. And betting a life on something that does not work or puts off seeking proper help until too late can obviously end up a deadly travesty.

But there is a lot of very interesting possibilities here. If you are thorough and use the available resources.

Some Alternates

I have personally found the best of alternate medicine to be exceptionally useful in prevention and dealing with chronic problems. While a traditional medicine is by far your better choice when working with urgent repairs.

There's a lot that's very good and very bad about both routes. I also do believe that most medical problems are your own dumb fault. Caused or made worse by lifestyle, activity, and diet considerations.

Your key secret to dealing with *any* problem, medical or otherwise, is to get *multiple information from several independent sources*. If you are dealing with a single source of medical info, the chances are more than good there may be hidden agendas or some cross purposes not in your best interest.

NEXT MONTH:
Don looks at some of his favorite web sites.

Second opinions are crucial.

Much more on these topics can be found in DONTSICK.PDF and in those alternate medicine links you can find at *www.tinaja.com/beewb01.html*.

Essential alternate medical reading is anything by or about Dean Ornish or most books relating to the Pritikin clan. Yes, "wash it down with a steak" near-vegetarianism seems to work like a champ. At least for me.

Medline

The definitive online research tool that all doctors and medical pros use is called *Medline*. Any time you want to know anything about *any* medical topic, it is just common sense to go to Medline for a second or third opinion. Sadly, Medline has been outrageously expensive. But a number of sites are now offering you free Medline access of one type or another.

One superb Medline access site is *Health World* at *www.healthy.net*. The second is *American Health Network* at *www.ahn.com*. Other gateway sites for medical stuff are Emory University's at *www.gen.emory.edu/medweb* and the folks at *www.medaccess.com*.

Convenient click-through links to all of these and a few others are found at *www.tinaja.com/beewb01.html*.

Medical Electronics Products

This is one of many free "shopper" industry trade journals which address medical electronics. Here's some more journals and shoppers ...

- *Biomedical Instrumentation and Technology*
- *Medical & Biological Engineering and Computing*
- *Medical Design Technology*
- *Medical Devices Report*
- *Medical Electronics & Equipment News*
- *Medical Electronics and Medical Electronic Products*
- *Medical Electronics Manufacturing*
- *Medical Equipment Designer*
- *Medical Product Manufacturing News*

As an aside, there's a company that specializes in those antique scientific instruments from the 16th to the 19th centuries. Find them at *Early Scientific Instruments*. And scads of intriguing books on turn-of-the-century science and technology can be found through *Lindsay* at *www.lindsaypub.com*, or use his banner link on my website.

Fun With Dentists

I may have actually found a use for dentists. Several actually.

Firstoff, they have these wonderful x-ray machines. Which are just dandy for snooping around inside of sealed modules such as telephone interface blocks or pulse monitors. Yeah, their film size is tiny and their res isn't that great. But, with practice, you can tell an awful lot about a chip simply by looking at its number of pins, its lead frame, and its die size.

Secondly, you might think of your dentist as a precision machine shop. I once needed a shaft coupling for a HP distortion analyzer. A little grinder work on a delrin rod, and a tricky-to-get item was cheaply substituted.

Dentists could be highly useful for carved shapes (such as odd connector cases or proof-of-concept plastics), to "unencapsulate," or simply for elegant mechanical design.

Some dental products may have all sorts of unintended uses. A few years ago, there was an introduction of new disposable low-cost handpieces. These were basically a small and powerful turbine that could be cut down to fit inside a plotter pen. And had all sorts of printed circuit, mini-CAD machine, and other flutterwumper uses. A few details appeared in HACK76.PDF. And there's great heaping bunches of light-curing plastics and other items.

One of several trade journals here is *Dental Products Report*. More on some of these mini-turbine possibilities at *www.tinaja.com/flut01.html*.

Finally, certain dentists seem to get off on all those perpetual motion and overunity energy scams so, better to let them buy those overpriced videos and books. Then, you'll borrow these

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RESOURCE BIN

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Northfield IL 60093
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(201) 783-3935

Diet & Nutrition Ltr
53 Park Place
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(800) 274-7581

Disability Bookshop
PO Box 129
Vancouver WA 98666
(800) 637-2256

Disabilities Digest
522 Cintl-Batavia Park
Cincinnati OH 45244
(513) 528-0404

Disability Policy Jnl
346 North West Avenue
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(501) 575-3656

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PO Box 145
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Educom Review
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Washington DC 20036
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Exceptional Parent
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Gale Research
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(313) 961-2242

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Harvard Heart Letter
164 Longwood Avenue
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Health & Healing
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Potomac MD 20859
(800) 539-8219

Health Wisdom for Women
7811 Montrose Rd
Potomac MD 20854
(301) 762-6061

Herb Quarterly
223 San Anselmo Ave #7
San Anselmo CA 94960
(415) 455-9540

In Vivo Metric
PO Box 249
Healdsburg CA 95448
(707) 433-4819

Issues in Law & Medicine
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Terre Haute IN 47808
(812) 232-0103

Lifetime Health Letter
PO Box 420342
Palm Coast FL 32142
(800) 829-9177

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(516) 484-2400

Preventionl/|Rodale Press
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Emmaus PA 18098
(610) 967-5171

Pritikin Center
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Santa Monica CA 90405
(800) 421-9911

Synergetics
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TASK
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Anaheim CA 92805
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Trace Center Publications
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Madison WI 53705
(608) 263-5408

Women's Health Advocate
10310 Main St #301
Fairfax VA 22030
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fiction works for utterly fascinating fantasy reading and viewing. Of the mesmerizingly awful.

More info on pseudoscience topics at *www.tinaja.com/pseudo01.html*.

Pulse Monitors

There sure appears to be a bunch of interest in pulse monitors lately. I've personally found these exceptionally useful for working around some long term medical problems. Others apply them extensively for aerobics.

There are two popular types. One low-cost solution is the *plethsymograph* that clips onto a finger, a toe, or your earlobe. These operate on finger or toe capillaries, expanding and contracting on each heart beat. They often consist of an infrared LED photoreflector.

The problem is that *motion artifacts* make these totally useless for aerobic excercise programs. Instead, the more costly EKG types can be used. Typical units are the *Polar Edge*. These consist of a chest strap that has two sensing conductors and a small transmitter. A separate "wristwatch" receiver senses and displays the pulse information.

The transmitter converts each pulse beat into a burst of roughly 35 cycles of 5 KHz sinewaves. The receiver detects the sinewave bursts and then averages and displays them.

You can think of this system as an ultra low-frequency pulsed CW radio transmitter. Or, as a loosely coupled higher-frequency audio transformer. Either way, a computer interface can be easily built. You can even sense the signal using an eight-inch loop of wire on a scope probe. Since you are very much in the near field, ranges above five feet or so will be hard to do.

Gotchas here include the nulls of the ferrite rod transmitter in the chest unit; making sure any other ferrites or cores used offer decent Q and good permeability at 5 KHz; and working out a suitable averaging algorithm for a stable yet current display. It would seem that a four beat running average is a pretty fair starting point.

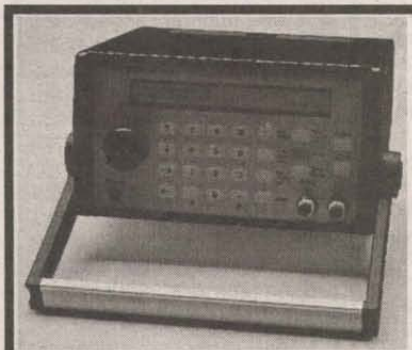
Interesting books on this subject do include John Parker's *Heart Monitor Training for the Complete Idiot*, and Ed Burke's *Precision Heart Rate Training*. I have placed links to these and others at *www.tinaja.com/amlink01*.

Tech details, sources, software, and insider info on pulse monitors can be found in HACK68.PDF. I've also got *InfoPacks* available on this.

Disabilities

We looked at several disability and handicapped resources way on back in RESBN44.PDF. Chances are that if you have come up with a "solution" to some limited hearing or limited vision problem, others are likely to already have a better approach. It also seems to me that there are lots of hidden agendas in the disability "industry" that you should be aware of. Profits are also exceptionally elusive.

At any rate, one extremely useful gateway resource is Trace Center. They appear to have the definitive CD-ROM resource bases on handicapped and disability aides. A bimonthly mag on using microcomputer technology for the disabled is *Closing the Gap*. One that targets children with disabilities is the *Exceptional*



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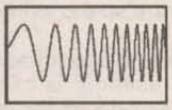
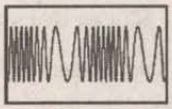

DC to 21.5 MHz linear and log sweeps

Int/Ext AM, SSB, Dualtone Gen.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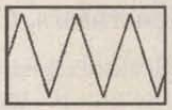
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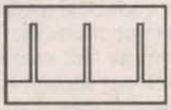
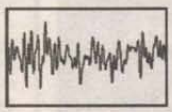
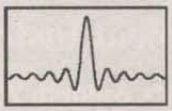

Pulse Generator


Noise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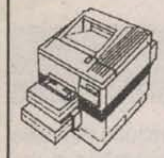

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misc.handicap

There's all sorts of newsletters and ezines as well. Normal web searches should be able to quickly pin all these down for you.

Brainwaves

Various *biofeedback* schemes can be based on sensing and acting upon low frequency brainwaves in that 1 to 12 Hz rregion. One apparently proven use is for stress management. Systems and results range the gamut from legitimate traditional medicine to far out new age hogwash.

The key source for biopotential skin electrodes seems to be *In Vivo Metric.* Additional suppliers do appear in the trade journals mentioned above.

But please think twice before you hot wire your cat.

The Placebo Effect

A patient that wants to get better and believes they are taking positive steps towards a "cure" is often much more likely to actually do so. This is called the *placebo effect.* Placebo effects are very real and very powerful. As such, they often mask whether some process or medicine is useful.

A lot of the locals around here seem to get off on "arthritis cures" that are magical little grey electrical boxes. In some of them, a very weak electrical current gets used (literally creating a "live" or a "warm fuzzy" sub-shock). But in others, the circuitry makes no sense whatsoever.

In my opinion, there is no credible basis as to why such a device would work. Except for that overwhelming placebo effect. But the locals are sure convinced otherwise.

As before, careful and independent research is essential. When something works, fine. But don't bet on a far out (or far off) device to the point where it gets too late for traditional medicine.

And do remember that "net" is the acronym for *not entirely true.* Always seek out second and third opinions. And realize that, the further you get away from Medline, the less likely the credible or useful results.

For More Info

There's bunches of books out there on medical electronics and medical instrumentation topics. Since there are so many of these, I have gathered them at *www.tinaja.com/amlink01.html.*

Additional research on any med electronics topic is available per my *InfoPack* service you will find at my *www.tinaja.com/info01.html.* Otherwise mentioned tutorial files are easy to find by using my website search.

I also have some new pulse monitor software I developed which appears exceptionally useful in chronic angina management and reversal. If you are a professional in this area, please do contact me for additional details. A credible co-author is being sought.

A few medical electronics bargains are at *www.tinaja.com/bargte01.html.* A lot of other medical gear can be gotten as military surplus at very low prices. We saw more on this in RESBN81.PDF and RESBN82.PDF.

This Month's Contest

As our contest for this month, just tell me about any useful, oddball, or unique medical electronics resource that I haven't already come across.

There'll be a dozen or more of my new *Incredible Secret Money Machine III* books going to the better entries. Plus an all expense paid *tinaja quest* for two (FOB Thatcher, AZ) going to the very best of all.

Send your written and snail-mailed entries on this contest directly to me here at *Synergetics.* Let's hear from you. **NV**

Microcomputer pioneer and guru Don Lancaster is the author of 35 books and countless tech articles. Don maintains his no-charge US tech helpline found at ***(520) 428-4073****, besides offering all of his own books reprints, and consulting services. Don also offers a free catalog full of his unique products and resource secrets. The best calling times are 8-5 on weekdays, Mountain Standard Time.*

Don is the webmaster of his Guru's Lair found at ***http://www.tinaja.com****. Full reprints and preprints of all Don's columns and ongoing tech support appear here. You can reach Don at Synergetics, Box 809, Thatcher, AZ 85552. Or send any messages to* ***don@tinaja.com****.*

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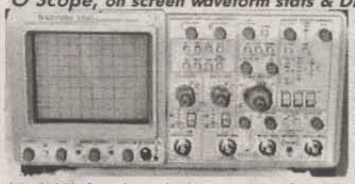
TEKTRONIX 2465A-DM, 4 Chan., 300MHz, O'Scope, on screen waveform stats & DMM READOUT



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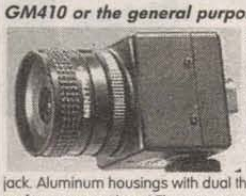

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Sleek black anodized, BRASS, housing is O-Ring sealed & WATERPROOF. Adjustabe mount included. Specs: 1/3" CCD, 400 Lines resolution, 0.05 Lux sensitivity, AGC, Auto Shutter. Operates on 12VDC @225mA, 3.6mm, 92° FOV lens, A real glass lens. NTSC video out. Superior construction. SENSITIVE to IR. Ultra small Size only: 1.25"diam. X 2" long. With 60 ft. cable. Great for general outdoor use also. REG. $299, **GM-300KIR.....$219**

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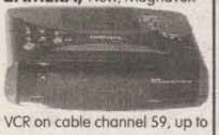
Used, refurbished, late model VICON model 424's at only 2/3 off the regular price. On screen programming, time/date stamp, audio, index search. power loss recovery and alarm inputs. Excellent, with manual. **VICON 424.... $499**

CLOCK RADIO COVERT CAMERA, New, Magnavox clock radio with covert low light video camera. Specs. per GM1000A shown below. Connect to anythig with a "video In" jack. via RCA style ouput. Also available wireless model, CRC-2W transmits to cable ready TV or VCR on cable channel 59, up to 500ft. No separate receiver req'd. **CRC-1std.. $129.ea or CRC-2W, Wireless..$279ea.**



COVERT CAMERAS available with audio, 1/3" CCD, 410 Lines Res., 0.2 Lux sens., Pwr. from 9 to 12VDC @100mA, 90° FOV lens, All focus from 3 ft. to infinity. NTSC video out. SENSITIVE to IR. note: Smoke & Motion detectors not functional, Clock & Exit operate normally. Dome is 3.5"H x 5.5"Diam. **Covert Clock, Smoke Detector, MotionDector or Dome Camera any model.....$119 Exit Sign.....$139 add $10 for audio.**

NEW MICRO CAMERA, w/audio 1/3" CCD, 410 Lines Res., 0.3 Lux sens., AGC, Auto Shutter. Pwr. from 9 to 12VDC @100mA, 250k PIXELS, Std. model, 3.6mm, 92° FOV lens, Pinhole, 90° FOV. A real glass lens. Both focus from 10mm to infinity. Std. NTSC video out. 1/2 once! SENSITIVE to IR. Size Std: 1.25"sq. x 1.0", PHIS 0.6"d, Both with 6" leads. **WARNING:** Don't confuse these models with LOW RESOLUTION, HIGH LUX C-MOS CAMERAS.Six models to choose from.

GM-1000A-STD.....$80 GM-1000A-STD/Aud.....$85
GM-1000A-PH.....$80 GM-1000A-PH/Aud.....$85
GM-1000A-CMNT..$80 GM-1000A-CMNT/Aud.$85

Micro Lenses for GM1000 series

2.5mm, 150°.....$22	**8.0mm, f2.0.....$22**
4.3mm, 78° f1.8.....$22	**12.0mm, f2.0.....$22**
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48 powerful LED's project a 40 deg. FOV beam up to 45 feet. Automatic on at dusk off at dawn! 110VAC power. Rugged anodized aluminum, housing with adjustable mtg. bracket Size: 4"x5"x6.3"L Commercially made. Brand New! **WPIR....$179ea.**

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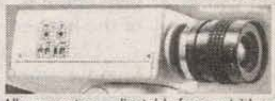

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- ***460 Lines***
- ***<1 lux Sensitivity***

All parameters adjustable from outside camera! Perfect for microscopy, inspection, capture or surveillance. Features internal or external sync, Interlaced or N/I, Adj. shutter, 1/60 to 1/10000 Sec., Auto White balance with three steps, Auto iris output, C or CS mount, Manual/auto gain or ext. variable gain. BNC video out, 12V@ 250mA pwr., via std. barrel jack. The GM470-C has it all! Aluminum housing. Size: 50mm W x 50mm H x 145mmL **New, GM470C, less lens.....$499ea.**

WEATHER RESISTANT Camera Enclosure

Solid, extruded aircraft aluminum. Glass window. Strain reliefs for cables. Size: 3.5"w x 3.7"h x14"L, **Special Price.....$59ea. with 110VHEATER...$69ea.**

PRICE BUSTER, DSP, COLOR CAMERA,

Brand New, model GM550, Size: 1.6" x 1.6" x1.5"L, 1/3" CCD with SONY CCD & DSP technology. 4mm, f1.8 glass lens, 80° FOV. Resolution >350 lines, sensitivity, 0.3lux, AWB, AGC & auto electronic shutter 1/60 to 1/10,000 sec. Pwr. 12VDC @160ma. NTSC out. Budget color surveillance. **GM550-STD.....$149ea. GM550-PH.....$149ea.**

CHECK THIS! ULTRA MINI and WEATHERPROOF

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So tiny you can install it right into a door with merely an 0.9" diameter hole. Sleek black anodized, extruded aluminum housing. Similar construction as the lipstick camera above only smaller! 1/3" CCD, 410 Lines Res., 0.3 Lux sens., AGC, Auto Shutter. Power from 9 to 16VDC @100mA, 250k PIXELS, 90° FOV Pinhole lens. A real glass lens. Std. NTSC video out. 1/2 once! SENSITIVE to IR. Size only 23mm Diam. x 35mm long. With 36" leads. Think of the places you could put this little jewel. **GM-200KPH lens,...$99**

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PRICE BUSTER, DSP, COLOR, MINI C-MOUNT, CAMERA, New, model GM859, Size only: 2" x 2" x2.5"L, Latest 1/4" CCD technology. Res. 350 lines, sens. , <3lux, auto white balance, AGC. Auto iris connector. 9-12VDC @150ma power. BNC video out. Switchable gain. Superior cast aluminum housing with top and bottom mounting. Perfect for general surveillance. Less lens. **Reg. $299, Save $100, Special, GM859..$189ea.**

NEWPORT, 495A MOTORIZED, ROTARY STAGE, Bidirectional 360° continuous rotation, 0.001° res. Integral DC motor & encoder. Load independent velocity servo. Mount in any orientation. Capacity: 55lbs. Size: 4.75"x5"x1.35" with 2" clear aperture. **Reg. $2141, Our Price $795**

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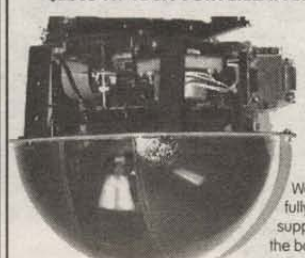

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- ***MOTORIZED, 360° CONTINUOUS PAN***
- ***MOTORIZED, TILT up to 90°***
- ***PHILIPS HIGH RES. 1/2" CCD CAMERA***
- ***OPAQUE BLACK INNER DOME***
- ***CLEAR ACRYLIC OUTER DOME***
- ***ZOOM LENS CONTROLLER with A/I***
- ***PAN and TILT CONTROLLER***

Walk into any major dept. store and you will see these fully integrated systems. From the same mfg. who supplied the Atlanta Olympics! These late model, new in the box systems are virtually ready to use. All you add is power. Philips B&W CCD camera, 450 lines res., 0.5 Lux sensitivity! Their best grade CCD. Anodized aluminum construction. Camera plus Pan & Tilt are powered by external 24VAC via the included Pan & Tilt controller. Motorized, Zoom, Focus and Iris Controller also included. Size of dome: 14"diam. Includes mount for drop ceiling. **COMPLETE SYSTEM SPECIAL....$895ea. or 2 for $1699**

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Incredibly only 0.98" x 0.8" x 0.037" in size. Transmits crystal controlled hi-res. images with 100mW output! The transmitter you've been waiting for. **Shown actual size.** Much smaller than the 9V battery which powers it. Draws only 35mA! Factory tuned ready to receive on cable channel 59. Will work with color or B&W cameras. UHF Bow tie antenna with balun and 3' F cable for TV included. Perfect with our GM1000A cameras. Both will fit in a cigarette pack....with the battery! The best deal anywhere. **TVX-100.$189. with GM1000A-PH CAM...$259.**

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CURI vs. Cat

by George Katz

For many years now, I have searched for practical uses for my robots, including my latest research project into behavioral control software that simulates a pet's behavior.

Most of my previous projects have been solutions looking for problems until last Thursday evening, when my wife and I discovered a visitor in our house. We were first alerted to the presence when I discovered a little (well not that little) cat surprise by the door. I thought this was strange because we do not have any pets. We looked through the house and could not see any signs of a cat, or whatever it was, and hoped that it was gone by now.

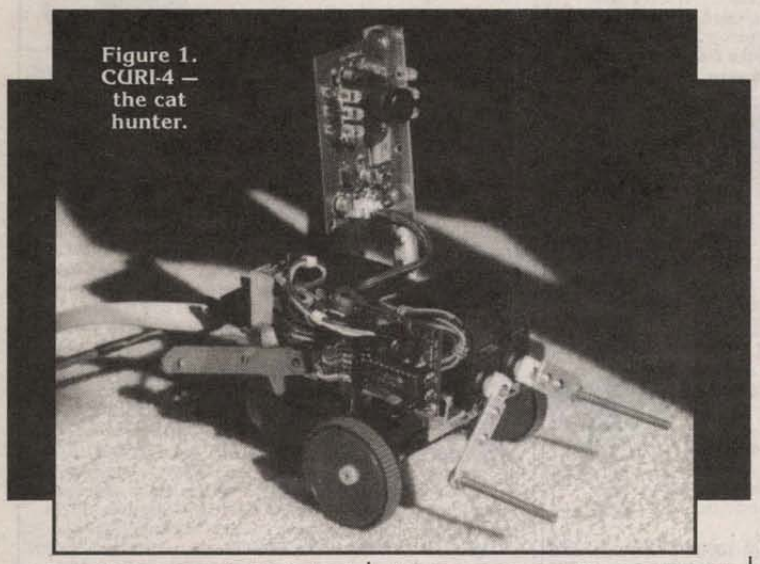

Figure 1. CURI-4 — the cat hunter.

The next morning Amanda put a small dish of assorted food on the floor of the kitchen as a precautionary measure to see if it really was gone.

At lunch time, we came home to find that the creature liked the tuna, not hot-dogs. We opened all the doors to the outside and searched the house to find a black cat hiding by the hot air vent in the living room. Though we chased the cat into another room where the door was open to the outside, we never saw it actually leave. Needless to say, we were still a little suspicious. With lunch hour running out, we closed all the doors and put another dish of food out to see if anything would bite. What has this to do with robots? I will get to that soon enough.

In the evening when we returned home, we knew to look for the cat by the heating vent. We opened all the doors again and the chase was on! At least for the first 20 seconds or so.

When the cat ran to the kitchen, I could not believe my eyes when I saw it disappear into a small hole about 4" x 5" in the kickboard of the kitchen counter.

Looking through the hole I found a small crawl space just big enough for the cat. There was no way we could reach in and grab it, the hole just was not big enough for an arm and cat to fit through. We agreed more bait would get it out.

Not wanting to drill a big hole in the cupboard, we needed a trap that would close off the hole when the cat came out. For a computer engineer, it did not take long to think of a solution involving a robot.

Just a week earlier, I finished building a small mobile robot named CURI-4, equipped with a small CCD camera and a gripper. CURI is tethered to a 486DX40 PC which is equipped with a frame grabber for capturing images. The camera is equipped with infrared LEDs allowing it to see in complete darkness for a distance of around 10 feet.

CURI's drive mechanism consists of two individually powered wheels each driven by a geared DC motor. CURI also has a servo which controls the pitch of the camera, two servos that are used by the gripper, and a fourth servo is used for a leg that allows the robot to raise or lower the gripper. The camera can be positioned so that it can see the objects the gripper is picking up. CURI's size is a mere 7.5" x 7" x 4" (20 cm x 18 cm x 10 cm), and even shorter with the camera fully retracted. Naturally, I tried to see if CURI would fit in the hole so it could drag the cat out by the tail, but the hole was just too small.

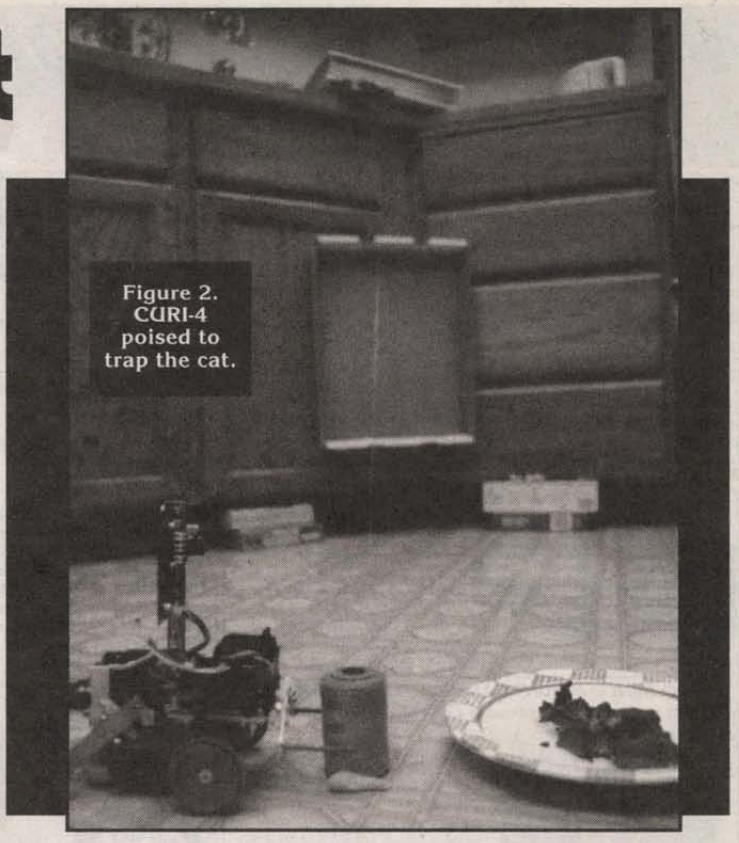

Figure 2. CURI-4 poised to trap the cat.

Normally, CURI's primary behavior is to play with a ball. This involves finding it, picking it up, and hiding it. For convenience, it forgets where the ball is hidden and repeats the finding/hiding behavior. Superimposed are higher priority behaviors that help CURI avoid obstacles and deal with other real-world situations. For example, if CURI hears a loud noise, it suspends the ball finding/hiding behavior and attempts to hide itself in a dark corner. After a period of silence, the original behavior resumes. All this hardware and software was about to meet its first simple, but practical test.

I recalled that about six months ago, I wrote a very sensitive motion detection program that worked with the camera onboard CURI. In 30 minutes, CURI's behavioral software was reprogrammed to move one of her gripper arms when it detected any movement. I suspended the lid of a cardboard box above the hole by a thin thread and wound it several times around a makeshift pulley. I then led the thread to CURI, which was positioned on the floor about three feet away from the hole where CURI's camera was aimed at the third dish of food. I placed CURI so that its gripper would release the spool of thread which lowered the trap door. After several trial runs and fine tuning, the trap was set! We turned off the lights and went to bed.

As I fell asleep thinking about CURI doing battle with the cat, (CURI's behavioral software telling her to move anytime the cat did), a

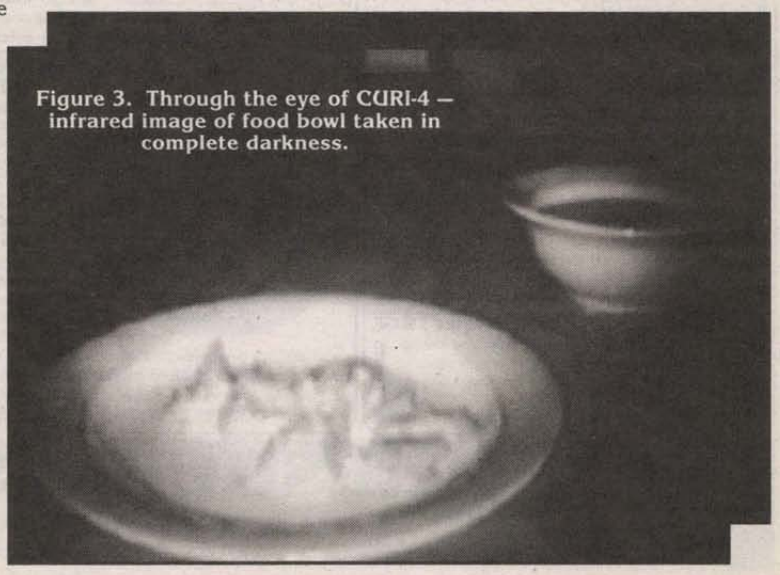

Figure 3. Through the eye of CURI-4 — infrared image of food bowl taken in complete darkness.

horrible thought struck me. "Hang on ... cats eat little moving things!" However, I was confident that the cat would take one look at the robot and laugh (in a cat sort of way).

Thud!! Two A.M. Amanda wakes me up and we found a vase lying on the carpet. The cat was out. I rushed to see if CURI survived the fight. CURI was sitting there, spool knocked over and trap door shut!!! I could see that CURI was happy to see me because it was moving its gripper back and forth.

"It worked!!" I shouted as Amanda pointed out that the cat was still somewhere in the house. I put a couple of paperback books over the hole and we went to the cat's favorite resting place (when it was not in the hole). Again, the chase was on. The cat did not hesitate this time, 10 seconds later it was dashing for the hole in the kitchen. We were both shocked when we saw the cat struggle with the books and manage to push them out of the way and slip back in the hole. Arrrrrggghhhh!!! CURI just sat there waving at us.

We decided to just wait until morning to see if the cat would come out. We put more food out, but by now the cat had more food in it than our fridge. By 7 A.M., no more food was touched and we resolved to drill a hole in the cupboard. Five minutes later Amanda reached in the new hole with thick gloves and the cat ran out through the little hole. We now placed heavy pots and pans and books and anything else not bolted to the floor over both holes. We found the cat again and with all the doors opened, it finally was last seen scrambling across the green lawn outside. Hopefully heading for another kitchen.

I guess the moral of the story is, a robot can be programmed to do something useful, but you can't teach a cat to eat hot dogs!

If you prefer fully-autonomous robots over tethered robots, check out my previous project: CURI-3 developed in 1994 for the University of New South Wales Artificial Intelligence Lab in Sydney Australia. CURI-3 is a fully autonomous mobile robot with a built-in IBM PC and stereo cameras. Currently it is being used for a number of research projects. **NV**

For further details about the cat or any of my robots, please visit my web page:

http://www.geocities.com/SiliconValley/Lakes/7156

or E-Mail me at: gkd@rtassoc.com

Events CALENDAR

Continued from page 27

County Fairgrounds, Hwy. 11 S. 8am-3pm. Doug Burt W4OFO, 252-524-5724
NJ - TRENTON - Hamfest. Delaware Valley Radio Assn., Darryl Foyuth N2JVP, 609-882-2240 E-Mail: n2jvp@amsat.org
OH - MAUMEE - Hamfest. Lucas County Recreation Center, 2901 Key St. 8am-2pm. Talk-in: 147.27+ or 442.85+. Toledo Mobile Radio Assn., Paul Hanslik N8XDB, 419-243-3836. Web: http://www.tmrahamradio.org
WV - CHARLESTON - Hamfest. Charleston Area Hamfest & Computer Show, Jimmie Hewlett WD8MKS, 304-768-1143

MARCH 27

CT - WATERFORD - Auction. Waterford Senior Center, Rt. 85. Talk-in: 146.730-. RAS of Norwich, Tony Griggs AA1JN, 860-859-0162. Web: www.ims.uconn.edu/~rason

MARCH 27-28

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

MARCH 28

CA - SANTA ANA - Swapmeet. ACP parking lot. Mary Russo 714-558-8813
OH - MADISON - Hamfest. Lake County ARA, Roxanne, 440-256-0320

APRIL 1999

APRIL 2-3

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

APRIL 3

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

APRIL 9-10-11

CA - FRESNO - Int'l DX Convention. Gordon Girton W6NW. E-Mail: gordon@svpal.org E-Mail: w6nw@amateur-radio.org Web: http://www.amateur-radio.org/ncdxc.org

APRIL 10

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves
MN - ROCHESTER - Hamfest. Rochester ARC, John Scott N0HZN, 507-285-6522. E-Mail: n0hzn@aol.com Web: http://members.aol.com/rarchams/
NC - MORGANTON - Hamfest & Computer Fair. Burke County Fairgrounds, Hwy. 181N (Exit 100 Eastbound, Exit 105 Westbound I-40). 8am-5pm. Talk-in: 147.15 (K4VLY repeater). Catawba Valley, Tom Tayler, 704-433-6205. E-Mail: kc4qpr@vistatech.net
WA - SPOKANE - Hamfest. Lilac City ARC, Warren Kelsey KJ7BB, 509-534-8443

APRIL 11

NC - RALEIGH - RARSFest. State Fairgrounds. Raleigh ARS, Wilbur Goss WD4RDT, 919-266-9883. E-Mail: k4hf@juno.com
WI - MADISON - Hamfest. Madison Area Repeater Assn., Paul Toussaint N9VWH, 608-245-8890. E-Mail: n9vwh@hotmail.com

APRIL 17

AL - ALBERTVILLE - Hamfest. Marshall County ARC, Buddy Smith KC4URL, 256-593-2516. E-Mail: kc4url@airnet.net
CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
ID - IDAHO FALLS - Hamfest. Eastern Idaho UHF Society, Jay Greenburg WA4VRV, 208-524-1388. E-Mail: wa4vrv@srv.net Web: http://www.srv.net/~wa4vrv/hamfest.htm
KY - MURRAY - Hamfest. Murray State University ARC, Pat Compton KF4FMZ, 502-762-6433. E-Mail: patrick.compton@murraystate.edu Web: http://mursuky.edu/clubs/msuarc/hamfest.htm
MO - JOPLIN - Hamfest. Joplin ARC, Ray Brown KB0STN, 417-781-4967. E-Mail: raybrown@ipa.net Web: http://www.joplin-arc.org

APRIL 18

CT - HARTFORD - 1999 Trinity College Fire-Fighting Home Robot Contest. Trinity College campus. Jake Mendelssohn, 190 Mohegan Dr., West Hartford, CT 06117. E-Mail: JMENDEL141@AOL.COM Web: http://www.trincoll.edu/~robot
MA - CAMBRIDGE - Flea Market. Kendall Square area. MIT. Nick Alternbernd KA1MQX, 617-253-3776. Web: http://web.mit.edu/w1mx/www/swapfest.html
PA - MONROEVILLE - Hamfest. Two Rivers ARC, Michael Kowalcheck, Jr. KV3L, 412-751-9657

APRIL 23-24

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

APRIL 24

IA - DES MOINES - Hamfest. Des Moines RAA, Duane Bower WB0UCY, 515-287-6542
NJ - HARMONY - Hamfest. Warren County Farmers Fairgrounds, Rt. 519 N. 8am-2pm. VE Exams. Talk-in: 147.375+ 146.730-. Cherryville RA II, Inc., Randy Vance N2MQZ, 908-788-4080 or 908-454-4370. E-Mail: n2mqz@aol.com
VA - CHESAPEAKE - Hamfest. Chesapeake AR Service, Jim Cannon KF4RQQ, 757-382-0193
WA - VANCOUVER - Hamfest. Clark County ARC, Luther Brisky KC7KVL, 360-896-8909 or 360-254-5082. E-Mail: lwayne@e-z.net Web: http://www.w7aia.org

APRIL 25

FL - GAINESVILLE - Hamfest. Gainesville ARS, H. Walter Johnston W4TKE. E-Mail: w4tke@juno.com E-Mail: w4tke@gator.net
IL - ARTHUR - Hamfest. Moultrie ARK, Ralph Zancha WC9V, 217-873-5287 or 217-543-2178. E-Mail: rzancha@one-eleven.net Web: http://home.stlnet.com/~jhudsonl/hamfest.html
OH - ATHENS - Hamfest. Athens County ARA, Drew McDaniel W8MHV, 740-592-2106. E-Mail: dmcdaniell@ohiou.edu

MAY 1999

MAY 1

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
TN - NASHVILLE - Hamfest. Nashville ARC, Bob Malone WB5ZDS, 615-865-6225
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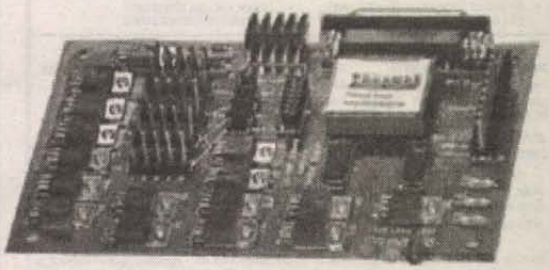

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by Gordon West

... Radio equipment and accessory after-use reviews, not influenced by advertiser clout ...

Ham radio and scanner magazines carefully monitor incoming reviews of their advertiser's products. After all, a bad review will probably lead to a terminated ad.

And then there are the "totally objective" reviews conducted on the bench with published results based only on measurements taken off an oscilloscope or digital voltmeter. While technically accurate, test equipment results don't necessarily prove out a product when it gets put into use out there in the real world of intermod, voltage fluctuations, accidental drops, and extra amounts of knob-twisting and button-pushing by most of us who like to play with the equipment long before reading the instruction manual.

The following reviews cover equipment that was either purchased or loaned to us by Radio School students who purchased them at ham-fests or at radio stores. Some of these little items are truly trick — dropping precisely in the category "I wish I had thought of that myself!"

PICK-UM-UP TRUCK MOUNT

If you have a big pick-up, and if you're looking for a way to mount a monster ham or CB antenna on it, you might forget about the old traditional ball mount that puts three big holes in the rear pick-um-up panel. And today's pick-up trucks have lighter weight "skin," so the old ball mount just won't do the trick.

If your pick-up has stake bed holes on the rail, it will accommodate a unique antenna mount called "Geo Tool."

The mount and coax cable connection plate slip down inside the rack mounting holes on the pick-up. We noted that there seems to be no standard for how big these holes should be, so Geo Tool Company also offers shim kits to fit most USA and import pick-up mounting holes. The hole should accommodate a 1.96" x 1.60" x 6.25" Geo Tool mount. We found that some rack-mounting pick-up holes are tapered, so you may need to go to the rear two holes that are normally not tapered.

We found that most pick-up trucks have double-wall construction that makes it almost impossible for the Geo Tool to fit in the forward holes. Actually, this is good because it forces you to mount your antenna as far away from the engine as possible for best reception. On the rear holes, you can get to the inside of the double-wall by removing the rear taillight assembly.

But before you go dropping this mount in the hole, you'll need to score some RG8X (Mini 8) coax cable that needs to thread up the bottom chassis bolt (yup, it has a hole in it) up the bottom two holes of the mount, and out the upper cavity of the mount where you do your solder job on the two supplied lugs. Make absolutely sure your finished solder work is completely covered with waterproof Coax Seal™, available at most radio stores, manufactured by Universal Radio in Ohio.

Then assemble the 3/8 x 24 x 1.75 antenna receiver with all of the supplied nylon insulating washers and the 1-1/2 inch bolts. Make absolutely sure you get the insulating washers correct — the idea is to keep the bolt from sliding over and shorting out to the grounded mount sides.

THE GEOTOOL PICK-UP TRUCK ANTENNA MOUNT WITH DETAILED INSTRUCTIONS.

Double-check that everything is in place, and make sure the drilled bottom bolt is on the bottom side of the floor on where you plan to drop the mount into. It's best to study the supplied paperwork to make sure everything is exactly where it needs to be before you drop the mount into the stake pockets.

Hopefully, everything goes together smoothly with the mount fitting snugly in the stake hole. You may need to shim it, or you may need to shave it for a perfect fit. The inventor (a ham radio operator) has an E-Mail site so you can contact him for more specific instructions.

Once everything is in place, Geo Tool can now handle any kind of monster HF whip antenna that has a 3/8 x 24 base thread — you know, the common thread on most HF ham radio or CB radio mobile antennas.

"I'm glad to see this accessory come along — getting a big antenna on a pick-up truck has always been a problem because ball mounts are no longer the answer," comments Jim Ford N6JF, a happy user of Geo Tool.

They have several different types of mounts to fit different types of pick-up trucks, so look them up at Geo Tool's web page: http://www.geotool.com, or ask for Rick at 949-759-3166 in Newport Beach, CA. The whole set up runs under $50.00, and he claims that the mount will fit almost any type of pick-up; and if it won't, he gives

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COST-EFFECTIVE IAMBIC KEY

I love my Bencher paddle. It's nice and heavy so it won't scoot around the operating table, and it looks impressive by its exotic springs-and-things construction. Any good ham CB operator runs the Bencher paddles.

But for a day out on the road where you don't want to take along a heavy paddle to go along with your memory keyer or rig with a built-in automatic keyer circuit, for under $20.00 you will marvel at the K9LU micro iambic key, made up of brass buttons and what-appears-to-be office supply clip. It's all mounted on a nice piece of wood with suction cups and 30-inch pre-wired cable with 3.5mm plug.

When we tried it out, we were amazed that the feel of the key was superb. To increase or decrease the spacing between the contact points, you give a little finger pressure at the appropriate spot as detailed in the brief instructions. Same thing with tension — a little finger pressure gets you just the right feel for this unique CW sending set-up.

I'm going to order a couple more to give my CW buddies a gift that they have never seen before! The thing is darn-right cute, and works swell. They also have a memory keyer that goes along with the iambic key, too.

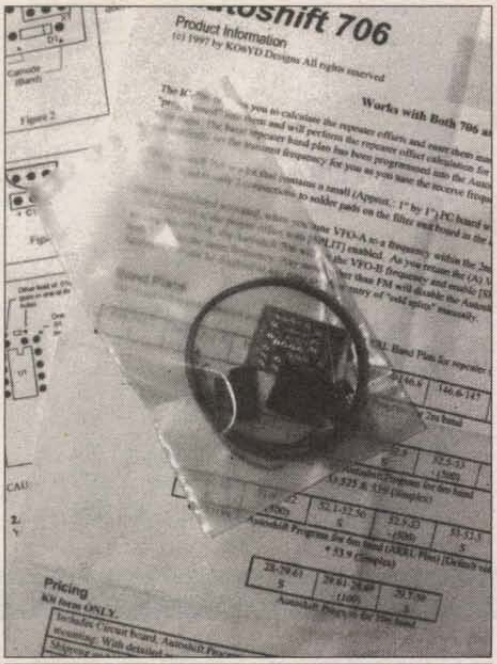
Look at it on the web at http://www.qth.com/k9lu, or phone them for a brochure at 630-443-8822 in St. Charles, IL. The electronic memory keyer is put together by W9XT, and the little paddle set from Louis Petkus K9LU. The key runs under $20.00; and if you want to do your own with the parts they supply, it's only $10.00! The memory keyer runs around $80.00. Look them up on the web. A terrific gift item, even though the holidays are over.

ICOM 706 AUTOSHIFT

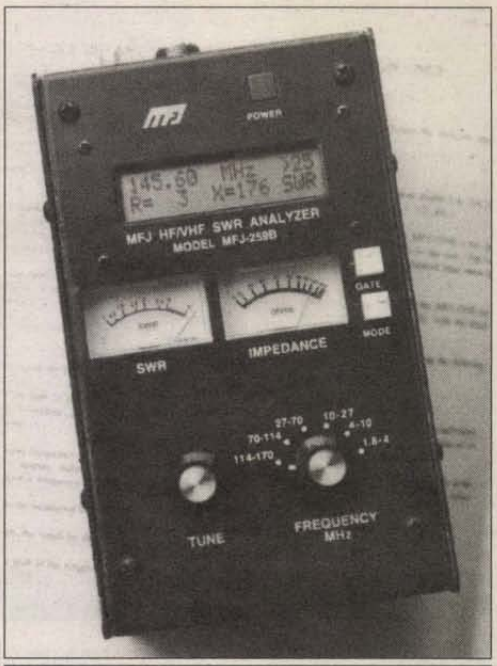
I see that the new ICOM IC-706G with the added 440 capability now includes automatic offset for the VHF and UHF bands. Thank goodness. With any ICOM IC706 Mark I or Mark II transceiver, two-meter repeater operation always requires several keystrokes to program-in the appropriate minus or plus offset. When it comes to a plus offset, it takes some extra steps to get your transmitter 600 KHz above RX as opposed to the easier minus 600 KHz. These extra keystrokes make it almost impossible to program two-meter repeaters when driving down the street.

The Autoshift 706, designed by KO6YD, will automatically set the VFO-B to the proper offset with split enabled on two meters, six meters, and even the FM repeaters on 10 meters. As you tune around with VFO-A, the split will be disabled. When you stop tuning, VFO-A will be the repeater output receive frequency, and VFO-B automatically enables split and automatically selects the offset through the ARRL band plan. And since there are several different six-meter band plans, there is a jumper that allows you to roll your own.

When you next tune to a simplex frequency, such as 146.520 MHz, the Autoshift 706 now puts both VFOs onto the same frequency. And you can still disable the autoshift in case you want to work VFO-A and -B on a repeater odd split.



THE AUTOSHIFT 706 WORKS WITH THE ICOM 706 MARK I AND MARK II. IT ASSEMBLES IN LESS THAN AN HOUR AND WIRES IN LESS THAN 10 MINUTES!



THE MFJ SWR ANALYZER COMES IN MANY VARIETIES, FROM $99.00 TO $259.00.

This is a kit project. But don't panic — the KO6YD designed board has all components labeled on the board, and it took one of our students only about 20 minutes to drop in the handful of components. We liked the idea of the chip socket to provide for easy installation of the Autoshift processor. "It will also allow future enhancements to be made by replacement of the processor chip," comments KO6YD Designs. "But we caution everyone to remember that the Autoshift processor is sensitive to static electricity, so please take precautions to avoid a static discharge when handling the chip."

Installing the Autoshift inside the IC-706 is a simple three-wire connection. One wire goes to +8 to +15 VDC, one wire to ground, and one wire to the CI-V data connection. The actual board is mounted in the area just to the left of the optional filter modules in the front-left of the radio.

Once we got our 706 up and running with Autoshift, getting onto repeaters was a snap. Putting them into memory was also a snap. Just be sure to remember that on the IC-706 Mark II, you must drop the tone into VFO-B to encode CTCSS for proper operation. If you are a Mark II owner and you can't seem to bring up certain repeaters, chances are you probably have

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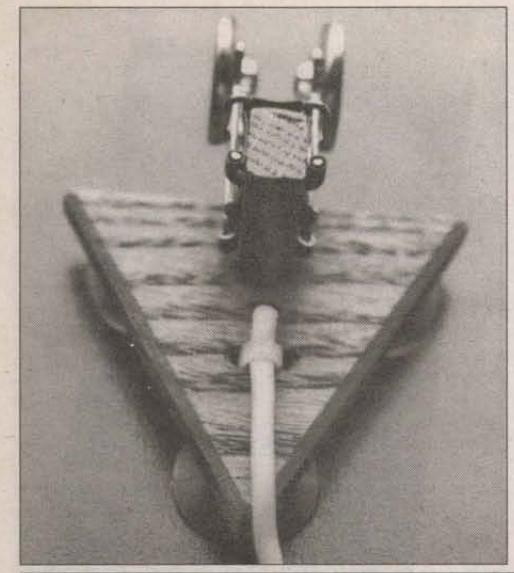

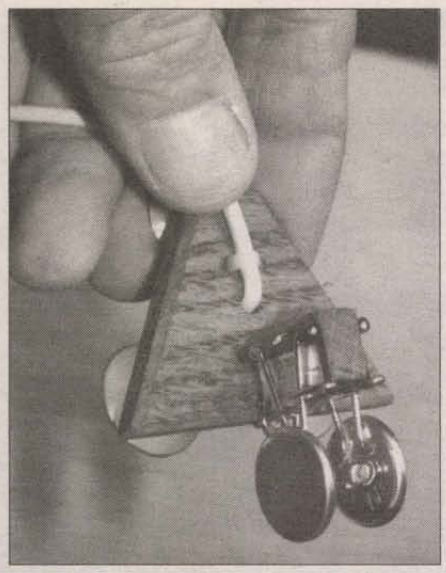

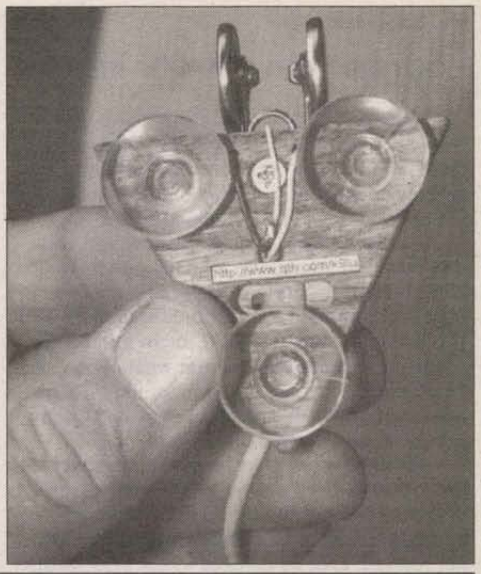

THE MICROPADDLE WORKS GREAT! A PERFECT GIFT, EVEN AFTER THE HOLIDAYS ...

encode on VFO-A, instead of where it should be on VFO-B. Check it out.

The Autoshift 706 comes with detailed assembly and operating instructions, and it is available for under $35.00. You can look it up on the web at www.jps.net/k06yd, or phone KO6YD Designs at 916-728-4539 in Elverta, CA.

THE MINDS AT MFJ

The company name MFJ stands for the initials of Martin F. Jue K5FLU, MFJ's president since the company started in 1977. MFJ offers hams, scanner enthusiasts, radio-computer folks, and shortwave listeners over 1,000 products, gadgets, and accessories. MFJ is also Ameritron — the linear amplifier people on HF — and Mirage — the VFH and UHF power amplifiers. They are also Vectronics — kits and finished radio equipment and accessories for the more technical radio enthusiast.

I am convinced that MFJ must allocate one day a month just for brainstorming. I can see a board room filled with half their active radio employees coming up with ideas on new products or figuring out ways to make what's already out there in the radio place more-trick and more-affordable.

The MFJ product line has matured, too. They continue to upgrade their production lines to insure all equipment going out is indeed tuned, tested, and "hot" out of the box. Richard Stubbs KC5NSZ, MFJ's customer service manager and active ham operator, backs up his claims of total customer satisfaction by being readily available on an 800 number without having to go through any arduous voice-mail keystrokes. I tried the 1-800-647-1800, and I got right through on the first ring!

The products I tried out were their new two-meter FM analyzer (MFJ-224), their new MFJ HF/VHF SWR analyzer (MFJ-259B), and their brand new 45-amp switching power supply (MFJ-4245MV).

Starting with the switcher power supply, my big interest was whether or not it was noisy on HF and VHF frequencies. It was quiet. In fact, so quiet that you could easily listen to an AM radio station with a little portable radio inside the shack without the switcher power supply tearing things up. And I tested the switcher at full idle, as well as powering a big marine SSB with 30 amps draw.

The 45-amp switcher weighs only 5.5 pounds, making it ideal to take along into the classroom to run all sorts of ham equipment. We also tested it for shutdown in the presence of a strong RF signal — no problem. With other transformer-type power supplies, many would actually cycle off in the presence of a strong RF source. The switcher did not.

The MFJ switcher power supply lets you vary the voltage from 9 volts to 15 volts DC. Sorry, nothing below 9. Nice three-inch meters are backlit to make it easy to monitor both your voltage, as well as load currents. A built-in fan turns on when the power supply is switched on, and runs relatively quiet.

We would have liked to have seen larger red and black binding posts for the 45-amp version of the power supply. If you're going to be running this kind of current, the red and black binding posts are tough to get the wire around unless you use lugs. But other than that, the switcher is doing just fine in the classroom.

The SWR analyzer, Model 259B, is the granddaddy of all MFJ SWR analyzers. Besides testing an antenna for minimum SWR, it can also indicate impedance, reactance, resistance, bandwidth, and resonant frequency. And if you're into doing your own antenna tuners, it puts out about 20 milliwatts which is more than enough power to tweak your output and input matching networks, along with chokes, suppressors, traps, and other tuned circuits. The output is also strong enough to let you put a signal out on the air to

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adjust your receiver and antenna tuner on receive for maximum input.

I liked running the receiver on a specific frequency, and then listening for the SWR analyzer as I would zero in on the operating frequency without having to look over at the LCD readout. I suppose this is also a good check for a receiver that is either good or blown.

The MFJ 259B also has more advanced features for hams "rolling their own" to check the resonant frequency and approximate "Q" of traps and tuned circuits, plus the value and self-resonant frequencies of small capacitors.

You could also measure coax loss by hooking into the 50-ohm cable with the opposite end of the coax having an open circuit, or a short circuit, or a pure reactance. You can also calculate impedance, return loss and reflection coefficient, distance to coax fault, resonance, and efficiency. These are covered in the "advanced operation" portions of the instruction manual; and if you regularly work on antenna projects, this meter may be the one for you.

But did you know that MFJ also makes HF, as well as VHF SWR analyzers for UNDER $100.00? They don't have the digital readout, but they work dandy in sweeping the band or bands, and indicating where the dip of SWR is found. To spot the exact frequency, simply dial around with your radio hooked up to a short piece of wire, and "spot" where the meter is indicating. The tuning dial is rather coarse, but your simple receiver can spot you right down to the Kilohertz.

We also tested the new two-meter FM analyzer. This battery-operated receiver tunes from 143.5 to 148.5 and monitors many important signal parameters found on the two-meter band. If you just want to use it as a VFO receiver, plug in a set of headphones and tune around.

Where there is a lot of two-meter activity, tune around SLOWLY. We found the big capacitor tuning circuit relatively sensitive and properly locking into a signal required the dexterity of a watchmaker. This is especially true if the weak signal you are trying to tune in is right beside a strong signal. In fact, in trying to pull out weak signals from strong signals, tune with the FM analyzer in the discriminator mode, and go for ZERO on the large front panel meter.

You can also check for field strength in dBm, as well as FM deviation in Kilohertz. But do this after you have dialed in the appropriate two-meter signal with zero offset on the discriminator.

You can also plug into the oscilloscope output to look at modulation waveforms and to measure instantaneously peak deviation.

So besides being a fun little dual-conversion, two-meter VFO-type receiver with adequate sensitivity, it's also a handy test set for working on two-meter mobile and handheld equipment.

For off-air monitoring, signal strength is calibrated in dBm, not S-units. Calibration of the scale in dBm is convenient because it allows comparisons of signal differences directly in dB. Here is how they convert dBm to sensitivity in microvolts:

Power in dBm	Microvolts
-100	3
-90	10
-80	30
-70	100
-60	300
-50	1,000
-40	3,000

We found the dBm calibration as good, but not necessarily spot-on. They tell you how to calibrate using professional equipment and adjusting the calibration trimpots back and forth until you get a good linear readout. As it came from the factory, we were close — but not quite right-on.

When we started tuning around the two-meter band with a set of headphones, we noticed that repeaters between 147 MHz to 148 MHz were not reading out near as close on the big tuning dial as simplex and repeater frequencies at the bottom of the two-meter band. In consulting the manual, we could adjust the frequency calibration for the entire band, but there was no way to easily recalibrate or spot-on the 4 MHz frequency points on two meters.

Radio School associate-instructor Jim Ford N6JF, wires in a three picofarad capacitor between one pin of the integrated circuit and the active leg of the variable capacitor, and then adjusts between two and three picofarads in order to expand the 144 to 148 MHz range to completely fill up the dial as indicated. Once the cap is in place, you will also need to re-adjust the tuning calibration coil to get back to 146 MHz in the center of the band. From there on, it's a slight tweak of the new added cap to electronically pull out the band edges until your FM signal analyzer is right on the nose.

FIRST, CALCULATE FREQUENCY ERROR AT EACH END OF THE TWO-METER BAND.

This is a handy piece of equipment for working on any piece of two-meter equipment, and we found the rest of the calibration right up to spec.

If you haven't seen the latest MFJ catalog, get on the web and go to www.mfjenterprises.com, or call them at 601-323-5869 and order one in for your review. We think that MFJ offers extraordinary value for their low-priced products, and any small amount of time in a slight retweaking of their product will certainly "tune you in" to all that goes on in the insides.

I can't think of any company that has contributed as much to happy radio as MFJ, and most recently all of their test equipment has certainly contributed to technicians working on their own and wanting the best equipment available for the buck. **NV**

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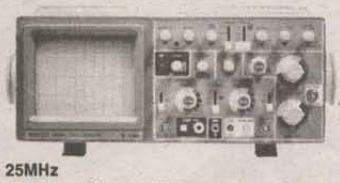

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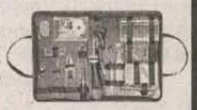

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PIC-Based Data Acquisition System Characterizes LASER Diodes

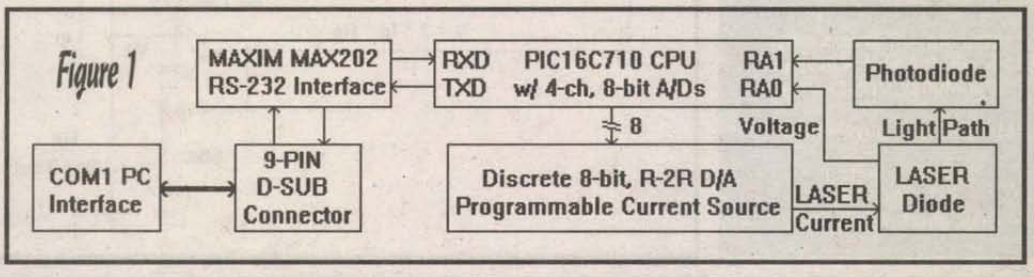
by Lawrence Foltzer

With the huge success of CD-ROM technology, semiconductor diode lasers have become readily available and inexpensive. But now a new, more exciting semiconductor laser has become available – the Vertical Cavity Surface Emitting Laser (VCSEL).

The VCSEL offers many advantages over its planar Fabry-Perot cavity cousin ... two of which are its low threshold current and total operating current requirements. However, having plotted numerous laser device characteristics manually, point-by-point, to determine the optimum bias and modulation levels, I decided it was finally time to automate the task.

What I needed was a simple data acquisition system that would interface to the PC for number crunching, and provide both hard and soft copy capability, and ... it had to be easy to build so as not to

Figure 1



LISTING 1

```
REM date: 10-13-98
REM QuickBasic 4.5 version
REM Plots LASER P vs I, Vf vs I
REM and Rs vs I (needs work)
REM creates bit mapped file of screen display
CLOSE : REM can't be too careful

REM vertical voltage scale fixed at 0.2 volts/div
REM then we scale power plot to match that grid and desired power/div
REM there are 13 intervals, and 14 horizontal lines
REM 480/13=36+, use 35. 256/13=19+, use 20, so scale factor is 35/20=1.75
REM so, Vplot%=ymax&-ymax&*(255-Vf)/128

Xoffset% = 100: Yoffset% = 100
z% = 40
REM the following values could be switch selectable,
REM in which case you would query for values before starting run
Rd! = 100: REM value of current source resistor
Rp! = 2500: REM value of detector current sampling resistor
IDmax! = 2500 / Rd!: REM IDmax in milliamperes
dId! = 2.5 / (255 * Rd!): REM 98ua per step for Rd! = 100
IPmax! = 2500 / Rp!: REM IPmax in milliamperes

SCREEN 12: CLS
xmax& = 639: ymax& = 479: REM screen 11/12 size
xs! = xmax& / 255: ys! = ymax& / 255: REM x & y scale factors

INPUT "Enter .bmp file_name to create: ", b$
bmpfile$ = b$ + ".bmp"

INPUT "Enter source wavelength (um): ", l!
REM L! = .85
INPUT "Enter detector quantum efficiency (0-1): ", QE!
REM QE! = .6 @ .85um for BP104
PRINT "Enter drive current scan range as a % of"; IDmax!; " ma.";
INPUT IDrange!
REM IDrange! = 60 => 15ma
Max% = 255 * IDrange! / 100
INPUT "Enter vertical scale increment (uw/div): ", dP!
INPUT "Enter horizontal scale increment (ma/div): ", dI!
INPUT "Enter number of scans desired: ", s%
Pmax! = 1240.7 * IPmax! / (l! * QE!)
REM Pmax! is full-scale reading in milliwatts
dPdD! = Pmax! / 256: M! = dPdD! / dP!

DIM Vf!(Max% + 4), P!(Max% + 4), Vave!(Max% + 1), Pave!(Max% + 1)
FOR t% = 1 TO Max%: Vave!(t) = 0: Pave!(t) = 0: NEXT t%

GOSUB makegrid

xz% = 0: vz% = ymax&: pz% = ymax&
Vf!(0) = 0: P!(0) = 0: Vave!(0) = 0: Pave!(0) = 0

REM open com port to talk to PIC plotter
portnum% = &H2E8: REM for 386 system, &h3f8 for pentium
OPEN "COM2:2400,N,8,2,BIN,CD0,CS0,DS0,OP0,RS,TB48,RB48" FOR RANDOM AS #1

FOR samples% = 1 TO s%

cont:
REM we do interlaced scan for faster (apparent) graphics

REM make it odd on way up
FOR d% = 1 TO Max% STEP 2
GOSUB retrieve
Vave!(d%) = Vave!(d%) + Vf!(d%)
Pave!(d%) = Pave!(d%) + P!(d%)
NEXT d%

REM now we sweep down
e% = d% - 1: REM make it even on way down
FOR d% = e% TO 2 STEP -2
GOSUB retrieve
Vave!(d%) = Vave!(d%) + Vf!(d%)
Pave!(d%) = Pave!(d%) + P!(d%)
NEXT d%

NEXT samples%

CLOSE

GOSUB makegrid

REM now we compute and display averages on screen
FOR d% = 1 TO Max%
Vave!(d%) = (Vave!(d%) / s%): REM AND &HFF
Pave!(d%) = (Pave!(d%) / s%): REM AND &HFF
NEXT d%

FOR d% = 2 TO Max%
REM Vf vs I
LINE (xs! * (d% - 1), 479 - 35 * 5 * 2.5 * Vave!(d% - 1) / 128)-(xs! * d%, 479 - 35 * 5 * 2.5 * Vave!(d%) / 128)
REM P vs I
LINE (xs! * (d% - 1), ymax& - 35 * Pmax! * Pave!(d% - 1) / (256 * dP!))-(xs! * d%, ymax& - 35 * Pmax! * Pave!(d%) / (256 * dP!))
REM dRs vs I
REM dVf! = (Vave!(d%) - Vave!(d% - 1)) * (5 / 255)
REM printout dynamic series resistance
REM dRs! = (dVf! / dId!)
REM LOCATE 5, 40: PRINT dRs!
NEXT d%

CLOSE
REM END

REM part 1 initialize monochrome .bmp file structure
RESTORE: c% = &HFF: M% = &H80: REM M is bit plot mask
a& = 1
DATA &H42, &H4D, &H9E, &HEA, 0, 0, 0, 0, 0, 0, &H3E, 0, 0, 0, &H28, 0
DATA 0, 0, &H20, 3, 0, 0, &H58, 2, 0, 0, 1, 0, 1, 0, 0, 0
DATA 0, 0, &H60, &HEA, 0, 0, &HCE, &HE, 0, 0, &HD8, &HE, 0, 0, 0, 0
DATA 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 255, 255, 255, 0, 255, 255, &H5A
OPEN bmpfile$ FOR BINARY AS #1
```

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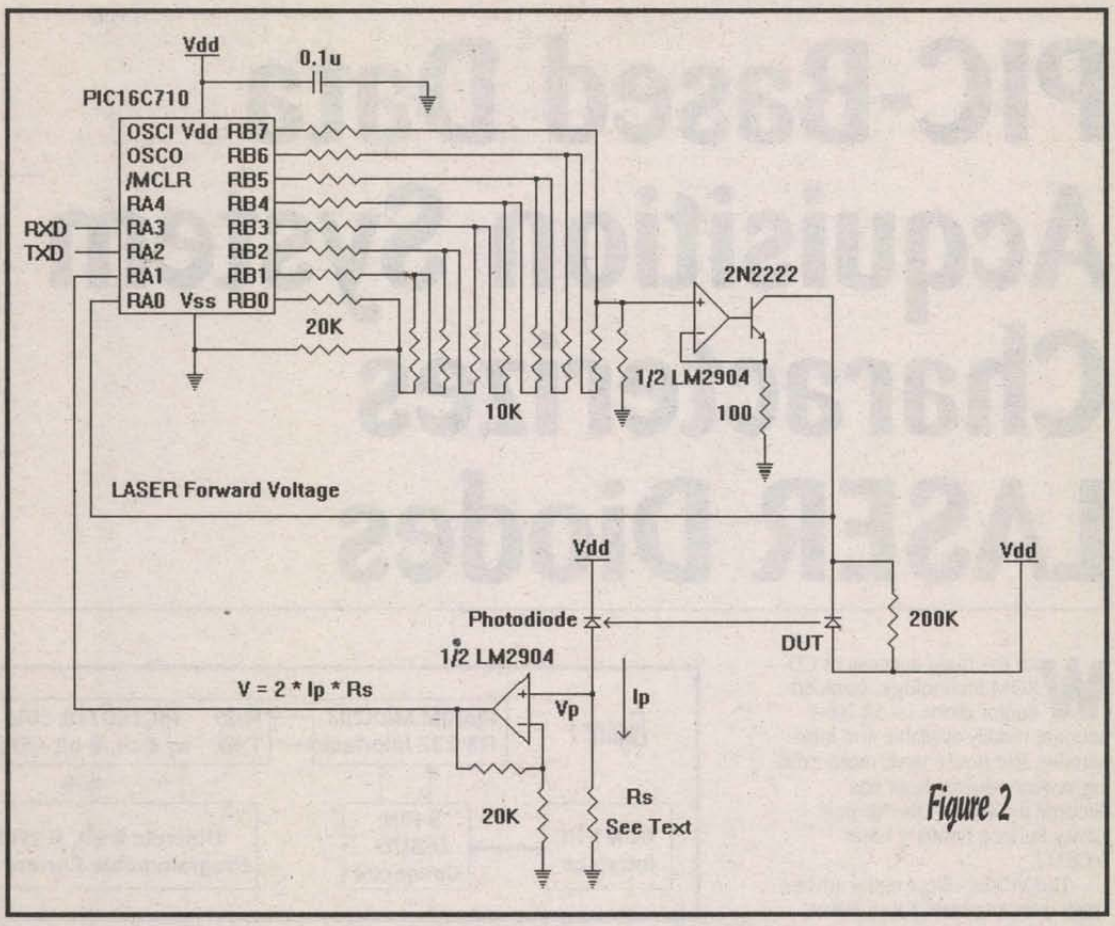


Figure 2

```
header:
READ d%
IF d% = &H5A THEN GOTO clearbody
PUT #1, a&, d%: a& = a& + 1
GOTO header

clearbody:
a& = a& + 1
IF a& >= 60063 THEN GOTO done
PUT #1, a&, c%
GOTO clearbody

done:
REM draw vertical drive current reference lines
inc% = 255 / (IDmax! / dI!)
FOR X% = 0 TO 255 STEP inc%
FOR y% = 1 TO 255
GOSUB drawBMP
NEXT y%
NEXT X%
REM draw horizontal dP reference lines
inc% = 20
FOR y% = 0 TO 255 STEP inc%
FOR X% = 1 TO 255
GOSUB drawBMP
NEXT X%
NEXT y%

REM reads averages and converts to bmpfile$.bmp
d% = 1
DO
X% = d% - 1
halfY& = (Vave!(d%) - Vave!(d% - 1)) / 2
FOR y% = 2 * Vave!(d% - 1) TO 2 * (Vave!(d% - 1) + halfY&)
GOSUB drawBMP
NEXT y%
X% = d%
FOR y% = 2 * (Vave!(d%) - halfY&) TO 2 * Vave!(d%)
GOSUB drawBMP
NEXT y%

X% = d% - 1
halfY& = (Pave!(d%) - Pave!(d% - 1)) / 2
FOR y% = 20 * Pmax! * Pave!(d% - 1) / (255 * dP!) TO 20 * Pmax! * (Pave!(d% - 1) + halfY&) / (255
* dP!)
GOSUB drawBMP
NEXT y%
X% = d%
FOR y% = 20 * Pmax! * (Pave!(d%) - halfY&) / (255 * dP!) TO 20 * Pmax! * Pave!(d%) / (255 * dP!)
GOSUB drawBMP
NEXT y%

d% = d% + 1
LOOP UNTIL d% = Max%

CLOSE #1
END

retrieve:
REM is interface to PIC plotter
REM now send redundant drive current command
FOR t = 1 TO 100: NEXT t
OUT portnum%, d%: REM d%
again:
FOR t& = 1 TO 1000: NEXT t&
OUT portnum%, d%: REM d%

t = 0
pool:
IF (t = 1000) AND (INP(portnum%) <> d%) THEN
GOTO again
END IF

IF INP(portnum%) <> d% THEN
t = t + 1
GOTO pool
END IF

FOR t = 1 TO 370: NEXT t: REM limits are 480 and 260, 370 nom
REM so, Vplot%=13*35*(1-(255-Vf)/128
X% = d% * xs!
Vf!(d%) = 255 - INP(portnum%)
temp% = 479 - 35 * 5 * 2.5 * (Vf!(d%) / 128): REM prep for screen plotting
LINE (xz%, vz%)-(X%, temp%)
vz% = temp%: REM make ready for next line segment

FOR t = 1 TO 200: NEXT t: REM 130 is minimum
P!(d%) = INP(portnum%)
temp% = ymax& - 35 * P!(d%) * Pmax! / (256 * dP!): REM prep for screen plotting
LINE (xz%, pz%)-(X%, temp%)
pz% = temp%: xz% = X%: REM make ready for next line segment
RETURN

drawBMP:
REM 1st byte location is &H3E(62), corresponding to
REM the lower-left corner of the display
REM there are 100 bytes (800 pixels) per line, last byte of line 1 is &HA1
REM next line starts at &HA2
REM top-left byte address is &HEA3A, top-right byte address is &HEA9D
REM See notebook #4, page 145
REM However, we use 865 as offset to get plot off floor and edge of map
a& = (100 * (Yoffset& + y%)) + 865 + INT((Xoffset& + X%) / 8)
REM is computer byte address of pixel
REM N is bit position to set
Bit% = M%
Position% = (Xoffset& + X%) - 8 * INT((Xoffset& + X%) / 8)
back:
LOCATE 2, 2
REM PRINT Position%
IF Position% = 0 THEN GOTO fini
Bit% = Bit% / 2: Position% = Position% - 1
GOTO back
fini:
```

get distracted from the task at hand.

The Hardware

I selected the Microchip PIC16C710 microcontroller for the project since it is inexpensive, readily available, and contained the number of A/D converter channels I needed. Figure 1 shows a block diagram of the PIC-based data acquisition system hardware. The hardware functions as a smart peripheral, responding to a single command issued from a host IBM PC via an RS-232 serial port. A QUICK BASIC program running on the PC performs all the number crunching, screen display tasks, and generates a bit-mapped plot file of the laser parameters that can be appropriately annotated using Microsoft Paint as required to document the measurements.

The CPU and A/D converters shown in Figure 1 are contained within the Microchip PIC16C710 microcontroller. The system uses two of the CPU's four eight-bit A/D channels. One A/D channel (RA0) monitors the LASER diode's forward voltage drop, relative to the "regulated" five-volt supply rail. The second A/D channel (RA1) monitors the photocurrent signal from the

```
PRINT Position%
Bit% = Bit% XOR &HFFFF
GET #1, a&, Q%
Bit% = Bit% AND Q%
PUT #1, a&, Bit%
RETURN

makegrid:
CLS
REM draw vertical grid lines
inc% = dI! * xmax& / IDmax!
FOR X% = 0 TO xmax& STEP inc%
LINE (X%, 0)-(X%, ymax&), , , &H1010
NEXT X%
REM draw horizontal grid lines
REM so, Vplot%=13*35*(1-(255-Vf)/128
y& = 0: inc& = 35
FOR H% = 0 TO 13
LINE (0, ymax& - y&)-(xmax&, ymax& - y&), , , &H2020
y& = y& + inc&
NEXT H%
LOCATE 14, 50: PRINT .2; "volts/div"
LOCATE 16, 50: PRINT dP!; "microwatts/div"
LOCATE 28, 50: PRINT dI!; "milliamps/div"
RETURN
```

LISTING 2

```
; file name: curvtrcr.asm
; code date/time: March 18, 1998

; D/A resistor ladder on pins RB0:7
; output range is: 0.0 <= DAC <= 2.5 , 10mv resolution.

; runs on RC oscillator: R=4.7K, C=100p: Fosc=1.49MHz
; 372.5KIPS
; serial baud rate = 2400: 155 instructions/baud
;
; functionality of hardware:
;
; most primative command is to set drive current:
; so we send current value twice and only execute
; set command if both copies match.
; ACKnowledgement is in 1st byte of three bytes of data,
; including "setpoint", "Vf value", "Ip value"
;
                list            p=16c711
                include         "P16c711.inc"
; other equates
vf              equ     0       ; forward voltage on RA0
ip              equ     1       ; photocurrent on RA1
rxd             equ     2       ; RA2 is serial input port
txd             equ     3       ; RA3 is serial output port
halfbit         equ     .24     ; n=0x18   155=5+3n
fullbit         equ     .50     ; m=0x32   155=4+3m
iadcon0         equ     0x41    ; clk/8 conversion clock
iadcon1         equ     0x02    ; RA0 & RA1 A/D inputs, Vdd reference
ch_mask         equ     0xe7
go              equ     2
ch1             equ     3
;*****************************************************
                org     0x0c
bitcnt          res     1
baud_time res   1
scidata         res     1
setpoint   res  1
stack           res     1
;*****************************************************
                org     0
reset           goto    init
;*****************************************************
                org     4
isr             return
;*****************************************************
init            clrw
                OPTION
                movwf   INTCON
                movwf   PORTB   ; set drive current to zero on startup
                tris    PORTB   ; all of PORTB is D/A output
                movlw   0x08    ; set TXD (PORTA,3)
                movwf   PORTA   ; idle txd on startup
                movlw   0xf7    ; make RA3 (txd) only output
                tris    PORTA
                movlw   iadcon0
                movwf   ADCON0
                movlw   iadcon1
                bsf     STATUS,RP0
                movwf   ADCON1
                bcf     STATUS,RP0
;*****************************************************
main            call    getchar
                movf    scidata,w
                movwf   setpoint
                call    getchar
                movf    scidata,w
                xorwf   setpoint,w
                btfss   STATUS,Z
                goto    main
                movf    setpoint,w
                movwf   PORTB
                call    sendit
readA2D         movlw   iadcon0
                andlw   ch_mask
                movwf   ADCON0
                call    aquire
                bsf     ADCON0,ch1
                call    aquire
                goto    main
;*****************************************************
getchar         btfss   PORTA,rxd
                goto    getchar
w84low          btfsc   PORTA,rxd
                goto    w84low
getchar2  clrf  scidata
                movlw   .8
                movwf   bitcnt
                movlw   halfbit
                movwf   baud_time
w8half          decfsz  baud_time,1
                goto    w8half
                btfsc   PORTA,rxd ; should be low if valid start bit
                goto    getchar
; now ready to sample at bit interval, in center of bit please!
getabit         movlw   fullbit
                movwf   baud_time
w8abit          decfsz  baud_time,1     ; 90 loops + 14 overhead cycles?
                goto    w8abit
                btfsc   PORTA,rxd
                bsf     STATUS,C
                btfss   PORTA,rxd
                bcf     STATUS,C
                rrf     scidata,1
                decfsz  bitcnt,1
                goto    getabit
; got data, now check for valid stop bit
                movlw   fullbit
                movwf   baud_time
w8atad          decfsz  baud_time,1
                goto    w8atad
                btfss   PORTA,rxd
                goto    getchar         ; error if not valid stop bit, redo
                return
;*****************************************************
aquire          goto    aq2
aq2             goto    aq3
aq3             goto    aq4
aq4             goto    aq5
aq5             goto    aq6
aq6             bsf     ADCON0,go
                goto    aq7
w84result  btfsc ADCON0,go
aq7             goto    w84result
                movf    ADRES,w
; falls through to sendit
;*****************************************************
sendit          movwf   scidata
                movlw   8
                movwf   bitcnt
                bcf     PORTA,txd ; send start bit
                movlw   fullbit
                movwf   baud_time
send2           decfsz  baud_time,1
                goto    send2
send3           movlw   fullbit-2
                movwf   baud_time
                rrf     scidata,1   ; send lsb 1st
                btfsc   STATUS,C
                bsf     PORTA,txd
                btfss   STATUS,C
                bcf     PORTA,txd
send4           decfsz  baud_time,1
                goto    send4
                decfsz  bitcnt,1
                goto    send3
                bsf     PORTA,txd ; send stop bits (2)
                movlw   fullbit
                movwf   baud_time
stop1           decfsz  baud_time,1
                goto    stop1
                movlw   fullbit
                movwf   baud_time
stop2           decfsz  baud_time,1
                goto    stop2
                return
;*****************************************************
                end
```

photodiode. The laser drive current level is controlled by the value written to port "RB" of the processor, which together with a discrete R-2R ladder network, makes up an eight-bit D/A converter.

The output of the R-2R ladder is then buffered by a high input impedance op-amp, which drives transistor Q1 to produce a proportional drive current through the emitter resistance. The schematic of the circuit is shown in Figure 2.

The photodiode detector (Siemens TP60P or BP104) is operated in what is called the photoconductive mode (reverse-biased). In this mode, the photodetector acts as a photon counter, generating an output current that is linear with light intensity over several decades of light intensity.

That current develops a voltage across Rsample that is then amplified and presented to the second A/D channel. As the LASER's drive current is increased, both its forward voltage and output power is measured and plotted.

Although not implemented here, one could test the forward voltage measurement against an upper limit, and limit or turn off the drive current to lessen the chance of damage to the device if connected backwards, for example.

A photograph of the hardware is shown in Figure 3. The photo shows both the initial handwired breadboard, and the first PCB prototype that included an on-board voltage regulator. The connections for the LASER diode and photodiode are indicated on the picture of the PCB.

You can see a laser facing upside-down toward a BP104 photodiode, just above the CA3260AE op-amp on the handwired unit.

Figure 4 shows the 1:1 artwork for the 2.25" by 5.8", second generation PCB. This version provides pads for both 1206 size surface-mount resistors and 1/4 watt through-hole resistors. Some of the power supply capacitors are double-padded as well. All of the other capacitors are 1206 size surface-mount types for better bypass characteristics, and are mounted on the foil side of the board.

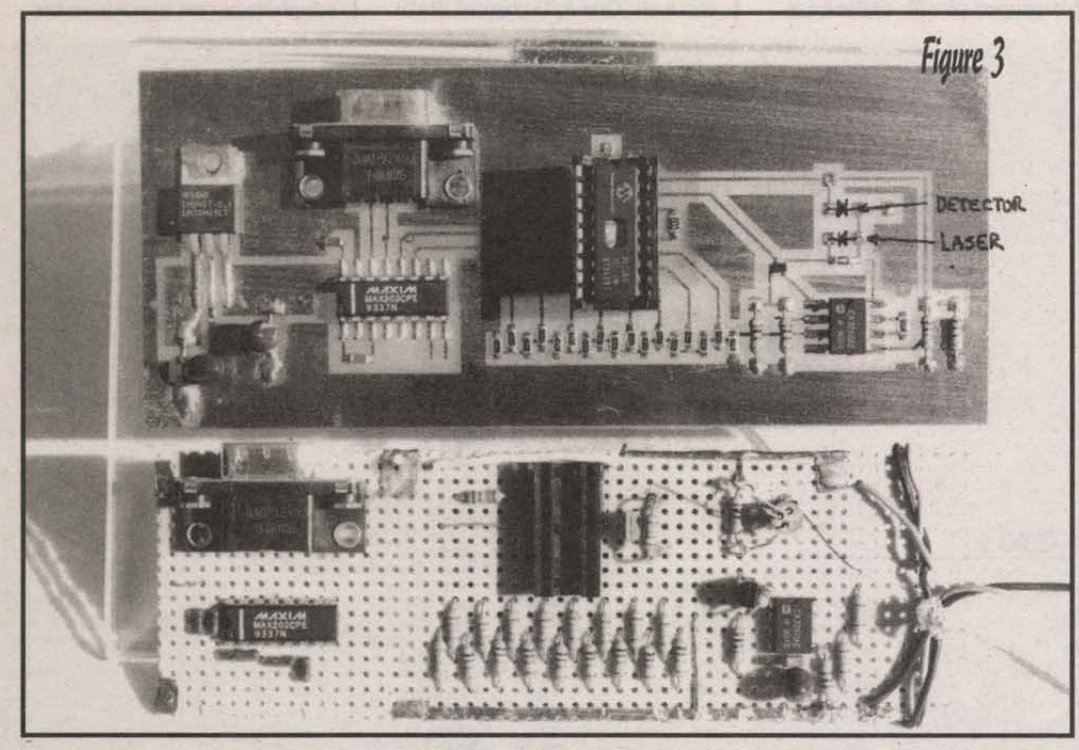


Figure 3

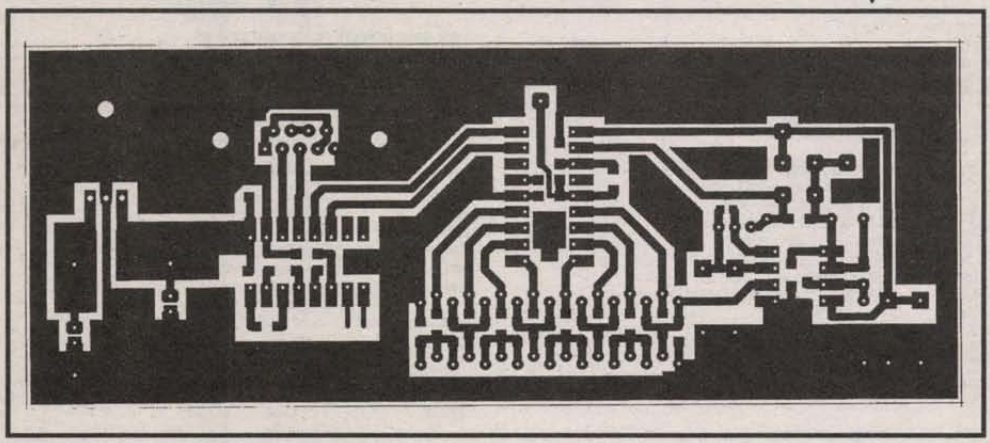


Figure 4

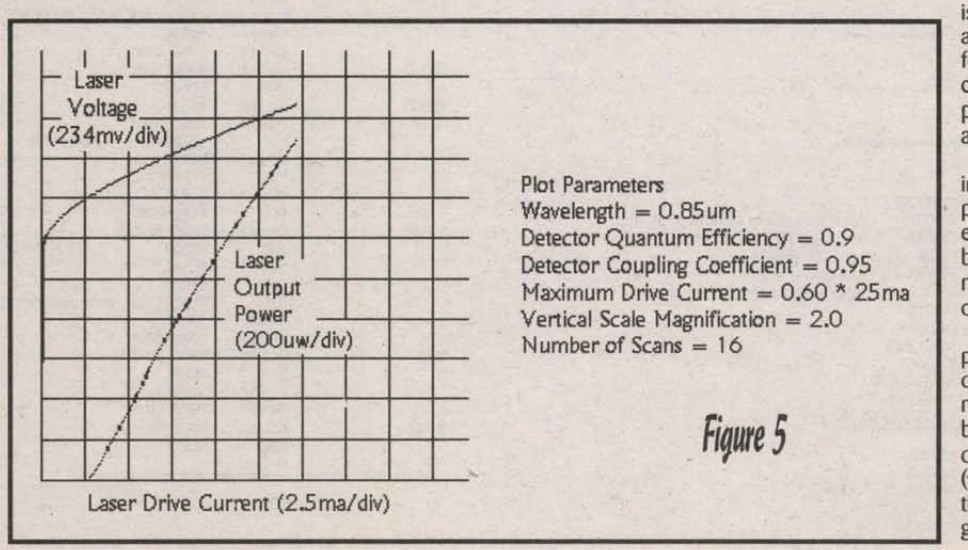


Figure 5

The Software

The BASIC program is shown in Listing 1. The code is segmented into groups for the purpose of discussion.

Code group three contains the values of two resistors used for plotting VCSEL characteristics. Rd! establishes the maximum LASER drive current to 2.5 volts / Rd! = 25 milliamperes. Rp!'s value is set to maintain 2.5 volts reverse bias across the photodiode for the highest anticipated photocurrent, which translates to 2.5 volts drop across Rp!. For Rp! = 1000 ohms, and Vcc = 5 volts, that equates to 2.5 milliamperes, or roughly 2.5 milliwatts peak.

You may choose to change these values to better fit your particular application, or add a pair of mullet-throw switches for added flexibility. If you add switches, then you will need to add code here to accommodate the new resistor values.

The fifth section of code requests the filename where the monochrome bitmap plot data will be stored. Blocks 21 through 27, and 33 do the work of formatting the file, adding the appropriate header information and setting the appropriate bits to build a MS WINDOWS PAINT compatible monochrome image.

The sixth block of code queries the user for plot calibration information. This data is used to establish the appropriate scale factors for converting the photon count rate to optical power at the source operating wavelength.

This scaling takes into account the fact that photons are essentially energy containers, where blue containers hold more energy than red ones.

So for a given optical power (optical energy delivery rate), it takes more red containers than blue ones. And since our detector counts photons (whose energy exceeds a threshold amount), we get more current for a

watt of red light than for a watt of blue light.

Code group six also asks how many scans to perform on a device. The data collected from these scans is first displayed in raw form on the screen, and averaged to create a reduced noise bitmap PAINT file. By averaging data from multiple scans, it is possible to improve the effective resolution of the A/D beyond its basic hardware limitation.

Code groups 28 through 32 are the interface code to the PIC CPU. These blocks send a redundant drive current command, check to see if the command was properly received, retrieves the A/D data, and plots the results on the screen.

The Firmware

Listing 2 is the PIC16C710 assembly code for the acquisition system. As you can see, it doesn't take much code (105 instruction words) to implement this functionality, which is basically that of a smart peripheral. The CPU simply examines the serial port looking for a repeated pair of current level command bytes.

When it finds a matching pair, it echoes the command to the host as an acknowledgment, and then sets the output current level as requested. The CPU then reads the two A/D channels, sending the data back to the host, and returns to monitoring for a new command.

Some Plot Examples

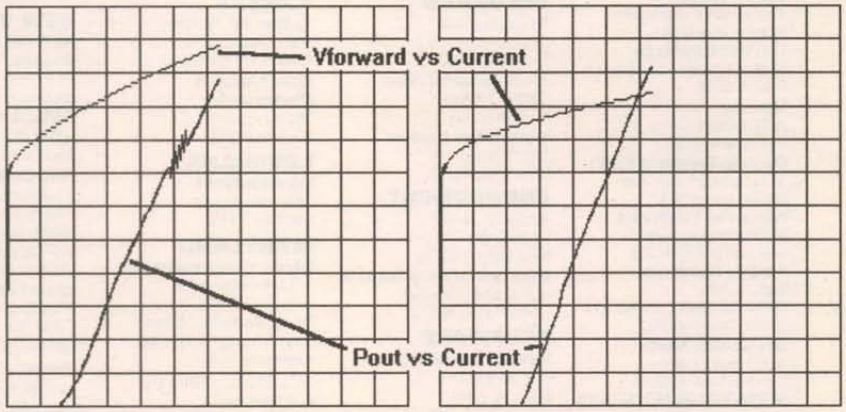
Figures 5, 6, and 7 show plots made on various VCSEL lasers, and the flexibility provided in terms of customizing plots of individual devices using the Paint program.

Other Applications

The simple functionality of the system should not be overlooked, for it lends itself to many other applications. An application closely related to the LASER curve plotter is the characterization of the Current Transfer Ratio (CTR) of optical isolators that contain both emitter and detector.

In fact, I tested the apparatus for the first time in this way, rather than take a chance and burn up a LASER had I wired something wrong.

Another application that comes immediately to mind is to use the system as part of a closed-loop proportional temperature controller, where heater power is controlled by the programmable current source, and a temperature sensor, such as a thermistor goes in place of the photodiode. Still another application might be in a dark room as an exposure meter. NV



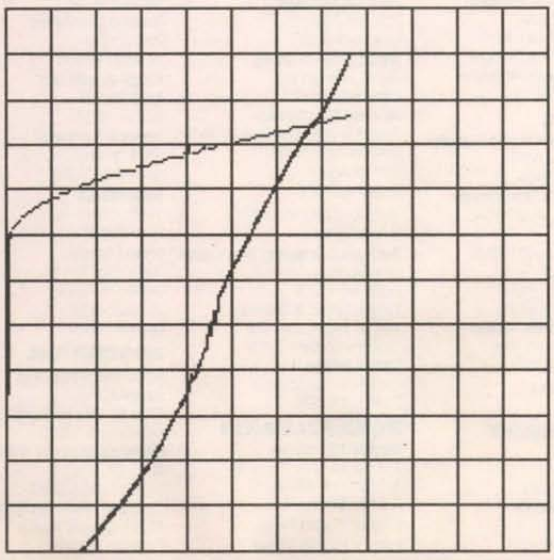
Mitel 1A440 VCSEL
Laser has interesting kink @ 10 ma
Horizontal: 2.0 ma/div.

Honeywell SV5637-001 VCSEL #2
Vertical: 0.2 volts/div, 200 uw/div.

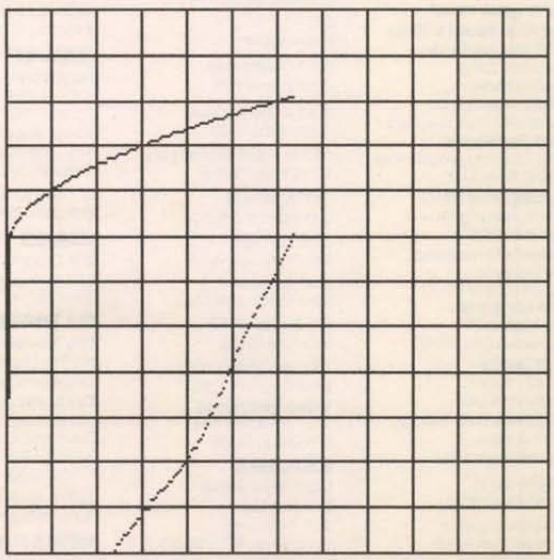
Figure 7

Figure 6

Filename: honey01.bmp
Honeywell SV5637-001 VCSEL
850 nm wavelength
Measured with 60% QE BP104 PIN
Horizontal: 2.0 ma/div
Vertical: 0.2 volts/div, 200 uw/div
Cathode @ Case
Anode @ TAB (isolated)



Filename: 1a448a01.bmp
Mitel 1A448A Eyesafe VCSEL
0.84 um wavelength
Measurements made with BP104
Detector, 60% QE @ 840nm
Horizontal: 2.0 ma/div
Vertical: 0.2 volts/div, 50 uw/div
Cathode @ pin 3,
Case @ pin 2, Center,
Anode @ pin 1, TAB



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Three More Ways to Use Graphic LCD Displays

by Ryan Sheldon, National Control Devices (404) 244-2432 http://members.aol.com/ncdcat

Three Convenient Sizes of LCD Displays Offer Complete Display Solutions for Most Embedded and PC Applications

I received lots of feedback and excellent suggestions from my previous graphic LCD display articles. I also heard from lots of curiosity seekers with good questions about LCD screens. I was very surprised to find that many of you wanted smaller graphic LCD screens, not larger. If anything, I would have thought you would have all wanted larger screens so you could display more information ... Instead, most of you preferred smaller screens to fit in your car, or as a discreet wall display in your house, or even in small-customized electronics project cases. And, after many phone conversations with several of my readers, I realized that the screens that I provided were simply too large for some applications.

So, I went back to the drawing board to see how I could adapt the LCD Animator 128 to use smaller screens. While this was theoretically possible, I had never really tried to do it until two days before this article was due for publication. So, I have not had time to change the LCD Animator 128 Setup program (included with the controller) to support these smaller screens. But, I went ahead and wrote a few Visual Basic 5 drivers that would get the job done.

This month, I will introduce two other displays for the LCD Animator 128. The smallest is 128x64, and the larger is 256x64. Both offer excellent image quality and one of these screens should fit your display requirements and budget.

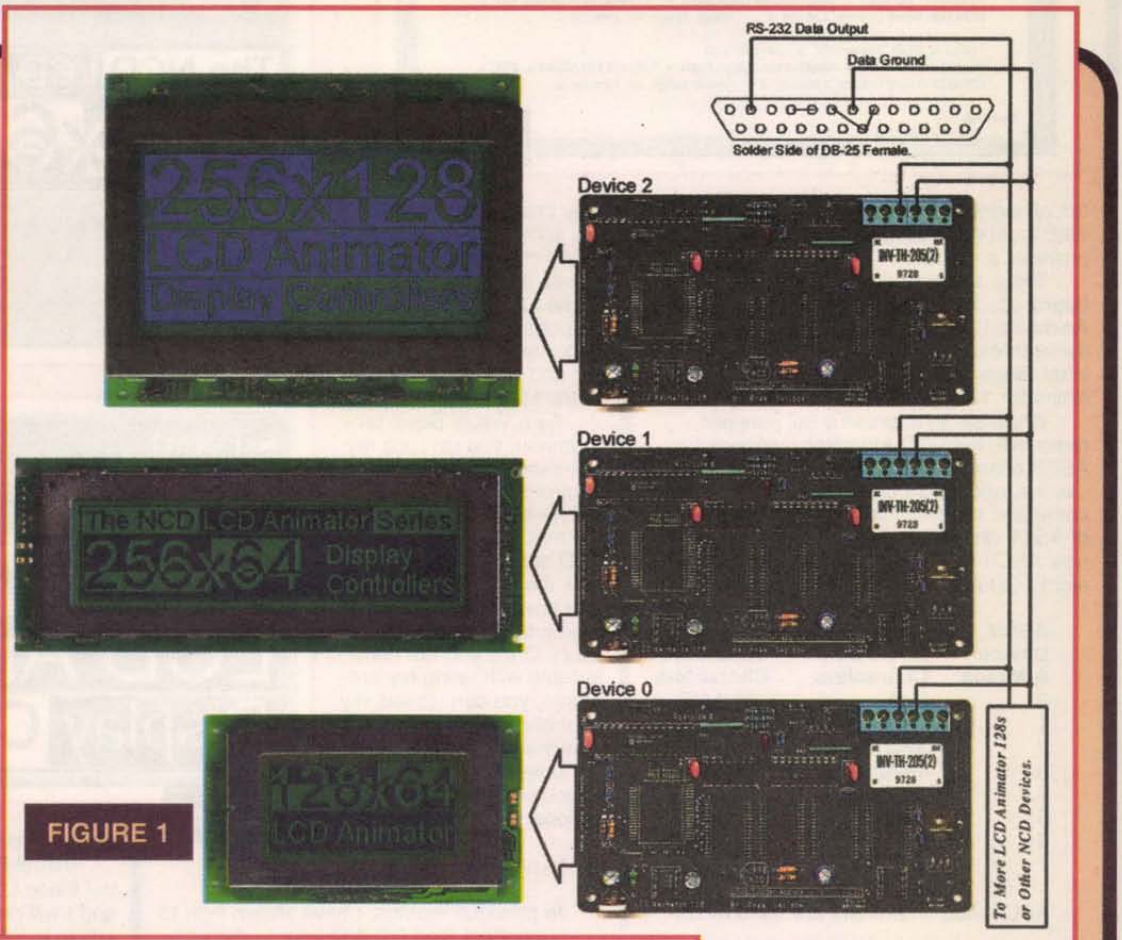

FIGURE 1

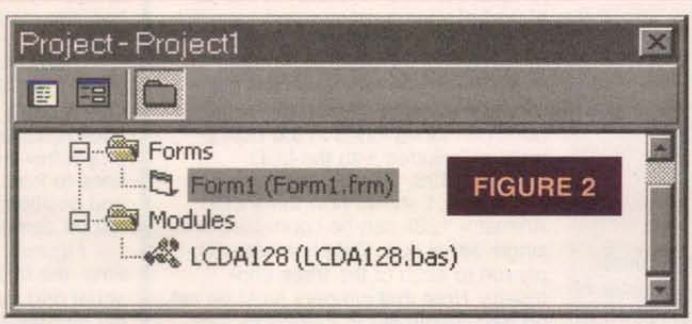

FIGURE 2

So this month, I am going to show you how to use these different LCD screens from Visual Basic 5, and I am going to take the opportunity to demonstrate the RS-232 networking feature built into the controller. This month's application will demonstrate how to drive three LCD Animator 128 controllers from a single serial port, each with a different size display attached, with each screen showing different images and text.

The RS-232 network typically allows you to control 16 NCD devices from a single RS-232 serial port on your computer. But since graphic LCD displays require more network resources, you can only have eight different (or same) graphic LCD displays attached to a single RS-232 serial port. You only need two wires to con-

```
Private Sub Form_Load()

    Form1.Visible = True                'Show Image on the PC's Screen

    MSComm1.Settings = "19200, n, 8, 1" 'Setup Serial Port
    MSComm1.CommPort = 2                'Select Comm2 of the Serial Port
    MSComm1.PortOpen = True             'Open the Serial Port

    'Initialize LCD Animator 128 with a 128x64 Screen Attached to Device 0
    LCDA128.Setup_128x64 0
    'Initialize LCD Animator 128 with a 256x64 Screen Attached to Device 1
    LCDA128.Setup_256x64 1
    'Initialize LCD Animator 128 with a 256x128 Screen Attached to Device 2
    LCDA128.Setup_256x128_With_64_Frames_Graphics_Text 2

    LCDA128.CLRTXT_128x64 0     'Clear a 128x64 LCD Attached to Device 0
    LCDA128.CLRTXT_256x64 1     'Clear a 256x64 LCD Attached to Device 1
    LCDA128.CLRTXT_256x128 2    'Clear a 256x128 LCD Attached to Device 2

    'Load a Test Image for a 128x64 LCD
    Picture1.Picture = LoadPicture(App.Path + "/TestPics/EG2201.BMP")
    LCDA128.SendPicture_128x64 0    'Send Image to Device 0

    'Load a Test Image for a 256x64 LCD
    Picture1.Picture = LoadPicture(App.Path + "/TestPics/EG2401.BMP")
    LCDA128.SendPicture_256x64 1    'Send Image to Device 1

    'Load a Test Image for a 256x128 LCD
    Picture1.Picture = LoadPicture(App.Path + "/TestPics/EG4401.BMP")
    LCDA128.SendPicture_256x128 2   'Send Image to Device 2

End Sub
```

FIGURE 3

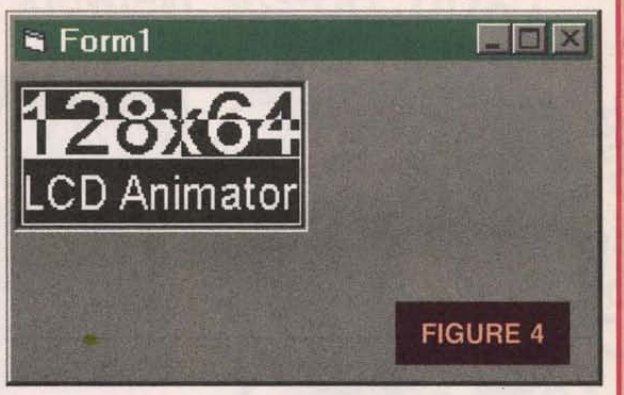

FIGURE 4

FIGURE 5

FIGURE 6

trol all eight LCD screens. One wire provides data to all eight devices, and the other wire provides a ground.

Three address jumpers identify each board: J1, J2, and J3. When the LCD Animator 128 boards are first powered up, these three jumpers are read to determine what range of ASCII characters the LCD Animator 128 will listen to.

When set to address 0 (all jumpers removed), the LCD Animator responds to ASCII characters 0 to 15 for data communications, and ASCII characters 128 to 143 for command communications. A complete table of ASCII characters (shown below) identifies how ASCII characters are used to control eight LCD Animator 128 boards.

ASCII Device Address	ASCII Data Characters	Command Characters
0	0-15	128-143
1	16-31	144-159
2	32-47	160-175
3	48-63	176-191
4	64-79	192-207
5	80-95	208-223
6	96-111	224-239
7	112-127	240-255

ASCII data characters are used to display images and text on the screen. ASCII command characters are used to turn on/off the backlight of the LCD display and are responsible for feeding important cursor positioning and setup commands to the LCD screen.

As a Visual Basic programmer, you can use my pre-canned routines to control these displays. You will never have to know too much about how the LCD screens work, just how the software works and how to use my programs to control these displays. Once you are comfortable with using my programs, you can dissect my control routines to find out how they work, and probably write better ones for your own custom applications.

Boards and Chips Available

Contact Ryan Sheldon
National Control Devices
Phone: (404) 244-2432
Fax: (417) 646-8302
E-Mail: NCDRyan@aol.com
http://members.aol.com/ncdcat/

The LCD Animator 128 is available exclusively to *Nuts & Volts* readers for the discounted price of $199.00. Please mention this article in *Nuts & Volts* when ordering to receive this discounted price.

Getting Started

In previous months, I have shown how to connect the LCD Animator to the serial port of your computer and have discussed power requirements and all the technical information required to make the controller work. I will not repeat this information in this article, but it can all be found in the user's manual included with the LCD Animator 128.

Figure 1 shows how three LCD Animator 128s can be connected to a single serial port. Data lines are simply run to each of the three controllers. Note that jumpers must be set on each controller to identify its location on the network. The 14-pin LCD interface is standard, and can be used to connect to most Epson graphic displays up to 256x128.

Visual Basic 5 will again be used to control these LCD screens. Send me an E-Mail and I will provide the necessary files for this article in ZIP format. Ask for CCWJAN99.ZIP. You can start by loading my example program.

I want you to pay particular attention to the LCDA128 module shown in Figure 2. This module contains all of the basic subroutines required to drive all three displays from only a few lines of code. I have written routines to load images, clear graphics and text, and position text on the screen. All of which will be demonstrated in the coming sections.

Figure 3 is where all the magic happens. First, the MSComm control is used to set the serial port for RS-232 communications. On my system, Comm 2 is used for the RS-232 serial port. Once the port and baud rate are set, the port is opened.

The first three subroutine calls set each

of the three LCD Animator 128 controllers for graphics and text mode. Since a different size LCD screen is attached to each controller, a different setup subroutine is required to tell each controller what type of screen is attached.

Device numbers 0 to 2 are used to identify each of the three controllers. Device 0 has a 128x64 LCD screen attached, so anytime you want to talk to device 0, you should use a subroutine written specifically for this size of display. I haven't written too many subroutines for these different size screens just yet, but there are certainly enough to cover the lion's share of graphics and text manipulation.

Once the three LCD Animators are told what size display is attached to each controller, I send commands to clear the text screen on each of the three controllers. Keep in mind, this ONLY clears the text layers, it does NOT affect the graphic layers. Again, three separate clear text (CLRTXT) subroutines are called. Each is optimized for a different size LCD screen.

Now for the fun part. I used a Picture Box in my application so I could see what images are being loaded on my PC screen. I use a different "SendPicture" subroutine for each of three sizes of LCD screens. Once a test image is loaded, I simply call the appropriate subroutine to dump the image from the "PictureBox" to the LCD display. Figures 4, 5, and 6 show the source image that is to be loaded. Figure 1 shows how each of the three images looks once loaded onto the LCD screen.

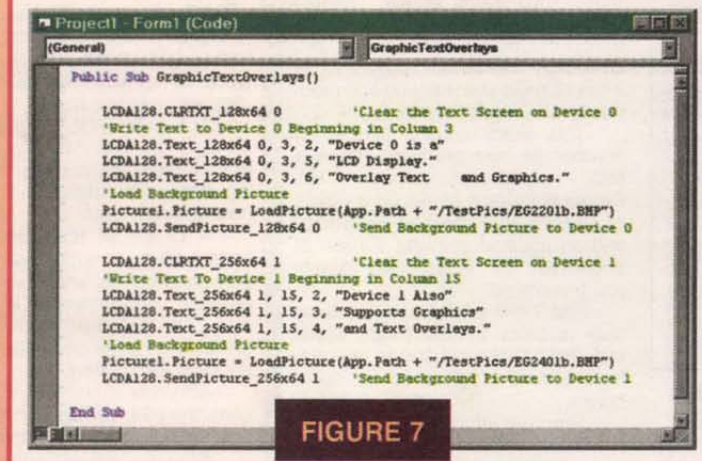

FIGURE 7

FIGURE 8

Graphics and Text Overlays

As I mentioned before, graphics and text can be overlaid independently on a single screen. You can change the image without affecting the text. Likewise, you can change the text without affecting the image. Figure 7 shows how to send text and graphics to each of these layers on two of the LCD screens.

The 128x64 LCD is the first display to show an overlay. I begin the subroutine by clearing the text layer. I then use the Text_128x64 subroutine to write text to the screen. The first parameter is 0, once again indicating we are speaking to device 0, which has a 128x64 LCD screen attached. I use 3, 2, "Device 0 is a" to move the cursor to column 3, line 2, and write the quoted text to the display. The 3, 2 set the cursor start position; as text is written to the screen, the cursor is automatically indexed. Once text is written, I load a background image into the "PictureBox." I again use the "SendPicture" subroutine to send the picture to device 0.

Similar steps are taken to overlay text with graphics on the 256x64 LCD screen. Again, device 1 is used to identify the LCD Animator with a 256x64 LCD attached. The 256x128 screen also supports graphics and text overlays. Figures 8 and 9 demonstrate the appearance of two LCD screens used in graphics/text overlay mode.

Technical Notes

The LCD Animator 128 set to Device 0 is shown controlling an Epson EG2201 128x64 Graphic LCD Display. The controller is configured for 16x8 text with graphics and can store 128 different text and graphic images. Model shown is a reflective display.

The LCD Animator 128 set to Device 1 is shown controlling an Epson EG2401 256x64 Graphic LCD Display. The controller is configured for 32x8 text with graphics and can store 128 different text and graphic images. Model shown has an emerald green EL backlight.

The LCD Animator 128 set to Device 2 is shown controlling an Epson EG4401 256x128 Graphic LCD Display. The controller is configured for 32x16 text with graphics and can store 64 different text and graphic images. Model shown has a white EL backlight.

Some displays made by other manufacturers will work with the LCD Animator 128. Additional information for interface will be available when the LCD Animator X is complete.

Thanks again for reading this month's "Computer-Controlled World." As usual, feel free to E-Mail, call, or write with your questions and comments. **NV**

FIGURE 9

New Product News

1999 OLD COLONY SOUND LABORATORY CATALOG

Audio Amateur Corp. announces the 1999 edition of the Old Colony Sound Laboratory has been printed and is ready to mail to over 40,000 DIY audio enthusiasts worldwide. This year's catalog features books on all aspects of audio, software, PC boards, test CDs, and equipment and vendor sources for all areas of audio construction and modification.

This year's catalog contains a number of new products including test equipment form TES Corporation, new books on a variety of subjects in audio and electronics and an updated software version of SoundEasy for loudspeaker design and placement.

The 1999 edition of the catalog also features a new index which includes authors, enhancing the catalog's use as a reference for audio books.

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1-888-924-9465 or 603-924-9464
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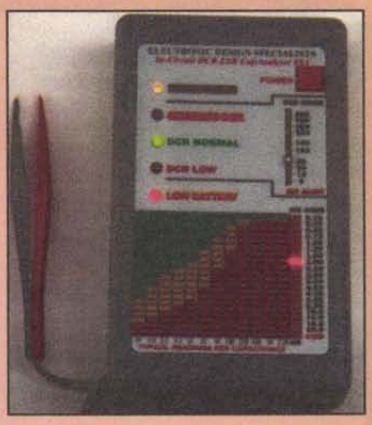
WEB: www.audioXpress.com

CAPANALYZER 88A



The CapAnalyzer 88A has improved test probes for testing both radial and all types of surface-mounted caps with just one hand.

A higher DCR range set-alert now adjustable up to 500 ohms, allows checking both electrolytic and now tantalum caps.

A QuickESR test has been added for super-fast ESR-only testing, with the original discharge/DCR test/ESR test mode still available for super-accurate good-fair-bad testing.

Also new is one-to-five beep multitone that allows a technician to know the ESR reading without having to read the 20-segment LED display. Battery life is also improved.

All of the original CapAnalyzer 88's desirable features remain, such as the three-color chart on the front panel that allows comparison of ESR to capacity, the expanded scale display, and the portability of battery operation to repair big screens in the field in minutes. An adapter is also available for all-day power at the bench.

NYE 330C KEY

Morse Express announces a new straight key from Wm. M. Nye Company – it's Nye's first new product since the late 1970s.

The Model 330C is a deluxe version of Nye's classic Master Key, with a highly polished chrome base, nickel-plated hardware, and Navy Knob.

The hardware is selected by hand and each 330C is carefully inspected before packing to ensure a flawless finish.

Model 330C has gold-plated hard silver contacts which are electrically isolated from the rest of the key, and is supplied complete with cord and 1/4" phone plug.

Unlike any other Nye or Speed-X key, each 330C has a serial number stamped in the base.

Nye's Model 330C is priced at $139.95 and is covered by Nye's standard two-year warranty.

For more information, contact:

MORSE EXPRESS
3140 S. PEORIA ST., #K-156
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AURORA, CO 80014-3155
303-752-3382 FAX: 303-745-6792
1-800-752-3382
E-MAIL: hq@MorseX.com
WEB: www.MorseX.com

LEAKSEEKER 82B

Technicians looking for a better way to find that elusive shorted or leaky component now have a new improved LeakSeeker 82B that can turn hours of endless searching into seconds of satisfaction. Simply touch LeakSeeker's probe to pads along the trace that you suspect a short or leaky component is; the pad where the beep is highest is the lowest resistance and therefore is the bad component.

Touch pads in one direction then the other, and LeakSeeker will beep higher or lower, and light the LED scale to show you if you are getting closer or further from the leaky part.

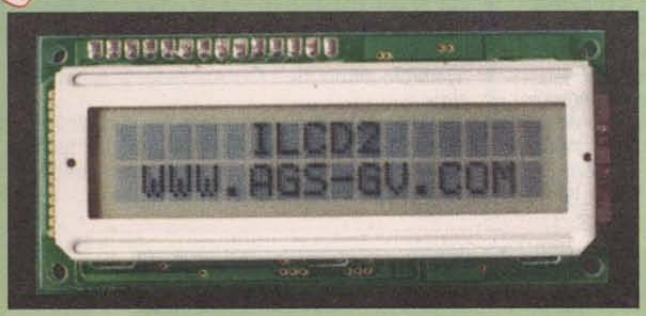
LeakSeeker 82B will automatically recalibrate itself as you make progress, or switch to manual and probe a small dense area where a bad part only a quarter of an inch away from a good part can be found.

LeakSeeker 82B will locate not only shorted components, but even leaky components that can be as high as 150 ohms. It can even find active shorts that only show up when the unit is turned on!

There is also a three-wire test mode to locate high-resistance shorts and thermally defective components. This is one very special piece of test gear that no productive technician should be without. It comes with a very complete manual and gold-plated test leads.

For more information, contact:

ELECTRONIC DESIGN SPECIALISTS, INC.
4647 APPALACHIAN ST., DEPT. NV
BOCA RATON, FL 33428
561-487-6103
WEB: http://www.eds-inc.com/



IIC LCD DISPLAY MODULES

Advanced Graphic Systems announces the release of its two newest products, IIC LCD Display Modules.

The IIC inter-controller communication bus has long provided accurate, rapid communication between microcontrollers along with a variety of peripheral devices.

Now, added to that list of devices is the AGS ILCD1 and ILCD2 liquid crystal display modules. The ILCD1 is a single line by 16 supertwist LCD module with large display characters. The ILCD2 is a back-lit, two line by 16 supertwist LCD module with standard display characters.

Both units include all the necessary microcontroller support hardware on board. External connections require a nominal supply voltage of 5 VDC, and the interface to the IIC bus, the SDA and SCL signals (external pull-up resistors are required).

They both utilize the standard seven-bit addressing scheme, can communicate at the 100Kbit/s transfer rate or the fast-mode rate of 400Kbit/s, and the internal module address can be programmed to reside at up to nine different locations making it possible to use several displays on one bus.

Both modules automatically clear the internal display memory queue after each write cycle so that the user need only send valid display data without the need for clearing previously displayed characters from the display, thus keeping programming overhead at a minimum.

Both devices measure approximately 1.5" x 3.25" so that use of standard 1x16 or 2x16 LCD mounting locations is still made possible.

Both modules are currently available and can be purchased for $55.00 in single quantities to $35.00 in 100+ quantities.

For more information, contact:

ADVANCED GRAPHIC SYSTEMS
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AUBURN, CA 95602
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WEB: www.ags-gv.com

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New Product News

PICWISER

The PICWISER from Embedded Micro Software (EMICROS) is a low-cost development system for learning microcontrollers, rapid prototyping, or as a PIC programmer. The integrated programmer allows programs to be downloaded from the PC parallel port into the PIC16F84 flash microcontroller and executed with the flip of a switch.

The PICWISER comes assembled and tested, complete with interface cable, solderless breadboard, prototyping wire, programming software, power supply, and manual.

For more information, contact:

EMICROS – EMBEDDED MICRO SOFTWARE
25759 RIDGEWOOD DR., DEPT. NV
FARMINGTON HILLS, MI 48336
248-477-6639
E-MAIL: picwiser@emicros.com WEB: www.emicros.com

E-Mail your New Products to: newproducts@nutsvolts.com

MCM ELECTRONICS CATALOG 42A

MCM Electronics announces the introduction of their newest catalog – number 42!

This latest catalog features more than 3,000 new products including project accessories, semiconductors, connectors, test equipment, computer and home audio products, along with thousands of original OEM TV/VCR repair parts. Prices have been lowered on products throughout the catalog and customers will find special values in all sections.

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CENTERVILLE, OH 45459-4072
1-800-543-4330
WEB: www.mcmelectronics.com

ADONIS AM-7500E DESKTOP MICROPHONE

Adonis USA introduces the AM-7500E amplified desktop microphone with a four-band graphic equalizer and three-stage speech compressor for use with amateur, and other two-way radios.

The AM-7500E four-band graphic equalizer provides tone control over your transmitted voice – while the speech compressor and audio amplifier allow control over the strength and consistency of your transmitted audio.

Other features include: a highly-sensitive electret microphone element; an output level control; both momentary and locking push-to-talk switches; up and down frequency controls; a VU meter; a battery level tester; and an alarm that warns if the AM-7500E has accidentally been left in transmit (this function can be turned off).

The AM-7500E is constructed of an anodized aluminum body and has a flexible metal gooseneck microphone. The microphone is powered by either four AA batteries, an optional DC power adapter (model PS-6A), or can be powered directly by some two-way radios.

The AM-7500E uses Adonis adapter cables (available separately) to connect to your transceiver, which makes switching between radios a 'solder-less' experience.

The AM-7500E retails for $269.95 and has a full one-year warranty.

OPERATE TWO TRANSCEIVERS WITH ONE DESKTOP MICROPHONE

Adonis USA introduces the AM-708E amplified desktop microphone with two transceiver outputs and a variable speech compressor for use with amateur, commercial, and other two-way radios.

The AM-708E has two microphone outputs for operating two different transceivers with one microphone. A two-position switch on the AM-708E allows the user to select and operate either transceiver. A speech compressor with a high, low, and a variable manual setting allows precise control over compression levels.

The AM-708E is constructed of an anodized aluminum body and has a flexible metal gooseneck microphone. The microphone is powered by either two AA batteries, an optional DC power adapter (model PS-3), or can be powered directly by some two-way radios.

The AM-708E uses Adonis adapter cables (available separately) to connect to your transceivers.

The AM-708E retails for $219.95 and has a full one-year warranty.

For more information, contact:

ADONIS USA
P.O. BOX 1124
ISSAQUAH, WA 98027
425-558-9592 FAX: 425-558-9704
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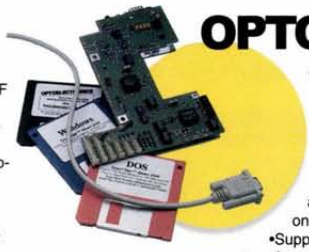

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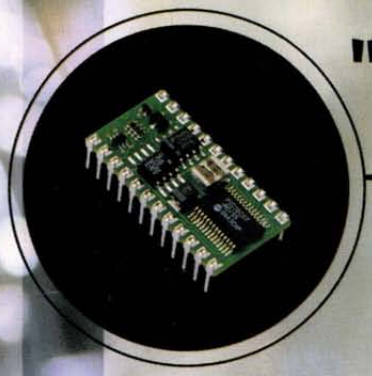
New Year's Resolution #1

"I will run faster in 1999."



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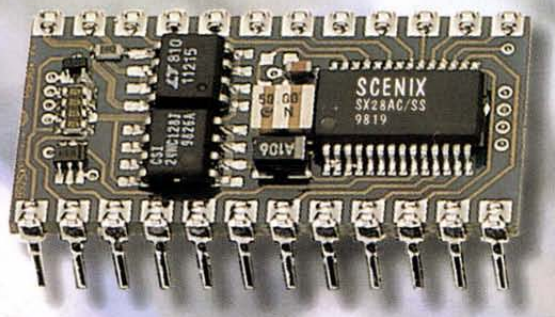

	BS2-IC	BS2SX-IC
Microcontroller	Microchip PIC 16C57	Scenix Semiconductor SX28AC/SS
Program Execution Speed	4,000 instructions/sec.	10,000 instructions/sec.
Processor Speed	20 Mhz	50 Mhz
Program Memory Size	2k Bytes	8 programs x 2k Bytes ea. (16K Bytes)
RAM Size	32 Bytes	32 Bytes
Scratch Pad RAM	N/A	63 Bytes
Current @5V	8ma Run/100µa Sleep	60ma Run/200µA Sleep
Source/Sink Current per I/O	20mA/25mA	30 mA/30mA

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