

Nuts & Volts

Exploring Electronics And Technology For The Hobbyist And Professional

July 1999 Vol. 20 No. 7



WWVB Clock Interface: Making Use of the Most Accurate – Continually Broadcast – Time Signals

EL LIGHT: PLAYING IN THE DARK

EL Lamps are everywhere, from cell phones to laptops.



• **Computer-Controlled World: Vacuum Florescent Displays**

• **Three-Axis Chopper, Step Motor Controller for Computer Numerical Control Applications**

Plus:

- **Voice Changer**
- **High-Power PIC Macro Library**
- **New Life for a Vintage Audio Filter**
- **Much More ...**

U.S. \$3.50 CANADA \$5.00

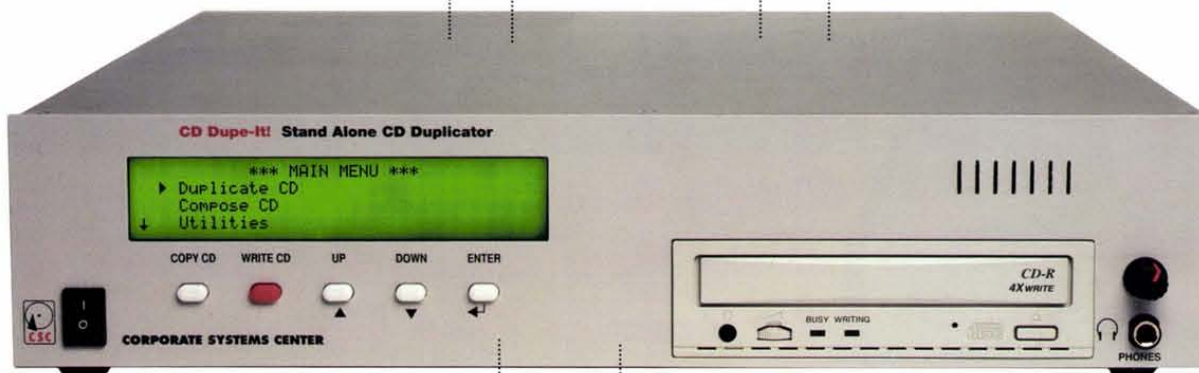


**BOTH SINGLE AND DUAL
DRIVE MODELS AVAILABLE.**

**INTERNAL A/V HARD DRIVE
STORES DISC IMAGES FOR MULTIPLE
COPIES, AND CUSTOM AUDIO DISCS.**

**EXTERNAL SCSI-II PORT WORKS
LIKE A STANDARD CD WRITER
FOR CREATING CUSTOM DISCS.**

**MAKE CUSTOM DISCS WITH
JUST THE MUSIC YOU LIKE.**



**TOTALLY SELF CONTAINED,
NO ADDITIONAL HARDWARE
IS REQUIRED**

**ADVANCED FORMAT DETECTION
PRODUCES PERFECT DUPLICATES
ON STANDARD CD-R MEDIA.**

COPY ANY CD NOW. NO PC REQUIRED.

DUPE-IT!

Instantly copy music and CD-ROM compact discs. Make backup copies of your favorite music and software on rugged, permanent CDs. Produce compact discs quickly and economically. No mastering or multimedia experience is required.

Insert your original CD and press "start." The multimedia processor quickly copies any disc to the internal A/V hard drive. Insert blank CDs and make as many copies as you like. You'll produce perfect duplicates. The system is totally self contained — no additional hardware is required.

**BUY DIRECT: FROM \$795!
100 BLANK CDs \$169!
408 330-5524**

Just plug in the power cord and press "start"—it's that easy.

You can even make your own custom music CD without a PC! Insert your original CD's, select the tracks you want, and Dupe-It will copy them to the internal hard drive. Then insert a blank CD, and you'll have a custom music CD with just the songs you want.

With the included CD mastering software, Dupe-It will work over-time as your personal CD design system. Just attach a SCSI cable

to your PC or Mac, and you're ready to design and create your own original CD's. Similar systems used in duplication houses cost over \$5,000. Now you can easily copy CDs yourself for a fraction of the price.



CORPORATE SYSTEMS CENTER
3310 WOODWARD AVE., SANTA CLARA, CA 95054
WWW.DUPEIT.COM

Musicians—ask about our pro-audio CD recorders. Software publishers—ask about our high-volume multi-drive duplication systems. Dupe-It is sold and intended for backup and in-house design purposes only. Copyright laws must be observed.

HSC Electronic Supply

Serving
Silicon Valley
since 1964!

...brings you a potpourri of high-tech goodies for the techno-tinkerer!
For thirty years we have been your source for Silicon Valley exotica!

Noise-Cancelling Headset!

- ◆ Andrea Electronics ANC-500 headset with microphone
- ◆ Features active Noise Cancellation technology
- ◆ Mono speaker & mic., use with your sound card, etc.
- ◆ New in bag, 90-day warranty



HSC#17445 \$4.95

Personal-size Ethernet Hubs!

- ◆ Astro-Link CT-1008D is the simple network solution!
- ◆ Tiny 8-port 10Base-T hub measures 6.75" x 4" x 1.25"
- ◆ Comes with power supply, manual
- ◆ New in box, 90-day warranty



HSC#17862 \$27.50

SCSI Hard Drive Deal!

- ◆ Seagate ST15150N 3.5" half-height drives
- ◆ Industry-standard high-capacity storage, 4.3 gigabytes
- ◆ SCSI - II interface, 1 megabyte buffer
- ◆ Very little used, tested good
- ◆ 8200 RPM, 9ms avg. seek time
- ◆ Non-partitioned, will need to be formatted
- ◆ HSC 30-day warranty

HSC#17908 \$199.00

Home Alarm Stuff!

These items are dealer-returned inventory (shelf worn packaging but unused) of home security components that were made by Teko Inc. Mix and match to create your own bargain security system! All items have mounting screws or adhesive pads, instructions, and alarm units have window warning stickers. All parts have 30-day warranty.

- ◆ ST911 Automatic Phone dialer has screw terminals for sensor input, power adapter, and very long phone cord.
- ◆ Instantly contacts up to four pre-selected phone numbers with your own digitally recorded 16 second message.

HSC#17718 Phone Message Dialer \$27.50

- ◆ S086N Glass Vibration Sensor Alarm - self-contained unit detects attempted entry or breakage of fixed or sliding glass windows and doors. Only 2" across!
- ◆ High output 90 db alarm sounds instantly, providing a powerful deterrent to would-be intruders. Self-stick adhesive requires no tools. Alarm battery included.

HSC#17753 Glass Vibration Sensor Alarm \$2.95

- ◆ S002M Digital Control Motion Alarm has wall-mount keypad, PIR infrared motion detector with 110° coverage to 60 feet, programmable security code, 10 - 15 second entry delay, extremely loud alarm.
- ◆ Uses 9V battery or AC Adapter (neither included)

HSC#17720 Digital Control Motion Alarm \$15.00

- ◆ S008B Digital Control Motion Alarm with Safety Chime has wall-mount keypad, PIR infrared motion detector (same as S002M above) with very loud alarm OR safety chime alert.
- ◆ Uses 9V battery or AC Adapter (neither included)

HSC#17721 Digital Motion Alarm/Chime \$17.50

- ◆ S082X Entry Guard Alarm has wall-mount keypad, mag-switch activation (one switch included), programmable security code, 10 - 15 second entry delay, extremely loud alarm or pleasant door chime.
- ◆ Uses 3 AAA batteries (not included)

HSC#17722 Digital Entry Guard Alarm \$12.50

Rechargeable Battery Buy!

Three types of rechargeable battery for a variety of uses!

Amazing power in a small package! Nickel-Metal Hydride (Ni-MH) batteries have the capacity of Nicads without the "memory" effect. These are factory-new, not pulls!



- ◆ Toshiba 8TH-F5-F1-AIR, 9.6VDC at 600 mAh, measures 4.5" x 1.875" x .25" thick (8 cells in series)
- ◆ Appears to have a thermal fuse for over-current protection

HSC#17871 \$17.50

...Or you can choose a NiCad battery pack in a similar form-factor. These are a flat array of cells, like the battery above, with handy solder tabs for connection.

- ◆ Thin NiCad pack, 8.4VDC at 450 mAh, measures 4.5" x 1.875" x .25" thick (7 cells in series)

HSC#17872 \$12.50

...Or you may need the power of a lead-acid battery. These are all new batteries with tab terminals. Perfect for hobbies, security systems, battery back-up, garden equipment, etc.

- ◆ TR1.2-12, 12VDC at 1.2 AH, measures 3.75" x 1.875" x 2"

HSC#17197 \$4.95

- ◆ TR4-6, 6VDC at 4 AH, measures 2.75" x 1.75" x 4"

HSC#17588 \$4.95

- ◆ BAT-0063 (x2), 12VDC at 10AH, 4" x 6" x 4", this is two 6-volt batteries packaged in series by Best Power

HSC#17810 \$17.50

PCI-Bus 56K Modem!

- ◆ Genica PCI-Bus 56K Modem at unheard-of price!
- ◆ Data, FAX, voice, full V.90 compatibility
- ◆ Voice from handset
- ◆ Windows 95/98 or NT only (Not Win 3.1 compatible)
- ◆ Uses latest Lucent chipset, comes with Lucent drivers
- ◆ New retail box, with expanded application software on CD
- ◆ 90-Day Warranty

HSC#17532 \$39.95

External SCSI Drive Cases

- ◆ Bargain case for 5.25" drives, brand new!
- ◆ 7" x 4.5" x 10.5" overall size
- ◆ 50-pin SCSI connectors
- ◆ SCSI ID switch
- ◆ 65W Power supply (lots of power for hard drives, etc.)
- ◆ Fan-cooled, uses standard IEC Power cord (not included)

HSC# 17130 \$39.95

- ◆ High quality low profile case for 5.25" drives, brand new!
- ◆ 7" x 2.25" x 11" overall size
- ◆ 50-pin SCSI connectors, RCA Audio connectors
- ◆ SCSI ID switch, termination switch
- ◆ Tiny 12W Power Supply (5VDC @ 1.4A, 12VDC @ .4A, probably only good for CD-ROM's)
- ◆ Fan-cooled, uses standard IEC Power cord (not included)

HSC# 17357 \$29.95

Price Breakthrough on Variable Transformers!

You say you've wanted one of these in the past, but the price kept you away? Now you can afford a brand-new variable AC supply for your workbench! All have enclosed cases, knob and dial.

- ◆ Model AICVR-500W, 110/220 VAC input
- ◆ 0 - 250 VAC output, 500 watts
- ◆ Measures 5" dia., 6" tall
- ◆ Features meter, binding post terminals for input, output
- ◆ New in box, made in China



HSC#80474 \$50.00

- ◆ Model AEEC-1090VR, 110 VAC 60 Hz input
- ◆ 0 - 110 VAC output, 1 KVA
- ◆ Measures 6.5" dia., 8" tall
- ◆ Features meter, illuminated switch, line cord, fuse
- ◆ New in box, made in China



HSC#80481 \$85.00

- ◆ Model AEEC-2090VR, 110 VAC 60 Hz input
- ◆ 0 - 110 VAC output, 2 KVA
- ◆ Measures 8" x 10" x 8" tall
- ◆ Features meter, illuminated switch, line cord, fuse
- ◆ New in box, made in China



HSC#80461 \$125.00

It's Back...DMM Bargain!

- ◆ Inexpensive Digital Multimeter is packed with features!
- ◆ 0.5% Basic Accuracy, 19 scales, battery included!
- ◆ Ohms, Volts DC & AC, Milliamps DC & AC, 10 Amps DC scale
- ◆ Diode Tester, Transistor checker
- ◆ With test leads, instructions
- ◆ New, 30 day warranty



HSC#80370 \$14.95

Sidewinder Slashed!

- ◆ Microsoft "Sidewinder" game controller ... Wow!
- ◆ New OEM package, high quality for fast action!
- ◆ Download drivers from Microsoft.com
- ◆ Eight programmable action buttons, two fire buttons



HSC#80486 \$17.50

External SCSI Drive Cases

- ◆ Bargain case for 5.25" drives, brand new!
- ◆ 7" x 4.5" x 10.5" overall size
- ◆ 50-pin SCSI connectors
- ◆ SCSI ID switch
- ◆ 65W Power supply (lots of power for hard drives, etc.)
- ◆ Fan-cooled, uses standard IEC Power cord (not included)



HSC# 17130 \$39.95

- ◆ High quality low profile case for 5.25" drives, brand new!
- ◆ 7" x 2.25" x 11" overall size
- ◆ 50-pin SCSI connectors, RCA Audio connectors
- ◆ SCSI ID switch, termination switch
- ◆ Tiny 12W Power Supply (5VDC @ 1.4A, 12VDC @ .4A, probably only good for CD-ROM's)
- ◆ Fan-cooled, uses standard IEC Power cord (not included)



HSC# 17357 \$29.95

Get the Right Touch with ALPS Input Devices!

Get name-brand quality at bargain-basement prices with these premium pointing devices -- all are new and have a 90-day HSC warranty. Some quantities limited!

Alps Adjustable Mouse

- ◆ For Macintosh computers
- ◆ The first mouse that adjusts to you!
- ◆ Three programmable buttons!
- ◆ Sleek design for comfort, easy handling
- ◆ Chording -- Program multiple button combinations!
- ◆ Requires Mac OS 6.04 or later, available ADB port
- ◆ 400 dpi resolution, Made in U.S.A.

HSC# 17827 \$17.50

Alps 2-Button Mouse

- ◆ Two-button type with PS/2 plug
- ◆ Ergonomic shape for comfort, easy handling
- ◆ Ultima Driver software v1.3 diskette included
- ◆ 400 dpi resolution
- ◆ New, OEM package, 90-day warranty

HSC# 17830 \$3.95

Compaq Docking Bay

- ◆ Compaq docking "Smartstation" for laptop computer (we don't know which!)
- ◆ Has two internal ISA slots
- ◆ SCSI port, network ports, serial, parallel, video, keyboard & mouse ports on back.
- ◆ Used, 90-day warranty



HSC#17713 \$39.00

Visit HSC's Website!

- ◆ Pay us a virtual visit on the World Wide Web!
- ◆ Simply point your browser to <http://www.halted.com>
- ◆ Site is constantly being revised, please visit often!
- ◆ Check out the amazing "Gizmo of the Week" feature!

HSC Catalog online!

- ◆ That's right, get HSC's catalog on the World-Wide Web!
- ◆ Simply go to www.halted.com and follow the big red link.
- ◆ Adobe .PDF files are available for download and viewing.
- ◆ Or drop on by and pick one up...we'd love to see you!

Terms: Some quantities limited; all items subject to prior sale. Minimum order: \$10.00 plus shipping. Orders under \$20.00 subject to \$2.00 handling fee, in addition to shipping. All orders shipped FOB Santa Clara, CA (this means you pay freight!) by UPS Surface (no P.O. Boxes) unless otherwise specified, in which case prevailing carrier rate plus \$5.00 handling fee applies. Prepaid orders that don't include shipping charges will be shipped freight COD. There is a \$5.00 UPS charge added to shipping charges for COD shipments. If you have questions about your order, please call Customer Service at (408) 732-1854 M-F 9AM to 5PM PST.

CATCH IT. HOLD IT. TUNE IT.

NEW

Tuning your receiver will never be easier. Introducing the all new Mini Scout Reaction Tuner. With a .001 second measurement time, the Mini Scout will not miss even the briefest of transmissions. While locking onto a frequency from up to 200 feet away (5w UHF), the Mini Scout automatically tunes the receiver* to the action using its patented Reaction Tune capability. No manual tuning necessary.

*Compatible Receivers:

ICOM
7000, 7100, 8500, 9000, R10
AOR
8000, 8000B, 8200
Optoelectronics
Optocom, R11
Radio Shack
Pro2005/6 with OS456/Lite
Pro 2035/42 with OS535

No modifications necessary. Interface cables required.

Specifications Scout Mini Scout

10MHz - 1.4GHz	•	•
Reaction Tune	•	•
LCD Display	•	•
<3mV Sensitivity	•	•
Signal Strength Bargraph	•	•
Filter Mode	•	•
Capture Mode	•	•
Backlight	•	•
Beeper	•	•
Vibrator	•	•
400 Memories	•	•
255 Hits Counter	•	•



Are FM Broadcast signals a Problem?

Knock them out with the N100 Notch Filter. Blocks 88 - 108MHz, Connect between antenna and Scout or Mini Scout.....\$99



Patent No. 5,471,402

**Mini Scout
Reaction Tuner**

\$249



Patent No. 5,471,402

AR8200 Not Included

**Scout Frequency Recorder
Reaction Tuner**

\$349



SPECIAL
DB32 & CC30 \$29

Place your
Order anytime
at the
Optoelectronics
Cyber Store
www.
optoelectronics.
com

OPTODIRECT • 800-327-5912
OPTOELECTRONICS®

5821 NE 14th Avenue • Ft. Lauderdale, FL 33334
Phone: (954)-771-2050 Fax: (954)-771-2052 E Mail: sales@optoelectronics.com
Prices and Specifications are subject to change without notice or obligation.

DB32 Antenna shown on Scout and Mini Scout sold separately. AOR, ICOM, Radio Shack are all registered trademarks

Write in 112 on Reader Service Card.

USING THOSE WIDE-RANGE, ALL-MODE HANDHELD RECEIVERS

Competition really heats up among manufacturers of DC to daylight all-mode handheld scanning receivers. So how do you decide which one is best for you? *Gordon West*

A HIGH-POWER PIC MACRO LIBRARY

An extensive library of PIC macros is presented here that you can add to your own assembly language projects. *Karl Lunt*

THREE-AXIS CHOPPER, STEP MOTOR CONTROLLER FOR COMPUTER NUMERICAL CONTROL (CNC) APPLICATIONS — PART 3

Configure, connect, adjust, and test the three-axis chopper driver built in last month's article. *Dan Mauch*

NEW LIFE FOR A VINTAGE AUDIO FILTER

Follow this easy conversion process for a filter that dissipates less heat and is lighter in weight than the original. *Ron Tipton*

EL LIGHT: PLAYING IN THE DARK

EL lamps are everywhere, from cell phones to laptops. Here's how they work, and how to make them work in your projects. *TJ Byers*

LOW LOSS ELECTRONIC SWITCH

With the "flip of a switch," easily go between portable and stationary power with this handy circuit. *Fernando Garcia*

VOICE CHANGER

Voice changing can be an interesting application of electronics. Try out the Holtek HT8950A: an electronic circuit using a digital signal processing-type approach, but with no programming required. *Jack Dennon*

AMATEUR ROBOTICS NOTEBOOK

The challenge of allocating I/O bits with Breadbot. *Robert Nansel*

COMPUTER-CONTROLLED WORLD

Vacuum Florescent (VF) Displays. One of the finest display technologies available is now easy to use with any device capable of sending RS-232 characters. *Ryan Sheldon*

ELECTRONICS Q & A

TJ Byers

OPEN CHANNEL

Notes on vibration detectors and seismographs — Part 1. *Joe Carr*

STAMP APPLICATIONS

WWVB Clock Interface: Making use of the National Institute of Standards and Technology radio station. *Lon Glazner*

Classified Ad Index

10. Ham Gear for Sale.....35	120. Components.....46
20. Ham Gear Wanted.....0	125. Microcontrollers.....58
30. CB/Scanners.....35	130. Antique Electronics.....58
40. Music & Accessories.....36	135. Aviation Electronics.....58
50. Computer Hardware.....36	140. Publications.....58
60. Computer Software.....37	145. Robotics.....58
70. Computer Equip. Wanted.....37	150. Plans/Kits/Schematics.....59
80. Test Equipment.....38	155. Manuals/Schematics Wanted.....60
85. Security.....40	160. Misc. Electronics For Sale.....60
90. Satellite Equipment.....42	170. Misc. Electronics Wanted.....61
95. Military Surplus Electronics.....43	175. BBS & Online Services.....0
100. Audio/Video/Laser.....43	180. Education.....61
110. Cable TV.....44	190. Business Opportunities.....62
115. Telephone/Fax.....45	200. Repairs/Services.....62

Departments

Advertiser's Index ... 66
Classified Ad Info ... 66
Dealer Directory ... 62
Events Calendar ... 63
New Product News ... 97
News Bytes ... 14
NV AdMart ... 72-74
NV Bookstore ... 91
Prize Drawing ... 49
Reader Feedback ... 14
Tech Forum ... 76

NUTS & VOLTS MAGAZINE IS PUBLISHED MONTHLY FOR \$19.00 PER YEAR BY TEL PUBLICATIONS, INC., 430 PRINCELAND COURT, CORONA, CA. POSTMASTER: SEND ADDRESS CHANGES TO NUTS & VOLTS MAGAZINE, 430 PRINCELAND COURT, CORONA, CA 91719.

**VOLUME 20
NO. 7
JULY 1999**



10

22

47

50

82

88

92

68

6

30

26

16

Published Monthly By
T & L Publications, Inc.
430 Princland Court
Corona, CA 91719
(909) 371-8497
FAX (909) 371-3052
E-Mail — editor@nutsvolts.com
URL — http://www.nutsvolts.com

**Subscription
Order ONLY Line
1-800-783-4624**

PUBLISHER
Jack Lemieux N6ZTD

EDITOR
Larry Lemieux KD6UWV
MANAGING EDITOR
Robin Lemieux KD6UWS
**ON-THE-ROAD EXHIBIT
COORDINATOR**
Audrey Lemieux N6VXW

SUBSCRIPTIONS
Abby Madain

CLASSIFIED ADS
Natalie Sigafus

DISPLAY ADS
Mary Gamar

Copyright 1999
by
T & L Publications, Inc.
All Rights Reserved

All advertising is subject to publisher's approval. We are not responsible for mistakes, misprints, or typographical errors. Nuts & Volts Magazine assumes no responsibility for the availability or condition of advertised items or for the honesty of the advertiser. The publisher makes no claims for the legality of any item advertised in Nuts & Volts. This is the sole responsibility of the advertiser. Advertisers and their agencies agree to indemnify and protect the publisher from any and all claims, action, or expense arising from advertising placed in Nuts & Volts. Please send all subscription orders, correspondence, UPS, overnight mail, and artwork to: 430 Princland Court, Corona, CA 91719.

The Computer Controlled World: RS-232 Network Control Methods and Applications

VF Displays: Bright, Brilliant, and So Easy to Use

by Ryan Sheldon, National Control Devices (404) 244-2432 <http://members.aol.com/ncdcat>

One of the Finest Display Technologies Available is Now Easy to Use with ANY Device Capable of Sending RS-232 Characters.

Walk into a room with a Noritake vacuum florescent display and your eyes will automatically be drawn to its brilliant glow. VF (Vacuum Florescent) displays are among the most brilliant display

technologies available, boasting high brightness and a wide viewing angle, captivating the unsuspecting on-looker with a unique and uncommonly beautiful presentation.

"Beauty and the Beast" more accurately

describes these technical marvels.

Traditionally, they have been difficult to control for novice users, keeping them at a safe distance from many potential consumers.

Fortunately, the burden of controlling these



Figure 1. Title VFD Screen

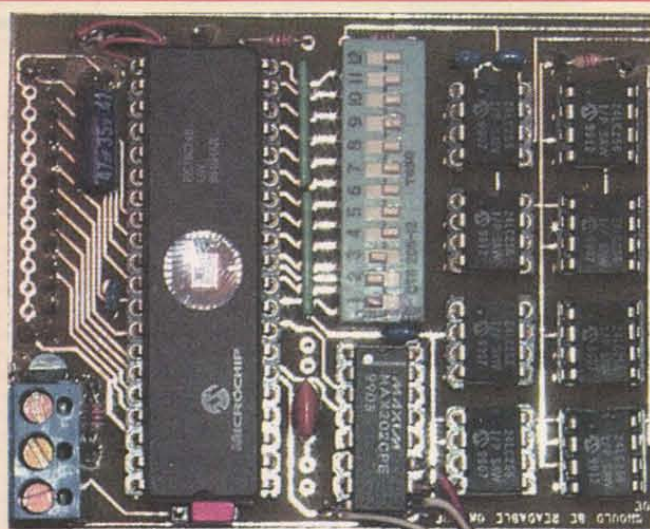


Figure 2. Picture of Controller



Figure 3. GDI Screen with Four Pictures

Figure 4. Change Image Command Screen

displays is finally over.

Gone are the days of hardware coding, bit-banging, parallel loading, and shifting. I have drawn on my experience of designing and building display controllers to integrate the features you have been asking for into the first of my series of Noritake VF display controllers. And I will confidently boast that you will not find a finer display or controller in this category.

This VFD display controller is the first in my line of devices to offer a simple ASCII-based command set. If you can send ASCII characters from your computer or micro-controller, then you can control this VF Display. Without exception, there is no easier way to control a vacuum florescent display. BASIC Stamp

```
Project1 - Form1 (Code)
(General)
ChangeImage

Public Sub ChangeImage(Frame)

    'This Subroutines Copies an Image Stored in EEPROM
    'to Display Page 1 of the Vacuum Florescent Screen.

    'Position Cursor on Page 1 of Display
    MSComm1.Output = Chr$(254) 'Enter Command Mod
    MSComm1.Output = Chr$(30)  'Go to Page 1

    'Issue Image Copy Command
    MSComm1.Output = Chr$(254) 'Enter Command Mode
    MSComm1.Output = Chr$(50)  'Issue Image Transfer Command
    MSComm1.Output = Chr$(Frame) 'EEPROM to Copy to Screen 1

End Sub
```



Figure 5. Noritake VFD Screen with Clock

users will have no problems writing simple BASIC control programs.

Forty-eight integrated commands allow you to plot pixels on the screen, copy images from memory to the screen, draw icons, scroll between images, write text, control the brightness, and much more. The VFD display controller holds 15 full-screen images (user-expandable to 127) in non-volatile EEPROM.

The controller shown here serves as a host for version 1.0 VF display control firmware. Using a PIC16C74 running at 20 MHz, a complex tangle of firmware plays host to your every desire, executing thousands of lines of code per second to hide the complexities of the display from the user. A set of 12 dip switches is used to set three start-up parameters. Three dip switches select baud

rates of 1200 to 115.2K baud, one dip switch is reserved for future expansion, and the last eight set a device number. The device num-

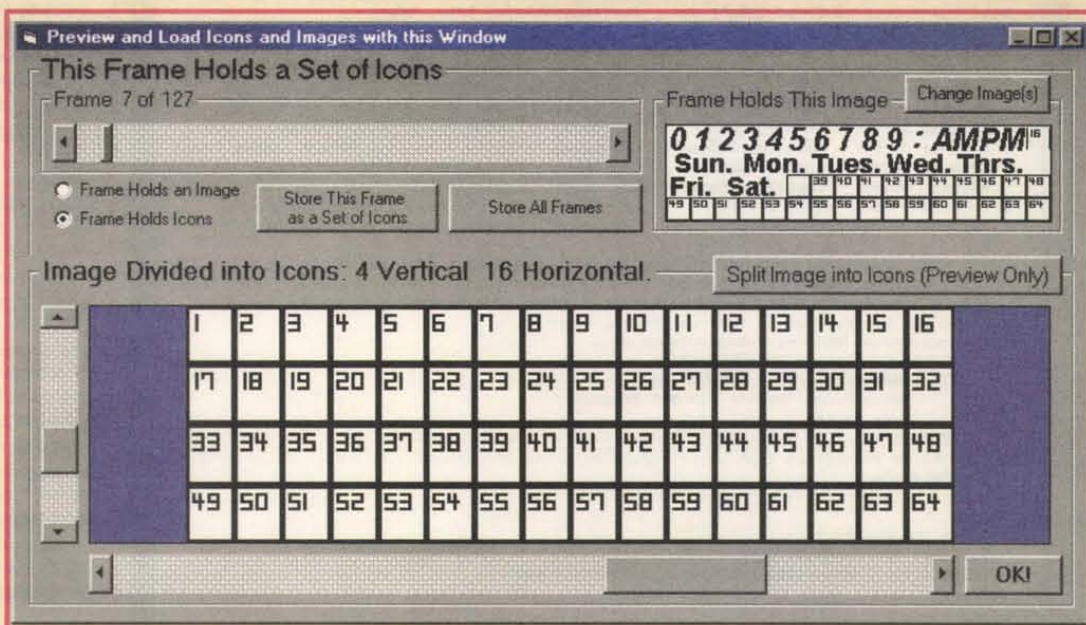


Figure 6. GUI of Numbers used in Clock and Icon Segmentation



Figure 8. System Monitor VFD Screen

ber allows you to control 256 devices on a single serial port. Speak to each device individually or all devices simultaneously.

A MAX202 is used to provide a three-wire RS-232 serial interface to your computer or micro-controller. The photograph shows the controller fully loaded with 256K of EEPROM (24LC256), allowing you to store up to 127 full-screen images. The base configuration stores 15 images and is user-expandable by simply installing more EEPROMs.

A complete graphical user interface further simplifies batch-loading images into the controller from a Windows 98 system. The Noritake GU256x64-372 VF Display holds

four images in its display memory. Figure 3 illustrates the GUI used to load images directly to display memory. Display memory may be scrolled using only six lines of code.

Scrolling is smooth because of the high refresh rate of the VF Display. Unlike many LCD displays, the Noritake VF Displays instantly refresh, eliminating the ghosting effect as images are scrolled or changed.

The VF Display screen memory is typically filled with garbage when first powered up. The VF display controller automatically loads the first four EEPROM images directly to the screen on power-up so the user is never confronted with unintelligible images.

Once the display is powered up, you may want to copy your own preloaded images to the screen. Images may be used as menus or as templates to a more complex user

interface as shown later in this article.

Upon power-up, the VF display controller is ready to accept data. Received data is sent directly to the screen. If ASCII 254 is received, the display controller is put in command mode. The next ASCII character defines a command, allowing you to scroll, copy images, control the brightness, plot pixels, or just about anything you can think of.

Figure 4 sends two commands to the display controller. The first command (30) tells the display to position the cursor on page 1. The second command (58) is used to copy an image stored in EEPROM to the display. The "Frame" identifies the image to copy to the screen. EEPROM memory is organized as frames, or full-screen images. The first EEPROM stores 15 frames. Each additional EEPROM adds 16 frames of storage to the controller.

One of the most powerful features of the VF Display controller is the ability to store icons. Icons can be used as Fonts in a limited capacity. Figure 5 illustrates the use of icons to display the current time and day of the week.

When loading images into the controller's memory, the user has the option of storing the image as a full-screen graphic or as a set of icons. The image shown in Figure 6 is loaded as a set of icons, allowing your program to reposition any portion of the image in just about any location on the display screen.

Figure 7 shows you how to use the paste icon command. This is the most CPU-intensive command, necessitating a few short delays between each ASCII character, giving the CPU time to perform the calculations necessary to position the graphic on the screen. Once this command is complete, ASCII character 85 will be sent to your computer or micro-controller signifying the completion of the icon paste command.

Figure 8 demonstrates the use of a complex user interface consisting of a template image (shown in the third image

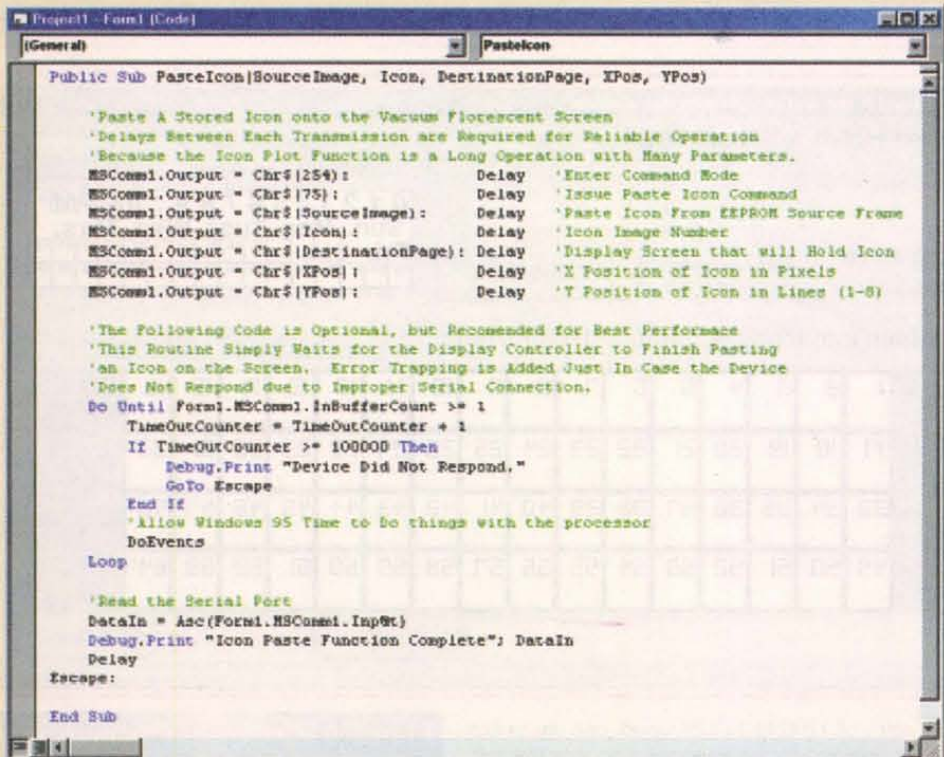


Figure 7. Paste Icon Source Code

Figure 9. GCI Level Meter Bars Icon Screen

of Figure 3) used as the background. Level meters are pasted into the interface for a graphical representation of analog values. These level meters were drawn in Photoshop 5 and loaded as icons, shown in Figure 9.

The graph on the left side in Figure 8 was drawn using the VFPLLOT command, allowing you to draw pixels anywhere on the screen. The VFPLLOT command is very easy to use. Figure 10 illustrates how to plot pixels on the screen.

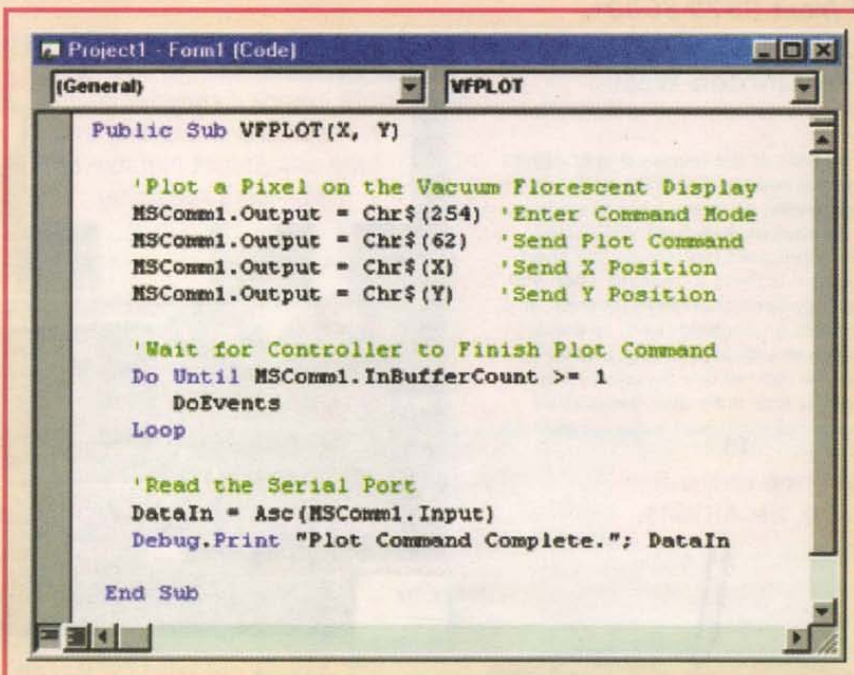
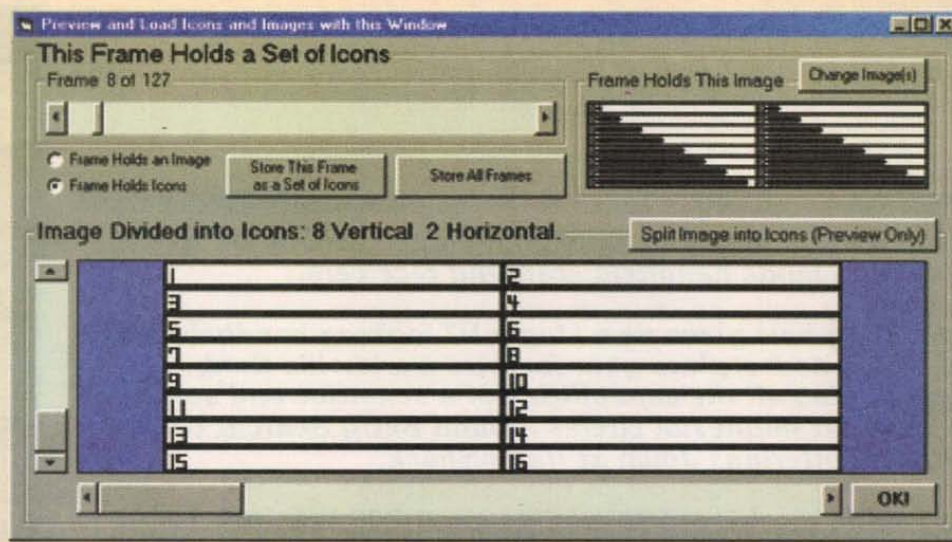
Again, ASCII character 254 is used to put the controller in command mode. ASCII 62 is used to access the plot function; X and Y represent the location of the pixel that is to be turned on.

VF Displays may be used in just about any indoor application. Unlike LCDs, VFDs are not suitable in sun-lit environments. The Noritake GU256x64-372 requires a five-volt power supply capable of delivering two amps. Because of the high power consumption, VFDs are not typically used in battery-operated devices.

I hope you have enjoyed learning some of the basics of Vacuum Florescent displays; they are a truly remarkable technology with many applications. Future articles will explore this technology further from a more technical standpoint.

The VFD display controller shown in this article is currently in production and is due to ship by mid-August to early September at the latest. The controller and display will sell for \$399.00; **Nuts & Volts** readers with a current paid subscriber number and expiration date may purchase an evaluation unit at the 10-piece price of \$349.00. An additional \$25.00 discount is offered for prepaid backorders. NV

Figure 10. VF Plot Function Source Code



THE COMPUTER CONTROLLED WORLD

PRINTED CIRCUIT BOARDS

**QUALITY PRODUCT
FAST DELIVERY
COMPETITIVE PRICING**

- * UL approved
- * Single & Double sided
- * Multilayers to 8 layer
- * SMOBC
- * LPI mask
- * Through hole or SMT
- * Nickel & Gold Plating
- * Routing or scoring
- * Electrical Testing
- * Artwork or CAD data
- * Fast quotes

PROTOTYPE THROUGH PRODUCTION

PULSAR, INC

9901 W. Pacific Ave.
Franklin Park, IL 60131
Phone 847.233.0012
Fax 847.233.0013
Modem 847.233.0014
www.pulsar-inc.com

Write in 33 on Reader Service Card.



Black Feather Electronics
10841 Noel St. #106
Los Alamitos, Ca. 90720

DIRECT DIAL: (714) 236-1776 FAX: (714) 236-1778 E-MAIL: blktea@juno.com
WWW.BLKFEATHER.COM
WE BUY EXCESS/SURPLUS ELECTRONIC SUPPLIES

Write in 32 on Reader Service Card.

USING THOSE WIDE-RANGE, ALL-MODE HANDHELD RECEIVERS

Competition heats up among manufacturers of DC to daylight all-mode handheld scanning receivers.

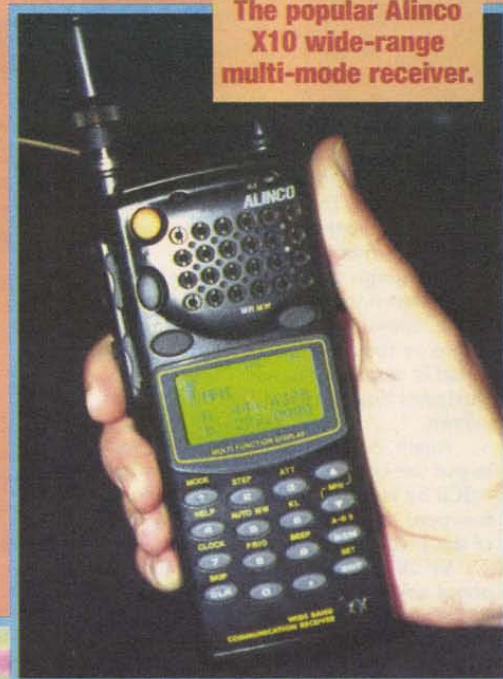
Technology now gives us a single HT-looking handheld radio that might now replace your favorite worldwide Sony and Grundig, plus all the capabilities of a sensitive and selective scanner that might run circles around Betty Bearcat or the VHF/UHF offerings down at RadioShack.

Multi-mode receive starts way down at 200 kHz, and could extend well above 1500 MHz. All in one nice, neat package priced from \$379-\$600+.

by Gordon West

When you look at the technical spec sheets on these scanning shortwave and VHF/UHF receivers, it's really hard to tell how they stack up against dedicated VHF/UHF scanners and dedicated high-frequency shortwave equipment. Is there a trade-off when you take a dictionary-sized shortwave receiver, and shrink it down to a handheld-sized, all-mode scanning receiver with built-in VHF and UHF capabilities? I wondered this myself, so I have tried each of the four units over the past six

The popular Alinco X10 wide-range multi-mode receiver.



ICOM America showing plenty of receivers, scanners, and ham equipment capable of wide-band receiving.



The AOR top-of-the-line receiver, the AR7000.



months, and found that they are all admirable performers, but all share some of the same limitations down on the worldwide bands, plus some limitations in the traditional VHF bands.

Each set looks much like a two-way ham or business band transceiver. Battery down on the bottom, speaker in the middle, and the keypad with an LCD display. Volume and squelch controls like a regular two-way radio, but no push-to-talk because these are receivers, not transceivers — except for the unique new Yaesu VX5 which is more like a ham transceiver with wide-band VHF/UHF coverage and AM-only modes down below 30 MHz.

Common to all four handheld scanning receivers, down on the shortwave bands, skywave reception with decent signal levels is pretty tough with the supplied little rubber-duck antenna. But

since this equipment has a BNC jack, it's relatively easy to substitute a telescopic whip that makes a fairly positive difference, or a long-wire antenna that makes a huge difference.

The AOR 8200 has a unique plug-in ferrite AM broadcast band antenna bar that kicks the receiver into overdrive when pulling in weak nighttime AM broadcast radio skip signals.

Is there a trade-off when you take a dictionary-sized shortwave receiver, and shrink it down to a handheld-sized, all-mode scanning receiver with built-in VHF and UHF capabilities?

The little plug-in ferrite antenna is so compact that I'm surprised they couldn't have figured out a way to build it inside the chassis — but nonetheless, if you want a hot AM radio for broadcast band reception, just plug in the little AM broadcast band ferrite bar.

On high-frequency shortwave, the ICOM, AOR, and Alinco all offer hot multi-mode reception coming out of that very small speaker. A set of stereo headphones really pulls in



Author West tunes in UHF business band calls in London.

the great audio capabilities but, of course, you won't get stereo — even on the FM music band.

In a recent test of the AOR handheld receiver in London, I was impressed that they made shortwave reception automatically mode selected. When you punch in 15 MHz or 10 MHz for the WWV time signals, it goes to AM. Punch in BBC or VOA frequencies, and the radio is on AM, again. But punch in a ham 40-

meter frequency — such as 7285 kHz — and presto, the automatic mode selector switches it over to lower sideband. Go to 20 meters, 14285 kHz, and presto, it comes up upper sideband.

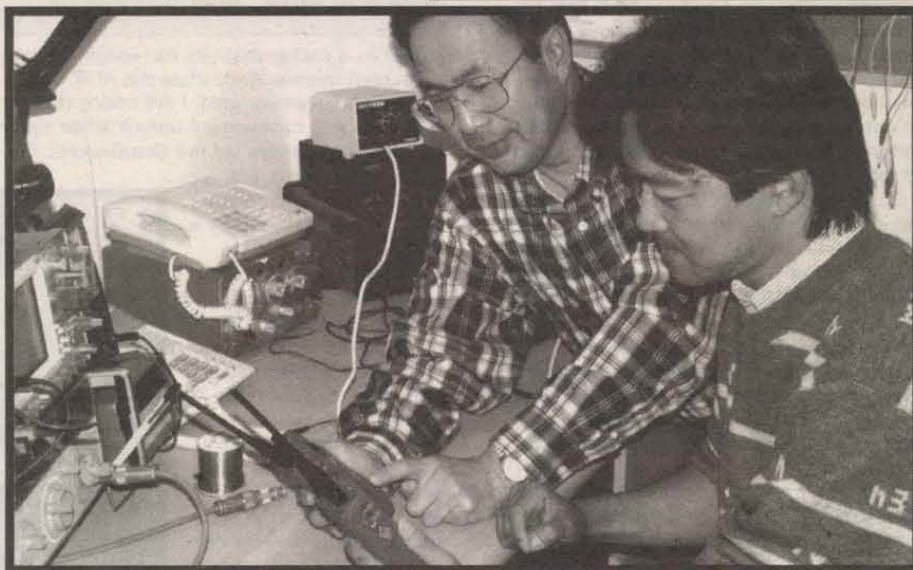
We found that each handheld scanner did a decent job for both sensitivity and selectivity on the high-frequency bands, but all equipment seemed to be operating with fast automatic gain control (AGC). If you're

an avid shortwave or ham radio listener, fast AGC is not as pleasant or as smooth to listen to as slow AGC. With fast AGC, background band noise rushes up after each syllable or dot and dash, and this makes for slightly noisier reception than tuning in a relatively strong signal on a regular shortwave receiver, and having the background noise hushed by the slow AGC action on strong voice syllables. When copying Morse Code, expert hams like fast AGC, but if the code is relatively strong, I prefer slow AGC.

When you find a station you want to store in memory, all of the receivers offer memory capabilities, along with name calling. This means you can enter some letters or numbers to come up on the screen each time you recall that specific shortwave or VHF/UHF frequency. With 1,000 memories, this sure beats bringing along a little cheat sheet that tells you what is where!

But with so many memories, all of these little handhelds really require diligent reading of the instruction book. In fact, unlike a simple shortwave set or simple scanner with just a couple of buttons, each of these handheld receivers are NOT ones that you can just turn on, start punching some buttons, and quickly

Taka and John testing a new shipment of wide-band AOR receivers.



• **ALINCO DJ-X10T**, all mode, 100 kHz to 2000 MHz, 1,200 memories, eight-character alphanumerics, triple conversion receiver; \$389.00.

• **AOR AR8200**, all mode, 530 kHz to 2040 MHz, 1,000 memories, eight-character alphanumerics, triple conversion receiver, computer-controllable; \$569.00.

• **ICOM IC-R10**, all mode, 500 kHz to 1300 MHz, 1,000 memories, eight-character alphanumerics, triple conversion receiver; around \$400.00.

• **Yaesu VX5**, tri-band ham transceiver, AM mode for shortwave, 500 kHz to 16 MHz, FM wide and narrow modes for 47 MHz to 999 MHz. Keep in mind two-meter, six-meter, and 440 MHz ham transceiver capabilities, too. No sideband mode for shortwave, 220 memories, computer-controllable. Price around \$500.00+.

WHOLESALE CABLE

COMPLETE LINE OF CABLE PRODUCTS

- ✓ Quality merchandise by brand name manufacturers
- ✓ Satisfaction guaranteed
- ✓ Free gift on first order
- ✓ Technical support
- ✓ 2 year warranty on new converters
- ✓ COD shipping & overnight shipping by request
- ✓ Experience where it counts
- ✓ Volume pricing

PLAIN CONVERTERS: ZENITH, OAK, PANASONIC, PIONEER, EAGLE, HAMLIN, STARGATE, PLUS MORE.

REMOTE CONTROLS: ALL MAJOR BRANDS, INCLUDING 2-4 FUNCTION UNIVERSAL REMOTES

Tell us the best price you were offered, where you got it from, and let us try to beat it.



WHOLESALE CABLE M-F 11am-6pm EST (718) 206-0879
(718) 262-0900 • FAX (718) 657-4015 • (718) 297-9221

No NY sales. Federal and local laws provide criminal and civil penalties for unauthorized use. Check with your cable providers for permission to use equipment. Must be paying for all services you receive. Order by model number only. Some equipment refurbished as new.



EPROM+

A device programming system for design, repair and field service

- ◆ EXCEPTIONAL POWER FOR THE PRO
- ◆ EASY-TO-USE FOR THE NOVICE

Here's what you get: A rugged, portable programming unit including the power pack and printer port cable both of which store inside the case. A real printed user and technical manual which includes schematic diagrams for the programming unit plus diagrams for all technology family adapters*. Comprehensive, easy-to-use software which is specifically designed to run under DOS, Windows 3.1, 95 and 98 on any speed machine. The software has features which let you READ, PROGRAM, COPY and COMPARE plus much more. You have full access to your system's disk including LOADING and SAVING chip data plus automatic processing of INTEL HEX, MOTOROLA S-RECORD and BINARY files. For detailed work the system software provides a full screen buffer editor including a comprehensive bit and byte tool kit with more than 20 functions.

Broad device support: Including FIRST GENERATION EPROMS (2708, TMS2716*, 25XX etc.) SECOND GENERATION EPROMS (2716-27C080) 8 MEG, 40 and 42 PIN EPROMS* (27C1024-27C160) (16 MEG) EEPROMS (2816-28C010) PLUS ER5901, FLASH EPROMS (28F29C29EE, 29F32) MEG, NVRAMS (12,20,X2210/12) 5 PIN SERIAL EPROMS* (24, 25, 85, 93, 95, 80011A) PLUS ER1400/MS8657* BIPOLAR PROMS* (74S/82S), SERIAL FPGA CONFIGURATORS (17CXXX) MICROS* (874X, 875X, 87C5X, 87C75X, 89C) ATMEL MICROS* (89S, 90S) (AVR) PIC MICROS* 8, 18, 28, 40 PIN (12CXXX, 16C5X, 6X, 7X, 8X PLUS FLASH & 17C) MOTOROLA MICROS* (68705P3/U3/R3, 68HC705C8/C9/J2/P9, 68HC711E9/D3)

Includes step-by-step tutorial plus explanation of EPROM fundamentals \$5.00 SHIPPING • \$5.00 C.O.D.
1 YEAR WARRANTY - 30 DAY MONEY BACK GUARANTEE VISA • MASTERCARD • AMEX
*REQUIRES SNAP-IN ADAPTER (ORDER FACTORY DIRECT OR BUILD YOURSELF)

ANDROMEDA RESEARCH, P.O. BOX 222, MILFORD, OHIO 45150
(513) 831-9708 FAX (513) 831-7562
website - www.arlabs.com email - arlabs@worldnet.att.net MADE IN THE U.S.A.

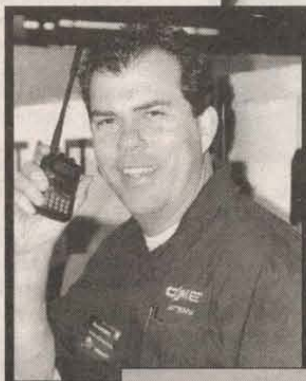
figure out what goes where in a matter of minutes. It's going to take you days, if not weeks, to master all of the many functions and options they have behind many of the on-screen menus.

The AOR AR8200 has an optional computer connection kit that includes cable and software for your Windows-based computer running from a CD-ROM. AOR is presently working on a software package that will be made available as an Internet free download from the AOR web site, www.aorja.com. The side-mounted AOR specific connector also supports cloning of memory data between two AR8200s, plus capabilities for tape recorder output, detector output, mute, and they say automatic gain control.

AOR goes one step further with a trap door on the bottom of the unit to accept optional slot cards. One memory slot card could increase storage of up to 4,000 memories, with 160 search banks. Another slot card could give you full encode and decode CTCSS squelch. Another interesting card is a 20-second voice recorder playback system, allowing you to repeat specific messages that you captured onto the digital voice recorder card. They have another card that is specifically designed to eliminate specific idle tones that will sometimes hang up scanners. But one card they say they cannot bring into the USA is the voice inverter card, designed to decode light-scrambled radio calls.

But since the AOR also does upper and lower sideband true carrier re-insertion, I suppose if you wanted to play around with this mode on certain signals you very well could pull in some intelligibility without the band voice inverter card.

I liked the AOR side-mounted tuning thumbwheel. This could allow me to hold the equipment in one hand, and do all of the tuning without needing to use my other hand. There is also a side four arrow keypad that



The very small Yaesu VX-5 wide-band scanning three-band transceiver.

works as a rocker that lets us navigate through on-screen menus. And, while the AOR had exceptional receiver gain, I did notice that the PLL goes into momentary unlock while zipping through frequencies via the thumbwheel. On scan, no problem, but keep this in mind so you don't accidentally zip by a frequency that may be occupied but you missed because you were going so fast, the PLL was still trying to achieve lock.

The AOR also has a band scope that I really didn't think I could ever use. But when I was in London, I found the band scope very useful in telling me where the major activity was for certain VHF and UHF calls,



like marine radio, air radio, THEIR business band frequencies, and THEIR public safety channels. The band scope mutes the receiver on search, but about 30 seconds later, you've got a great 10 MHz insight on what is around the center frequency you have initially dialed in.

A highlight in England was going to the zero meridian, and standing next to the Greenwich mean time (GMT) clock. I wondered whether or not we could hear USA WWV signals, and sure enough, there was faint reception to a long telescopic whip as long as I held it in just the right position near a big mass of ungrounded metal.

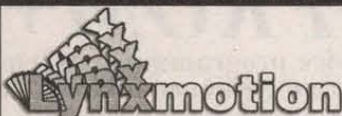
On the way back home, there was plenty of interesting AM aeronautical traffic at Heathrow Airport, JFK New York, and LAX in California. Again, the band scope on the AOR



The Alinco X10 in action at a shortwave listener's convention.

**So which one is best for you?
Alinco? ICOM? AOR? Yaesu?**

5 Axis Robotic Arm Kit \$195.00 Plus S&H



You can build this Robotic Arm!

Impressive, fast, accurate and repeatable motion. Any computer capable of sending 2400 or 9600 baud serial data can control the arm, even a Basic Stamp! This arm makes a great foundation for AI and motion control experiments. Position the arm in an X, Y, Z, grid with a joystick or keyboard using the new RoboMotion for Windows. The kit includes all of the hardware and structural components, six quality Hitec HS-300 servos, pre-assembled SSC servo controller, DOS and Windows software, and an illustrated assembly manual.

We have many more cool robots, check out our web page or ask for our free catalog!
3 Axis Version \$155.00 • Mobile Version \$250.00 • Mobile Robots Book \$32.00

Lynxmotion, Inc.
104 Partridge Road
Pekin, IL 61554-1403 USA
<http://www.lynxmotion.com>



Tel: 309-382-1816
Fax: 309-382-1254
sales@lynxmotion.com
tech@lynxmotion.com



Equipment Management Technology

Moving Sale

Tel 650-631-1700 Fax 650-631-1200 Email sales@emt1.com

SELECTED SPECIALS!

HP 16505A	\$250	HP E1345A	Make Offer!
HP 16510A	\$100	HP E1347A	Make Offer!
HP 16515A	\$100	HP E1364A	Make Offer!
HP 16516A	\$400	HP E1400B	Make Offer!
HP 3314A	\$1400	HP E1401A	Make Offer!
HP 5335A	\$500	HP E1662A	Make Offer!
HP 59501B	\$250	HP E1671A	Make Offer!
HP 6266A	\$250	HP E1672A	Make Offer!
HP 8016A	\$500	HP E1681A	Make Offer!
HP 83545A	\$3850	HP E1682A	Make Offer!
HP 8493B	\$100	HP E1693A	Make Offer!
HP 8958A	\$5000	HP E1725A	Make Offer!

We buy, rent, and sell high quality test and measurement products. We occasionally offer great deals on computers as well.

HP OmniBook 600C color subnotebook weighs a mere 3.7lbs for ultimate portability. Special Nuts & Volts price is only \$250!

Dave is test equipment!
Bigdave@emt1.com
Kerry is computers!
kwhite@emt1.com

956 Bransten Road
San Carlos, CA 94070

NEW ADDRESS

8200 proved helpful in identifying where to tune for the action.

Up on VHF and UHF, all four scanning receivers did well. AOR has again preset modes according to popular USA and foreign ham band operation. Down at the bottom of six meters, two meters, the 222 MHz band, and 430 MHz, the equipment would automatically come up in upper sideband. When I tuned in the satellite portion of the two-meter band at 145.80 to 146.00, sure enough, the AOR went from FM back to upper sideband for weak signal reception. As soon as I tuned to 146 MHz, it jumped back to narrow-band FM. The AOR also has some additional more-narrow filters for restricting AM, FM, and several other modes of reception to a tighter bandwidth.

But I did notice something with the AOR 8200 that also seemed to affect — to a lesser extent — some of the other receivers. The problem is overload from 152 MHz pagers when tuning ham band and marine band frequencies near 140 MHz-165 MHz. I had tuned in some weak national weather service frequencies on the little rubber antenna, and then switched over to the telescopic whip to see how much the distant stations would improve in signal strength. They improved a lot. I then plugged in a big 9 dB gain Shakespeare 476-1 VHF collinear antenna, and all of the weak weather stations mysteriously disappeared. In fact, so did our nearby strong weather station. And there was nothing wrong with my big outside antenna.

When I went to the band scope to see exactly what the problem was, I could instantly see a huge spike at 152 MHz. This was a local paging transmitter that is on the air almost continuously, except for a brief 10-second carrier drop right on the hour. And sure enough — as soon as their carrier would drop, the big antenna would instantly pull in the distant weather stations loud and clear. But as soon as the paging transmitter came back up on 152 MHz, it literally swamped the VHF section of the AOR 8200 handheld receiver, and I had to go back to a smaller antenna.

But, to some extent, this has happened with a lot of VHF handhelds on my test bench, and I have a nice little notch filter that can easily go in line to quiet the squawk from the 152 MHz paging transmitter just a couple of miles away.

These little handheld scanners on VHF and UHF offer almost non-stop coverage from your local 40 MHz state police frequencies all the way up to the GPS band at 1575 MHz. It probably won't be too long until they include a little card for GPS reception, too!

If you go to air shows, I found running the ICOM R10 in the scan-up mode around 300 MHz quickly seeks out the air-to-air and air-to-ground action. If you're running the Yaesu VX5, you can call your buddies on two meters, six meters, or 70 cm, and tell them where the action is. But few dual-band and tri-band ham transceivers offer hot 300 MHz military reception. The Yaesu and ICOM ham sets do!

The AOR did nicely on wide-band AM reception down at 137 MHz for NOAA satellite signals. I would feed them into a SSC weather FAX computer program, and voila, I could easily decode twice-a-day weather facsimile broadcasts coming in from polar-orbiting weather satellites. It takes wider than usual AM capabilities to get good satellite reception, and the AOR has an extra-wide setting for extra-wide AM data receive. It also gives some extra fidelity to tuning in BBC and VOA calls, too.

On all of the equipment, each manufactur-

er has blocked out the cellular segments of 800 and 900 MHz. I could still tune in my favorite 856.4625 MHz public safety calls, but a little above that the equipment jumps to the public safety bands above cell phone. By FCC order, there is no simple way to unlock cellular. But if you really get bored, try tuning FM just below 50 MHz, hold onto your earphones, and keep your lips sealed.

I have a repeater on 1282.400 MHz, and both the Alinco, as well as the AOR, picked up the signals best of all. In fact, I think these little receivers did a slightly better job than a little 1270 MHz two-way handheld I own. I was

The AM broadcast ferrite loop antenna.

impressed. But my handheld had a lot more audio output than the little scanners, so that is something else that you may wish to find out before you plunk down the dollars — what kind of speaker and how much audio can you really get out of this equipment when it is hanging on your belt?

Probably the best part of this kind of gear is its portability and capabilities of running on just four AA batteries for several days on end. Of course, the louder you play the volume, the more it's going to deplete the internal batteries. The AOR battery tray accepts either AA alkalines or AA rechargeables. They send along a Maha recharger for either nickel cadmium or nickel metal hydride cells, but you still need to go to the trouble of removing the batteries in order to give them a recharge. And, when we tried to plug in alkaline AA cells, I had to take out my handy fingernail file, and give the top of the AA positive contacts a

The AOR thumbwheel frequency selector, with the rocker selector seen below.

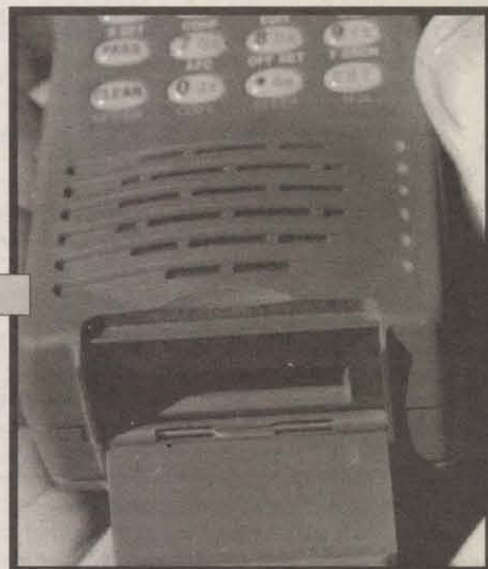
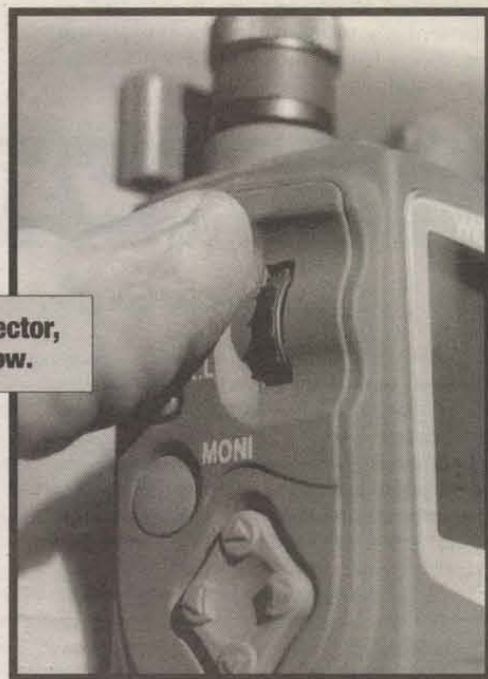
little file job in order to get them to finally fit in the very tight holder. But "Taka" at AOR tells me this is the way it's supposed to be in order to keep the batteries in nice and tight and free from loose connections. I guarantee on the AOR, they won't be loose!

So which one is best for you? Alinco? ICOM? AOR? Yaesu? Each seems to have its own style of operating, and your best bet is to get your hands on each brand of equipment, and play it for a few minutes down at the radio store in order to get the "feel" of how it operates.

On some equipment you will find the audio volume lacking dramatically. Yet on others, it's reasonably loud. Some have more base, and some seem a bit tinny. But it all depends on what you like to hear from a portable scanner, and what it sounds like through your own set of lightweight headphones — which means I won't try to tell you which set is going to be exactly the best one

The slot card trap door.

for you — all four performed well beyond their listed specs, and the AOR 8200 that went halfway around the world with me really pulled in some exciting calls and gave me the portability to keep it hanging on my hip and barely noticeable as a powerful shortwave and VHF/UHF scanning receiver. Check all of them out at your local radio dealer or their catalogs, and then choose the one that you seem to like best. **NV**



reader FeedBack

Dear Nuts & Volts:

I wish to acknowledge all the letters of correction regarding my "Tech Forum" response published in the Mar. '99 issue (Question #3996: Non-Polarized Electrolytic Capacitor Replacement).

To all writers of those letters: I offer MY HEARTFELT AND SINCERE THANKS for correcting my errors AND "re-educating" me regarding capacitor behavior!

For the record: It WAS NOT my intention to provide erroneous and potentially dangerous information/suggestions to the individual I replied to. To that end, I'm ETERNALLY GRATEFUL to

those who cared enough to correct my unintended misinformation.

To Mr. Broussard (original asker) and "anyone else" needing similar info: while the "concept" in my answer was basically valid, PLEASE heed the warnings and recommendations regarding voltage ratings for the capacitors! Your safety, as well as the safety of your equipment, isn't worth going "the cheap route."

I thank the readership of *Nuts & Volts* for being "on the ball" in quickly catching these kind of errors and summarily correcting them.

Ken Simmons
Auburn, WA

meant a REACTer's personal communications had to be on a different repeater frequency.

Since REACT is a non-profit volunteer organization with limited funds, it would have been a financial hardship to maintain two repeaters — one for each purpose. According to W. Robert Stone, REACT Chairman of the Board, some teams were planning to move their repeaters off the .675 frequency for not being able to support two separate ones. This would have left .675 with less chance — not more — of an answer for emergencies and assistance.

One aspect of Docket 98-20 was not revised, and is still in effect. Licensees of any GMRS frequency can use any other GMRS frequency. At this time, it is unknown how owners might react when unknown users start to appear on their repeater.

REACT was founded in 1962 and is the recipient of the President's Volunteer Action Award. Although first use involved CB radio — which still exists — most teams now also use the GMRS. There is an extensive network of GMRS repeaters throughout the country.

In a typical year, members may monitor CB, GMRS, Amateur, VHF, and Marine frequencies over three-million total hours. Approximately 170,000 calls will be taken and 39 million dollars will be saved by taxpayers because of this work.

Many areas of the country still need REACTers even though it only takes three people to start a team. Information may be found on the Website: www.reactintl.org

Newsbytes

Embedded Design Bulletin

The Embedded Design Bulletin is a free quarterly newsletter of interest to engineers, new product developers, design/manufacturing firms, and all else interested in electronic and microcontroller-based circuit design.

Containing the latest in new cost-saving components, professional hints and tips to aid in fine-tuning microcontroller designs, reader input on field-trials of various design techniques, and mini-tutorials on cutting-edge topics, it's an excellent way to stay on top in the fast-paced electronics design world!

Both an electronic and a printed version of the Embedded Design Bulletin are available. Anyone can subscribe to this free newsletter by completing a simple address form on our web site at <http://www.elabinc.com>.

e-lab™ Digital Engineering, Inc.

P.O. Box 520436

Independence, MO 64052-0436

816-257-9954 Fax: 816-257-9945

FCC Restores Non-Emergency Use On 462/467.675 Frequency

Action by the Federal Communications Commission June 10th has re-instated the original use of an important GMRS frequency pair.

Throughout the country, many licensees had been using 462/467.675 for personal communications. This was eliminated by the FCC on March 8th as part of Docket 98-20. Many letters were received in Washington protesting this action, which has now been reversed after three months.

Many REACT (Radio Emergency Associated Communications Team) monitor .675 for emergency and motorist assistance. It has been known as the unofficial channel for that purpose although not the only use that was allowed. The FCC action in March makes it exclusively for that kind of use. In the case of numerous teams that own .675 repeaters, this

Hall Duncan, Fred Lanshe — Directors of Community and Public Relations

Bob Leef, Ron McCracken — Public Relations Committee Co-Chairs

Ninth Annual Shareware Industry Conference To Be Held July 22-24 in Tampa

TAMPA, FLORIDA — The Shareware Industry Conference (SIC), an international meeting of software programmers, developers, and distributors, will hold its ninth annual gathering from July 22-24 at the Wyndham Harbour Island Hotel in Tampa, Florida.

One of the most important segments of the fast-growing software industry, shareware is a marketing channel where users are able to evaluate programs before making a final purchase. The "try it before you buy it" software market accounts for nearly \$650 million in annual sales, and has been influential in the premiere of new technologies including Internet browsers, anti-virus products, e-mail programs, and Windows utilities. Most shareware sales occur online, making it one of the most significant examples of electronic commerce.

The SIC 99 conference will feature the Shareware Industry Awards, the most prestigious honors bestowed upon shareware programs, and will also include the latest round of inductions into the Shareware Hall of Fame, a special pantheon celebrating the pioneering individuals and groundbreaking products which have propelled this industry segment since its debut in 1983.

SIC 99's breakout sessions will feature a lively mix of technology-related subjects as well as focus groups dealing with marketing, sales and business management. Registrations for SIC 99 can be processed online at the conference's web site at <http://www.sic.org>. The web site also includes information on discount airfare, hotel accommodations, conference exhibit booths, and sponsorship. Registrations can also be accepted by telephone at (800) 218-8294. SIC 99 is sponsored by the Shareware Industry Awards Foundation.

Contact: Michael E. Callahan — mike@drff.com

BEST Prices - Brand Name - Full Year Warranty

Netcom Friendly Staff Since 1983

Cruiser & Work Horse Compaq LTE ELITE 486 DX4-75

9.5" Active Matrix Display
(Sharper & Brighter than a standard display)
810m Standard Hard Drive -or- (1Gig \$29 option)
16M Ram Standard -or- (24M \$19 option / 32M \$39)
28.8k FAX MODEM -or- (33k \$15 option)
2-PCMCIA Expansion Slots & All Standard Ports
(1S,1P,1VGA,1Kbd)
Hydride Battery (2X the Power) \$150 Value FREE
EJECTABLE: Battery, Hard Drive & Ram
Expandable & Upgradable
INCLUDES Lifetime Compaq Tech Support
Built-in Floppy & Power Supply
Searchable Owners Manual Software
FAX Modem Software, W95

Got more in



WOW 2 easy payments of
\$288!
0% Financing!
On Credit Cards only

0% Financing!

For up to the minute
Availability we'll fax or
email you (with Pictures)

Racy & Web Ready IBM THINKPAD 486 DX4-100

Huge 10.5" Active Matrix Display
(Sharper & Brighter than a standard display) *Wow!*
1 Gigabyte Hard Drive Standard -or- (2 Gig Drive \$59! Option)
24M Ram - 33k FAX MODEM - 2 PCMCIA Expansion Slots
Dual Infrared Ports (Front & Rear)
Track Point Mouse All Standard Ports (1S,1P,1VGA,1Kbd)
Pop out - Hard Drive, Ram, & Battery
Ram & Hard Drive Expandable & Upgradable.
Includes Power Supply & Hydride Battery (a \$150 value)
INCLUDES Lifetime Tech Support
Internet Ready, AOL 4.X Latest Version
Fax Modem Software, Searchable Owners Manual S/W,
Ask about Desktop Docking Station & Port Expander

ACTIVE COLOR
a \$300 Value FREE



WOW 2 easy payments of
\$325!
0% Financing!
On Credit Cards only

MAXIMUM ABUSE

strictly for professionals

Blazing Sunlight or Rain Storm

On the **DESERT** or **SNOW**

Instant ON - ZERO boot up time

Drop 3' to Concrete

Actual Selling
Price from IBM
\$6912

Rain: (4"/hr Rain w/ 40 MPH Winds)
Silicone Rubberized & Diecast Case!
Ultra Shock Mounted 1Gig EIDE Hard Drive!
ESD/EMF & RF Resistant, Works from -4 to 120 Deg F
& Vacuum to 15,000 ft

- > 1- PCMCIA (type 1, 2 or 3), Serial & Parallel Ports in rear
- > 16m Ram / 1m Video / 32 Bit Local Bus 486-50 Mhz & Math Co-processor, 28.8k Modem (Internet Ready)
- > Long Lasting Hydride Battery (\$150 Value)
- > Sound & Microphone, External Mini 3.5 Floppy
- > 8.25" Display-64 Shade Monochrome REFLECTIVE
- > (Optional) Touch Screen with

Handwriting Recognition
Rough Service Handle with Loops for optional Shoulder Strap
Roxanne's Voice Annotates all Windows 3.X Functions
(a real kick)

- 32 Bit Mother Board makes it compatible with W95
- > Optional 12V Car cord \$29
- > Optional 33k Baud PCMCIA Fax / Modem Upgrade \$35

This was a unique (one shot) purchasing opportunity
IT'S NOT OPEN STOCK

WHEN THEY'RE GONE, THEY'RE GONE FOR GOOD
Sold till recently by IBM through their Local Area Network
Division at \$4,699 & \$6,912 as shown here (they were never discounted)

IBM ROAD WARRIOR

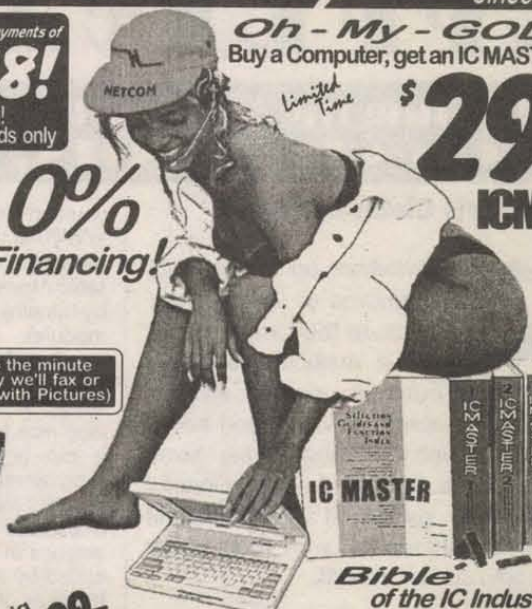
An Extremely Serious Piece of Equipment

WOW 2 easy payments of
\$399!
0% Financing!
On Credit Cards only



Oh - My - GOD!
Buy a Computer, get an IC MASTER for

\$29!!
ICMaster



IC MASTER

Bible
of the IC Industry
Every Cross-reference
3 Volume Set with Tons of Information

	with computer	alone	regular
ICMaster \$195 Publisher	\$29 95 edition	\$49	\$69
	\$39 96 edition	\$59	\$89
	\$49 97 edition	\$69	\$129

Mega Sale Ends Soon

The Screamer

IBM THINKPAD Pentium P-75

2 Gig Hard Drive! (Standard)

All other features same as the IBM DX4-100

INCLUDES Lifetime Tech Support

Ask about Desk Top Docking Station & Port Expander



WOW 2 easy payments of
\$428!
0% Financing!
On Credit Cards only

Original \$3,499

ACTIVE COLOR
a \$300 Value FREE

Auto Power Adapter \$59

Notebook Attache'

\$39 with purchase

\$59 alone

\$139 in Office Max



1 Year Warranty - Satisfaction Guaranteed - The Friendliest People - The Best Customer Service
2 PAYMENT PLAN with Credit Card -or- Layaway ONLY 843-650-5700 For Questions-or- email: netcomd@aol.com
COD's SINGLE PAYMENT ONLY ORDERS ONLY 800-733-3733 ORDERS ONLY FAX 843 650 5777 10am-8pm Mon-Sat

STAMP APPLICATIONS

by Lon Glazner



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

WWVB Clock Interface

Somewhere up in the misty mountains of Colorado (or a little to the east, I'm told) lies a magical place. An ethereal signal sweeps across America, and keeps the whole country moving at the same tempo. No, it's not the 24-hour Grateful Dead concert station, it's the National Institute of Standards and Technology (NIST) radio station WWVB.

Overview

The WWVB is located near Fort Collins, CO and continually broadcasts highly accurate time signals. These time signals are used throughout the United States to synchronize time-sensitive applications. The binary coded decimal (BCD) time code can be received and utilized with an accuracy in the 0.1ms range.

The time code sent includes information such as Daylight Savings Time (DST), leap second, and leap year indicators, as well as the time, year, and day of the year information. All of this is broadcast at 60kHz with 30kW of power.

I think it's safe to say that the government spent a pretty penny putting together this system. And, as a taxpayer, I would be remiss in not making adequate use of it, and so would you. So here it goes.

Defining the Design

I guess there's three ways that we could go about accessing the WWVB time signal. The first is to design from scratch a receiver and decoder unit. No thanks! This is, after all, a BASIC Stamp article. The second method would be to hack one of the WWVB clocks that are available through retail stores. Again, I'm afraid the resulting information would be of little use to those of

you that might like to build a product based on WWVB timing information. The third way — and my preferred method — is to use the highly versatile Atomic Time Clock Interface manufactured by Ultralink (hereafter referred to as the Ultralink module).

The Ultralink module operates with a simple serial interface that can be accessed with the BASIC Stamp SERIN and SEROUT commands. One nice feature of the Ultralink module is that it can be separated into two modules: the receiver module which has the antenna, and the decoder module which your BASIC Stamp communicates with. This allows you to place the antenna in a location away from the noise generated by many of the electronic devices in the home or office.

My goal for this article was simple. I wanted to simply display the WWVB time data via the DEBUG command.

Connecting the Parts

The schematic for this design is incredibly simple, but there are a couple of things I should mention to avoid any confusion for those of you that build this system.

The pin designations on the Ultralink module are defined relative to the module itself. For example, the Rxd pin is the data input for the Ultralink module. Therefore, it is connected to the Txpin in my BASIC Stamp2 (BS2) code. Likewise, the Txd pin of the Ultralink module is connected to the Rxpin in my BS2 code.

Early on in testing the Ultralink module, I was having a hard time getting the

receiver to lock on to the WWVB signal. I talked with the Parallax Technical Support staff and Rod Mack of Ultralink, and they both had valuable input for me. I figure it's my job to pass

this information on. The Ultralink module is shipped with the receiver connected to the decoder via a short three-pin connector. This three-pin connector is secured to each of the boards (receiver and decoder) by a screw terminal. I replaced this connector with about 10 feet of wire. This allowed me to place the receiver further from all of the test equipment around the office.

As it turned out, antenna placement was paramount to successful reception of the WWVB signal. It was also recommended to me that I place indicator LEDs on the test board, and run the BS2 and Ultralink module off of a battery. In this way, I could take the test board outside and get a lock on the WWVB signal. Since I'm in a metal building, surrounded by metal buildings, this proved necessary.

With the LED indicators and a mobile test

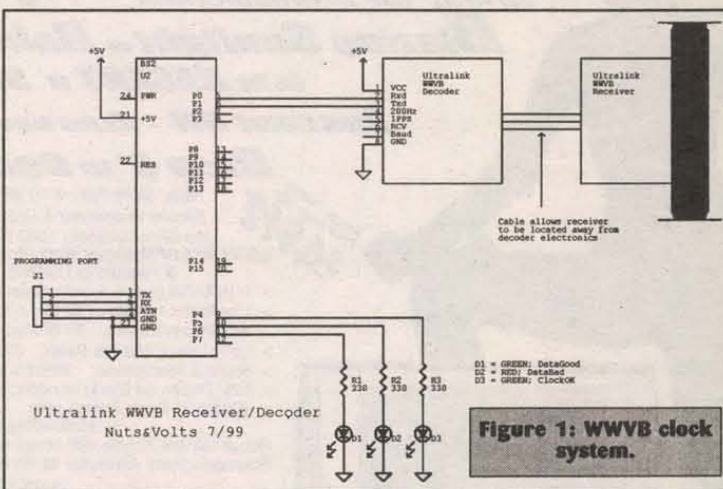


Figure 1: WWVB clock system.

USB Relay Module

Model JSB-210

Controls 8 to 16 "form C" relays over the USB (Universal Serial Bus). Program the module with simple commands in any program language that supports USB Communications. Driver and sample code provided

J-Works, Inc

12328 Gladstone St., Unit 4
Sylmar, CA 91342
(818) 361-0787 Voice (818) 270-2413 Fax

Other Products

RS-485 Remote I/O
ISA Waveform Generator
RS-485 to DS-1820
RS-485 Temperature I/O
DS-1820 Probe

Visit our Web site for
Information on all our products
<http://www.j-works.com>
E-mail sales@j-works.com

Explore Fuzzy Logic

with the AL220 device and

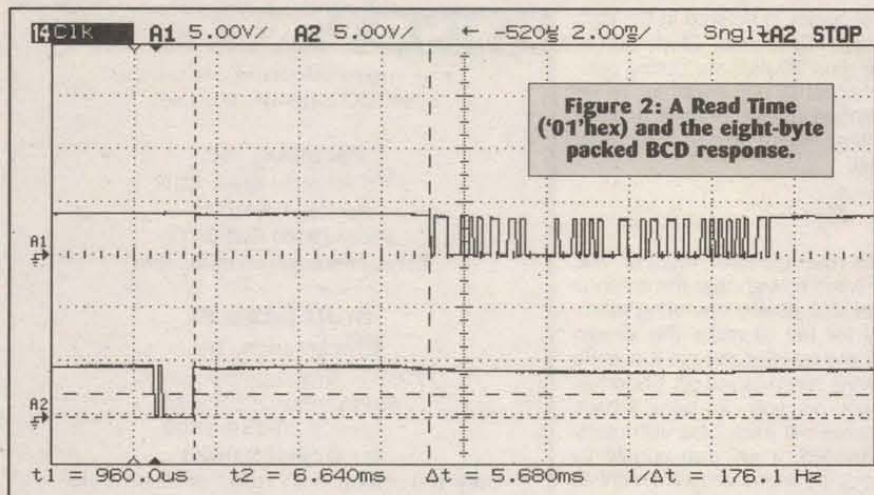
Fuzzy Logic Applications Expert (FAE) Development System.

The AL220 Device is a complete Single Chip Fuzzy Logic microcontroller which contains 4 analog inputs and 4 analog outputs. It was voted the most innovative product of 1994 by EDN magazine. Now it is available with a complete PC based development system, programmer, and real time hardware Emulator for hobbyists as well as professionals! Check out our web site at www.BasiConcepts.com for free data sheets, application notes, and additional product information.

Order	Description	Price Each
AL220	18 Pin Dip AL220 Device	\$12
FAE	FAE Dev System for Win 95/98 on CD	\$65
Hobby Pack	AL220, FAE, and Printer Port Programmer	\$95
Professional Pack	AL220, FAE, Programmer, and Real Time Hardware Emulator System	\$495

BasiConcepts, Inc. 312 W. First St. Suite 201, Sanford, FL 32771
Tel: (407)322-5608 Fax: (407)322-5609 Email: info@BasiConcepts.com

STAMP APPLICATIONS



board, I was locked on to the signal in under two minutes. The schematic in Figure 1 shows the connectivity used for this WWVB clock system.

Writing the Code

There are a few things about how this code works that require some explanation. There are quite a few features built into the Ultralink module. I didn't use all of them and, in fact, kept the code as basic as I could. The Ultralink module has both an ASCII and a packed BCD interface built into it. I opted for the packed BCD interface which required less variable space and was easier to manipulate for display with the DEBUG command. Binary coded decimal, or BCD, is simply using binary nibbles (four bits, or half a byte) to store values that range from 0-9. Packed BCD uses both the high and low nibble of a byte to store BCD values. For instance, a packed BCD '95'hex, is the same as a '10010101'binary, or 149 in decimal.

This leads to some interesting conversion needs in the code. For example, the RAW_DAY register can only return a value from 00 to 99 in packed BCD. Yet there are 365 days in a non-leap year. So where do you get the DAY value when you reach 100+ days? This information is held in the lowest two bits of the LT register (see NV_JUL99.BS2 code listing). The binary value in these bits is the number of 100s that you must add to the DAY register for the actual day of the year. So, if it was day 254, the RAW_DAY register would contain '54'hex, and the LT register would read 'xxxxx10'binary (where x is not used). This is handled in the code by first determining the value in the lowest two bits of the LT register by ANDing that register with a value that masks all of the bits except for the lowest

two. The lowest two bits are then multiplied by '100'hex, which is a BCD representation of 100. The RAW_DAY register is then added to this value and stored in the word variable DAY.

A similar operation is required to determine the century. Bit 4 of the LT register designates whether the century value is 1900 or 2000. The RAW_YEAR value

can then be added to the BCD representation of the century and stored in the word variable YEAR.

There are five commands that the Ultralink module will accept. They include ...

- '01'hex "A" ASCII Read Time: returns date and time string
- '02'hex "B" ASCII Diagnostic Receive: returns a status byte each second
- '03'hex "C" ASCII Force Update: initiates a receive update cycle
- '04'hex "D" ASCII Read UT1 Correction: returns a two nibble time correction
- '05'hex "E" ASCII Read Firmware Rev.: returns current firmware revision

The source code that I generated only makes use of the first two commands, and uses the BCD communication method. The code listing NV_JUL99.BS2 waits three seconds after power-up for the Ultralink module to complete its reset cycle. Then the BS2 places the Ultralink module into its diagnostic mode (command '02'hex) and begins receiving status bytes from the Ultralink module at a rate of one every second. These bytes can represent a Zero ('00'hex), a One ('01'hex), a Mark ('10'hex), or an unknown or bad byte ('11'hex). In this code, the BS2 must receive 60 consecutive bytes that are not a '11'hex in order for the BS2 to start reading and displaying the WWVB time. Indicator LEDs are set or cleared based on the number of good bytes read.

Finally, the WWVB time is in UTC which is a French acronym for "Universal Coordinated Time," which is the same as Greenwich Mean Time (GMT). I didn't further modify the time from GMT, but you'll probably want to for your own design.

Serial Communication and Time Accuracy

The serial communication format for the Ultralink module can be selected for either 2400bps or 9600bps. The 2400bps mode is ideal for interfacing to a BASIC Stamp 1 (BS1). An example of the serial communication for a Read Time ('01'hex) command can be seen in Figure 2. The time delay from sending a Read Time command until a response is initiated is specified as at least 5ms. This allows a BASIC Stamp enough time to prepare for the incoming data.

The Ultralink module provides time base values down to the 10s

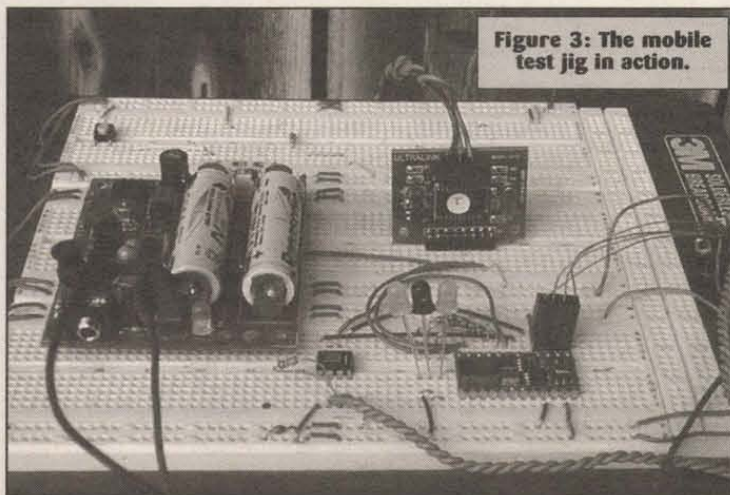


Figure 3: The mobile test jig in action.

JFETS

ULTRA LOW NOISE
LS843 - 3nV/Hz typ

TIGHT MATCHING
LS843 - 1 mV max

- ♦ N & P Channel
- ♦ Duals & Singles
- ♦ Custom Screening
- ♦ Die, SMT, Thru-Hole
- ♦ No Order Minimum
- ♦ COD's Accepted

Second Source for Domestic & Foreign JFETs & Bipolars

Full Service U.S. Manufacturer of Specialty Linear Products

LINEAR SYSTEMS

4042 Clipper Court
Fremont, CA 94538
510-490-9160/510-353-0261 (Fax)
E-mail: 3623671@MCIMAIL.COM

Write in 107 on Reader Service Card.

PICmicros & BASIC

PicBasic Compiler - \$99.95

Put BASIC Stamp I programs right into a PIC microcontroller - no BS1 module necessary! The programs run faster and can be longer. You also get more variables and extra instructions. For mid-range PIC12C67x, 16C55x, 6xx, 7xx, 8x, 9xx.

PicBasic Pro Compiler - \$249.95

PicBasic Pro is BASIC Stamp II compatible, and like the standard compiler above, eliminates the need for a BS2 module. Pro adds built-in LCD support, interrupts in BASIC, arrays, program size to 16K, real if. Then. Else and I/O to any PIC pin. For mid-range PIC12C67x, 16C55x, 6xx, 7xx, 8x, 87x, 9xx and high-end 17Cxxx.

New! PIC-XI Experimenter/ Lab Board

Bare PCB only - \$49.95
Kit with parts - \$139.95
Assembled - \$199.95



EPIC Plus PIC Programmer - \$59.95

Programs PIC12C5xx, 67x, 14Cxxx, 16C505, 55x, 6xx, 7xx, 8x, 87x and 9xx. Optional ZIF adapters for DIP, SOIC, MQFP, PLCC. Runs off two 9-volt batts or optional AC adapter. Includes programming software and assembler.

PICProto Prototyping Boards

Get it wired quicker! High-quality blank prototyping boards for PICmicros. Holds 5V reg. caps, osc, DB9-25, large proto area. \$8.95 - \$19.95



microEngineering Labs, Inc.

Box 7532 Colorado Springs CO 80933
(719) 520-5323 (719) 520-1867 fax
<http://www.melabs.com>

Write in 108 on Reader Service Card. 17

ON-LINE AUCTION

www.gosam.com

HP
WAVETEK
FLUKE
TEKTRONIX
Other electronic "stuff"
Auctions every
2nd & 4th week

Can't wait till your next
swap meet? log-on@
www.gosam.com

PRINTERS

samelectronics.com

Canon, HP, Epson,
Lexmark
Order on-line & SAVE

MONITORS

ACER, NEC, etc.

samelectronics.com

STAMP APPLICATIONS

of milli-seconds. Clock accuracy is defined in the data sheet as $\pm 20\text{ms}$ upon synchronization. Clock drift is expected to be no larger than 20ms/hour during periods where the WWVB signal is not available. To be sure, the best way to maintain time accuracy is to place the antenna in a position where it can effectively receive the WWVB signal.

In Closing

Communicating with the Ultralink module was smooth sailing. Keep in mind though that the antenna position is paramount to this device operating effectively. It was necessary for me to make this design mobile (see Figure 3 for the test jig) and get it outside of my office for the WWVB reception to go smoothly. Once the device is locked on, you can bring it back inside. The Ultralink module will track time accurately as long as power is provided. It will also update its internally generated clock as more accurate WWVB time stamps become available.

It's important to understand that while I moved my Ultralink module in and out of my building to receive time updates, for serious applications, the antenna should be positioned so that it can effectively receive the WWVB signals. I have also been informed from a reliable source at Ultralink (thanks Rod) that a cable used between the receiver and decoder parts of the module can be very long. The data sheet specifies 200 feet, but much longer cable (up to 1000 feet) has been used successfully with this module. **NV**

RESOURCES

For more information on the
BASIC Stamp, contact:

Parallax, Inc.

3805 Atherton Road, #102
Rocklin, CA 95765
phone (916) 624-8333

http://www.parallaxinc.com

Scott Edwards Electronics, Inc.

1939 S. Frontage Rd. Ste. F
Sierra Vista, AZ 85635
phone 520-459-4802
fax 520-459-0623

www.seetron.com info@seetron.com

Solutions Cubed

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

For more information on the Ultralink
atomic time clock interface:

Bus systems, to WWVB based time code
receivers.

Ultralink was founded in 1984, and has
completed designs ranging from ISA
bus links to the STD, VME, and Multi

Rod Mack - Ultralink
phone: 775-782-9758
E-Mail: rodmack@ulio.com

Code Listing: NV_JUL99.BS2

'NV_JUL99.BS2: This BS2 code interfaces to the Ultralink WWVB Receiver and
'decoder module that is available through Parallax, Inc. This code makes
'use of two of the features available in the module. The first feature
'is a diagnostic mode which returns a byte each second. The value of the
'returned byte is useful in determining whether or not your WWVB receiver
'has locked on to the signal coming out of Fort Collins, CO. The second
'feature displayed by this BS2 code is the reading of the WWVB time and date.
'The time is read in BCD format and displayed with the DEBUG command.

RXpin	CON	1	'serial data receive pin
TXpin	CON	0	'serial data transmit pin
DatGood	CON	6	'signal lock LED indicator
DatBad	CON	5	'signal not locked LED indicator
ClockOK	CON	4	'clock data OK LED indicator
BAUD	CON	84	'9600 bps, 8N1, true serial data
LT_CENT_MASK	CON	%00010000	'mask isolates the century bit
LT_DAYS_MASK	CON	%00000011	'mask isolates the hundreds of days bits

LOW	DatGood	'default LED status displays no signal
LOW	ClockOK	'condition
HIGH	DatBad	

RX	VAR	BYTE	'receive status byte
YEAR	VAR	WORD	'year value storage word
RAW_YEAR	VAR	BYTE	'year value received from WWVB decoder
LT	VAR	BYTE	'leap year, century, DST, days modifier bits
RAW_DAY	VAR	BYTE	'days value received from WWVB decoder
DAY	VAR	WORD	'day value storage word
HOUR	VAR	BYTE	'hours value received from WWVB decoder
MINUTE	VAR	BYTE	'minutes value received from WWVB decoder
SEC	VAR	BYTE	'seconds value received from WWVB decoder
MSEC	VAR	BYTE	'milli-seconds value from WWVB decoder
DAT1	VAR	BYTE	'data received in diagnostic mode
TEMP_REG	VAR	BYTE	'counting/working register

PAUSE	3000	'Allow > 2s for decoder reset cycle
GOSUB	DIAGNOSTIC_MODE	'verify reception of signal

START:		
GOSUB	READ_WWVB	'read and display WWVB time each second
	PAUSE 1000	
	GOTO START	

READ_WWVB:

```
SEROUT TXpin,BAUD,[S01]          '01'hex requests time from decoder
SERIN
RXpin,BAUD,500,no_response1,[RX,RAW_YEAR,LT,RAW_DAY,HOUR,MINUTE,SEC,MSEC]
HIGH                               ClockOK                               'light valid time LED
DEBUG                              "RX BYTE ",BIN8 RX,CR              'display flag registers in binary
DEBUG                              "LT BYTE ",BIN8 LT,CR              'display flag registers in binary
DEBUG                              "TIME = ",hex2 HOUR,";",hex2 MINUTE,";",hex2 SEC,";",hex2
MSEC,CR
TEMP_REG = LT&LT_DAYS_MASK         'mask all but lowest two bits of LT
DAY = (TEMP_REG*$100)+RAW_DAY      'lowest 2 bits = #100's of days to add

YEAR = $1900+RAW_YEAR              'Year = 1900 + raw year
TEMP_REG = LT&LT_CENT_MASK          'unless masked century value is '10'hex
IF TEMP_REG <> $10 THEN Display_Years
YEAR = $2000+RAW_YEAR              'Year = 2000 + raw year
Display_Years:                      'display year and date
DEBUG                              "YEAR = ",HEX4 YEAR," DAYS = ",HEX3 DAY,CR,CR
```

```
RETURN
no_response1:                      "NO RESPONSE",CR
DEBUG
RETURN
```

```
DIAGNOSTIC_MODE:
SEROUT TXpin,BAUD,[S02]          'execute diagnostic mode
TEMP_REG = 0                      'counting register is reset to zero
Read_Mode:
DEBUG                              "COUNT = ",DEC TEMP_REG,CR          'display count
SERIN
RXpin,BAUD,2000,no_response2,[DAT1]
DAT1 <> %00000011 THEN Increase_Count 'see if diagnostic
mode returns a '03'hex
TEMP_REG = 0
HIGH                               DatBad                               'light no signal lock LED
LOW                                DatGood                               'extinguish signal lock LED
GOTO Read_Mode                    'continue checking
Increase_Count:
TEMP_REG = TEMP_REG + 1
IF TEMP_REG < 60 THEN Read_Mode
HIGH                               DatGood                               'increment count of "good" responses
LOW                                DatBad                               'after a minute of "good" responses
RETURN                             'consider the receiver locked
no_response2:                      'set LEDs to display data as valid
GOTO DIAGNOSTIC_MODE
END:
```


TEKTRONIX 495P SPECTRUM ANALYZER, 30Hz to 1.8GHz

TEK 495P. No compromise performance. Optimized for use in baseband through UHF measurements. Covers 100Hz to 1.8GHz with -130dBm Sensitivity and +/- 1dB Frequency Response. Minimum resolution 30Hz, as well as 10⁻⁴ Marker and center frequency accuracy. Built in signal counter can determine the frequency of marked signals only 30Hz apart, or count the exact delta frequency between two marked signals regardless of amplitude. External reference input. 10⁻⁴ Frequency accuracy. Intelligent markers with signal processing functions. Direct keypad entry of control parameters. Nonvolatile memory allows storage of up to nine front panel settings and nine waveforms. A permanent record of CRT display is available from the direct plot capability. Unit is fully GPIB programmable. Help menu explains front panel controls and signal processing functions. Now is your chance to obtain a top notch spectrum analyzer at an excellent price. This unit is in excellent condition. **DON'T WAIT.....\$3995**



SLEEK, 100MHz, TEK 2337, PORTABLE, FIELD SERVICE O'SCOPE with DMM

Dual trace, Delayed Sweep, 50ns/div, Sweep Rate, 5mV Vert. Sensitivity. Differential time meas. on LCD display plus DMM for AC/DC volts plus Ohms. Extra rugged, perfect for field service work. Package includes two probes and manual. Mint condition. Six month warranty. **New.....\$4850 Now.....\$795**



OPTICAL ENCODERS, HEAVY DUTY, HIGH RESOLUTION, 2048ppr, 8,192ppr Quadrature!

BEI MODEL: E258B-6R-2048-ABZC-8830-LED-SC18. That's a mouthful! Brand new with flex shaft coupler for 0.375" shaft. Size of encoder is 3.25" diam. x 2" deep. Cast aluminum housing. Shielded bearing, complementary output through 8830 driver. Side cable exit. 5VDC Pwr. Continuous rotation. **NEW LTD. QTY. \$89**



ABSOLUTE OPTICAL ENCODER, 256ppr, 8 bit accuracy. OMRON, E6C-A

12VDC power. 6mm diam. ball bearing shaft. 50mm diameter X 78mm deep. Removed from equipment, excellent condition. Similar to photo with sq. mtg. flange. **LTD. QTY. \$79ea.**



TEK 492, OPT. 01, 02, 03, SPECTRUM ANALYZER, 50KHz to 21GHz

Up to -115dBm Sensitivity and +/- 1.5dB Frequency Response. Amplitude comparison in 0.25dB steps. 80dB dynamic range. Frequency span per division range: 500Hz to 500MHz per division. Resolution bandwidth: 1MHz to 100Hz. Long term drift at fixed center frequency: 3KHz/10minutes. Sweep time: 20us to 5s/div. CRT readout displays reference level, center frequency, frequency range, vertical display mode, frequency span /div, resolution bandwidth and RF attenuation. Now you can own the instrument for less than the cost of the options alone! **SPECIAL.....\$5500**



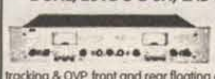
75mW ARGON LASER. Brilliant Turquoise beam, Uniphase Model 2213-75 w/2113 power supply.

The 488nm, TEM00 mode is something to see! Power for a "serious" display. Excellent plug and play condition. Power supply (used) can be controlled remotely with optional interfaces. Standard 220VAC operation. Compact power supply and fan cooled head. Less than one third the regular price. Unused heads. **Reg. \$6000, SPECIAL THIS MONTH.....\$1595**



DUAL, 20VDC @ 3A, LAB POWER SUPPLY, HP 6253A

Two independent outputs of 0-20 volts @ 3 amps. Extremely low ripple @ only 1mV. Each with constant current & constant voltage mode, as well as tracking & OVP, front and rear floating outputs, rack mountable. **New.....\$1350 Now.....\$249ea.**



TEK 475, 200 MHz portable,

Dual trace, Delayed sweep.....\$649ea.

SCOPE INCLUDES PROBE, MANUAL AND COVER.

RECONDITIONED & CALIBRATED, 6 MONTH WARRANTY

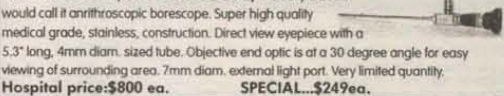
TEK 494P SPECTRUM ANALYZER, 10KHz to 21GHz

TEK 494P. Provides the widest amplitude calibrated frequency range of the Tektronix line. Covers 10KHz to 21GHz with 30KHz to 1MHz resolution range, -125dBm Sensitivity and up to +/- 1dB Frequency Response. Amplitude range: +30 to -125dBm. Display dynamic range: 80dB. Built in frequency counter to 325GHz. Help manual in ROM. Intelligent markers with signal processing functions. Direct keypad entry of control parameters. Nonvolatile memory allows storage of up to nine front panel settings and nine waveforms. A permanent record of CRT display is available from the direct plot capability. Unit is fully GPIB programmable. Help menu explains front panel controls and signal processing functions. Now is your chance to obtain a top notch spectrum analyzer at an excellent price. This unit is in excellent condition. **SPECIAL.....\$7500**



SUPER SLUETH, SPY BORESCOPE. Actually a doctor

would call it anarthoscopic boreoscope. Super high quality medical grade, stainless, construction. Direct view eyepiece with a 5.3" long, 4mm diam. sized tube. Objective end optic is at a 30 degree angle for easy viewing of surrounding area. 7mm diam. external light port. Very limited quantity. **Hospital price:\$800 ea. SPECIAL.....\$249ea.**



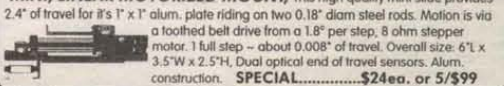
FORGET "BIG ASS CAPS" FORGET "HUGE ASS CAPS" THESE ARE "MEGA ASS CAPS"

Two types available. Both are MIL SPEC. from AXEL Co. 2uf @ 36,000V and 1.5uf @ 30,000V. They're BIG. They're HEAVY. They're PERFECT for your project. UNUSUED. Only a few available. Don't wait. **SPECIAL.....\$99ea.**



MINI, LINEAR MOTORIZED MOUNT. This high quality mini slide provides

2.4" of travel for its 1" x 1" alum. plate riding on two 0.18" diam steel rods. Motion is via a toothed belt drive from a 1.8" per step, 8 ohm stepper motor. 1 full step - about 0.008" of travel. Overall size: 6" x 3.5" x 2.5". Dual optical end of travel sensors. Alum. construction. **SPECIAL.....\$24ea. or 5/\$99**



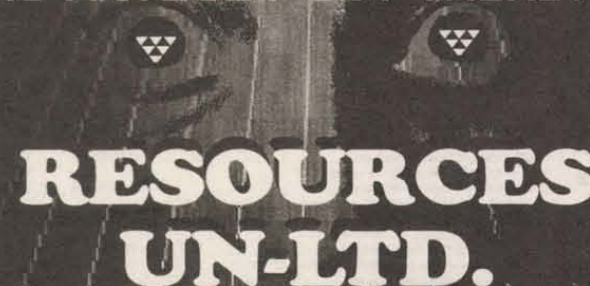
NEWPORT TRANSLATION STAGES. also a few other goodies too!

MODEL:	DESCRIPTION:	EACH
270	LAB JACK	\$249
RSA-2T	360 deg. Rotary Stage with Clear Aperture.	\$129
625A-4	Laser Holder	\$149
481A	Rotary Stage	\$189
M36	Translation Stage	\$249
460A-XY	X-Y Translation Stage	\$189
M37	3 Axis Trans. Stage	\$289
415	Vertical Trans. Stage	\$129
M360-90	Minfling. Plate 90deg.	\$29
M436	Translation Stage	\$199
M150	Magnetic Mtg. Base	\$129
420	Linear Trans. Stage	\$119

MISC. OPTICAL COMPONENTS:

HP10706A	INTERFEROMETER	\$129
HP10703A	INTERFEROMETER	\$129
HP10702A	INTERFEROMETER	\$129
HP10780A	RECEIVER	\$199
RUCKER & KOLLS 222	X-Y-Z MICRO POSIT.	\$ 50

IS ANYBODY OUT THERE?



VISA, MC, AMEX, DISCOVER, COD.

ORDER: 800-810-4070 TECH: 603-668-2499

FAX: 603-644-7825 E-MAIL: unltd4u@m20.net

300 BEDFORD STREET, MANCHESTER, NH 03101

NEW, "STEALTH CAM", MICRO SIZE, with AUDIO!

The sleek aluminum housing fits like a glove! Removeable mounting bracket and a 1.3M cable with BNC vid., RCA aud., internal mic & DC barrel jack for, no sweat hook up. Why fool around with an open P.C. board? Now you can have the "STEALTH CAM". 1/3" CCD, 410 Lines, 0.3 Lux, AGC, Auto Shutter. Pwr. from 9 to 12VDC @110mA, 250k pixels, Std. model, 4mm, 78° FOV lens, Pinhole model, 90° FOV. A real glass lens. Focus from 10mm to infinity. NTSC video out. Only 1.7 ounce! SENSITIVE to IR. Size Std: 30mm sq. x 29mm d. PH is 16mm d. **WARNING: Don't confuse these models with LOW RESOLUTION, HIGH LUX C-MOS CAMERAS.** **GM-2005-STD, w/aud.\$79.00** **GM-2005-PH, w/aud.\$79.00**



BAYSIDE, RIGHT ANGLE, GEARHEAD DRIVE

Gearhead	Torque	Input Speed	Backlash	Eff.
Model	in-lb (Nm)	RPM	arcmin	%
NR 23	50 (6)	4,000	30	92
Max.	Radial	Axial		
Weight	Load	Load		
lb kg	lb N	lb N		
3 (1.4)	150 (670)	100 (440)		



SPECIAL.....\$89ea. or 2 for \$169

6V@12AH SEALED, RECHARGEABLE, BATTERY

New Panasonic, LCR6V12P. Tough to get at a discount. Very compact. Two top mounted 1/4" faston connectors. Perfect for high drain projects. Size: 5.9" x 3.7" x 1.9" D **2/\$20, 10/\$89**



NEW! DAYLIGHT to LOW LIGHT MINI CAM, w/ A/I LENS

For those applications that must work from dawn till dusk, this is it. Rugged aluminum housing with dual mounting sockets. Specs: 1/3" CCD, 420 lines resolution, 0.1 Lux sens., AGC, Auto shutter. 12VDC @120mA. Take full advantage of camera sensitivity with the super, 4mm, f1.4, 78° FOV Auto iris lens included. Video out on BNC. Size: 50mm sq. X 65mm long. Power adapter included. Ready to go! **GM-510A/1.....\$199 or 2/\$369**



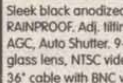
END FIELD of VIEW GUESSWORK! 3.5 to 8mm VARI-FOCAL LENS

Brand New, super f1.8 lens allows you to smoothly adjust from a 97° FOV @ 3.5mm to a 44° FOV @ 8mm. Now you can frame your area of interest just the way you want it! Standard CS-Mount with adjustable focus and iris. **SPECIAL.....\$99ea. or 2 for \$189**

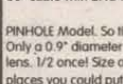


ULTRA MINI and WEATHERPROOF "LIPSTICK" CAMERA

Sleek black anodized, alum. housing. O-Ring sealed & RAINPROOF. Adj. tilting mount. 1/3" CCD, 380 Lines, 0.3 Lux, AGC, Auto Shutter. 9-12VDC @100mA, 4mm, f1.8, 78° FOV real glass lens, NTSC video. <100mV IR SENSITIVE. 23mmx50mm, 16" cable with BNC video & DC barrel jack. **GM-200K-STD.....\$99**



PINHOLE Model. So tiny you can install it directly into a door. Only a 0.9" diameter hole! Specs as above. 90° FOV Pinhole lens. 1/2 ounce! Size only 23mm d.x35mm long. Think of the places you could put this little jewel. **GM-200K-PH lens.....\$99**



NOW YOU CAN SEE WHAT THE "FISHES ARE DOIN' (down 60 ft.)

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



ULTRA MINI, COLOR WEATHERPROOF "LIPSTICK" CAMERA

For those applications that must be color, this is it. Black anodized, aluminum, housing is O-Ring sealed & RAINPROOF. Adjustable tilting mount included. Specs: 1/3" CCD, 400 Lines resolution, <1 Lux sensitivity, AGC, Auto Shutter. 12VDC @180mA, 4.3mm, 78° FOV lens. A real glass lens. Std. video out. Size: 32mm diam. X 65mm long. 24" leads with RCA jack and DC jack. With power adapter. **GM-400K.....\$199**



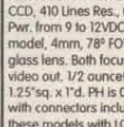
Brand New, Video Motion Sensor. Model VM10. Attach to any

standard video signal and you've got an electronic "watchman" diligently watching the entire scene. Or any adjustable size area within the scene. Such as a doorway or even a drawer or cabinet. A state of the art security aid. The unit will close a contact when it senses a change. Use it to turn on a VCR or call the hounds. Auto or manual reset. Compact, ac powered. Adjustable sensitivity. Video loop through. **NEW VM10.....\$189**



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

CCD, 410 Lines Res., 0.3 Lux sens., AGC, Auto Shutter. Pwr. from 9 to 12VDC @100mA, 250k PIXELS, Std. model, 4mm, 78° FOV lens, Pinhole, 90° FOV. A real glass lens. Both focus from 10mm to infinity. Std. NTSC video out. 1/2 ounce! SENSITIVE to IR. Size Std: 1.25" sq. x 1" d. PH is 0.6" d. 1.6M long wiring harness with connectors included. **WARNING: Don't confuse these models with LOW RESOLUTION, HIGH LUX C-MOS CAMERAS.** **GM-1000A-STD.....\$59 GM-1000A-STD/Aud.....\$64** **GM-1000A-PH.....\$59 GM-1000A-PH/Aud.....\$64** **GM-1000A-CMNT.....\$59 GM-1000A-CMNT/Aud.....\$64**



Micro Lenses for GM1000 series

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

C-MOUNT LENSES

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

NEW, 9" SECURITY MONITORS

We were fortunate to obtain these Hi-res 700 Line. B&W units. Original manufacturers boxes, 90 day warranty. BNC video in and loop through. Rugged steel case. Current production model. Limited qty. They will make your video look super! **SPECIAL.....\$129.00ea. 2 for \$238.00**

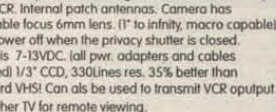


NEW, 2.4GHz VIDEO + STEREO AUDIO TRANSMITTER with SONY, CCM-PCS COLOR CAMERA.

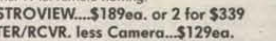
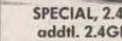
Originally sold for \$500! Now available for a fraction of that price. Great looking styling. Camera has a very stable, adjustable tilting base, front panel LED pwr. indicator and sensitive built in electret mic, providing excellent audio and video performance from one compact package. Simply connect camera to the completely self contained 2.4GHz transmitter. All cables supplied. You can transmit up to 700 feet clear line of sight! Companion matching receiver works with any TV or VCR. Internal patch antennas. Camera has adjustable focus 6mm lens. f1 to infinity, macro capable! Auto power off when the privacy shutter is closed. Power is 7-13VDC. (all pwr. adapters and cables included) 1/3" CCD, 330Lines res. 35% better than standard VHS! Can also be used to transmit VCR output to another TV for remote viewing. **SPECIAL, 2.4GHz SONY-ASTROVIEW.....\$189ea. or 2 for \$339** **addtl. 2.4GHz TRANSMITTER/RCVR. less Camera.....\$129ea.**



MOTORIZED ZOOM LENS SPECIAL 6X magnification, 12X on a 1/3" camera! Auto iris too! New, fabulous hi-res. optics with std. C-Mount. Superior Fujinon and Vicon lenses. Normally cost from \$600 to \$1500. There is no substitute for a good lens! All drive motors will operate from 6-12VDC. Auto iris has a built in amp which works with any cameras video output for control. **Type B-6, 12.5 to 75mm, 6X, f1.2 \$179 or 2 for \$349** **ZOOM LENS CONTROLLER, NEW \$169**



10V @ 2.5 AH SEALED, LEAD ACID, PACK Each pack consists of five, 2 Volt cells. Each cell the size of a std. D' battery. They are arranged as 1X5 cells. Enclosed in an ABS outer shell, (removed for photo). Mint condition. Perfect for robotics and other high drain applications. Buy several, make custom packs of any rating. Size: 7.5" x 2.8" x 1.5" **5-five packs for \$20, 30 for \$99**



WESTERN TEST SYSTEMS

WE HAVE
MOVED!

WE BUY AND SELL

Inquiries 307-635-2269 • Fax 307-635-2291

Orders 800-538-1493

2701 Westland Court, Unit B, Cheyenne, Wyoming 82001

OSCILLOSCOPES & ACCESSORIES

OSCILLOSCOPES

TEK 2247A 100 MHz 4-ch. Oscilloscope, w/voltsmeter & counter-timer	\$1,600.00
TEK 2465 300 MHz 4-channel Oscilloscope	\$2,250.00
TEK 7104 1 GHz Oscilloscope, w/7A29, 7A29-04, 7B10, 7B15	\$3,500.00
TEK 7844 900 MHz Dual Beam Oscilloscope with 7A24, 7A26, 7B80, 7B85	\$900.00
TEK 7904 500 MHz Oscilloscope, with 7A24, 7A26, 7B80, 7B85	\$900.00
TEK SC502 15 MHz Dual Trace Oscilloscope, TM500 series	\$375.00
TEK SC503 10 MHz Dual Trace Storage Oscilloscope, TM500 series	\$375.00

PROBES

HP 1122A Probe Power Supply	\$150.00
HP 1101A Accessory Power Supply, for FET probes	\$200.00
TEK P6046 100 MHz Differential Probe	\$500.00
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	\$250.00
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 3310B 5 MHz Function Generator, variable phase trigger	\$350.00
HP 3312A 13 MHz Function Generator	\$500.00
HP 3314A 20 MHz Function Generator, HP1B	\$1,500.00
HP 3325A 21 MHz Synthesized Function Generator, HP1B	\$1,000.00
HP 8165A-002 Prog. Signal Source, 1 mHz-50 MHz, log sweep	\$1,750.00
HP 8904A-001,002,004 Multifunction Synthesizer, DC-600 kHz	\$2,500.00
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 1 MHz Function Generator, TM500 series	\$300.00
TEK FG503 3 MHz Function Generator, TM500 series	\$250.00
TEK RG501 Ramp Generator, TM500 series	\$175.00
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 8082A 250 MHz Dual Output Pulse Generator	\$1,250.00
HP 8112A 50 MHz Programmable Pulse Generator, HP1B	\$4,000.00
HP 8115A 50 MHz Dual Channel Pulse Generator, HP1B	\$2,750.00
HP 8116A-001 50 MHz Pulse / Function Generator, burst & log sweep	\$3,900.00
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, HP1B	\$500.00
HP 3478A 5-1/2 digit Voltmeter, HP1B	\$600.00
KEITHLEY 181 6-1/2 digit Nanovoltmeter, 10 nV sensitivity, GPIB	\$900.00
SOLARTRON 7081 8-1/2 digit Voltmeter	\$3,250.00
TEK DM5010 4-1/2 digit Multimeter, TM5000 series plug-in	\$300.00
TEK DM501A 4-1/2 digit Multimeter, TM500 series plug-in	\$225.00

CALIBRATION

FLUKE 810A AC Reference Standard, 10 VRMS, 0-10 mA	\$450.00
FLUKE 815A Portable Calibrator, DC/AC/Ohms, line & battery power	\$900.00
FLUKE 8220A Transconductance Amplifier, DC-5 kHz, 0-20 A	\$3,000.00
FLUKE 731B DC Reference Standard	\$400.00
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 50 V, 500 mA	\$500.00
HP 6181C DC Current Source, to 100 V, 250 mA	\$500.00
HP 6186B DC Current Source, to 300 V, 100 mA	\$300.00
HP 6186C DC Current Source, to 300 V, 100 mA	\$750.00
KEITHLEY 225 Current Source, 0.1 uA-100 mA, 0-100 V compliance	\$500.00
KEITHLEY 227 Current Source, 1 uA-1 A, 0-50 V compliance	\$800.00
KEITHLEY 251 Picoampere Source	\$375.00
KEITHLEY 614 Electrometer	\$650.00
TEK A6303 AC/DC Current Probe, 500 Amps peak	\$850.00
TEK CT-5 High Current Transformer, for P6021/A6302, to 1000A	\$375.00
TEK P6022 AC Current Probe w/termination, 935 Hz-120 MHz, 6 A pk	\$275.00

IMPEDANCE & COMPONENT TEST

L.C.R.

BOONTON 62AD 1 MHz Inductance Meter, 2-2000 uH	\$550.00
BOONTON 7280 1 MHz Capacitance Meter, 3-1/2 digit display	\$650.00
HP 4262A-101 3-1/2 digit LCR Meter, 120 Hz/1 kHz/10 kHz test, HP1B	\$1,750.00
HP 4280A-001 1 MHz C Meter / C-V Plotter, 5-1/2 digit res. C	\$3,000.00

STANDARDS

E.S.I. SR-1 Standard Resistor, various values	\$125.00
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, 0-111,110 Ohms, 0.01 Ohm resolution	\$100.00
GR 1433-K 4-Decade Resistor, 0-11,110 Ohms, 0.1 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, 0 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
VALHALLA 2724A Programmable Resistance Standard, 0-11 Gigaohms, GPIB	\$1,250.00

HI & LO RESISTANCE

HP 4328A Milliohmeter	\$1,200.00
T.D.R.	
TEK 1502-opt.04 Time Domain Reflectometer, 0-2,000 feet, chart recorder	\$1,400.00
TEK 1503B-03,04 T.D.R., 0-50,000 ft., chart recorder & battery power	\$3,000.00
TEK 1503-opt.04 Time Domain Reflectometer, 0-50,000 feet, chart recorder	\$1,400.00

POWER SUPPLIES

SINGLE OUTPUT

GLASSMAN PS-WH-03R150XE2 0-3000 V 0-150 mA CV/CC Power Supply	\$800.00
HP 6011A Autoringing 0-20 V 0-120 A Power Supply, 1000 W max.	\$1,400.00
HP 6032A 0-60 V/0-10 A/1000 W Autoringing System Supply, HP1B	\$2,000.00
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	\$250.00
HP 6260B-027 0-10 V 0-100 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	\$550.00
HP 6269B-028 0-40 V 0-50 A CV/CC Power Supply, 230 VAC line	\$900.00

HP 6281A 0-7.5 V 0-5 A CV/CC Power Supply	\$150.00
HP 6289A 0-40 V 0-1.5 A CV/CC Power Supply	\$200.00
HP 6299A 0-100 V 0-750 mA CV/CC Power Supply	\$200.00
HP 6384A 0-40 V 0-5 A CV/CC Power Supply	\$125.00
HP 6443B 0-120 V 0-2.5 A CV/CC Power Supply	\$450.00
HP 6672A System DC Power Supply, 0-20 V 0-100 A CV/CC, HP1B	\$2,750.00
KEPCO ATE 36-300 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
LAMBDA LK-352-FM 0-60 V 0-15 A CV/CC Power Supply	\$600.00
SORENSEN DCR 20-25B2 0-20 V 0-25 A CV/CC Power Supply	\$550.00
SORENSEN DCR 600-0.75B2 0-600 V 0-750 mA CV/CC Power Supply	\$550.00
SORENSEN DCR 600-1.5B 0-600 V 0-1.5 A CV/CC Power Supply	\$700.00
SORENSEN SRL 20-12 0-20 V 0-12 A CV/CC Power Supply	\$400.00
SORENSEN 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 6228B Dual 0-50 V 0-1 A CV/CC Power Supply	\$450.00
HP 6236B Triple Output Supply, +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	\$450.00
HP 6255A Dual 0-40 V 0-1.5 A CV/CC Power Supply	\$450.00
KEPCO MPS-620M Triple Output Supply, dual 0-20V 1A tracking & 0-6V 5A	\$250.00
LAMBDA LPD-422-FM Dual 0-40 V 0-1 A CV/CC Power Supply	\$300.00
LAMBDA LPT-7202-FM Triple Output Power Supply	\$450.00
TEK PS5010 Programmable Triple Power Supply, TM5000 series	\$650.00
TEK PS503A Dual Power Supply, TM500 series	\$200.00

MISCELLANEOUS

ACME PS2L-500 Programmable Load, 0-75 V / 0-75 A / 500 Watts max	\$350.00
ELGAR 501CA/400SD AC Power Source, 45 Hz-5 kHz, 500 VA, 0-135 VAC	\$1,150.00
HP 59501B HP1B Isolated DAC/Power Supply Programmer	\$175.00
HP 6825A Bipolar Power Supply/ Amplifier, +/- 20 V 2 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 5314A-001 100 MHz/100 nS Universal Counter, TCXO reference option	\$275.00
HP 5315A-001 100 MHz/100 nS Universal Counter, TCXO reference option	\$450.00
HP 5315A-002,003 100 MHz/100 nS Univ. Counter, batt. power & 1 GHz C-ch.	\$650.00
HP 5315A-003 100 MHz/100 nS Univ. Counter, 1 GHz C-channel option	\$550.00
HP 5315B 100 MHz/100 nS Universal Counter	\$500.00
HP 5316A 100 MHz/100 nS Universal Counter, HP1B	\$600.00
HP 5316A-001,003 100 MHz/100 nS Univ. Counter, HP1B, TCXO, 1 GHz C-ch.	\$750.00
HP 5316B 100 MHz/100 nS Universal Counter, HP1B	\$750.00
HP 5364A Microwave Mixer / Detector, for modulation domain an.	\$3,000.00
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	\$950.00
TEK DC503A 125 MHz/100 nS Universal Counter, TM500 series	\$275.00
TEK DC509 135 MHz/100 nS Universal Counter, TM500 series	\$275.00

FREQUENCY COUNTERS

EIP 545A 18 GHz Frequency Counter	\$750.00
EIP 575 18 GHz Source Locking Counter, GPIB	\$1,250.00
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 5343A-001 26.5 GHz Frequency Counter, OCXO reference	\$3,500.00
HP 5345A/5355A/5356B 26.5 GHz CW/Pulse Frequency Counter	\$3,500.00
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 5061A Cesium Frequency Standard, 0.1/1.0/5.0/10.0 MHz outputs	\$6,500.00
HP 5065A-002 Rubidium Frequency Standard, 0.1/1.0/5.0/10.0 MHz out	\$3,500.00
HP 5067A Distribution Amplifier, 12 outputs at 1 MHz	\$1,500.00
HP 5067A-opt.032 Distribution Amplifier, 12 outputs at 5 MHz	\$1,750.00
HP 5067A-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 7L5L3/R7603 Spectrum Analyzer, 20 Hz-5 MHz, 10 Hz min. res., w/frame	\$1,500.00

DISTORTION 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
TEK DA4084 Programmable Distortion Analyzer	\$750.00

RMS VOLTMETERS

FLUKE 8922A True RMS Voltmeter, 180 uV-700 V, 2 Hz-11 MHz	\$450.00
---	----------

OSCILLATORS

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., 5 Hz-500 kHz, 70 dB step atten., TM500	\$200.00

MISCELLANEOUS

KROHN-HITE 3103 High/Low Pass Filter, 10 Hz-3 MHz, 24 dB/octave	\$350.00
---	----------



90 DAY WARRANTY PARTS AND LABOR • 10 DAY INSPECTION TEST EQUIPMENT WANTED CALL OR FAX LIST • OPEN ACCOUNTS



KROHN-HITE 3202 Dual HP/LP/BP/BR Filter, 20 Hz-2 MHz, 24 dB/octave	\$450.00
KROHN-HITE 3342R Dual HP/LP Filter, 0.001 Hz-99.9 kHz, 48 dB/octave	\$900.00
KROHN-HITE 3750 LP/HP/BP/BR Filter, 0.02 Hz-20 kHz, 6/12/18/24 dB/oct.	\$600.00
KROHN-HITE DCA-10R 10 Watt Amplifier, 20 dB gain, DC-1 MHz, 600-1000 Ohms	\$450.00
ROCKLAND 852 Dual Highpass/ Lowpass Filter, 0.1 Hz-111 kHz	\$900.00
TEK AM502 Differential Amplifier, 0.1 Hz-1 MHz, TM500 series	\$475.00

RF & MICROWAVE

SPECTRUM ANALYZERS

HP 11517A/18A/19A/20A Mixer Set, 12.4-40.0 GHz, for HP 8555A/8569A	\$600.00
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 3585A Spectrum Analyzer, 20 Hz-40 MHz, 3 Hz min. res. bw.	\$4,500.00
HP 8559A/853A-001 Spectrum An., 0.01-21 GHz, 1 kHz res., w/rackmount frame	\$3,750.00
HP 8559A-100 Spectrum Analyzer, 10 MHz-22 GHz, 100 Hz min. res.	\$3,500.00
HP 8569B Spectrum Analyzer, 10 MHz-22 GHz, 100 Hz min. res. bw.	\$7,500.00
TEK TR502 Tracking Generator, 0.1-1800 MHz, for 7L13/7L14	\$950.00
TEK WM782V WR15 Harmonic Mixer, 50-75 GHz	\$1,500.00

NETWORK ANALYZERS

HP 11650A Network Analyzer Accessory Kit, APC7	\$600.00
HP 35678A Reflection/Transmission Test Kit, 5 Hz-200 MHz	\$1,000.00
HP 8405A Vector Voltmeter, 1-1000 MHz	\$450.00
HP 85020A Directional Bridge, 10-4300 MHz, N(f) test port	\$850.00
HP 85027C Directional Bridge, 0.01-18 GHz, N(f) test port	\$1,750.00
HP 85044A Reflection/Transmission Test Set, 300 kHz-3 GHz	\$1,500.00
HP 8730A/85046A Network Analyzer, 300 kHz-3 GHz, w/S-Parameter Test Set	\$9,500.00
HP 8756A Scalar Network Analyzer	\$2,500.00
HP R85026A WR28 Detector, 26.5-40 GHz, for HP 8757 series	\$1,200.00
WILTRON 560-96KF50 SWR Autotester, 10 MHz-40 GHz, for Wiltron 560 series	\$1,800.00

SIGNAL GENERATORS

FLUKE 8060A Synthesized Signal Gen., 0.1-1050 MHz, 10 Hz res., GPIB	\$1,900.00
FLUKE 8060A/AN Synthesized Signal Gen., 10 kHz-520 MHz, 10 Hz res., GPIB	\$1,500.00
FLUKE 8060B/BAK Synthesized Signal Gen., 0.1-1050 MHz, 10 Hz res.	\$2,250.00
GIGATRONICS 1018 Synthesized Signal Gen., 50 MHz-18 GHz, 1 MHz res.	\$4,500.00
GIGATRONICS 800/6-12 Synthesized Source, 6-12 GHz, 1 kHz res., GPIB	\$2,500.00
GIGATRONICS 840-18 Freq. Multiplier, 18-26 & 26-40 GHz outputs 0 dBm	\$2,750.00
GIGATRONICS 875/50 Levelled Multiplier, x4, 50.0-75.0 GHz output, -3 dBm	\$2,500.00
GIGATRONICS 875/86 Levelled Multiplier, 26.5-40.0 & 50.0-75.0 GHz outputs	\$3,750.00
GIGATRONICS 900/2-8 Synthesized Signal/Sweep Gen., 2-8 GHz, 1 MHz res., GPIB	\$2,500.00
HP 1720A Pulse Modulator, 2-18 GHz, 80 dB on/off ratio	\$450.00
HP 3335A Synthesizer / Level Generator, 200 Hz-81 MHz	\$4,500.00
HP 85100V Frequency Mult., 10-15 GHz In / 50-75 GHz output >0 dBm	\$3,750.00
HP 8840B Signal Generator, 0.5-512 MHz, AM, FM, pulse modulation	\$1,000.00
HP 8856B-001 Synth. Signal Gen., 0.1-990 MHz, 10 Hz res., CCOXO ref.	\$2,500.00
HP 8857A-002 Signal Generator, 0.1-1040 MHz, 10 Hz res., HP1B	\$3,250.00
HP 8860C/88602B-002 Synth. Sig. Gen., 1-1300 MHz, FM / Phase mod. w/88635A	\$2,750.00
HP 8860C/88603A Synthesizer, 1-2600 MHz, AM / FM, w/88633B	\$3,250.00
HP 8872A Synthesized Signal Generator, 2-18 GHz, +3 dBm output	\$6,000.00
HP 8873D-H16 Synth. CW Signal Generator, 50 MHz-26 GHz, +8 dBm out	\$16,000.00
HP 8873E Synthesized Signal Generator, 2-18 GHz, +8 dBm output	\$9,500.00
HP 8873G-004 Synth. CW Signal Generator, 2-26 GHz, +8 dBm output	\$12,500.00
HP 8884B Signal Generator, 5.4-12.5 GHz, AM/WBFM/Pulse	\$3,500.00

SWEEP GENERATORS

HP 8350A/8354A-002 Sweep Oscillator, 5.9-12.4 GHz, 70 dB step attenuator	\$4,000.00
HP 8350A/83570A Sweep Oscillator, 18.0-26.5 GHz, +10 dBm levelled	\$5,500.00
HP 8501A Generator/Sweep, 0.1-110 MHz, +20 dBm levelled	\$400.00
HP 8620C Sweep Oscillator Frame	\$550.00
HP 8622B-002 RF Plug-In, 10-2400 MHz, +13 dBm levelled, 70 dB atten.	\$1,250.00
HP 86230B RF Plug-In, 1.8-4.2 GHz, +10 dBm levelled	\$375.00
HP 86240C RF Plug-In, 3.6-8.6 GHz, +16 dBm levelled	\$700.00
HP 86241A-001 RF Plug-In, 3.2-8.5 GHz, +8 dBm levelled	\$300.00
HP 86242D-004, 008 RF Plug-In, 5.9-9.9 GHz, +10 dBm levelled	\$300.00
HP 86245A-001 RF Plug-In, 5.9-12.4 GHz, +17 dBm levelled	\$600.00
HP 86250D RF Plug-In, 8.0-12.4 GHz, +10 dBm levelled	\$500.00
HP 86260A RF Plug-In, 12.0-18.0 GHz, +10 dBm levelled	\$500.00

HP 86260A-H04 RF Plug-In, 10.0-15.0 GHz, +10 dBm unlevelled	\$500.00
HP 86290A-004 RF Plug-In, 2.0-18.0 GHz, +7 dBm levelled, rear output	\$1,750.00
HP 86290B-004 RF Plug-In, 2.0-18.6 GHz, +10 dBm levelled, rear output	\$1,850.00
WAVETEK 962 Sweep Generator, 1.0-4.0 GHz, markers, +12 dBm unlvld.	\$1,250.00
WILTRON 6647M Sweep Generator, 10 MHz-20 GHz, +10 dBm levelled	\$4,500.00

POWER METERS

ANRITSU MP-81B/ML-83A Power Meter, 75-110 GHz (WR10), -20 to +20 dBm	\$2,500.00
BOONTON 4200-01A, 03A-4A x2 Dual Channel Microwave meter, w/(2) 1 MHz-7 GHz sensors	\$950.00
BOONTON 42B/41-4B Analog Power Meter, with 1 MHz-12 GHz sensor	\$375.00
BOONTON 42B/41-4E Analog Power Meter, with 1 MHz-18 GHz sensor	\$500.00
GENERAL MICROWAVE 476/4240A Power Meter & Sensor, 0.01-18 GHz, -35 to +10 dBm	\$300.00
HP 435B/8481A Power Meter, -30 to +20 dBm, 10 MHz-18 GHz	\$900.00
HP 435B/8482H Power Meter, -10 to +34 dBm, 100 kHz-4.2 GHz	\$900.00
HP 436A/8481A Power Meter, -30 to +20 dBm, 10 MHz-18 GHz	\$1,400.00
HP 8477A Power Meter Calibrator, for HP 432 series	\$500.00
HP 8486A WR42 Thermistor Mount, 18.0-26.5 GHz, for 432 series	\$350.00
HP 8486A Power Sensor, 33.0-50.0 GHz, WR22, for 435/6/7/8	\$1,500.00
HP 8486A WR28 Thermistor Mount, 26.5-40 GHz, for 432 series	\$350.00
HP 8486A WR28 Power Sensor, 26.5-40 GHz, for HP 435/6/7/8	\$1,500.00

RF MILLIVOLTMETERS

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

AMPLIFIERS, MISCELLANEOUS

AMPLIFIER RES. 1W1000 Amplifier, 30 dB gain, 1-1000 MHz, 1 Watt output	\$650.00
BOONTON 82AD-opt.01A Modulation Meter, AM, FM, 10-1200 MHz, GPIB	\$750.00
HP 415E SWR Meter	\$200.00
HP 465A Amplifier, 20/40 dB, 5 Hz-1 MHz, 1/2 Watt/50 Ohms	\$125.00
HP 8447A Amplifier, 20 dB, 0.1-400 MHz, 5 dB NF, +8 dBm output	\$375.00
HP 8447E Amplifier, 22 dB, 0.1-1300 MHz, +13 dBm output	\$750.00
HP 8901A Modulation Analyzer, 150 kHz-1300 MHz	\$2,500.00
HP 8901B-1,2,3 Modulation An., 0.15-1300 MHz, rear input, CCOXO, ext.LO	\$3,000.00
HP 8970A Noise Figure Meter	\$4,000.00
HUGHES 117702F000 TWT Amplifier, 4.0-8.0 GHz, 10 Watts output	\$1,500.00
ROHDE & SCHWARTZ ESHZ Test Receiver, 9 kHz-30 MHz	\$5,000.00

COAXIAL & WAVEGUIDE

AMERICAN NUCLEONICS AM-432 Cavity Backed Spiral Antenna, LHC, 2-18 GHz, TNC(f) "NEW"	\$95.00
AVANTEK AMT-400X2 WR28 Active Doublers, 13-20 GHz, +10 dBm in, +10 dBm out	\$450.00
BAYTRON 3-28-300/10 WR28 Directional Coupler, 10 dB, 26.5-40 GHz	\$300.00
BIRD 4110A/4110-3 Waveguide, 2-30 MHz, 10 W - 1 kW f.s., N(f)	\$400.00
BIRD 6735-300 1 kW Load, 25-1000 MHz, LC(f), with wattmeter	\$650.00
BIRD 8001 500 Watt Oil Cooled Load, DC-2.5 GHz, N(f)	\$350.00
CONTINENTAL MW. RAE26-K-M WR28 x K(m) Endfire Adapter	\$225.00
FXR/MICROLAB S3-02N Triple Stub Tuner, 200-1000 MHz, 100 Watts max., N(m/f)	\$125.00
GR 874-LTL Constant Impedance Trombone Line, 0.4-4 cm, DC-2 GHz	\$400.00
HP 11590A-01 Bias Connector, 1.0-18.0 GHz, APC7	\$450.00
HP 11638A 2-Way Power Divider, DC-18 GHz, N(m/f)	\$300.00
HP 11692D Dual Directional Coupler, 22 dB, 2-18 GHz	\$800.00
HP 33321K Programmable Step Atten., 0-70 dB, DC-26.5 GHz, 3.5mm	\$475.00
HP 33327L-006 Programmable Step Attenuator, 0-70 dB, DC-40 GHz, 2.9mm	\$1,200.00
HP 774D Dual Directional Coupler, 20 dB, 215-450 MHz	\$275.00
HP 777D Dual Directional Coupler, 20 dB, 1.9-4.1 GHz	\$275.00
HP 778D-011 Dual Dir. Coupler, 20 dB, 100-2000 MHz, APC7 test port	\$450.00
HP 8431A 2-4 GHz Band Pass Filter, N(m/f)	\$150.00
HP 8494G-002 Programmable Step Attenuator, 0-11 dB, DC-4 GHz, SMA	\$350.00
HP 8495H-002 Programmable Step Attenuator, 0-70 dB, DC-18 GHz, SMA	\$400.00
HP 8497K-004 Programmable Step Attenuator, 0-90 dB, DC-26.5 GHz	\$750.00
HP K382A WR42 Direct Reading Attenuator, 0-50 dB, 18-26.5 GHz	\$2,900.00
HP K422A WR42 Flat Broadband Detector, 18.0-26.5 GHz	\$350.00
HP K532A WR42 Frequency Meter, 18.0-26.5 GHz	\$450.00
HP K870A WR42 Slide Screw Tuner, 18.0-26.5 GHz	\$275.00
HP K914B WR42 Moving Load, 18.0-26.5 GHz	\$300.00
HP Q752D WR22 Directional Coupler, 20 dB, 33-50 GHz	\$650.00
HP R382A WR28 Direct Reading Attenuator, 0-50 dB, 26.5-40 GHz	\$2,000.00
HP R422A WR28 Crystal Detector, 26.5-40 GHz	\$400.00
HP R532A WR28 Frequency Meter, 26.5-40 GHz	\$500.00
HP R752C WR28 Directional Coupler, 10 dB, 26.5-40 GHz	\$450.00
HP R752D WR28 Directional Coupler, 20 dB, 26.5-40 GHz	\$450.00
HP R914B WR28 Moving Load, 26.5-40 GHz	\$250.00

HP V365A WR15 Isolator, 25 dB, 50-75 GHz	\$750.00
HP V752D WR15 Directional Coupler, 20 dB, 50-75 GHz	\$650.00
HP X870A WR90 Slide Screw Tuner	\$150.00
HUGHES 45712H-1000 WR22 Frequency Meter, 33-50 GHz	\$900.00
HUGHES 45714H-1000 WR15 Frequency Meter, 50-75 GHz	\$900.00
HUGHES 45716H-1000 WR10 Frequency Meter, 75-110 GHz	\$900.00
HUGHES 45721H-1000 WR28 Direct Reading Attenuator, 0-50 dB, 26.5-40 GHz	\$900.00
HUGHES 45724H-1000 WR15 Direct Reading Attenuator, 0-50 dB, 50-75 GHz	\$1,000.00
HUGHES 45732H-1200 WR22 Level Set Attenuator, 0-25 dB, 33-50 GHz	\$250.00
HUGHES 45732H-1100 WR22 Thermistor Mount, -20 to +10 dBm, 33-50 GHz	\$400.00
HUGHES 45735H-1100 WR12 Thermistor Mount, -20 to +10 dBm, 60-90 GHz	\$800.00
HUGHES 47316H-1111 WR10 Tunable Detector, 75-110 GHz, positive polarity	\$600.00
HUGHES 47741H-2310 WR28 Phase Locked Gunn Osc., 32,000 GHz, +18 dBm	\$2,000.00
HUGHES 47742H-1210 WR22 Phase Locked Gunn Osc., 42,000 GHz, +18 dBm	\$2,750.00
HUGHES 47974H-1000 WR15 SPST PIN Switch, 250 MHz speed, 60-62 GHz response	\$375.00
KRYTAR 2618S Directional Detector, 1.7-26.5 GHz, K(f/m)/SMC	\$200.00
M/A-COM 3-19-300/10 WR19 Directional Coupler, 10 dB, 40-60 GHz	\$450.00
MICA C-121S06 Circulator, 17.5-24.5 GHz, SMA(f/m/m)	\$75.00
MIDWEST MICROWAVE 3537 DC Block, 0.1-12.4 GHz, SMA(m/f) "NEW"	\$40.00
MINI-CIRCUITS ZFDC-20-4 Directional Coupler, 19.5 dB, 1-1000 MHz, SMA(f)	\$25.00
NARDA 3000-SERIES Directional Couplers	\$150.00
NARDA 3024 Bi-Directional Coupler, 20 dB, 4-8 GHz	\$300.00
NARDA 3090-SERIES Precision High Directivity Couplers	\$225.00
NARDA 3688BN Coaxial High Power Load, 500 Watts, 2.0-18 GHz, N(m)	\$600.00
NARDA 3752 Coaxial Phase Shifter, 0-180 deg./GHz, 1-5 GHz	\$1,000.00
NARDA 3753B Coaxial Phase Shifter, 0-55 deg./GHz, 3.5-12.4 GHz	\$1,000.00
NARDA 4000-SERIES SMA Miniature Directional Couplers	\$75.00
NARDA 4226-10 Directional Coupler, 10 dB, 6.5-18.0 GHz, SMA(f)	\$275.00
NARDA 4227-16 Directional Coupler, 16 dB, 1.7-26.5 GHz, 3.5mm(f)	\$325.00
NARDA 4242-20 Directional Coupler, 20 dB, 0.5-2.0 GHz, SMA(f)	\$100.00
NARDA 4247-20 Directional Coupler, 20 dB, 6.0-26.5 GHz, 3.5mm(f)	\$200.00
NARDA 4247B-10 Directional Coupler, 10 dB, 6.0-26.5 GHz, 3.5mm(f)	\$200.00
NARDA 4799 Level Set Attenuator, 0-15 dB, 4-18 GHz, SMA(f)	\$135.00
NARDA 5070-SERIES Precision Reflectometer Couplers	\$300.00
NARDA 562 DC Block, 10 MHz-12.4 GHz, 100 V max., N(m/f)	\$65.00
NARDA 765-10 10 dB Attenuator, 50 Watts, DC-5 GHz, N(m/f)	\$165.00
NARDA 768-10, 20 dB or 20 dB Attenuator, 20 Watts, DC-11 GHz, N(m/f)	\$120.00
NARDA 792FF Variable Attenuator, 0-20 dB, 2.0-12.4 GHz	\$375.00
NARDA 794FM Direct Reading Variable Attenuator, 0-40 dB, 4-8 GHz	\$375.00
OMNI-SPECTRA 2085-6010-00 Crystal Detector, 1-18 GHz, negative polarity, SMA(m/f)	\$50.00
PAMTECH KYG1014 WR42 Junction Circulator, 18.0-26.5 GHz	\$250.00
SONOMA SCIENTIFIC 21A3 WR42 Circulator, 20 dB, 20.6-24.8 GHz	\$75.00
TRG B510 WR22 Direct Reading Attenuator, 0-50 dB, 33-50 GHz	\$1,000.00
TRG B528 WR22 Direct Reading Phase Shifter, 0-360 deg., 33-50 GHz	\$1,250.00
TRG V551 WR15 Frequency Meter, 50-75 GHz	\$600.00
TRG W551 WR10 Frequency Meter, 75-110 GHz	\$750.00
WAVELINE 100800 WR28 Terminated Crossguide Coupler, 30 dB	\$200.00
WEINSCHTEL DS109 Double Stub Tuner, 1-13 GHz, N(m/f)	\$150.00
WEINSCHTEL DS109LL Double Stub Tuner, 0.2-2.0 GHz, N(m/f)	\$150.00

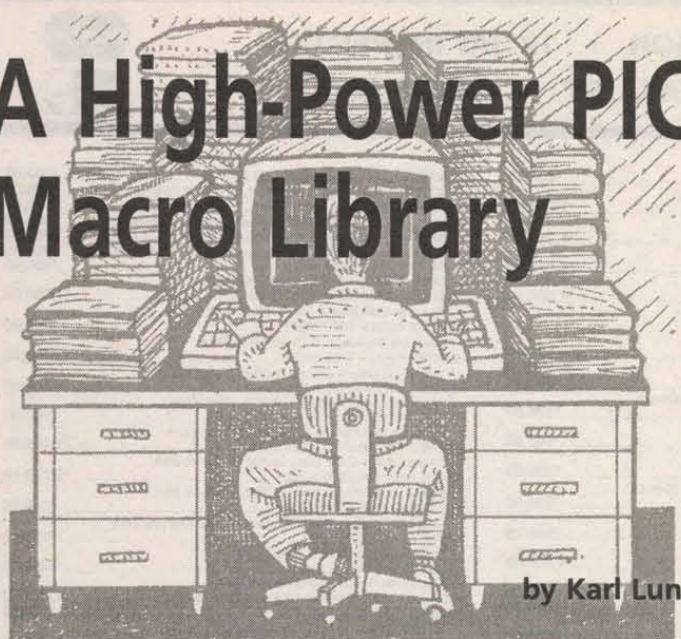
COMMUNICATIONS

HP 4935A-001 Transmission Test Set, 20 Hz-110 kHz, battery option	\$700.00
HP 59401A HP1B Bus Analyzer	\$700.00
TEK 1410R NTSC Gen., w/SPG2 sync. generator, TSG7 color bars	\$800.00
TEK 1411R PAL Gen., w/SPG12 sync; TSG11 color bars; TSG13 linearity	\$750.00
TEK 1411R PAL Test Gen., w/SPG12, TSG11, TSG13, TSG15, TSG16	\$1,000.00
TEK 1411R PAL Test Gen., w/SPG12, TSG11, TSG12, TSG13, TSG15, TSG16	\$1,100.00
TEK 1411R opt.04 PAL Test Gen. w/ SPG12, TSG11, TSG11, TSG13, TSG15, TSG16	\$1,400.00
TEK 147A NTSC Test Signal Generator, with noise test signal	\$800.00
TEK 148 PAL Insertion Test Signal Generator	\$700.00
TEK 520A NTSC Vectorscope	\$750.00
TEK 521A PAL Vectorscope	\$750.00

MISCELLANEOUS

FLUKE 2180A RTD Digital Thermometer	\$500.00
HP 7090A Measurement Plotting System	\$1,500.00
P.A.R. 5205-95, 96 Two-Phase Lock-In Amp., 2 Hz-100 kHz, GPIB	\$1,500.00
TEK TM5006 5000-series 6-slot Programmable Power Module	\$600.00
TEK TM504 500-series 4-slot Power Module	\$175.00
TEK TM506 500-series 6-slot Power Module	\$250.00
TEK TM515 500-series 5-slot Traveller Power Module	\$275.00

A High-Power PIC Macro Library



by Karl Lunt

The PIC microcontrollers pack a lot of power and speed in a tiny, inexpensive package, but the hobbyist is somewhat limited when it comes to writing software for them. The BASIC interpreter built into the Stamps is slow, the few high-level compilers can be expensive if you're on your own dime, and I've always found the assembler too weird to use.

But PIC assembly language runs so fast, and can be so small, that I wasn't willing to give up on using it. This article describes an extensive library of PIC macros that you can add to your own assembly language projects. Including this library with your PIC source file gives you the power of programming structures such as FOR-NEXT loops and greatly simplifies your code, all with minimal code bloat. Best

of all, the library works with the standard Microchip MPASM assembler.

Using the library

You can find the library file — macros.asm — on my web site at www.seanet.com/~karllunt. I've included comments in the file to describe how to invoke each of the many macros. I also describe one or two problems that you'll need to watch for on the older PICs, such as the PIC 16c54.

Just copy the file into your working PIC directory. Next, edit your assembly language source file and add the following line somewhere near the top of the file:

```
include ".\macros.asm"
```

The best place to put this line is immediately following the statement where you include the equates specific to the PIC chip you're using. For example, if your assembly source file targets the PIC 12c508, the first few lines of your source file might look like:

```
include ".\p12c508.inc"
include ".\macros.asm"
```

Note that the macro library assumes that you are using the Microchip equates file for your target MCU, and relies on some common register definitions. If you don't use the Microchip equates file, you will need to provide the required register definitions yourself.

With this change made, you can now invoke any of the supplied macros. Let's take a look at what is available in the macro library.

BEQ and BNE

These are simple, and I use them virtually everywhere. As implemented in the macro library, they check the state of the Z bit in the status register and branch accordingly. You use them immediately after performing some operation that alters the Z bit.

The BEQ macro is of the form:

```
beq    foo    ; if Z is set, branch
                to foo
```

where foo is a label somewhere in your source file. If the Z bit is set when this macro is executed, control jumps to label foo. Otherwise, control continues with the next instruction in line.

The BNE macro is nearly identical:

```
bne    foo    ; if Z is clear, branch
                to foo
```

where foo is a label somewhere in your source file. If the Z bit is clear when this macro is executed, control jumps to label foo. Otherwise, control continues with the next instruction in line.

FOR-NEXT

The FOR-NEXT family of macros provides an iterated looping structure. This structure gives you a simple way to perform a task a given number of times. The basic form of the FOR macro is:

```
for    var, begl, endl
```

where var is a variable you've chosen to use as the index, begl is a literal for the starting value of the index, and endl is a literal for the ending value of the index.

When the FOR macro first executes, it writes the literal value begl to the index variable var. At the top of the FOR loop, the macro tests the current value in var against the literal

Note that the macro library assumes that you are using the Microchip equates file for your target MCU, and relies on some common register definitions.

value endl; if they match, control exits the looping structure at the associated NEXT macro. If they don't match, control continues with the next statement in sequence. This macro makes it easy to write counted loops. If you need to issue a certain amount of pulses, you could use code such as:

```
for    n, 0, 60    ; need to issue 60
                    ; pulses
bsf    portb,1    ; raise a line
bcf    portb,1    ; drop a line
next   n           ; end of loop
```

Note that FOR-NEXT structures — like all of the macro structures in this library — can be nested as deep as you like. This allows you to do some fancy loops:

```
for    x, 0, 10    ; do 10 times
for    y, 30, 50    ; step across y
bsf    portb,3    ; raise a line
bcf    portb,3    ; drop a line
next   y           ; end of y loop
movlw  100         ; need to delay
                    ; now
call   delay       ; do the delay
next   x           ; end of x loop
```

As you can see, the macros save you from having to muck about with the W register and the flag bits. They also take care of all the labels and goto opcodes used in such operations. Thus, you get to focus more on what you want the program to do, and spend less time on how it gets done.

The FOR macro uses a pair of literals; one for the starting value of the index and one for the ending value. Sometimes, however, you need to use a variable to hold the ending value. In such cases, you can use the FORF (for-flag) version of this macro:

```
forf   var, begl, endl
```

PIC'n Books

LEARN ABOUT PIC MICROCONTROLLERS

EASY PIC'n - Beginner \$29.95

PIC'n Up The Pace - Intermediate \$34.95

NEW!

PIC'n Techniques - Intermediate \$34.95

- 8-pin PICs
- Timer 1, timer 2 and the capture/compare/PWM (CCP) module
- Talking to a PIC with a PC using a terminal program
- Test equipment and data logger experiments

See Table Of Contents: <http://www.sq-1.com>
Secure Online Ordering Is Available

+ \$4 s/h in US for 1 book, \$5 for 2 books, \$6 for 3 books
VISA, MC, AMEX, MO, Check
CA residents please add 7.25% CA sales tax
PIC and MPLAB are trademarks of Microchip Technology Inc.

SQUARE 1 ELECTRONICS

P.O. Box 501, Kelseyville, CA 95451
Voice (707) 279-8881 FAX (707) 279-8883
<http://www.sq-1.com>
E-Mail sqone@pacifi.net

PRINTED CIRCUIT BOARDS

Since 1969

Prototype to Production
Quick • Quality • Service • Price

- Single Sided
- Double Sided
- Multi-Layer
- Surface Mount
- Punch Press Capability
- LPI

QUICK TURN AROUND
COMPLETE IN-HOUSE CAPABILITY

CIRCUIT ETCHING TECHNIQS

Since 1969

700 Lee Street
Elk Grove Village
Illinois 60007

Phone: 847-228-1722
Fax: 847-228-1816
Modem: 847-228-6549
Toll Free: 888-657-3827

E-MAIL — CET@MET-NET.COM
WEB ADDRESS —
WWW.MET-NET.COM/USERS/CET

Write in 74 on Reader Service Card.

where var is a variable you've chosen to use as the index, begl is a literal for the starting value of the index, and endf is a variable that holds the ending value of the index.

This macro works just like the basic FOR macro above, with one important difference. When this macro tests the index variable to see if the loop should end, it uses the value in the variable endf. This means your code could modify the endf variable, resulting in a FOR-NEXT loop that runs a variable number of iterations.

A typical use of this structure might be:

```
for  n, 0, steps ; need to issue
      ; some pulses
bsf  portb,1 ; raise a line
bcf  portb,1 ; drop a line
next n ; end of loop
```

where the actual number of pulses to issue isn't known when you write the assembler source, but is held in the variable steps when the program runs.

Both versions of the FOR macro above end with a NEXT macro that refers to the same variable name. The basic NEXT macro looks like this:

```
next  var
```

where var is the same index variable used in the matching FOR or FORF macro.

It is important that you match the FOR or FORF index variable with the corresponding NEXT index variable. The NEXT macro adds one to the index variable and loops back to the matching FOR macro so the variable can be tested. If the variables don't match, the FOR index variable will never change and the loop will never end.

In some cases, you need to add more than one to the index variable at the NEXT macro. This is similar to BASIC's FOR-NEXT-STEP structure. I've included the NEXTL macro to provide that capability. This macro looks like:

```
nextl  var, incl
```

where var is the same index variable used in the matching FOR or FORF macro, and incl is a literal that is added to the index variable. For example, the following loop steps through several odd integers:

```
for  n, 1, 31 ; start of loop,
      ; n = 1
nextl n, 2 ; end of loop, add
      ; 2 to n each time
```

NOTE: The NEXTL macro contains an addlw instruction, one of the newer PIC opcodes. Thus, older devices — such as the 16c54 — cannot execute this macro. If you assemble a source file for the 16c54 or similar processors, and the assembler detects this instruction, it will issue an assembler error.

To complete the package, the NEXTF macro works just like the NEXTL macro, but it instead adds the value in a variable to the index variable:

```
nextf  var, incf
```

where var is the same index variable used in the matching FOR or FORF macro, and incf is a variable whose contents are added to the index variable. This lets you create loops that execute a variable number of times:

```
for  n, 1, 31 ; start of loop,
      ; n = 1
nextf n, steps ; end of loop, add
      ; steps to n each
      ; time
```

REPEAT-structures

In some cases, you need to create a conditional loop. That is, you need a structure that loops until a specific condition exists or ceases to exist. For that, I've built the REPEAT series of structures. The REPEAT macro marks the beginning of the structure, and is of the form:

```
repeat
```

Exactly what type of structure you create depends on what macro you use to match up with this REPEAT macro. The simplest such structure is the unconditional loop, built from the REPEAT and ALWAYS macros. Here, control endlessly executes the code between the REPEAT and its matching ALWAYS macro. For example:

```
repeat ; start an endless
      ; loop
bsf  portb,1 ; raise a line
bcf  portb,1 ; drop a line
always ; do forever
```

You can build a conditional loop using the UNTILEQ macro with the REPEAT macro. This combination yields:

```
repeat
untilq
```

Now control executes the code between the REPEAT and UNTILEQ macros until the Z bit in the status register is set when the UNTILEQ macro executes. The instructions just prior to the UNTILEQ should perform some operation to test for the ending condition, with the ending condition signaled by setting the Z bit. For example:

```
repeat ; start a loop
movfw portb ; read a port
andlw 0x20 ; leave only bit 5
untilq ; loop until bit 5 is
      ; low
```

Here, the Z bit will be set when the W register is 0 after executing the AND operation; that is, when bit 5 of portb is 0.

Exactly what type of structure you create depends on what macro you use to match up with this REPEAT macro.

The macro library provides the matching and opposite function with the UNTILNE macro. It works just like the UNTILEQ macro, except that control loops until the Z bit is cleared when the UNTILNE macro executes. The above example could be rewritten as:

```
repeat ; start a loop
movfw portb ; read a port
andlw 0x20 ; leave only bit 5
untilne ; loop until bit 5 is
      ; high
```

Now the loop repeats until bit 5 of portb goes high. This condition leaves the Z bit cleared when the UNTILNE macro executes, and control

leaves the loop.

SELECT-CASE structures

The SELECT-CASE structure acts as a large switch table, allowing your code to take one of several paths, based on the value of a selector variable. The general format of a SELECT-CASE structure looks like this:

```
select
case
.
.
.
endcase
case
.
.
.
endcase
endselect
```

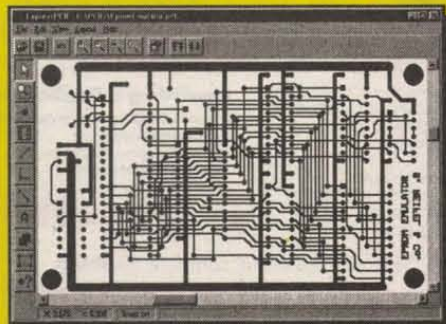
This general description shows how a SELECT statement marks the beginning of the structure. If the selector variable holds the value called for in the first CASE statement, then code between that CASE statement and its matching ENDCASE statement is executed. If not, then the selector variable is tested against each successive CASE value in turn.

If the selector variable does not match any CASE value, the code immediately following the last ENDCASE statement, if any, is executed as a default. After executing any CASE block of code, control passes immediately to the matching ENDSELECT statement, skipping over any intervening CASE blocks.

This creates a very powerful structure, ideally suited for many robotic applications, where functions to be performed depend on the value in some global state variable. As implemented in the macro library, the SELECT macro is simply:

PCB LAYOUT Software For Win95 - FREE

- 1 Download our board layout software
- 2 Design your 2 sided plated-through PCB
- 3 Send us your layout over the Internet
- 4 In 2-3 business days, UPS delivers your boards, often under \$100

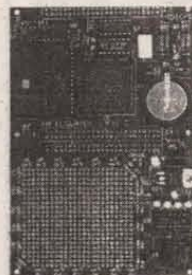


www.expresspcb.com

MORE POWER!

68HC11, 80C51 & 80C166

AM Research supports over 30 of the most popular Embedded controllers with both **hardware** and **software**.



- ✓ More Microcontrollers
- ✓ Faster Hardware.
- ✓ Faster Software.
- ✓ More Productive.
- ✓ More Tools & Utilities.
- ✓ IIC Peripherals.
- ✓ Single Chip Capable.
- ✓ Outstanding Support.
- ✓ Custom designs.

Call or email for a free full line brochure

Orders (800) 949-8051
Info (916) 652-7472
fax (916) 652-6642
www.amresearch.com

AM Research, Inc.
PO Box 43
Loomis, CA 95650

The Embedded Controller Experts

Write in 75 on Reader Service Card.

JULY 1999 23

select var

where var is the selector variable. When the SELECT macro executes, the underlying code copies the value in variable var into the PIC's W register.

The CASE macro actually tests the contents of the W register; the macro looks like this:

case lit

where lit is a literal value used for testing. When the CASE macro executes, it compares the literal value lit against the contents of the W register. If they match, the code immediately following the CASE statement is executed. If, however, they don't match, control passes to just below the matching ENDCASE statement.

This macro library makes heavy use of the powerful macro operators built into the Microchip MPASM assembler.

Note that regardless of whether the test passes or not, the contents of the W register are preserved. Thus, code following the CASE statement may rely on the W register containing the literal value called out in the CASE statement.

The ENDCASE macro marks the end of a CASE-ENDCASE structure. This macro looks like:

endcase

There must be a matching ENDCASE macro for each and every CASE macro. When code inside a CASE-ENDCASE block hits the ENDCASE macro, control passes immediately to the ENDCASE macro that closes out the current SELECT-ENDSELECT structure.

The ENDSELECT macro marks the end of a SELECT-ENDSELECT structure. This macro looks like:

endselect

There must be a matching ENDCASE macro for each and every SELECT macro. If any code exists between the final ENDCASE macro and an ENDSELECT macro, that code is treated as a default case. This means that any time a selector value fails all CASE tests, the code after the final ENDCASE is executed.

An example should make all of this clearer:

```
select foo ; use foo as the
           ; selector variable
case 5 ; if foo = 5...
bsf portb, 1 ; raise a line
endcase ; all done
case 8 ; if foo = 8...
bcf portb, 1 ; drop the line
endcase ; all done
incf count ; default, not 5 or
           ; 8, count it
endselect ; end of select
           ; structure
```

Here, I've used the variable foo as the selector value. The SELECT macro copies foo into the W register. The first CASE statement compares W to the literal 5. If they match, the code sets bit 1 of portb, then jumps to the ENDSELECT macro. If they don't match, the second CASE statement compares W to the literal 8. If they match, the code clears bit 1 of portb, then jumps to the ENDSELECT macro. If they don't match, then foo contained neither 5 nor 8.

In this case, the default code following the last ENDCASE is executed, incrementing the variable count. Finally, control falls through to the ENDSELECT macro.

The macro library contains an alternate form of the CASE macro, useful when you need to test the selector value against another variable, rather than a literal. The CASEF macro looks like:

casef var

where var is a variable whose contents are compared against the W register. This means you can write CASE structures such that the test values aren't known at assembly time, but are created in the code at run time.

WAITWHILE and WAITUNTIL

These macros create very small, very fast loops that block, or wait, until a specific condition exists or ceases to exist. They are ideal for monitoring one or more I/O lines for an input condition. The WAITWHILE macro looks like:

waitwhile addr, andl, xori

where addr is the port register to monitor, andl is a literal value used as an AND mask, and xori is a literal value used as an exclusive-or (XOR) mask.

This macro creates a small loop that reads the value in the port register at address addr, ANDs that value with the literal andl, then XORs the result with the literal xori. This sequence of operations repeats for so long as the final result is non-zero. Control does not leave the WAITWHILE macro until the final result is zero. At that time, control passes to the statement following the WAITWHILE macro.

The use of the andl as an AND mask should seem obvious. It isolates only those bits in the port register value that match bits in the andl literal.

A mask value of \$0f, for example, lets your code test the lower four bits of an address without caring what happens to the upper four bits.

The XOR mask may not seem so obvious. This effectively inverts the state of selected bits, allowing your code to test for active-low inputs. For example, suppose bit 2 of the port is active-low, and your code needs to wait while that bit is 0. Using an XOR mask with bit 2 set (\$04) inverts that bit, yielding a logic 1 when the input is a logic 0. An example might help:

waitwhile portb, 0x02, 0x02

This WAITWHILE macro reads the value in register portb, ANDs that value with \$02 to leave only bit 1 intact, then XORs that value with \$02 to invert the state of bit 1. If the resulting value is non-zero, control repeats the WAITWHILE macro. Otherwise, control falls through to the statement following the WAITWHILE.

The opposite of WAITWHILE is WAITUNTIL, which loops until a certain condition is non-zero. The WAITUNTIL macro looks like:

waituntil addr, andl, xori

This macro creates a small loop that reads the value in the port register at address addr, ANDs that value with the literal andl, then XORs the result with the literal xori. This sequence of operations repeats until the final result is non-zero. Control does not leave the WAITUNTIL macro until the final result is non-zero. At that time, control passes to the statement following the WAITUNTIL macro.

Note that if you use a value of 0 for the xori literal in either of the above macros, the macro does not generate any PIC code for the XOR operation. XORing a value with 0 leaves that value unchanged, so there is no point in generating code for that operation.

POLL and ENDPOLL

The WAITWHILE and WAITUNTIL macros create fast blocking loops, but your code cannot perform any operations inside the loops. The POLL-ENDPOLL structure lets you perform functions inside an I/O polling loop. The POLL macro looks like:

poll port, andl, xori

where port is the address of a port register to monitor, andl is a literal value used as an AND mask, and xori is a literal value used as an XOR mask.

This macro acts just like the front end of the WAITWHILE or WAITUNTIL macros. It reads the value at the address port, ANDs that value with the literal andl, then XORs the result with the literal xori. If the resulting value is true (non-zero), control falls through to the next instruction in sequence. If, however, the resulting value is false (zero), control jumps to just below the matching ENDPOLL macro.

Each POLL macro must be paired with an ENDPOLL macro. The END-

PRIMECELL

IF YOU NEED NEW BATTERIES FOR YOUR ELECTRONIC EQUIPMENT
DON'T PITCH EM - SEND THEM FOR REBUILDING - SAVE \$ \$

CUNARD ASSOC. INC., 9343 US RT 220, Bedford, PA 15522

- WE INSTALL NEW NI-CAD OR NI-MH BATTERIES INTO YOUR ORIGINAL CASE.
- WE IMPROVE CAPACITY TO BETTER THAN ORIGINAL.
- WE FIX WHAT CAN'T BE FOUND, (OR AFFORDED)
- WE PROVIDE QUICK SERVICE / EXTENDED LIFE FOR OLDER EQUIPMENT
- WE OFFER FREE QUOTES / FREE RETURN IF QUOTE IS REFUSED.
- WE PROPERLY DISPOSE OF YOUR OLD CELLS BY RECYCLING.
- WE GIVE YOU A 12 MONTH WARRANTY.
- WE WILL BE HERE WHEN YOU NEED US / EST. 1986
- WE SAVE YOU \$\$\$ MONEY \$\$\$

NO JOB IS TOO LARGE OR TOO SMALL VOLUME DISCOUNTS AVAILABLE

GENERAL ELECTRIC	UNIDEN	RADIO SHACK
19A704850P(1200mAh) \$ 34.95	APX650 1050 \$ 29.95	HTX Packs \$ 29.95
19A704860P(1800mAh) \$ 39.95	1000 1010 1070 \$ 34.95	New 8.4V pack & chgr
PL19D429783(777)G1/3 \$ 37.95	1100 1200 Series \$ 36.95	1500mAh nimh \$ 34.95
19A705293P 344A4506P \$ 34.95	BP205 650mAh \$ 19.95	
	BP200 1500mAh \$ 24.95	KENWOOD
	SC150 1500mAh \$ 22.95	PB2 / KNB3 \$ 29.95
M AXON SA-1155 1160 \$ 39.95		PB21/21H \$ 14.95
TAD 1450 1510 1520 \$ 21.95		PB25/H26 \$ 24.95
MOTOROLA		
P200 HT600 MT1000	BP2 / BP3 / BP22 \$ 18.95	
NTN 4585 4824 5414 \$ 37.95	BP5 / BP23 / 24 \$ 24.95	
NTN 5447 5521 5545 \$ 37.95	BP7 / CM7 / BP8 \$ 32.95	
NLN 5860 NTN 4327 \$ 39.95	BP180 / CM79 \$ 34.95	
MIDLAND		
70-B10 B16 B19 B21 \$ 39.95	YAESU	
B25 B26 B32 B36 B60 \$ 39.95	FNB 3 4 12 14 16 \$ 32.95	
	FNB19 21 26 27 36 \$ 32.95	
	FNB 10 1117 25 35 \$ 29.95	
		COMPUTER PACKS
		Send battery for quote.

FOR INFORMATION ABOUT YOUR REQUIREMENTS CONTACT US:
PHONE OR FAX: (814) 623-7000 E-MAIL TO: PRIMECELL@AOL.COM
SEND YOUR PACKS FOR FREE QUOTATION VIA UPS, RPS OR US MAIL
VISIT OUR WEB SITE <http://members.aol.com/primecell/primecell.htm>

BATTERY REBUILD SERVICE

MANY OTHERS AVAILABLE - WRITE OR CALL
FREE CATALOG
ADD \$ 4.50 SHIPPING & HANDLING PER ORDER

Master Card VISA

BIG POWER LOW COST



Dominoes are rugged, miniature encapsulated controllers that combine lots of analog and digital I/O with a fast control-oriented floating-point BASIC to provide a one-stop computation and control solution for cost-sensitive control tasks. Used stand alone or connected via RS-232/RS-485, Dominoes are true plug-and-go control.

Domino 1 features:

- Full floating-point ROMED BASIC
- 32-KB SRAM and 32-KB EEPROM
- 12 bits of parallel I/O
- 2 PWM outputs
- PC bus
- 2-channel 12-bit ADC
- Serial port: 19.2-kbps RS-232A, RS-422, or RS-485
- +5V @ 15 mA

Domino 2 has:

- everything in Domino 1 plus
- 16 more bits of high-current parallel I/O
- Hardware clock/calendar
- Wide-range power operation
- Hardware PWM output

\$99 to \$139

Visit our Web site for complete datasheets
www.micromint.com

To Order Call: **1-800-635-3355**

740 Florida Central Pkwy., Longwood, FL 32750
(407) 262-0066

POLL macro looks like:

endpoll

When control reaches the END-POLL macro, it returns automatically to the previous matching POLL macro.

Thus, the POLL-ENDPOLL structure lets your code monitor, or poll, a set of I/O lines for a specific condition. If that condition occurs, your code can take appropriate action, as defined inside the POLL-ENDPOLL structure. For example:

```
poll    portb, 0x80, 0x80
incf   count
endpoll
```

Here, the POLL macro tests for a low on bit 7 of portb. If that bit is low, then the variable count is incremented. If, however, that bit is high, control passes directly to the ENDPOLL macro and count is not incremented.

Under the hood

This macro library makes heavy use of the powerful macro operators built into the Microchip MPASM assembler. The following paragraphs will walk you through the design of one of the macros, so you can see

The use of the andl as an AND mask should seem obvious.

how I built it. You can then apply these techniques to create your own macros.

Here is the code specific to the FOR macro. I have added line numbers for reference only; they do not appear in the macro source file:

```
1.   variable _forknt=0
2.   variable _nxtknt=0

3. for macro var,begl,endl
4.   movlw begl
5.   movwf var
6.   _for#v(_forknt)
7.   movlw endl
8.   subwf var,w
9.   beq _next#v(_forknt)
10.  _forknt set _forknt+1
11.  _nxtknt set _forknt
12. endl
```

Lines 1 and 2 define two assembler variables that will be used by both the FOR and NEXT macros. Note that these are NOT variables used by your PIC program when it runs. These variables exist only while MPASM assembles your source, and they will only be used by MPASM. I intentionally use a leading underscore on all of my MPASM variable names, to avoid conflicts with PIC variables that you might declare in your program.

Line 3 declares the format of the FOR macro, as required by MPASM. Here you can see that the FOR macro requires three arguments, and you can see the names that they will be given throughout the FOR macro. MPASM is smart enough to know that a macro argument, such as begl, is different from a variable or equate that

you have declared elsewhere in your source file.

Lines 4 and 5 copy begl, the literal value used as a starting index, to the index variable var. This code is executed once, when control enters the FOR macro at run-time.

Line 6 shows one of the powerful features of the MPASM macro operators. This line creates an assembler label composed of the characters "_for" followed by the characters for the current value of the assembler variable _forknt. Thus, if _forknt holds the value 3, line 6 will assemble as:

_for3

Note how the #v() macro operator reads the value of an assembler variable and adds that value to the end of a label. For more details on using the #v() macro operator, consult the MPASM Assembler User's Guide from Microchip.

Lines 7 through 9 test the current value of var against the ending literal value endl. If var matches endl, then the PIC's Z-bit will be set. The beq macro at line 9 will either pass control outside the FOR-NEXT loop if the Z-bit is set, or allow control to fall through to the next line of code if the Z-bit is clear. Note how line 9 again uses the #v() macro operator to build up the label used for the beq target. Here, the label consists of the string "_next" followed by the value in the assembler variable _forknt. Thus, if _forknt holds the value 4, then line 9 will assemble as:

beq _next4

Line 10 increments the value in assembler variable _forknt, so the labels created at the next use of the FOR macro will differ from those just created. This ability to modify the val-

ues in the assembler variables is another powerful feature in the MPASM macro utility, and is essential to the proper functioning of this library.

Similarly, line 11 changes the value in assembler variable _nxtknt. The FOR macro doesn't use this variable in creating any labels, but it must perform the bookkeeping so the matching NEXT macro does create the correct label. Remember that the NEXT macro must generate a branch back to the top of the FOR macro, at the label in line 6. This adjustment of the assembler variable _nxtknt ensures that the correct branch label will be created.

Finally, line 12 contains the endm pseudo-op, used to indicate the end of a macro definition. This explanation is still pretty theoretical. It may not be clear yet how all of this comes together when the assembler actually processes a FOR macro. Let's finish up with a specific example. Assume that at some point in the assembly of your program, assembler variables _forknt and _nxtknt both hold the value 3. Your program now contains the FOR macro:

for foo, 4, 20

Given the above, MPASM will create the following assembler source lines for your macro:

```
4.   movlw 4
5.   movwf foo
6.   _for3
7.   movlw 20
8.   subwf foo,w
9.   beq _next3
10.  _forknt set _forknt+1
11.  _nxtknt set _forknt
```

I have eliminated all the setup lines from the above FOR macro exam-

I've presented a suite of powerful PIC macros that you can add to your own assembler source files.

nation, leaving only those actually used by MPASM when it processes your FOR macro. Note that the beq opcode in line 9 is itself a macro, so MPASM will expand it as well. I have left the beq unexpanded for clarity.

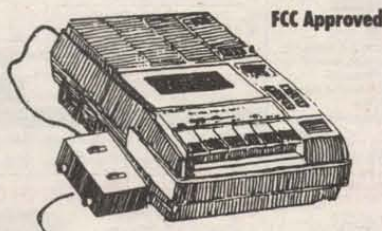
This example should make clear the power behind the MPASM macro utilities and this macro library. You don't need to match up the labels in the FOR macro with the labels in the corresponding NEXT macro. You don't have to worry that you might have used the ending literal in the FOR initialization, rather than the starting literal. All you have to do is write the FOR macro and match it up with a NEXT macro, and you're done.

That's a wrap

I've presented a suite of powerful PIC macros that you can add to your own assembler source files. These macros provide most of the common programming structures, such as FOR-NEXT and REPEAT-ALWAYS. Additionally, I've added structures such as WAITWHILE and POLL-ENDPOLL that simplify writing embedded control code, where monitoring I/O lines occurs frequently.

I hope you'll look on these macros as a beginning, not an end. Feel free to expand what I've done here. By studying my use of the assembler variables and the #v() macro operator, you should be able to create complex macros of your own. And, as your use of control structure macros increases, writing PIC assembly language programs should become simpler and less frustrating. NV

TELEPHONE LISTENING DEVICE WITH 12 HR. RECORDER



Record telephone conversations in your office or home. Starts automatically when phone is answered, records both sides of phone conversation. Recorder stops when phone is hung up. \$99.95 + \$7 shipping. For telephone listening device separately \$19.95 + \$2 ship.

For comprehensive 50 page catalog of Micro Video, VHF transmitters, Surveillance, and Counter-surveillance and much more! Send \$3.00

Call 407-725-1000

USI CORP

P.O. Box N2052 Melbourne, FL 32902

COD'S OK

Write in 78 on Reader Service Card.

World Passing You By?

Are you interested in Microprocessors & Embedded Control Systems? If not you should be! Look around, just about everything these days has an embedded microprocessor in it. TVs, cars, radios, traffic lights & even toys have embedded computers controlling their actions. The Primer Trainer is the tool that can not only teach you how these devices operate but give you the opportunity to program these types of systems yourself. Examples & exercises in the Self Instruction manual take you from writing simple programs to controlling motors. Start out in Machine language, then move on to Assembler, & then continue on with optional C, Basic, or Forth Compilers. So don't be left behind; this is information you need to know!

Examples Include:

- Measuring Temperature
- Using a Photocell to Detect Light Levels
- Making a Waveform Generator
- Constructing a Capacitance Meter
- Motor Speed Control Using Back EMF
- Interfacing and Controlling Stepper Motors
- Scanning Keypads and Writing to LCD/LED Displays
- Bus Interfacing an 8255 PPI
- Using the Primer as an EPROM Programmer
- DTMF Autodialer & Remote Controller (New!)

The PRIMER is only \$119.95 in kit form. The PRIMER Assembled & Tested is \$169.95. This trainer can be used stand alone via the keypad and display or connected to a PC with the optional upgrade (\$49.95). The Upgrade includes: an RS232 serial port & cable, 32K of battery backed RAM, & Assembler/Terminal software. Please add \$5.00 for shipping within the U.S. Picture shown with upgrade option and optional heavy-duty keypad (\$29.95) installed. Satisfaction guaranteed.

EMAC, inc.

11 EMAC WAY, CARBONDALE, IL 62901
618-529-4525 Fax 457-0110 BBS 529-5708
World Wide Web: <http://www.emacinc.com>

1985 - 1998
OVER
12
YEARS
OF SERVICE

Write in 79 on Reader Service Card.

JULY 1999 25

Open Channel

by Joseph J. Carr

Notes on Vibration Detectors and Seismographs — Part I

The idea behind
any sensor is to find
some "transducible
property" that
responds to the event
being measured.

A number of scientific and engineering instruments measure vibration signals. For example, civil and mechanical engineers can characterize a metal plate or beam by placing a vibration sensor on it, and then giving it an impact.

I've seen one case where students placed strain gauge sensors on a metal beam (Figure 1) and then whacked the other end with a "dead blow" hammer (i.e., a hard rubber hollow mallet filled with B-B shot). The idea behind using the "dead blow" hammer is to prevent bouncing of the hammer from creating more than one blow — it's kinda like "switch contact bounce" with an attitude.

In another case, sensors were placed at critical points on a bridge, and then a small explosive charge was ignited at the other end. The charge was on the order of a cherry bomb (it's called an "M-80") so caused no damage (of course, it's dangerous to use). In both

cases, the idea was to cause a single impact, and then record the vibrations in the structure that resulted from it.

If you saw the movie Jurassic Park, then you saw another use of vibration sensors. Early in the movie, before the team was recruited, the paleontologist was researching dinos, presumably in the Rocky Mountains. A shotgun shell blank was held in a rig against the ground and exploded. The seismic waves were recorded on a laptop computer and processed to show the all-too-realistic image of a raptor skeleton (real images are not that good!).

Oil exploration is done the same way. An explosion is set off at a site, and a cluster of vibration sensors around a perimeter are used to sense the vibrations. From their data, the geologists can construct an image of the underly-

ing structure, and from it predict where oil might be found. A friend of mine designed and built a number of systems like this for oil geologists at the University of Texas ... until a drunk driver got him one rainy night near Austin.

In other cases, a repetitive blow is delivered to the object under test. The idea is to set the thing into motion, and see what happens. Presumably, standing waves will arise in some cases. It was this type of experiment that led engineers to a better understanding of chaos in mechanical systems. It seems that resonance isn't the only way to destroy a metal beam or plate!

The idea behind any sensor is to find some "transducible property" that responds to the event being measured. A number of things can be used. For example, the strain gauge consists of a thin resistive wire stretched across a membrane or diaphragm (Figure 2). When the wire is deformed, its dimensions change, so its resistance will also change. This phenomenon is called piezoresistivity. When the strain gauge resistor is used in a Wheatstone bridge, then a sensitive measure of the deformation caused by vibration can be obtained. The circuit in Figure 2 is used for a lot of strain gauge sensors.

Another transducible property for vibrations is the inductance of a coil, as shown in Figure 3A. The inductance of the coil of wire is determined by the number of turns, diameter of the coil, the length of the coil, and the nature and position of the core. If a ferrite or powdered iron core is used, then a large increase of inductance occurs when the core is slipped into the coil form. "Slugged" inductors are used in radio circuits. A threaded core is adjusted to be more or less inside the coil, depending on the value of inductance required. Vibration sensors can be made by placing the core on a spring, pendulum, or some other means of translating the motion caused by vibration into motion of the core ... and therefore a change of inductance.

In Figure 3B, a pendulum is used to move the core in and out of the coil form. This only works, however, if the coil form is arced to accept the

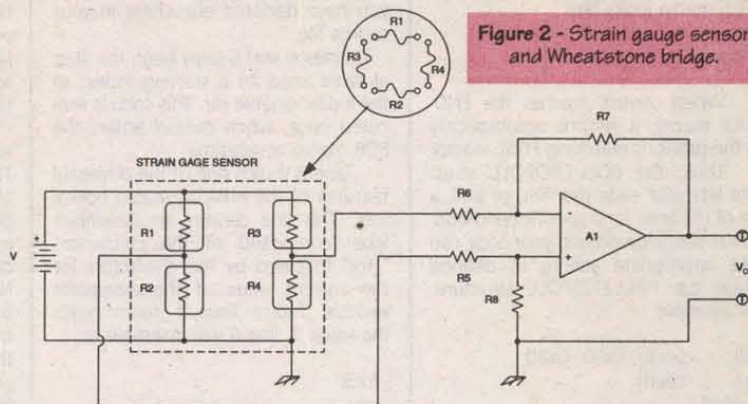


Figure 2 - Strain gauge sensor and Wheatstone bridge.

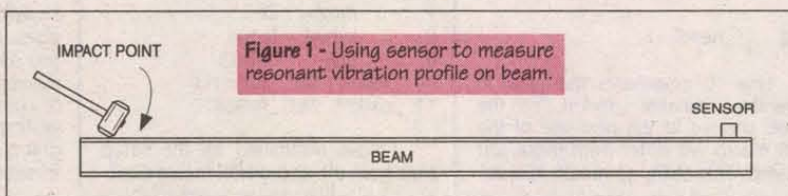


Figure 1 - Using sensor to measure resonant vibration profile on beam.

AMAZING PRODUCTS!

BOX 716 AMHERST, N.H. 03031

INFORMATION

UNLIMITED adnv599c

VISIT OUR "ACTION" WEB SITE@
<http://www.amazing1.com>

Laser Window Listener

Access Internal Sounds Via A Beam Of Light!!

Remarkably simple concept uses a beam of laser light to illuminate a window acting as a microphone vibrating to the sounds and reflecting back to a sensitive filtered optical receiver that now reproduces this modulated light back into the actual sounds as heard thru a set of headphones.

LWB9 Plans for Three Complete Systems.....\$20.00

Complete System for Demonstration of Concept LWB60 Demo System with 5mw VisRed Laser...\$159.95

Below Electronics for Two High Performance Infra Red Systems Shown Built From Above LWB9 Assembly Plans

LLR40 Optical Receiver/Processor.....\$199.95

CWL10 10 mw Infra Red Class IIIB Laser.....\$149.95

IR Burning Laser Gun

High Power Class IV CW Output at 1 Micron Uses New High Efficiency IR Diodes Available as Gun or Bench Assembly for Lab Use Battery or AC Line Powered

Shown Built in Gun Configuration Many Uses Include:

Source of Focused Heat for Lab Experiments and Research, Ultra Bright Illumination for Target Designation, Night Vision and Laser Window Bounce Listening Research, Directed Energy Beam Experiments for Potential Weapons Demonstration and Material Testing Plus Plus!

Frequency Doubles to a 300mw Ultra Bright Green Laser

CWL5 Plans.....\$15.00

CWL5K Complete Kit Available on Request

FM Transmitter Kits

- 1 Super Sensitive Ultra Clear 1 Mile+ Voice Transmitter
- 2 1 Mile+ Phone Transmitter
- 3 Line Powered Phone Transmitter Never Needs Batteries!
- 4 Tracking/Homing Beacon "Beeping Transmitter"
- 5 Video/Audio Rebroadcaster+1 Mile
- 6 TV/FM Radio Disrupter Neat Prank!!! Discretion Required

Includes Tricks Using Wireless Devices

COMBOX Above 6 Kits/Plans...\$59.95

COMBOP Above 6 Plans Only...\$10.00

Kinetic Electric Gun

Pioneer a Futuristic Weapon

500 Joules Energy Storage Constant Current Charging Triggered Spark Switch Ballistic Velocities Handheld, Battery Operated, Labeled "Dangerous Product"

EGUN1 Plans.....\$20.00

All Parts are Individually Available

250 KV Tesla Coil

10-14" Explosive Bolts of Lightning! Transmits Energy, Ion Motors Anti Gravity, Size - 20"H x 8" Square Weight - 25 Pounds Input - 115 VAC/2Amps See in "Action" on web www.amazing1.com

BTC3 Plans.....\$15.00

BTC3K Kit/Plans.....\$349.95

BTC30 Ready to Use.....\$449.95

BTC4 Plans 30" Sparks.....\$20.00

Ion Ray Gun

Projects Energy

Star Wars Technology Demonstrates Weapons Potential, Force Fields, IonMotors, AntiGravity etc. Projects electric shocks without contact! Conduct many weird and bizarre experiments

IOG7/9 Plans.....\$10.00

IOG7K Kit/Plans.....\$99.50

IOG70 Assembled/TESTED.....\$149.95

Higher Powered Device

IOG9K Kit/Plans.....\$129.95

IOG90 Assembled/TESTED.....\$199.95

Gravity Generator

Demonstrates a unique phenomena of electrical reactions that produce the effect of "anti-gravity". You build a small mock space ship from simple materials and use our power supply for energizing. Excellent demonstration of a fascinating method of levitation.

GRA3 Plans with Book.....\$20.00

GRA3K Pwr Sup Kit/Plans/Book.....\$99.95

GRA30 Assembled with Book.....\$149.95

Shock Force Field Vehicle

Object Electrifier

Hand shock balls, wands. Mini circuit is easily hidden Great feedback for those wise guys.

SHK1K Kit/Plans.....\$19.95

Attention

High Voltage Experiments Battery Powered Mini Sized Modules For Research In: Hovercraft, Ion Guns, Force Fields, Shockers Etc.

MINIMAX4 4KV@10ma.....\$19.50

The Sizzler

300,000 Volts of Explosive Stunning and Stopping Power Intimidatingly Effective to 20' SIZZ300 Complete.....\$49.95

1 800 221 1705 Orders Only! Fax 1 603 672 5406 Information 1 603 673 6493 Free Catalog on Request

Pay by MC,VISA,Cash, Check, MO, COD. Please Add \$5.00 S&H plus \$5.00 if COD. Overseas Please Contact for Proforma

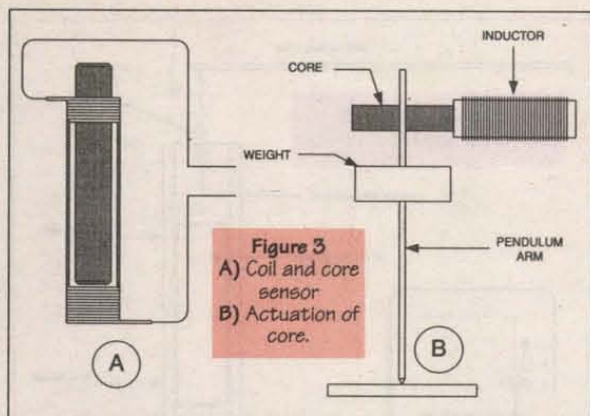


Figure 3
A) Coil and core sensor
B) Actuation of core.

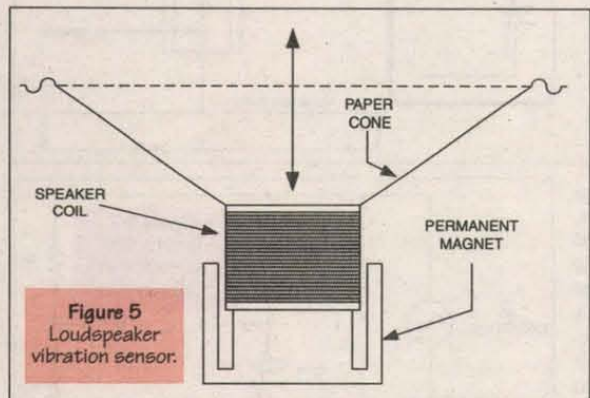


Figure 5
Loudspeaker vibration sensor.

pendulum swing, or if there is mechanical linkage to translate the arced motion of the pendulum to the linear motion of the core.

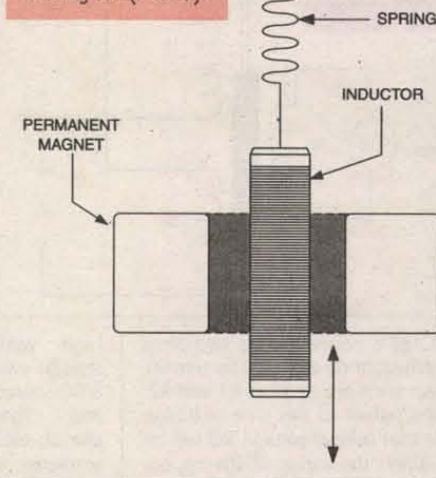
There is a class of motion sensors that depends on the fact that a magnetic field and coil in motion relative to each other causes a current to be induced into the coil. It doesn't matter whether the coil moves or the magnet moves, so long as there is relative motion.

Figure 4 shows a crude form of a permanent magnet moving coil (PMMC) vibration sensor. A horseshoe magnet is positioned such that an inductor can move inside of its field. The coil, which may have many, many turns, is connected to a spring. When vibration is sensed, the coil moves up and down against the spring, causing a current to be

induced because of the magnetic field. A more familiar example is something that you might not at first see as a vibration sensor. The ordinary radio or television loudspeaker (Figure 5) will do this neat trick. The PMMC loudspeaker consists of a fixed permanent magnet (usually made of Alnico), and a lightweight moving coil that is attached to the paper speaker cone. When an electrical current from the radio output stage flows in the coil, it will produce a magnetic field that either attracts or repels the permanent magnet's field, depending on the polarity of the audio signal. Thus, as the polarity of the audio signal switches back and forth, the coil and cone move in and out.

The same loudspeaker that can be used as a radio output device can also be used as a microphone. Intercom sets that allow talk-back use this phenomenon. When sound

Figure 4 - Large vibration sensor using permanent magnet and moving coil (PMMC).



vibrations impinge the cone, it will move the coil relative to the magnet causing a current to be induced into the coil. This tiny current can be amplified and used as an audio signal.

Note that word in the previous paragraph: vibration. I judge science fairs, and once saw a kid use a six-inch loudspeaker as a clever vibration sensor. If the vibrations being measured can be coupled to the speaker cone, then the speaker will act as a vibration sensor. I've seen speakers placed flat against metal plates for the purpose of recording vibrations. The science fair student cemented a plastic drinking straw against the bottom of the speaker cone, and used it to couple to the vibration source. Essentially, the kid made a large-scale "spike microphone."

Linear Differential Voltage Transformers (LDVT)

Figure 6 shows a special form of large vibration or displacement sensor called a linear differential voltage transformer (LDVT). It consists of three inductors (L1 through L3). Inductor L1 is excited by an AC

signal, which is magnetically coupled to secondary coils L2 and L3. When the core is exactly midway between L2 and L3, the currents flowing in them will be identical. The dots indicate the phasing of the two secondary coils. Because of the connection of L2 and L3, the currents are in series opposing. Thus, when the core is midway, the currents are equal and opposite, so null to zero. But when the core is offset in one direction or another, then one of the coil currents will predominate.

The amplitude of the output signal (expressed as a voltage) gives us an indication of the magnitude of the core shift, while the polarity tells us the direction. When the core is coupled to something like a pendulum or diaphragm, then the vibrations received will move the core in and out of the coil-pair ... causing an AC output signal to appear.

Differential Capacitor Sensors

Capacitance exists whenever two metallic objects are in close proximity to each other, and are separated by an insulating material (i.e., "dielectric"). Such a device is called a capacitor. Capacitance is a measure of the capacitor's ability to store an electrical charge in an electrical field set up between the plates. The value of capacitance is proportional to the area of the metal surfaces and a property of the dielectric called the dielectric constant ($\epsilon = 1$ for dry air), and inversely proportional to the distance between the metal surfaces (in other words, the closer together they are, the higher the capacitance).

Capacitors are used in a variety of electronic applications. But in this particular case, we are interested in a class of capacitors that are variable, and can be made to vary under the influence of vibration.

Differential Capacitors. This class of variable capacitor actually consists of two variable capacitors actuated by the same shaft or other mechanical device. They are config-

Do You Repair Electronics?

For only \$7.95 a month, you'll receive a wealth of information:

Repair data for TV, VCR, monitor, audio, camcorder, & more.

Over 100,000 constantly updated problem/solutions plus...

- TechsChat live chat room.
- UL/FCC number lookup.
- Private user discussion forums.
- Hot tips bulletin board.
- Automated email list server.
- Manufacturer information.

To access RepairWorld, direct your internet browser to <http://www.repairworld.com>

RepairWorld.com

Electronix Corp. 1 Herald Sq. Fairborn, OH 45324 (937) 878-9878

Write in 95 on Reader Service Card.

DIGITAL SATELLITE TV REVOLUTION!

KNOWLEDGE is POWER!

- A clear explanation of all aspects of digital satellite TV
- Communication fundamentals and standards
- Digital compression, MPEG-2, DVB, error correction
- Uplink, satellite and receive system operation
- Internet operation and satellite delivery of data
- Installing fixed and tracking dishes
- Retrofitting older systems and mobile systems
- Conventional and IF distribution systems
- Troubleshooting and repair ... and much more ...

www.baylin.com
or... call 800-483-2423

ORDER via Internet or Send \$60 plus \$5 s/h to:

Baylin Publications, 1905 Mariposa, Boulder, CO 80302
MASTER, VISA & AMEX / COD orders accepted

FREE CATALOG - Satellite TV books, videos and software



486 pages, 8-1/2" x 11"

JUST PUBLISHED!

Telephone: 303-449-4551
FAX: 303-939-8720

Write in 97 on Reader Service Card.

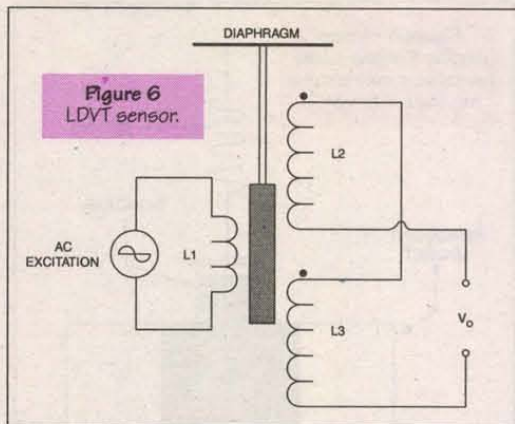
Nuts & Volts Magazine/JULY 1999 27

ured such that one capacitance increases its capacitance while the other decreases its capacitance in the same manner. If you were to measure the total capacitance across the two capacitors, then you would find that the net capacitance does not change even though the values of the two capacitor sections does.

Figure 7 shows a large vibration sensor that works on the differential capacitance phenomenon. The two capacitors are formed by two metal cylinders (C1 and C2), separated by a small dielectric gap of air or other material. These cylinders share a metal plunger that is inside and axially concentric with them. An insulating sleeve prevents the plunger (the "common plate" of the differential capacitor) from shorting out against either cylinder. When the plunger is equally inside both cylinders, favoring neither, then their respective capacitances are equal. But if the actuating arm moves, then the plunger will move more deeply into one cylinder and out of the other. As a result, the ratio of the two capacitances changes.

The inset in Figure 7 shows the equivalent circuit schematic for the differential capacitor vibration and displacement sensor.

A circuit for using a differential capacitance sensor is shown in Figure 8. The differential capacitor (C1A



and C1B) is connected as two arms of a Wheatstone bridge. The remaining two arms are resistors R1 and R2. It is the nature of this type of bridge circuit that output voltage V_0 will be zero when the ratios of the capacitive reactances and resistances are equal:

$$\frac{X_{C1A}}{X_{C1B}} = \frac{R1}{R2} \quad V_0 = 0$$

If $R1 = R2$, the output voltage will be zero when the differential capacitor is balanced, i.e., $C1A = C1B$. When vibration or other motion displaces the plunger, however, $C1A \neq C1B$, so the bridge is unbalanced and V_0 is non-zero. The amplitude of V_0 depends on the amplitude of the mechanical displacement of the plunger.

Other forms of circuit can be used with a differential capacitive sensor. For example, the two capacitors (C1A and C1B) can be used to control the frequency of radio frequency oscillators. When $C1A = C1B$, then the two frequencies would be equal, but a change in that equality will force the frequencies apart. One frequency will rise, while the other will fall. If the two frequencies are combined in a non-linear mixer, then the resultant heterodyne beat note will be proportional to the deflection of the plunger. A frequency-to-voltage (F/V) converter or other form of circuit can be used to produce the analog waveform.

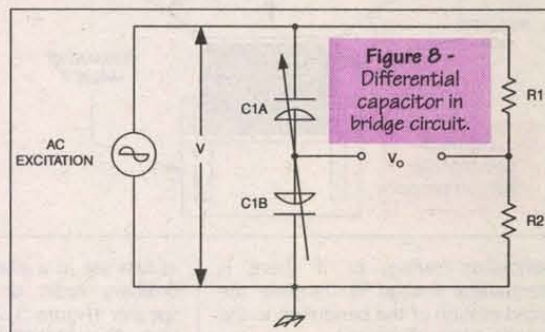
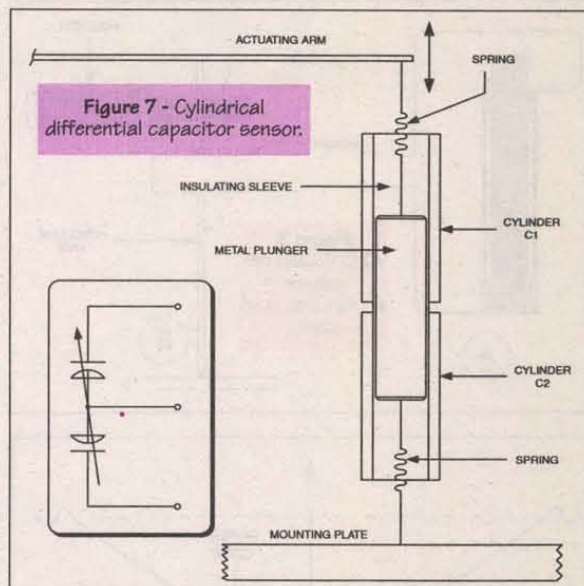
Another approach is shown in Figure 9. It is derived from a sensor called the Shackleford-Gunderson seismometer. In this type of sensor circuit, the common plate of the capacitor is excited by a 4 to 6 MHz RF signal, and the other two are used as "receive antennas." When the detected and integrated outputs of these receive antennas are combined, the resultant signal is proportional to the vibration.

Still another approach is to charge the capacitors through a

high value resistor with a DC source, and then use an electrometer to measure the voltage across the capacitors. The voltage will be proportional to the charge which, in turn, is set by the capacitance. The result is that the two DC voltages will vary according to the position of the plunger.

Note: "Electrometers" are amplifiers with extremely high input impedances, so can be used to measure the charge developed across small value capacitors.

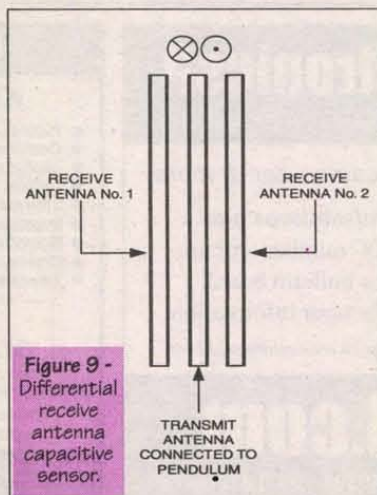
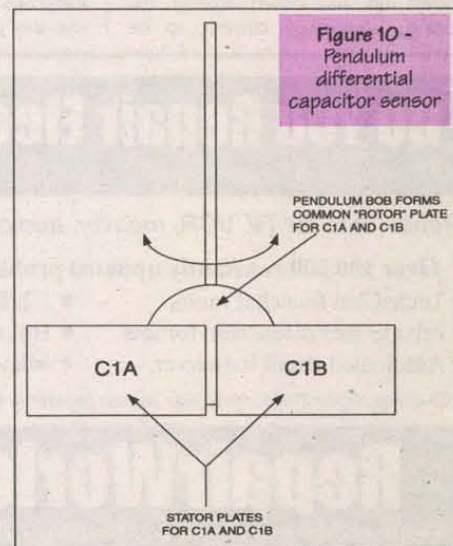
Another form of differential capacitor vibration sensor uses a pendulum (Figure 10) to move a metal disk between two sections of the capacitor. One inset shows the schematic symbols for C1A/C1B, while the other shows a top view of the capacitor/pendulum. The stator plates of C1A and C1B are made with bits of sheet metal, or blank unetched printed circuit board stock (which might be easier to work).



Two sets of plates are used for each capacitor, and they are connected together. As the pendulum bob swings back and forth, it will "shade" more or less of each set of stator plates depending on the amplitude and direction of the swing. Similar circuit strategies as above will also work for this sensor. **NV**

Connections ...

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



Learn MICROCONTROLLERS EMBEDDED SYSTEMS and PROGRAMMING...

with the AES learning system/ embedded control system. Extensive manuals guide you through your development project. All programming and hardware details explained. Complete schematics. Learn to program the LCD, keypad, digital, analog, and serial I/O for your applications.



THREE MODELS AVAILABLE. Choose from an Intel 8051, Intel 8088, or Motorola 68HC11 based system. All models come with:

- 32K Byte ROM, 32K Byte RAM • 2 by 16 Liquid Crystal Display • 4 by 5 Keypad • Digital, Analog, and Serial I/O • Interrupts, timers, chip-selects • 26 pin expansion connector • Built-in Logic Probe • Power Supply (can also be battery operated) • Powerful ROM MONITOR to help you program • Connects to your PC for programming or data logging (cable included) • Assembly, BASIC, and C programming (varies with model) • Program disks with Cross Assembler and many, well documented, program examples • User's Manuals: cover all details (over 500 pages) • Completely assembled and ready to use • Source code for all drivers and MONITOR • Optional Text Book

Everything you need. From \$279
Money Back Guarantee
Call for Free Info Pack, or see
WEB at <http://www.aesmicro.com>
714-979-1091, FAX 714-979-1093

Call 1-800-730-3232

AES
Advanced Embedded Systems

AES: 2110 S. LYON ST., STE. C, SANTA ANA, CA 92705 USA

BOOM MIKE

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

92A001 \$4.95 each

**"Semiuniversal" RCA 39-BUTTON REMOTE CONTROL**

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

97V010 \$9.95 each

13.8 VDC REGULATED POWER SUPPLY

Rated 6A continuous, 8A maximum. Features include illuminated on/off switch, fuse, binding posts and cigar lighter socket.

99E004 \$39.95

ULTRABRIGHT WHITE LED

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

SE5082H \$4.95 each

6 METER FSK RECEIVER

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

92A067 \$9.95 each

RF SNIFFER

Wideband RF detector measures RF field strength in the 100KHz to 500MHz range at low levels. The kit includes all components, except 9V battery. The power reading indicates the presence of RF and its relative level. It makes a great BUG detector. Use it to test the output of any RF transmitter: cb, ham, cordless telephones, and even car alarm transmitters! The circuit has an adjustable attenuator to handle low to high power levels. Use during RFI/EMI precompliance testing. The kit is easy to assemble and comes with schematic diagram and complete instructions.

97K005 \$29.00 each

**BLACK (UV) LIGHT**

Avon "Derma-Spec" imager designed for skin evaluation, but ideal for many other applications. Plastic case contains a UV-B bulb and reflector. Auto turn-off after 50 seconds. Powered by 12VDC @ 500mA wallwart (not included).

98L009 \$7.95 each

**TRANSPARENT 3-BUTTON MOUSE**

Watch your mouse in action! Selectable 2- or 3-button operation. Fully compatible with Mouse Systems and Microsoft. 300 DPI optical-mechanical encoder. Six-ft. cable with DB-9 connector. FCC approved. Easy-to-follow instructions and software on 2.5" floppy disk.

MUS3C \$7.95 each

TELEPHONE SPEECH NETWORK

With Dialer Interface Telephone line powered. Adjustable gain. Works with electret mike and receiver or earphone. Impedance 150 Ohms or higher. Provides regulated voltage for external CMOS dialer. With docs.

97V005 \$4.95 each

100 FEET RG/58U CABLE

With BNC male connectors.

97W028 \$19.95 each

12VAC 1A WALL WART

Input 120VAC, 60Hz, 16W. Phone plug. 3.5mm plug size.

98E001 \$4.95 each

14-DAY PROGRAMMABLE TIMER

Originally used to control a satellite receiver through its IR port. Time on/off for eight distinct events. Modify it for your needs or dismantle it for its parts. Programmable with a 2732 EPROM in a removable "personality" module, the unit may be modified to control any IR device through its IR port. Contains Z80 CPU, clock display and associated parts. Operates from 9VDC 500 mA wall transformer which is included.

92V014 \$9.95 each

**NEC AMPLIFIED SPEAKERS**

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

98V013 \$9.95/pr.

NEC SPEAKERS with POWER SUPPLY SEMI KIT

These speakers have crisp quality and deep bass. The kit provides the transformer, rectifier, and cable; everything needed to power our NEC speakers (98V013).

98V015 \$14.95

NEC SPEAKERS with POWER SUPPLY

This includes a pair of amplified NEC speakers, factory power supply, and cables.

98V015 \$19.95

"FLUKE TYPE" METER PROBE KIT

Shrouded type banana plugs fit Fluke and other popular DMMs.

97Z017 \$4.95 set

NEODYMIUM MAGNETS

100+ Gauss each. Size approx 0.5" sq. x 0.125".

92N003 6 for \$9.95

VIDEO SWITCHING CENTER

This switch box has four inputs and three outputs. Console-mounted switches and instructions allow you to switch between a wide choice of video sources.

95V020 \$9.95 each

TV INTERNAL A-B SWITCH

12VDC @ 15mA controls relay. Non-latching. Remotely switches between two signals. Specs included.

98G001 \$7.95 each

**ELECTRONIC COMPASS KIT**

A Global Positioning System receiver may be the ultimate location finder device, but for casual hiking, biking or camping this amazing digital electronic compass is an economical alternative. The compass kit uses an advanced Hall-effect sensor to detect the earth's magnetic field and converts the information to a directional display. Runs on 9V battery.

97K001 \$32.00 each

**60 MHz SCOPE PROBE**

Attenuation: X1 @ 15 MHz, 60 pF or X10 @ 60 MHz, 12 pF. Working voltage: 600VDC (including AC peak). Working temperature range: -13 deg. F (-25 deg. C) to 158 deg. F (70 deg. C). Compensation range: 15pF to 50pF. American-made.

94Z001 \$19.50 each

100 MHz SCOPE PROBE

Attenuation: X1 @ 10 MHz, 75pF, X10 @ 100 MHz, 11pF. Working voltage: 600 VDC (including AC peak). Compensation range: 15-50 pF. Include 6" ground lead, spring hook, BNC adapter, I.C. tip, insulating tip, and trimmer tool. American-made.

94Z002 \$24.50 each

SURFACE MOUNT TOOL

The Handi-Vac® is used to remove/replace surface mount components. Vacuum to lift the part is generated by the squeeze bulb. Four suction cups complete the ensemble for handling all types of delicate components. Of course, everything is anti-static.

HV-Kit \$9.95 each

FERRITE ROD

1KHz-1MHz frequency range. Material 33. Approx. 150mH/2" for short coils centered on the rod. Approx. 50mH/2" for windings covering the full length of the rod. 5.875" long by 0.5" dia. Docs included.

98P005 \$4.95 each

RS232 CABLE

25-ft. DB25-M to DB25-F.

97W019 \$9.95 each

REMOVABLE HARD DRIVE

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

97C024 \$9.95 each

MINIATURE FOLDED HORN SPEAKER

8 Ohms impedance. Frequency response $\pm 6dB$, 120 Hz to 14 KHz. Use two in parallel for sound enhancement. Applications include multimedia (connects into sound card), ham radio (visor mount), etc. Measures only 3 1/2" x 4 1/2" x 1 1/2". Incredibly good sound for such a small speaker!

95V017 \$1.49 each

**24V DIAPHRAGM AIR PUMP**

24VDC @ 400mA (max.). Free air 0.3 CFM. Max. pressure approx. 11 lbs. Max. vacuum approx. 28"Hg. Dimensions 4"W x 4 1/2"L x 3 1/2"H.

99U002 \$19.95 each

30V POWER SUPPLY

This desktop power supply is 30V @ 400mA. Center negative. 3mm X 6.5mm plug size.

99E005 \$7.95

COMBO PACKAGE

This includes everything you need to hook up our 24V air pump (99U002) and our 30V power supply (99E005).

99U005 \$24.95

24VDC @ 25A LAMBDA SWITCHING POWER SUPPLY

24VDC @ 25A (up to 40°C). Input 187-250 VAC, 790W, 0.7pF (260-350 VDC). Size 4.5" x 5" x 13". Weight approx. 9.5 lb.

98E027 \$74.95

LAPLINK CABLE

Six-ft. "competition yellow" DB-25M to DB-25M cable. Works with LapLink, pcAnyWhere, or Win95/98 Direct Cable Connection and similar programs.

98W005 \$5.95 each

PLANO-CONVEX LENS

21mm (5/8") dia. Focal length 25mm (approx. 1").

97L018 \$1.50 each

STEPPER MOTOR

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

96M005 \$4.95 each

BIPOLAR STEPPER MOTOR DRIVER IC

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

L293D \$3.00 each



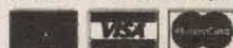
ALLTRONICS

2300-D Zanker Road - San Jose, CA 95131-1114

World Wide Web: <http://www.alltronics.com>

(408) 943-9773 - Fax (408) 943-9776

Store Hours: 9-6 M-F & 10-3 Sat. - Pacific
Visa, M/C, AmEx Accepted. All Sales Final.
California Residents Add Sales Tax.
Shipping Additional on All Orders.
Prices Subject to Change Without Notice.
Prices Good 60 Days from Date of Publication



Visit our website and download our catalog.

010799

ELECTRONICS Q & A

With TJ Byers

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

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

You can reach me at:

TJBYERS@aol.com

TJBYERS@juno.com

or by snail mail at

*Nuts & Volts Magazine,
430 Princland Ct.,
Corona, CA 91719.*

What's Up:

• EL lamp circuits galore!
See the companion article on page 82. • Other laptop display problems. • More DSS solutions, and simplification of two previous answers: • a remote thermometer and • garage trigger device. • Two gel-cell chargers, and • a great IC find for zero-crossing, • noise-free dimmer circuits, plus • some computer music. Finally, • feedback from our readers that add a honing edge to previous answers. Enjoy!

More PC Screen Problems

Q - Recently, a friend was given an AT&T Safari computer, a circa 1993 Intel-based 386 notebook. She's not a computer person, but would like to use it with Microsoft Word and likes the small footprint. The problem is that the LCD display backlight doesn't work, and the display is virtually impossible to read without the backlight. There's an external monitor port which works fine, so the problem has to be in the LCD display. I would like to fix the backlight, if possible, but I've been unable to find any info from either AT&T or NCR. The light does flash at power down, which makes me suspect it's trying to work. Would you have any ideas or info?

Andy
via Internet

A - The backlight is a Cold Cathode Fluorescent Tube (CCFT). The lamp life of a CCFT is defined as the time when either of the following conditions occurs in continuous operation:

- The brightness becomes 50 percent of the original value.
- The kick-off voltage exceeds the maximum value.

Most of today's CCFT backlights are rated for 10,000 hours of operation. Depending on the display, you may be able to replace the backlight yourself. However, I don't recommend doing this unless you've cracked open a laptop computer before. There's a lot more to break under the display just by removing a couple of screws. Call your local PC repair shops and see if it's worth it (these old lamps aren't cheap, and I recently bought a refurbished IBM 486 notebook for less than \$500.00).

DSS Signal Splitting?

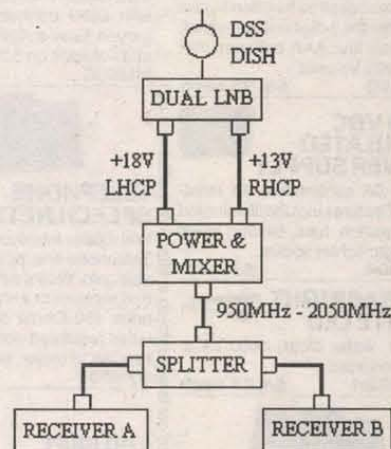
Q - The conventional wisdom within the Direct Satellite Systems (DSS) community is that the signal cannot be split at the Low Noise Blockdown (LNB) amplifier. If you want two set-top Integrated Receiver Decoders (IRDs), you need a dual LNB with two coaxial downlinks. Why can't I simply put a splitter at the LNB and run a coax cable from each side of the splitter (two total) to each of two receivers, like I do with my cable TV? The clerks at RadioShack, Circuit City, and Best Buy (etc.) have no idea, of course. (Their stock answer is, "Uhh, that's just the way it is, man ...") So do you know why? Is the signal too weak, cross-modulated, or maybe there's a power supply conflict? Am I oversimplifying things?

Mike Quinn
via Internet

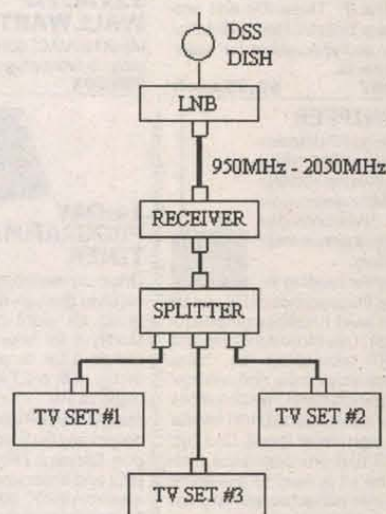
A - Actually, it's a combination of factors, but here's the bottom line. In order to cram more signals into a very sharply focused beam from outer space, the DSS signals are focused into right-handed circular polarization (RHCP), dubbed vertical, and left-handed circular polarization, called horizontal. The polarization selection of the desired signal is done at

the dish by the LNB via a voltage applied to the downlink coax: +13 volts will select vertical (RHCP) signals, whereas +18 volts will select horizontal (LHCP) signals. Different channels can appear on different transponders, which get sorted out by cross polarization. The receiver knows what channels are on which transponders, and thus when you select a particular channel, it knows what voltage to send to the LNB for the appropriate polarization.

This scheme works great for a single receiver, but what happens when you have two receivers in parallel, each trying to control the polarization of the amplifier? My guess is that the receiver with the higher output voltage wins, which means you'll only get half the channels. In a properly-designed dual LNB setup, you have two receivers, each controlling one LNB. If you want to reduce that to just one main feed line with all the channels, one LNB is fixed to receive RHCP signals and the other LHCP signals. These signals are now mixed in a diplexer (or similar mixing device), amplified, and distributed to as many receivers as you can afford. Here's a simplified diagram.



Now if you're comfortable with having a single channel that's distributed to more than one TV set in the house, here's how it's done.



Notice that the split isn't done at the LNB, but after it goes through the receiver where the frequencies are lower and the insertion and cable losses are less.

Hard Boiled Batteries

Q - I recently acquired quite a few 12-volt, 6 AH sealed lead-acid batteries. Unfortunately, most of the batteries were completely discharged upon arrival. I tried to charge them using a plain old variable voltage power supply, using an external amp meter to

monitor the charging current manually. I usually charge them at 14 to 16 volts, at around 2 amps. However, when I connected one and put juice to it, it wouldn't draw any amperage. After a while of this, it started to draw about 100 mA, but would not hold the charge. After several attempts to charge them, I gave up. I was wondering if you know of a way to charge a dead lead-acid battery, or how to modify my method. I know I'm using a very crude method to charge them, and probably overcharge them, but it is the only way I know of because I'm not old enough to take any high school courses on electronics.

Tyler Graff
via Internet

A You don't need a high school education to have fun with electronics — you can start at any age. For example, you'll find a wealth of information in the pages of this magazine. Even if you don't build the project, just reading about how it works and why it works helps a lot. Then there are books, like *Getting Started In Electronics* by Forrest Mims (\$4.99) and *Basic*

Electronics by McWhorter & Evans (\$9.99), both are available from RadioShack. As to why your batteries are dead, I think they have been "boiled" to death in a former life. Typically, a gel-cell (sealed lead-acid battery) shouldn't be charged faster than 200 mA per amp-hour (AH). In your case, that's 1.2 amps (2 amps is acceptable for a short time). After the battery is nearly fully charged, though, the charging current has to be reduced or it will start to "boil," that is, venting hydrogen gas. In most cases, the maintenance current is about 20 mA per 1 AH — 120 mA for a 6 AH battery. To prevent further damage to the remaining good batteries, I'd use the battery charger circuit described in the next question, "Gel-Cell Standby Charger." Sorry, but I don't know of a way to bring a dead gel-cell back to life.

Gel-Cell Standby Charger

Q I'm trying to duplicate an old but reliable 12-volt gel-cell charger that calls for an Motorola HEPR0170 diode, for which I can't find a cross-reference. I have tried substituting various diodes, but none

Dick Lynas, to remind me that Harris still makes the venerable CA3162 A/D Converter for 3-Digit Display. (I thought it was long extinct!) Originally invented by RCA, this chip converts a -99 mV to +999 mV input into BCD code. When paired with the companion CA3161 chip, a BCD to 7-segment LED decoder, you have a complete DVM with just four external parts (not including the LEDs). Both chips are available from Jameco (TK) and JDR (TK). The sensor is an LM334 current source and temperature sensor, which is available from the same sources. Total cost is about \$10.00.

The LM334 sensor has a linear temperature coefficient of exactly 10 mV per Kelvin when configured as shown. In case you don't know what a Kelvin is, it's the same measurement as Centigrade, except that the scale starts at absolute zero instead of the freezing point of water (0 °C) — minus 273.1 °C, to be exact. At 25 °C (68 °F), this translates into 2.981 volts. At 125 °C, the voltage across the 10k resistor becomes 4 volts. So far so good; 100 degrees Centigrade for a 1-volt span — just what the CA3162 needs. However, the display won't read right. At 25 °C, the display will read EEE — an error message sent by the CA6231 to indicate that the input voltage has exceeded 999 mV. Fortunately, the input to this chip is differential; that is, similar to an op amp. So if we raise the input voltage of the LO pin to 2.73 volts, the equivalent of 0 °C, the display will read 250 mV at 25 °C. As the temperature inches its way up, so will the display voltage. At 90 °C, the display will read 900 mV. With the simple insertion of a decimal point, we have a digital thermometer that measures from -75 °C to 99.9 °C — a range from the Antarctic to a boiling cauldron.

To calibrate the instrument, short pins 10 and 11 and adjust ZERO for zero out. Next, submerge the sensor in an ice-water bath and adjust the CAL LO for zero out. Finally, place the sensor in a pot of boiling water and adjust CAL HI for 99.9 (subtract about 1 °C for each 1000 feet above sea level). That's it! Again, my thanks to reader Dick Lynas for letting me know these chips are still alive and well — and cheap.

Digital Thermometer Takes Bite Out Of Frost

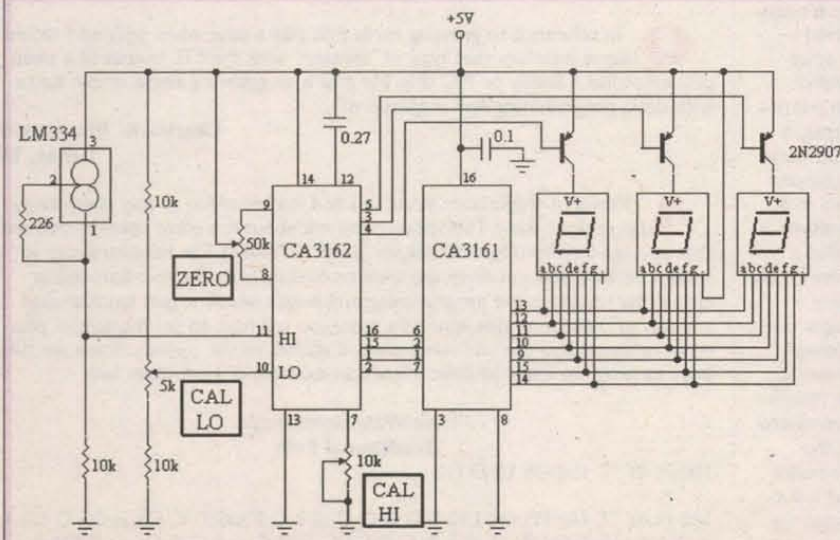
Q How does one go from an LM334 (temperature sensor) to a 74192 (up/down counter) to construct a seven-segment LED readout thermometer? If it's not easily done can you suggest alternative ICs? If there's a version that goes to -30 °C it would really be nice. (It's a real pain to step outside this "igloo" just to check the thermometer.)

Ken Schultis
Salmon Arm, BC, Canada

Q I've "inherited" the responsibility for maintenance of a digital temperature readout on a piece of commercial gear on a mountain top. The problem is that the sensor part of the circuit was fried by a lightning strike. The unit uses a very large seven-segment, common-anode LED display, which survived the attack. While it's hard to tell from the char, it appears the temperature sensor was a series of diodes. I suspect the other chips are configured as a DVM that senses the current flow through the diodes and converts it into a readout of 0 to 100 Celsius. We don't have a big budget here, and I have several modules to replace, so what I need is a very simple circuit to replace that which has gone bye-bye.

John White, WB6BLV
Porterville, CA

A Although I answered a question similar to this in an earlier column, it took an alert reader,



D.T.M.F. DECODER

For interconnect and remote control applications

Model NC401

The Model NC401 is a micro-miniature DTMF decoder, designed for selective control of local or remote applications. Measuring .80"Wx1.37"Lx.23"H, the NC401 combines three distinct, multi-addressing decoders offering multiple user-configurable functions. All programmed features are stored in non-volatile E2PROM memory and are easily programmed by means of a conventional DTMF encoder or the Model NC500 Universal/P.C. programmer. This highly engineered decoder is ideal for portable radio applications having limited space for accessories. The NC401 comes complete with micro-miniature 14 pin header and 12" color coded cable assembly.

\$59.95

Nor-fax Doc. #5545

VOICE SECURITY ENCRYPTION

Model NC802

The Model NC802 is a miniature inversion scrambler designed to provide intermediate level security for two-way radio voice communication systems and is a perfect, cost-effective solution to entry-level voice scrambling as a defense against unauthorized or casual listeners. The NC802 provides eight user selectable carrier codes commonly used by other manufacturers and interfaces easily to most radios with near transparency to the user.

\$59.95

Nor-fax Doc. #5759

For Detailed Specifications or Product Catalog call our 24-Hour NorFax retrieval system at 530-477-8403 or on our Web Site at www.norcommcorp.com



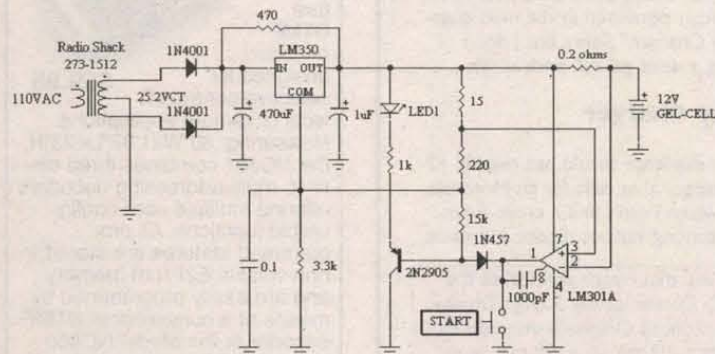
800-874-8663

15385 Carrie Drive
Grass Valley, CA 95949 USA

permit a charging current to flow through the battery, even though the LED lights. If I boost the charging voltage to 18 volts, I get a slight "boiling" condition in the battery. Do you have a good circuit to use instead as a standby charger for an alarm power pack?

Michael I. Herman
New York, NY

A The circuit you sent is old and reliable — for its day. Fortunately, technology has advanced since then, and there are more sophisticated designs available at lower cost. Here's the circuit I recommend. It's simple, inexpensive, and easy to use.

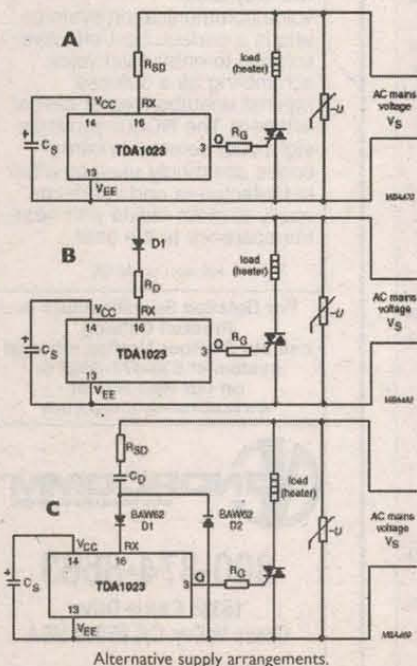


When the START button is pressed, the output voltage of the charger goes to 14.5 volts, which provides a quick-charge current of about 2 amps to the gel-cell. When the battery reaches full charge, the charging voltage is reduced to 12.5 volts and the battery is placed on a "float" current charge — about 125 mA. At this point, the transistor lights the LED to indicate a fully-charged battery. Of course, you'll have to press the START button again when the alarm goes off and power is taken from the battery, but I suspect you have to press a RESET button on the alarm anyway, so just add this step to your alarm-reset checklist. (By the way, the HEPR0170 is an ordinary silicon diode rated at 2.5 amps and 1000 volts.)

Zero-Crossing Triac Controller

Q - Could you help me design, or indicate if it exists already, a circuit to control average current to a resistive load of 20 amps at 230VAC using a triac and zero voltage firing? What I'm looking for is not your typical slice-the-sinewave cycle you so often see in light dimmers. What I envision is a timing cycle where you have three cycles on and three cycles off to produce a 50% duty cycle, all done at zero switching to eliminate RF interference, to control a heater or other resistive device. The control element will be a potentiometer or similar dialing device.

Victor Gladysz
Montreal, Canada



A - Sure, it's a common practice. After wadding through my catalogs, I came up with the TDA1023 from Philips Semiconductor. It's just what the doctor ordered — including a low \$2.25 price tag! Order it from <http://www.questlink.com>. Here's a typical application straight from the TDA1023 data sheet.

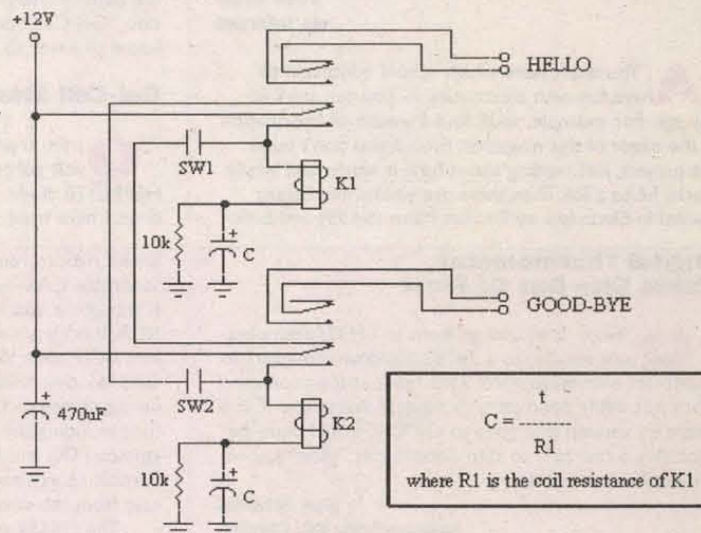
The TDA1023 is a bipolar IC for controlling triacs in a zero-switching proportional manner, commonly called a burst firing mode. A few cycles here, and a couple more there. Overall, it averages out to be a steady-state power output. Just be aware that it can only be used with resistive loads, typically a heater, where the load averages out the bursts. Use of this controller with a motor or other inductive device could damage the appliance.

Driveway In/Out Update

Q - I need information on how to install an inexpensive driveway enter/exit detector. I'm certain I can make one for less than the \$200.00+ they're asking!

Mac Mars
Sorrento, FL

A. I answered a question similar to this last month in the Jun. '99 column. The original circuit used six relays plus a couple of hefty capacitors, at a cost of about \$7.00 each — not cheap. Since then, I've had time to reflect on the circuit and one restless night dreamed up this simpler design.



It uses just two relays and a couple of capacitors. The relays are triggered by a pressure switch that's laid across the traffic lanes of your driveway. They're labeled SW1 and SW2, and can be any kind of pressure activated NO (normal-closed) switch. Check your local auto supply store; I know Grand Auto and Pep Boys (Indy 500 sponsor) sell them. Place the strips about 4 feet apart. When the front wheels of the car run across SW1, let's call it "Welcome," K1 engages and removes power to K2, preventing it from engaging. At this point, capacitor C starts charging, which holds relay K1 closed even after the strip switch opens. The amount of time the relay remains closed is determined by the formula $t = 1.4 RC$ where R is the DC resistance of the relay coil — typically 480 ohms. A 10,000 uF capacitor will hold the relay in for about a second. Fortunately, low-voltage, high-value capacitors are cheap, about the same price of the relay. **Digi-Key (1-800-344-4539; <http://www.digikey.com>)** lists a 33,000 uF cap for under \$7.00. This should be enough time for all four tires to cross the switches before the circuit resets itself. The 10k resistor discharges the capacitor between cars. Going the other direction K2 turns on first and prevents K1 from engaging ("Goodbye"). This lets you know whether the car is coming or going.

BASIC Music

Q - In reference to greeting cards that play a tune when opened, I would like to interface that type of "speaker" with the TTL output of a small processor, like a Stamp or PIC chip. My goal is to generate some simple tunes with Basic programming. Any suggestions?

Charles W. Blumentritt
Dallas, TX

A - Plenty of suggestions, because I find it a lot of fun to play rinky-dinky piano using Basic. The speaker you ask about is a piezo speaker element that you can buy from RadioShack for \$2.49 (273-091). The hardware part is simple, because you can drive the speaker directly from the microprocessor chip. What's tricky is the programming, and here's where it gets fun. Although you can only generate one note at a time, you still have to set the tempo, plus if you're clever, you can add some discord sounds to the melody. There are two ways to program music in Basic. Here's an example of each. Have fun!

'Irish Washerwoman'

Traditional Folk

100 PLAY "T 160 O5 L2 D C"

I 10 PLAY "T I 60 MS O4 L12 B G G D G G B G B O5 D C O4 B O5 C O4 A
A D A A O5 C O4 B O5 C E D C O4 B G G D G G B G B O5 D C O4 B

O5 C O4 B O5 C O4 A O5 D C O4 B G G L8 G L24 O5 D C"

120 PLAY "T 160 MS O4 L12 B G G D G G B G B O5 D C O4 B O5 C O4 A
A D A A O5 C O4 B O5 C E D C O4 B G G D G G B G B O5 D C O4 B
O5 C O4 B O5 C O4 A O5 D C O4 B G G L8 G L24 GA"

130 PLAY "T 160 MS O4 L12 B G G D G G B G B B A G A F + F + D F + F + A
F + A A G F + E G G D G G C G G O3 B O4 G G O5 C O4 B O5 C O4 A
O5 D C O4 B G G L8 G L24 GA"

140 PLAY "T 160 MS O4 L12 B G G D G G B G B B A G A F + F + D F + F + A
F + A A G F + E G G D G G C G G O3 B O4 G G O5 C O4 B O5 C O4 A
O5 D C O4 B G G L8 G"

'Stars & Stripes Forever'
John Phillip Sousa

a\$ = "<g6>d6<b6>d6<g6>d6<b6>d6<g6>d6<b6>d6<g3p20"
b\$ = ">d4d4c6<b6b4a#6b6b2p20a#6b6b4a#6b6>d4<b6>d6c2<a3p20"
c\$ = "a4a4g#6a6a4g#6a6>c2<b6a6b6>d3e3e6<a2p20"
d\$ = ">d4d4c6<b6b4a#6b6b2p20a#6b6b4a#6b6>c6<b6a6f6a2g3"
e\$ = "g4g4f#6g6b-4a6g6>g2<g6a6b>d6<g6a6b6>d6<d6e6b6a2g3"
PLAY a\$
PLAY b\$
PLAY c\$
PLAY d\$
PLAY e\$

Commodore Cornucopia

Q Do you know the name of the square power supply connector that's used on Commodore C128 computers, or a source for them? The C64 uses a common DIN plug, but the only way I can get a C128 connector is from a dead C128 power supply.

Frank Nally
via Internet

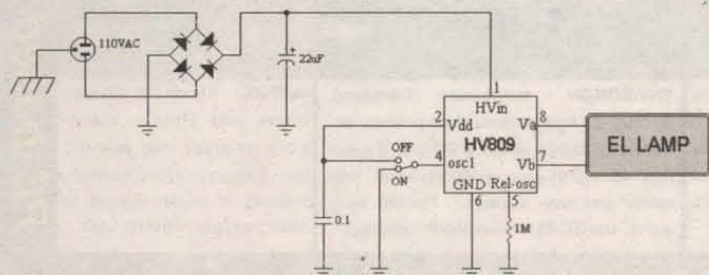
A - No I don't know its name, but I can tell you where to buy one — and a lot more. So listen up all you Commodore aficionados, because have I found a Commodore one-stop gold mine. **Creative Micro Design** (<http://www.cmdweb.com/home.phtml>) has a list of Commodore peripherals, accessories, and replacement parts that'll send you reeling. They sell everything from complete systems, to disk drives, to nuts and bolts. They even have a wide selection of software titles and a long list of JiffyDOS chips. Some prices are bargains, others seem a bit steep; it all depends on what you're looking for. The part you're looking for is part number CN128, and it sells for \$12.00.

Practical EL Lamps

Q I scrapped out an old Tandy 1400 laptop and now own (among other things) an electroluminescent LCD backlight panel. Do you know what voltage (and frequency) is required to make the panel glow?

John McMichael
via Internet

A - EL lamps are usually rated at 115 volts AC, 400 Hz. This operating parameter comes about because it's the typical power available in the cockpit of an aircraft, where EL found it's initial application. Check out the companion article "EL Light Playing In The Dark" on page 82 to find a bevy of circuits that'll make it work. In a hurry, and don't want to flip the page? Okay, this is the circuit I recommend for this panel.



Still gotta flip the page to find where to buy the IC, though. Naw, just kidding. You can get it from a number of jobbers, including Nu Horizon and others. Check out the <http://www.supertex.com> web site for a supplier in your neighborhood.

SUPERCIRCUITS

America's #1 Microvideo Source

AMAZING!

**MICRO
VIDEO
TOP 10**

OVER 120 NEW VIDEO PRODUCTS!

1. World's Smallest Video Camera* 1 lux, 3oz. \$59.95
2. Pinhole Video Camera..... 410 lines, 0.5 lux, Sharp chip \$39.95
3. Color Video Camera 350 lines, 2 lux, Remote head \$89.95
4. Live Aerial Video R/C Videotape..... How to & more \$24.95
5. Wireless Covert Tape Cam 300' range, FCC OK \$349.95
6. Super Tiny Color Pinhole..... 350 lines, less than 1" sq. \$98.95
7. Micro Video Transmitter 1000' range, ATV band \$159.95
8. Complete Wireless ATV Video Set ... 3 Miles Range \$419.95
9. World's Smallest Wireless Video Cam Please Call
10. Video Goggles Dual hi-res LCD's, 3D capable \$589.95

Buy your microvideo equipment where NASA, The Air Force, JPL, Lawrence Livermore Labs and the FBI does.
Call us today.

For the best in high performance microvideo equipment, call the experts at Supercircuits. We've grown to be America's microvideo leader by consistently offering the best equipment at the lowest prices, with unbeatable service...compare our plug 'n play ease of use, warranties and return policies. Of course, Supercircuits microvideo is used by some of the biggest names in science, industry and national defense. But with prices starting at under \$40 for tiny high resolution video cameras, it is technology that is as affordable as it is amazing. Call us today, and get our free 72 page Microvideo Catalog, loaded with photos, specs and more.

1-800-335-9777 ext NV
Or fax us at 512-260-0444
One Supercircuits Plaza, Leander, TX 78641
www.supercircuits.com

*Supercircuits PC-21XP and PC-51XS are listed as world's smallest pinhole and spy video cameras

Don't be stupid.



Smart techs know that to be productive you need to find defective components quickly. Maybe that's why 37 TV stations, General Motors, Matsushita Industrial, Sears Service, Pioneer Electronics, Panasonic Authorized Service, and thousands more independent service technicians have chosen the **CapAnalyzer 88** over all of the other capacitor checkers. Check www.eds-inc.com/88users.html for actual **CapAnalyzer** users' comments as they compare their **CapAnalyzer** to the "wizards" and "z-meters" they already own. They all prefer the **CapAnalyzer 88** because it

does what you expect it to do: check electrolytic capacitors, in-circuit, with 100% accuracy. Period. No unsoldering to check out-of-circuit, no mistaking a shorted or leaky cap as good, as other "ESR" meters do, no guessing about whether a value is good or bad. With our exclusive three-color chart right on the front panel, auto-discharge, multi-beep alert, and one-handed tweezer test probe, even your pet monkey could find defective caps in that problem TV, monitor or VCR in a few seconds. 55% of sales of **CapAnalyzers** are from recommendations by other **CapAnalyzer** owners, and 9% of sales are from previous customers buying a second unit. So get smart and buy one for yourself. It's only \$179. With our exclusive 60-day satisfaction-or-money-back guarantee, you risk nothing. Your only problem will be running out of work as you take care of all of those "dogs" that you've been sitting on. We're EDS. We make test equipment designed to make you money. Available at your distributor now. 561-487-6103

www.eds-inc.com



The RF Connection
213 North Frederick Ave.
Suite 11NV
Gaithersburg, MD USA
20877

<http://www.therfc.com/>

Complete Selection of MIL-Spec Coax, RF
Connectors and Relays

UG-21B/U N Male for RG-213/214.....\$5.00
UG-21D/U N Male for RG-213/214.....\$3.25

N Connectors for 9913/Flexi4XL/9096

UG-21B/9913.....\$6.00 Pins Only.....\$1.50
UG-21D/9913.....\$4.00 Extra Gasket......75

Amphenol 83-1SP-1050 PL-259.....\$0.90

UG-176/U Reducer RG-59/8X .25 or 5/1.00

UG-175/U Reducer RG-58/58A .25 or 5/1.00

Silver Teflon PL-259/Gold Pin.....\$1.00 or 10/\$9.00

MIL-Spec Coax Available (Teflon, PVC IIA)

New Product: Belden 9913F. 9913 with
High Density PE Foam dielectric, stranded
center cond. and Duobond III Jacket.....
80/ft or \$76.00/100ft

Also New: 9092, RG8X with Type II Jacket
Intro Price.....\$23.00/100ft

Call for Specials of the Month

Full Line of Audio Connectors for Icom,
Kenwood, and Yaesu

8 Pin Mike Female.....\$2.50

8 Pin Mike Male Panel.....\$2.50

13 Pin DIN for Kenwood.....\$2.75

8 Pin DIN for Icom.....\$1.00

8 Pin DIN for Kenwood.....\$1.50

Prices Do Not Include Shipping

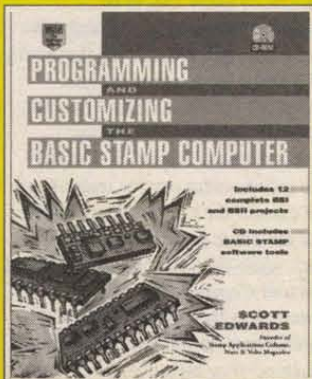
Orders 800/783-2666

Info 301/840-5477

FAX 301/869-3680

Write in 94 on Reader Service Card.

Order Today!



**"PROGRAMMING AND
CUSTOMIZING BASIC
STAMP COMPUTERS"**
by Scott Edwards

Build smart electronics projects
with the inexpensive, simple-to-
use, surprisingly powerful BASIC
Stamp.

ONLY \$34.95

As a paid subscriber to
Nuts & Volts, you'll receive
10% off the list price!!

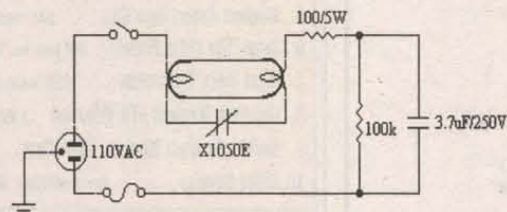
(See ad on page 91 for ordering details
and other titles currently available.)

Electronics Q & A

MAILBAG

Dear TJ:

Regarding the letter from Mr. Chris in the Jan. '98 issue concerning the capacitor in his fluorescent shop lamp: Yes, Virginia, ballastless fluorescent lamps have been on the market for some time now (although 1985 seems a bit early). It appears there are two types: those that use a high-frequency, high-voltage inverter and those that use a capacitor only (which Mr. Chris probably has). Here is an example of the capacitor-only lamp circuit that comes from a SNAPIT Model 07006 lighted power strip.



It uses a 3.7uF capacitor to light a 5-inch long fluorescent lamp. However, I KNOW this circuit WON'T light a 4-foot F40 bulb — I tried it. I imagine it would take a larger capacitor, but I haven't had time to play with it.

Unsigned

Dear TJ:

In the May '99 issue, there was a question from Mr. Bill Pippin in Dallas, TX about his need to power a 12-volt fan from a 36-volt forklift battery. I had a similar problem with a 24-volt system. I solved my needs by

connecting two, identically matched 12-volt fans in series. By connecting three fans in series, Mr. Pippin could move a considerable amount of air for a low price.

John
via Internet

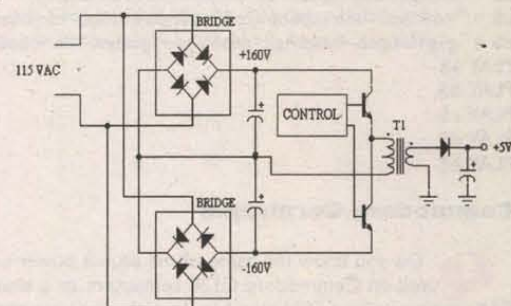
Dear TJ:

There seems to be an error in the switching power supply shown on page 77 of the Apr. '99 issue. The AC to one of the bridges is a short circuit.

Luisnan
via Internet

Response:

It's not a short circuit, because it won't do any damage, but it's certainly a misplaced wire. Here's a corrected schematic. My apologies and thanks for your alertness.



TJ Byers
Q & A Editor

Q & A or Tech Forum?

If you have questions about any aspect of electronics, from circuit design to theory explanations, or just need to be pointed in the right direction to get that project started (or finished), WE CAN HELP!

The Tech Forum will get

your question looked at by thousands of readers. Sometimes several answers might be published giving different approaches to solving your problem.

The Q & A column generally offers a quicker response from noted electronics author TJ Byers. Follow-up or spin-off questions and/or discussions might also appear

in this column.

Send to:
Nuts & Volts Magazine
430 Princland Court
Corona, CA 91719
Fax 909-371-3052
E-Mail:
tjbyers@aol.com
forum@nutsvolts.com

Use your PC as a scope and datalogger!

Parallel Port Scope
spectrum analyzer, and digital multimeter



ADC Virtual Instruments turn your PC or laptop into a sophisticated storage scope AND spectrum analyzer AND multimeter. Display simultaneously on large screen! 100MS/s 8-bit or 1.2MS/s 12-bit or 333KS/s versions. Great for schools, test depts, etc. Input to Excel! LabView/NT drivers included.

Environmental Logging
record temperature, humidity, etc.



ENVIROMON - temperature (thermistor), humidity & light sensors, door position, etc. Record for 365/24 without a PC even if power fails. Monitor 30 sensors 400 yds away. With cables and easy software. Remote audio alarm. Use TC-08 for most thermocouples.

osziFOX
20MS/s handheld scope



osziFOX - handheld storage scope and DVM - stand-alone or plugs into your PC for display, store-to-disk, printing in color. Inputs to 100V, trigger, backlit LCD.

Download FREE demo software. Sales only: 1-888-7SAELIG

www.saelig.com 716-425-3753 • -3835 (fax) saelig@aol.com

Stocked in NY by Saelig Company: Virtual Instruments, I2C and embedded controllers, BITlink 2-wire networks, RS232/422/485, frame grabbers, etc. See www.saelig.com for Product of the Month!

pico
Technology Limited

PC-based Instruments!

HAM GEAR FOR SALE

HAM EQUIPMENT repair or overhaul Collins, Drake, Swan, Astro, Yaesu, Kenwood, etc. 20 years experience with former Slep Electronics Co. Same excellent service, same reasonable rates, satisfaction guaranteed. Brooks Electronics, 828-349-3503. E-Mail: rwbrooks@dnnet.net

WANTED: ROCKWELL-Collins HF-80 equipment, 851S-1, 237B-3 log periodic, Collins literature. Jim Stitzinger 805-259-2011, 805-259-3830 (fax), bfl-jfs@smartlink.net



THE SMART BATTERY CHARGER for lead acid or gel cell batteries. Can be left connected to the battery **INDEFINITELY**, will not overcharge! Standard kit is 12V @ 1 amp. This kit is 100% complete. For the kit order #150-KIT at \$59.95. For an assembled and tested unit, order #150-ASY at \$79.95. CA residents add 7.75% sales tax. Add \$6.50 per unit shipping. MC/VISA accepted. A&A Engineering, 2521 W. La Palma #K, Anaheim, CA 92801. 714-952-2114, FAX 714-952-3280.

LML RADIO & electronic. Let us be your one stop shop for all your radio equipment, test equipment & other surplus needs. Free catalog 909-873-1319. Fax on demand 24 hr. 909-820-1885. Web catalog <http://members.aol.com/hrh6> Write: 424 E. Shamrock, Rialto, CA 92376.



2.4 GHz/1.2 GHz VIDEO TRANSMITTER & RECEIVER designed exclusively for HAM ATV bands. 8 switchable frequencies; F/SMA type connectors with two 1/4 wave rubber-duck antennas included; 100 mw output power. Receiver has greater than -80 dB sensitivity. **Price \$119.** Related camera, video, and security systems also available. Two additional audio channels can be used for digital data applications. Due to high response, please contact by E-Mail: info@4atv.com Website: www.4atv.com

NEW PRODUCTS FROM S & S: UPGRADE YOUR OLD RIGS! Digital dial (counter) has 10Hz resolution HF, 100Hz VHF and frequency range 50KHz to 230MHz; kit \$99.95; assembled \$149.95. **NEW Digital VFO** with 1Hz resolution to 54MHz; kit \$169.95; assembled \$219.95. S&H \$7 (Continental US). **GUARANTEED TO WORK.** For info send **SASE.** Call/write to order: S & S Engineering, 14102 Brown Rd., Smithsburg, MD 21783. 301-416-0661, E-Mail: N3SAD@aol.com or see <http://www.xmetric.com/sseng>

DEALERS WANTED: Digital Satellite Systems for "free-to-air" programming. Wholesale prices. <http://www.dmsi.usa.com> 1-888-591-4416.

FOR SALE: ORBIT 360 antenna rotator. Full instructions. Never used, \$40 obo. 949-494-0072.

HAM GEAR WANTED

CB - SCANNERS

SALES & SERVICE: CB equipment, modification kits, meters, antennas, mics, radios, transistors, repairs & hard-to-find items. Complete list \$4. D&R Electronics, 10 Park St., Thomaston, CT 06787. 860-283-9492 or RTed821836@aol.com

SCANNING USA: monthly magazine 100% scanning. All the news and product reviews from the writers you trust. Get more from your scanner. Subscriptions \$24.95, samples \$3. Call 1-800-651-0922 your Visa or MasterCard, or write 2054 Hawthorne, Joliet, IL 60435

FREE CATALOG: hobby radio books; frequencies, modifications, repairs, upgrades, maintenance & more! Largest source of monitoring books available in one catalog! CRB, PO Box 56-NV, Commack, NY US 11725. Phone: 516-543-9169, 9-3, M-F. Fax: 516-543-7486. E-Mail: catalog@crbbooks.com

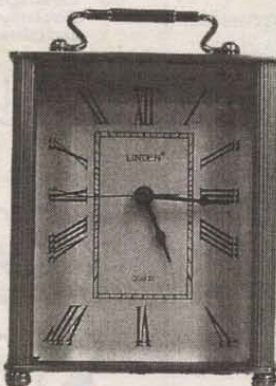
KONNEX DISTRIBUTING. Call 1-888-777-7874. PO Box 451372, Los Angeles, CA 90045. CBs, antennas, meters, transistors. Best prices. Credit card acceptable.

HALCON COMMUNICATIONS Wholesale only: Cobra, Uniden, Midland, Galaxy, CTE, Super Star, Kenwood, Yaesu, Icom. Free catalog, Free call 1-800-683-6999.

Surveillance

You must mention ad to receive special pricing

Only Japanese Color Cameras



Carriage Clock Cam \$250
Sale Ends 9/15/99

BC-985 Color Board Camera	\$125
BC-985P Pinhole Lens Camera	\$145
BX-985 Black Box Camera	\$155
SD-985 Smoke Detector Cam	\$195
EX-985 Exit Sign Cam	\$195
EL-985 Emergency Light Cam	\$225
PS-985 Pencil Sharpener Cam	\$225
CL-985 Carriage Clock Cam	\$250
VB-985 Video Bag w/12 hour Battery Pack and Charger	\$295
VP-400 Video Pen w/ 2 hour Battery Pack and Charger	\$1500

Color Camera Specifications

High Resolution -- Over 380 TV lines
Low Light Sensitivity -- Only 2 Lux
Built-In Backlight Compensation
2 Year Limited Warranty

American Innovations, Inc.
383 West Route 59
Spring Valley, NY 10977

M-F 11:00 - 8:00 P.M.
Sat. 12:00 - 6:00 P.M.
Tel (1) 914-371-3333
Fax (1) 914-371-3885

www.spysite.com

Write in 44 on Reader Service Card.

ALLTECH ELECTRONICS		WE CHOP			
WWW.COMPUTERCHOPPER.COM		PRICE\$!			
4X SCSI CD ROM Matsushita CR504-L Apple CD 600i PC or Mac SCSI \$19	486 Mini System 486SX25 • Great for Linux DX266 Upgradable • 2 ISA Slots • VGA, LPT, 2COMs • FD \$29	3.5" SCSI Open Face External Case - For 1/3 Height DAT & Zip Drives or Similar Devices. Two 50 Pin & ID Set. \$24	10" Open Frame SVGA Metal Enclosed - Displays Up to 1024 x 768 • 110V AC Also Available in a standard case. \$119	6 SCSI CD's in a Tower 6 CR-504-L Drives in a SCSI Tower \$149	Ball Bearing Slide Drawer Sliders • Extends 2' Three piece telescopic extension. See the web for more detail 6 Pair for \$29
10" SVGA The same 1024x768 26dp monitor but with a slight burn in spot in the center. Our Pain is Your Gain! \$59	Cellular Data Adapter For Motorola Flip Phone and compatible. Use ANY landline device, modem, fax, etc. \$39	9" Mono VGA Small footprint monitor Great for servers, test benches, etc. 640 x 480 only. Refurbished. \$49	9.75" Mono VGA LCD w/Controller Great for Servers: Powered from the card Great for a headless system. Windows NT Server Console, Linux Server, etc. 16 Bit (ISA) Interface with Cirrus Logic GD6235 512K RAM. Non Upgradable Win95/98 Compatible 10" x 6.75" x 3/8" \$89		Cheaper Ethernet Stuff Industrial Surplus PC Parts • Mac Parts For more information on these products and hundreds of other products check out: www. ComputerChopper .Com
760/724-2404 Fax 760/724-8808 Computer Circulation Center, Inc. 2618 Temple Heights Drive Oceanside, CA 92056		Mon-Fri 9AM - 5:30PM - Or see us on the internet. VISA • Mastercard • Discover • American Express Prices & Availability subject to change without notice • Government & Educational PO's Accepted. • Not Responsible for Typographical Errors			

Identify and Control with Radio Frequency Identification

Tags/Transponders, Antennas, Reader/Decoders

RFID for access control, factory automation, timing, animal feeding, ticketing, vehicle identification, inventory control, datalogging, pallet tracking, personnel security, asset management, ...

Since 1991

INTERSOFT

1840 Lockmill Rd, Estill Springs TN 37330, USA

Tel: 1-931-967-8643 Fax: 1-931-967-5069

<http://www.cafes.net/intersoft>

Development kit
US\$ 179.00

Write in 43 on Reader Service Card.

Write in 45 on Reader Service Card.

Nuts & Volts Magazine/JULY 1999 35

When Visiting Disney World And Sea World...
Come To The World Of Electronic Surplus!

SKYCRAFT

PARTS & SURPLUS, INC.
ORLANDO, FLORIDA



Located At The Intersection Of I-4
And Fairbanks Avenue.

Self-Service Retail Outlet Featuring Commercial
And Government Electronic Surplus Including:

- | | |
|--------------------|-----------------------|
| ★ WIRE | ★ COAX |
| ★ SWITCHES | ★ RELAYS |
| ★ RESISTORS | ★ HARDWARE |
| ★ TRANSISTORS | ★ CAPACITORS |
| ★ TRANSFORMERS | ★ PANEL METERS |
| ★ TEST EQUIPMENT | ★ CIRCUIT BOARDS |
| ★ NI-CAD BATTERIES | ★ INTEGRATED CIRCUITS |

★ ★ ★ ★ ★ ★ ★ ★

We Buy Surplus
Electronic Parts —
FAX your list.

www.skycraftsurplus.com

FAX 407/647-4831

PH 407/628-5634

P.O. BOX 536186

ORLANDO, FLA. 32853-6186

HOURS:
Monday - Friday 8:30-6:00
Saturday 8:30-5:00



MESSANGER, RED Devil, Shooting
Star, Palomar, Superstar, Uniden, CB
radios, microphones, exports, Galaxy,
etc., more!! 5 page picture price sheets
\$1 (refundable) scanners too!! Galaxy,
Box 1202, Akron, OH 44309. Over 15
yrs. in business!

CB MODIFICATIONS! Frequencies,
books, kits, high-performance acces-
sories, plans, repairs, amplifiers, 10-
meter conversions. The best since
1976! Catalog \$3. CBCI, Box 1898NV,
Monterey, CA 93942. www.cbciintl.com

www.nutsvolts.com

240+ CHANNEL CB/HAM/COMMER-
CIAL radios: AM/FM/SSB/CW
export/domestic: RCI, Motorola, Uniden,
Cobra, Alinco, Kenwood. Mics, antennas,
linears, meters, books, night scopes, and
tons more stuff! Catalog \$3. MAXTECH,
Box 8086, New York, NY 10150. 718-
547-8244.

MUSIC &
ACCESSORIES

ACP's 92nd GIANT COMPUTER SWAP★MEET

Orange
County's
Original!

Be a
Seller
...for
your
space
Call
Mary



All Day
Sunday 8am-2pm

July 25th

FREE Admission & Parking
Shop 100's of Sellers

in ACP's Giant Parking Lot !!!

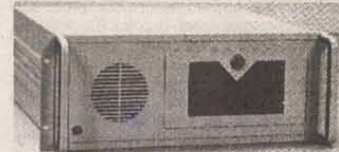
Advanced Computer Products, Inc.

ACP
SUPER★STORE
Since 1976

1310 E. Edinger
Santa Ana, CA
714-558-8813



WE CARRY a variety of cables, switch
boxes, accessories, and adapters to con-
nect PCs, printers, Mac's, networks,
telecommunications, and audio/video
equipment. We offer: custom cables, free
catalogs, and same day shipping on
most orders. Visit our website at www.
rogerssystems.com or call 1-800-366-
0579.



19" RACKMOUNT PC chassis: Heavy
duty, 4U, for standard 7 slots ATX moth-
erboard. Four (three hidden) 3.5"/two
5.25" drive bays, power supply not
included, \$169 with this ad! Add \$6 for 7
slots AT conversion kits. Monitor chassis
\$229, keyboard chassis \$129. 8255-
8253 I/O card with prototyping area \$69,
12-bit ADDA card \$89. Computronics
Technology, 972-242-8087, www.cti-
texas.com



CABLE READY TV card with capture
and remote \$79. USB cables: ATX
form card 18 pin header, 2 USB, 1
PS/2, 1 IF \$15. 16 pin 2 USB \$10. 10 pin
(2 5 pin) \$10. 847-657-1160 or
www.saveware.com



333MHz MMX CPU w/fan & TX-Pro II
motherboard, 4 megabyte AGP video,
3D 32 voice sound, 2 PCI Ultra DMA IDE
ports, 4 72 pin EDO/FP & 2 168 pin
DIMM/SDIMM sockets, 2 serial, 1 paral-
lel, 2 USB, PS/2, infrared ports, ATX or
normal power, 2 year warranty, combo
deal only \$119. Similar as above, but
with 366MHz Intel CELERON/A 128K
cache Pentium II CPU, Intel jumperless
i440LX/EX AGP chipset, 3D 8MB video,
56K modem/fax/voicemail \$199. 847-
657-1160 or www.saveware.com

SONY/AMIGA/MAC/IND. MULTISCANS
CPD-1302/1390 TTL/analog sync/gen.
Refurb. 6 mo. warr. \$175. Pikul & Assoc.
314-937-0335.



333MHz MMX system w/4.3 gigabyte
hard drive, 44X CD-ROM, 1.44 floppy,
32 megabytes SDIMM memory, AGP 4
megabyte video, 56k modem/voice/fax,
3D 32 voice sound, 200 watt speakers,
enhanced multimedia keyboard, Internet
scroll mouse, mini-mid sliding door case,
2 year parts and labor warranty. Only
\$459! Same as above, but with 366MHz
Intel CELERON/A 128K cache Pentium
II CPU and Intel jumperless i440LX/EX
AGP chipset motherboard with 3D 8MB
video, mid ATX case \$559. Installed
FULL versions WIN95B \$59, WIN98
\$119, 847-657-1160 or www.sav-
eware.com

CABLE TV CONVERTERS

WILL NOT DECODE

The Best Prices and Service • In Business over 15 years!

Phone 218-346-6660 Fax 218-346-6664

TIMELESS PRODUCTS

New! "TP 125 V"
128 Channel Converter with Volume

Special Prices for
TP150PC
Call for Details

Panasonic still available!

- REFURBISHED CONVERTERS ALSO AVAILABLE •
- QUALITY REPAIR DEPARTMENT FOR ALL YOUR TUNER REPAIRS •
- REMOTES AVAILABLE FOR MOST CABLE BOXES •

DEALERS ONLY • GREAT QUANTITY PRICES • NO DECODER SALES

NewComputer.com! OVER 50,000 hardware and software products. Orders over \$500 shipped free. Our unique product categories and search features let you quickly locate the item you're looking for. The next time you need computer equipment, try NewComputer.com



SONY PLAYSTATION GAME-ENHANCER, Play backups/imports. No messy soldering of mod-chip and breaking the warranty, simply plug the enhancer into your playstation! Skips both Sony Logos on bootup! The power to bust your games wide open!! Just imagine, infinite lives, unlimited energy, extra levels, hidden levels! Optional communications package to connect to your PC! View any file on CD, copy memory cards and much, much more! \$29 (free priority shipping). 847-657-1160 or www.saveware.com

4 MB, 72 pin SIMMs \$4 ea. P-100 CPU \$25 ea., 400 VA UPS \$30 ea. Pikul & Assoc. 314-937-0335.

EVERYTHING NEW w/warranty! MII 333MHz \$165, 15"/17" SVGA monitors \$135/215. Pentium systems from \$250. Also multimedia kits, hard drives, scanners, printers, SCSI adapters \$45. Memory, cases, etc. Call for monthly specials. CCI 714-778-0450. E-Mail: cci@net999.com

HARD DRIVE liquidation. 420 megabytes \$45. 3.2 gigabyte \$89. 8.4 gigabyte \$155. Mouse \$1.95, SVGA monitors \$95, flatbed scanners \$45, 56K modems \$35, 1.2 floppy \$10, Adaptec SCSI controllers \$45, memory 1.25/megabyte. 714-778-0450.

COMPUTER SOFTWARE

FREE IBM DISK CATALOG of quality Shareware and CD-ROMs. **MOM 'N' POP'S SOFTWARE <ASP>**, PO Box 15003-N, Springhill, FL 34609-0111. 352-688-9108. momnpop@gate.net

CAM & MOTION SW/HW: Z-trace, PCB toolpath. Plotcam motion control, step drivers. cmheater@juno.com MSG/FAX 407-452-7197, 407-459-2729. www.me.gabits.net/ddt

STEALTH MOD chips for Sony PlayStation. Now even your anti-mod games will work. Only \$9.95 ea. + \$3.35 shipping. Call Toll Free 1-888-467-6150. All credit cards accepted. www.computerconnectionusa.com

GAME WIZARD cartridge for PlayStation. Works like a mod chip and the best cheat cartridge all in one. It will use all the same cheat codes the others use. Only \$29.95 free shipping. Toll Free 1-888-467-6150 all credit cards accepted. www.computerconnectionusa.com

LIQUIDATION WIN 95/98. Office97, Win95 Companion \$9, WindowsNT call, 10 PACK CDs 1,000 games \$25, Lotus SmartSuite \$10, Wordperfect Suite \$35, Printmaster \$9, Antivirus \$5. 714-778-0450.

FORBIDDEN SUBJECTS³ hacking CD-ROM \$12 postpaid. Free trubbleware diskette catalog. Amazing subject matter. No commercial or shareware here, just lots of technical fun! Peregrine Dynamics, 720 Portage Trl., Cuyahoga Falls, OH 44221-3035.

MAKE MONEY ON THE INTERNET! Illustrated manual and IBM 3.5" disk shows how to build your own web site. Step-by-step guide with sample pages, source code, HTML tags list, and page layout templates get you started FAST! Complete system, \$15. BP Cunningham, 12506 NW 234th St., Alachua, FL 32615. E-Mail: b.cunningham@cwix.com

COMPUTER EQUIPMENT WANTED

WANTED: HPI5C calculators. Will pay. Call Hugh Adams 850-864-2414.

DEC EQUIPMENT WANTED!!! We are buying DEC systems, boards, terminals, drives and peripherals. Also Scientific Micro Systems (SMS), DSD, Datability, Dialog, other DEC compatibles, and Computer Output Microfilm (COM) units. Please call for a quote or fax us your equipment list. We buy, sell, and trade. **KEYWAYS, INC.,** 937-847-2300 OR fax 937-847-2350.

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

WANTED: TERMINALS + PRINTERS: DEC, Wyse, IBM, ADDS, Okidata, Data South, Epson, C.I.TOH, etc. Call for quote on any surplus computer equipment. Call Jeremy, 603-673-8077.

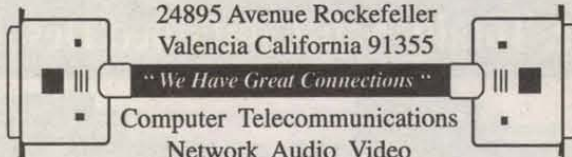
HP CALCULATORS wanted: models 10, 70, calculator watch, others for private collection. Cash paid. Bob Morrow, 765-855-2348, rkmorrow@aol.com

WANTED: DEAD/alive 1Gig hard drive for Apple Powerbook1400 series. Must have the little SCSI adapter card. John Altstatt 650-949-1266.

Discount Electronics Books See Page 91

Roger's Systems Specialist

24895 Avenue Rockefeller
Valencia California 91355



Computer Telecommunications
Network Audio Video

www.rogerssystems.com



Category 5 Patch Cables

TE-068-L5X	7 ft. Crossover	\$2 ⁰⁰
TE-068-L5	7 ft. Straight Patch	\$2 ⁰⁰
TE-508-L5	50 ft. Straight Patch	\$10 ⁰⁰
TE-108-L5	100 ft. Straight Patch	\$20 ⁰⁰

USB Cables

CC-USB-6	6ft. USB "A" to "A" M/M	\$5 ⁰⁰
CC-USB-AB6	6ft. USB "A" to "B" M/M	\$5 ⁰⁰
CC-USB-PP	6ft. USB to IEEE Printer Cable	\$36 ⁰⁰
CC-USB-6	6ft. USB "A" to "A" M/F	\$5 ⁰⁰
CC-USB-AB10	10ft. USB "A" to "B" M/M	\$6 ⁰⁰
CC-USB-AB15	15ft. USB "A" to "B" M/M	\$8 ⁰⁰
CC-USB-X10	10ft. USB Extension	\$6 ⁰⁰



USB Accessories

CC-USB-8	USB (2) to 2x8 pin w/ Bracket	\$5 ⁰⁰
CC-USB-9	USB (2) to 2x5 pin w/ Bracket	\$5 ⁰⁰
USB-PCI	USB x2 PCI Add on Card	\$27 ⁰⁰
USB-KB-104	USB 104-Key Kybrd Win98/PS2	\$24 ⁰⁰
USB-MOUSE	3-Button USB Mouse 4200dpi	\$12 ⁰⁰
USB-CAM	C-IT USB Cam w/ Software	\$69 ⁰⁰



3.5 MM PLUG
6 FT. CORD

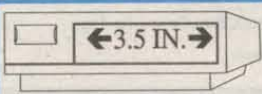
Clip/Stick-on Lapel Microphone

TM-MIC-2



Network Cards

NT-TBT-10	10-Base 16Bit ISA Slot Card	\$12 ⁰⁰
NT-TBT-100	10/100 32-Bit PCI Slot	\$19 ⁰⁰
NT-TBT-200	10-Base 32-Bit PCI Slot	\$12 ⁰⁰
NT-TBT-3C905B	3COM 3C905B-TX 10/100 PCI	\$62 ⁰⁰



External SCSI Case

TM-CASE-HDS \$15⁰⁰

Limited to stock on hand

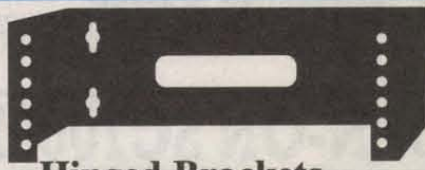
50 Pin centronics pass through connector
Push button I.D. setting, On/Off switch
Internal Fan, 50P Ribbon, 30watt Power Supply

Mice

TM-290	3-Button Serial DB9	\$6 ⁰⁰
TM-290-2	2-Button Serial DB9	\$6 ⁰⁰
TM-290-Mic	Microsoft Mouse OEM	\$25 ⁰⁰
TM-290-Net	Designer Netmouse PS/2	\$12 ⁰⁰
TM-290-PS	PS/2 2-Button 6-pin Din	\$6 ⁰⁰



Major Brand!!



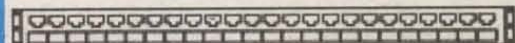
Hinged Brackets

HB2	19" wide/ 3.5" tall	\$9 ⁰⁰
HB3	19" wide/ 5.25" tall	\$10 ⁰⁰
HB4	19" wide/ 7.00" tall	\$11 ⁰⁰
HB6	19" wide/ 10.5" tall	\$14 ⁰⁰
HB8	19" wide/ 14" tall	\$17 ⁰⁰



For Hubs, Patch Panels, Wire Minders

Patch Panels



PP-24P-5	24 Port Cat5 Patch Panel	\$59 ⁰⁰
PP-48P-5	48 Port Cat5 Patch Panel	\$119 ⁰⁰
PP-12P-5	12 Port Cat5 Patch Panel	\$42 ⁰⁰

All Category 5 568B Wiring

- \$20.00 min. order required
- Add \$4.50 shipping for prepaid orders
- Prices subject to change without notice
- All major credit cards accepted
- Special offers only valid on items in stock
- California residents add tax
- Call for quantity discounts
- No out of state checks accepted

800-366-0579

661-295-5577

Fax 661-295-8777

TEST EQUIPMENT

FREQUENCY STANDARDS FTS1200 quartz module, 5 1/2" by 3" square, 4 buffered 5MHz SMA outputs, 24VDC .6/1 amp, dB-9 connector for power and zero to plus 10V control voltage, <1X10-10/day, internal vacuum bottle for maximum stability, special price thru end of Aug., only \$165; HP 5335A counter with GPIB, \$325 (\$425 with high stability oscillator). Corby Dawson, 805-736-0288.

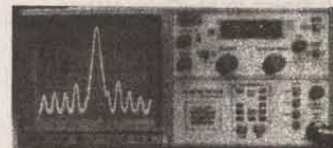
KENTRONIX TEST EQUIPMENT SPECIALS. Check our WEB site at <http://www.kentronix.com> for monthly specials. We are also looking to buy test equipment, coaxial and waveguide components, manuals, etc. Contact Brian at 732-681-3229 or FAX 732-681-3312. E-Mail: brian@kentronix.com

EQUIPMENT SALE: HP 8565A 21GHz spectrum analyzer \$3,250; Wavetek 3001 signal generator \$300; Hewlett Packard 8015A opt 03, \$350; 8015A \$250. HP 3403C opt 03 TRMS voltmeter \$300; 3403C \$200. HP 3763A error detector \$400. Psitech Plus 707-745-4804, www.psitech-plus.com

AFFORDABLE HP power sensor repair! Most 8481As repaired for \$255 or less. We also handle 478As and many others. Call or fax for more information. Willamette RF, Inc., 541-754-7226, FAX 541-753-4629.

POOR MAN'S Spectrum Analyzer/Monitor Receiver Kit. 2 to 1,700 MHz. Basic kit only \$78. Now available with switched resolution filters, tracking generator and direct digital frequency readout. Works with ANY scope or IBM compatible computer. Send stamped envelope for details. Science Workshop, Box 310B, Bethpage, NY 11714. <http://www.science-workshop.com>

BRUEL & KJAER BUY, SELL, BEST PRICES. EXCALIBUR ENGINEERING, 3198-C AIRPORT LOOP DRIVE, COSTA MESA, CA 92626. 714-540-0169, FAX 714-540-5417.



ENGINEER TESTED: Spectrum analyzers, frequency counters, frequency standards, meters, scopes, generators, curve tracers, and more. **VISA, MASTERCARD, AMEX.** "Performance tested." **NIST calibrated. Warranted. New & used.** Gary N6ZD. <http://TECH-SERVICES.COM> 831-385-7519.

QUALITY EQUIPMENT: HP 6033A system autoranging power supply (20V, 30A) \$975; HP 3488A mainframe \$550 (cards available); HP 4140B pA meter, DC voltage source with HP 16055A fixture \$2,300; HP 436A/022 RF power meter with cable \$975; HP 5343A/1,6,11 26.5 GHz microwave frequency counter \$3,500; HP 8112A 50MHz pulse generator \$3,900; HP 8116A/001 50MHz pulse/function generator with burst, logarithmic sweep \$3,700; HP 8161A/020 100MHz dual channel pulse generator \$2,500; HP 83522A .01-2.4GHz 8350B plug-in \$2,900; HP 83570A 18-26.5GHz 8350B plug-in \$3,900; HP 8410C, 8410B network analyzer mainframes \$595, 425; HP 8411A/018, 8411A harmonic frequency converters \$395, 250; HP 8743B/018, test set \$495; Audio Precision SWR-122F balanced switcher \$650. All with warranty, excellent condition. Pepper Systems (<http://home.earthlink.net/~peppersys>) 214-353-0257 (Fax 214-902-9511). E-Mail: peppersys@earthlink.net

INSTRUMENT REPAIR Labs. Excess equipment for sale. Monthly specials (take 20% off listed price), E-Mail your order to: sales@calibration.com Include Visa, MC, name, and expiration date, with shipping address. We have been in business since 1980. See our web page and bookmark it! Scopes for sale: Hitachi V-1050 analog scope 100MHz scrap parts, \$150; Hitachi V-1100A 100MHz 4 ch analog scope, \$1,395; Hitachi V-209 analog scope w/battery 20MHz 2 ch, \$795; Hitachi V-509 analog scope 50MHz 2 ch, \$950; Hewlett Packard 1725A analog scope 275MHz scrap parts unit, \$150; Hewlett Packard 1744A analog storage scope scrap parts, \$150; IWA SS-5710 analog scope 60MHz, \$600; IWA SS-5711 analog scope 100MHz, 2 ch, \$1,100; Leader LBO-325 analog scope 60MHz 2 ch, \$600; Philips PM3262 analog scope 100MHz 2 ch scrap parts, \$150; Sencore SC61 scope 100MHz for TV & video, \$800. sales@calibration.com <http://www.calibration.com> Phone: 303-469-5335 Fax: 303-469-5336. Used listings Web Page: <http://www.calibration.com/sale/index.html>

DEC EQUIPMENT WANTED!!! We are buying DEC systems, boards, terminals, drives and peripherals. Also Scientific Micro Systems (SMS), DSD, Datability, Dilog, other DEC compatibles, and Computer Output Microfilm (COM) units. Please call for a quote or fax us your equipment list. We buy, sell, and trade. **KEYWAYS, INC.**, 937-847-2300 OR fax 937-847-2350.

HP 4815A Z-meter: Sandford Associates. TOTAL service specialist. Repairs warranted to HP/QA factory specs. Former HP tech/supv with expertise, parts, and tooling. Tel/fax: 908-852-7989, E-Mail: GeoSA4815@compuserve.com

PROFESSIONAL DESOLDERING with the World's Best Transportable, Totally Self-Contained Desoldering Tool

Mike Murphy - Service Center - Van Nuys CA 818-785-7805

The single best investment of repair equipment we've made. It outperforms all other desoldering tools we've used. Easier to use and least expensive.

Dick Manning - Dicks Electronics - Hartland WI 414-367-8339
The ease & speed of component removal greatly increases productive time. The SMD kit makes SMD removal a breeze, even for inexperienced Techs.

Don Scott - LAV Electronics - Healeah-Miami Lakes FL
I am a constant user of the SC7000 Desoldering Tool and for quick component removal, this unit has no equal. It also comes with excellent company support. I am very satisfied and highly recommend it to anyone in the servicing field.

George Hefner - Hefner Electronics - Coleridge NE 402-283-4333
Being a one-man service center, I hesitated to spend the money on a desoldering tool, however all that changed when I nearly ruined a \$400 computer logic board. It has cut my desoldering time by 50%.

Don Cressin - Certified Electronics Service - Ellicott City MD 301-461-8008
We have obtained excellent results with the SC7000 including repairing high density U/V tuners. It is one of the best purchases we have made.

Doug Pettit - LuRay Electronics - LuRay VA 703-743-5400
We found that the SC7000 not only saves money vs. wick, but saves valuable time in troubleshooting. It allows you to be more accurate in removing SMD's.

MSRP \$475.00
Sale Price \$395.00

FREE TRIAL
Available on Request

Price includes
stand worth \$25.00
one extra filter and
two tip cleaners.

Timothy Kraft - Monikraft, Inc.
Cherry Hill NJ 609-751-3252
We replaced all our existing desoldering stations with the SC7000. Our technicians are very pleased with the improved performance, portability, and reliability over our previous higher priced equipment.

Bill Warren CET/CSM -
Warrens Audio & Video -
Knoxville TN 234-546-1128
We have been extremely satisfied with the quality and durability of the DEN-ON SC7000 as well as with after the sale support.

Keith Sahs - J & M Electronics
Omaha NE 402-291-7100
It's a must tool for my bench. I can desolder multiple pin IC's quickly and clean. It will even take up large solder amounts on tuner and case grounds.

DEN-ON SC7000Z

Sale Price
\$395.00

For More Info
and 5% Savings Go To

www.howardelectronics.com/den-on/sc7000zb.html

New Features

- ◆ Totally Self Contained diaphragm vacuum pump and AC motor for high vacuum suction or reversible hot air blow for SMD removal.
- ◆ 100 Watt Ceramic heater with zero-crossover switching heater control circuit which prevents spikes and leakage currents.
- ◆ Unique patented long lasting filter cartridge design. Solder builds up on easily cleaned baffle, while air flows around the outside of baffle.
- ◆ Totally ESD Safe. The housing contains carbon and the tip is at ground potential for complete ESD Protection.

Howard Electronic Instruments, Inc.
6222 N. Oliver Kechi, KS 67067

New Specifications

- ◆ Voltage AC 100v, 120V, 230V, 50/60 HZ
- ◆ Power Consumption 120W
- ◆ Pump Diaphragm Type
- ◆ Motor Output 12W
- ◆ Vacuum Attained 650mm Hg
- ◆ Temperature Range 300°C - 500°C (572°F - 932°F)
- ◆ Air Flow Rate 15 Liter/Minute (Open)
- ◆ Heater 100W (Ceramic)
- ◆ Control System Feed Back Zero Cross-over Type
- ◆ Net Weight 420 Grams

Visa - M/C - Discover - American Express - Terms to Qualifying Companies
30 Day Money Back Total Satisfaction Guarantee - One Year Parts and Labor Warranty

HOWARD ELECTRONIC INSTRUMENTS INC.
Your Desoldering Specialists

Toll Free U.S. and Canada

1-800-394-1984

www.howardelectronics.com
sales@howardelectronics.com
International (316) 744-1993
or Fax (316) 744-1994

Professional 10 HOUR RECORDER Factory Direct

"BUILT LIKE A BATTLESHIP"

- Heavy duty commercial recorder - NOT improvised from consumer models
- 12, 14, and 16 hour models also available
- BUILT-IN voice activation (add \$30)
- Applications information included
- Dimensions: 11.5 x 7.0 x 2.75"

SPECIAL Nuts & Volts Price.. \$159

FREE 40-PAGE SPECIAL EQUIPMENT CATALOG!

COD's OK. Sorry, no credit cards. Free catalog USA only; other countries \$5. Price includes UPS to 48 States on Pre-Paid Orders

Viking International 150 Executive Park Blvd. #4600 San Francisco, CA 94134
Phone: (415) 468-2066 • Fax: (415) 468-2067 • Web: www.vikingintl.com

Write in 48 on Reader Service Card.

TEST EQUIPMENT sale: HP 3455A, \$225; HP 3466A, \$125; Fluke 8050A, case and probes, \$125; Fluke 8050A, hard case and probes, \$125; Fluke 8600A, with probes, \$65; HP 6265B, \$200; Tek 7904 with 7B92A, 7B53A, 7A19, 7A26, \$600; Tek 7834, 7B85, 7B80, 7A19, 7A26, \$575; Tek AM502 with A6302, \$850; Tek TM515, \$100; Tek TM504, \$125; Tek TM506, \$125; TM501, \$75; DC503A, \$125; DC504, \$90; DC509, \$125; DM502A, \$100; DM511, with temp probe, \$200; FG502, \$100; FG503, \$100; SC502, \$225; PG501, \$75; TM5006, \$400; FG5010, \$500; AM502, \$125; SC503, \$250; PS503A, \$125. All with 10 day right of return and 30 day warranty. Coppes Enterprises, 520-749-8471, fax 520-760-7780.

TEST EQUIPMENT sale: HP 141T, frame, \$400; HP 4191A, accy. kit, \$800; HP 5006A, \$300; Wavetek 3000, \$350; HP 59401A, \$75; HP 3403C, \$225; HP 3437A, \$100; HP 3456A, \$500; HP 3478A, \$400; HP 5300A/5302A, \$100; HP 5314A, \$150; HP 5315B, \$300; HP 5326A, \$50; HP 5328A opt 11, 96, \$200; HP 5335A, \$400; HP 5335A opt 10, 20, \$550; HP 5342A, opt 1, 3, 11, \$1,000; HP 5345A opt 11, 5354A, \$600; HP 5383A, \$250; HP 11636A, \$125; HP 33320H, \$250; HP 33322H, \$250; HP 350D, \$50; HP 436A, opt 022, \$550; HP 436A, no opt, \$500; HP 4260A, \$225; HP 423A, \$75; HP 911A, \$50; HP 3312A, \$300; HP 3314A, \$1,500; HP 3325A, \$850; HP 3325A, opt 1, 2, \$1,250; HP 5257A, \$75; HP 435B, with scales, \$250; HP 436A, opt 022, with HP 8481A and cable, \$1,100; HP 436A, opt 022, with HP 8482A and cable, \$1,150. All with 30 day warranty and 10 day right of return. Coppes Enterprises, 520-749-8471, fax 520-760-7780.

TEST EQUIPMENT sale: HP 1630A with pods, \$400; HP 5345A opt 12, \$400; HP 200CD, \$65; HP 456A, current probe, \$150; RFL 5950 xtal tester, with 254, 460, plug-ins, \$350; HP 1741A, \$250; Tek 466 DM44, \$350; HP 4342A, \$750; Tek 442, \$125; Tek 2246 mod A, \$650; HP 6521A, \$550; HP 3400A, \$85; HP 1980B, \$400; Tek 7A29, \$175; 7B10, \$150; 7B15, \$150; Tek 7603 with 2 ea., 7A26, 7B53A, \$275; 7603 with 2 ea., 7A18A, 7B53A, \$250; HP 5420ID, \$850; Tek 7633R 2 ea., 7A26, 7B53A, \$325; Wavetek 271, \$375; HP 651B, \$85; HP 654A, \$150; HP 8660C opt 1, 5, 100 with 86603A, 86633B, \$2,000; GR 1863, \$450; HP 6186T, \$400; HP 355F, \$50; HP 355E, \$50; Keithley 616, \$600; HP 350D, \$50; HP 11636A, \$125; Wavetek 157, \$550; Hughes 1277H03R000, \$1,100; Interstate Elec. 860, \$550; Hippotronics HD 103 with probe, \$550; HP 3330B with 3571A, \$650. All with 10 day right of return, 30 day warranty. Coppes Enterprises, 520-749-8471, fax 520-760-7780.

AS NEW OSCILLOSCOPES: Tek 7904 w/7A26, 7A24, 7B80, 7B85 with manual \$775; Tektronix 2445B, 150MHz \$1,000; 7104 1GHz \$1,200; 2235 100MHz \$425; 30 HSN W/Doc 2GHz high speed analyzer new in factory box \$200. **FLUKE PM 3394A** autoranging, combiscope as new with service manual \$3,250. All with money back warranty. **Psitech Plus** 707-745-4804, www.psitech-plus.com

Sell Nuts & Volts in your store!
Contact us for complete details.

phone 909-371-8497

fax 909-371-3052

E-Mail distributors@nutsvolts.com

WIDGETS

Sensors to RS232, 422 or 485

**PRESSURE
THERMOCOUPLE
RTD
VOLTAGE
CURRENT
MOTION
GASES
RH
And more**

Each system comes complete with one sensor, 10, 12 or 14 bit resolution w/ 7 extra channels of A/D, 30k of remote data storage, power supply, serial cable and WINLP-Lite data acquisition software (trending, storing and display)

1-888-597-3588 (530) 647-2028

LEMON-PLADD INC. FAX (530) 647 8951
 PO Box 1683 POLLOCK PINES CA. 95726
WWW.LEMONPLADD.COM

Write in 49 on Reader Service Card.

Modern computing and standard surge suppressors... a recipe for disaster.

Almost all surge protection devices use MOV's (metal oxide varistors) as their active element. MOV's are sacrificial/wear/limited life components. Surge suppressors based on this technology are doomed to failure. These surge "suppressors" also don't suppress a thing. They divert powerline surges equally to the ground and neutral wire. When you put current on the common ground wire of interconnected equipment some of that current will flow (through the inherent ground loops) to the data lines. This is a major cause of lock-ups and misoperations that plague today's computer environments. Another fact; all modern computers use switch mode power supplies. During surges the power supply capacitors must charge to the clamping level of the MOV before the MOV turns on. A recent study has shown that it takes a 3000A surge 15 microseconds (15,000 nanoseconds) to charge the typical capacitors of these power supplies to that level. The surge is virtually over before the MOV reacts. (See five things you probably don't know about your surge suppressor at www.fivethings.com.)

THE POINT: Standard surge suppressors allow too much current to hit the computer. Standard surge suppressors divert surge current to the ground wire and disrupt data transfer. Standard surge suppressors eventually fail without warning. Modern computers have logic voltage levels (the signals that transmit the data) and power supply voltages that are dramatically lower than that of their recent predecessors. Modern computers use integrated circuits with transistors of ever decreasing physical geometries. Modern computers are virtually always interconnected to other computers or peripheral equipment. The bottom line; *modern computers are much more sensitive and susceptible to powerline anomalies.*

INTRODUCING BRICK WALL SURGE FILTERS. . .

The World's Best Surge Suppressor

Initially engineered for critical, non-fail industrial applications, this patented device protects indefinitely and sets a new standard for every measure of surge suppressor and powerline filtering performance.

A Brick Wall 1) Utilizes NO MOV'S or Any Other Sacrificial Components (a two pound inductor and nine capacitors are the heart of the unit) 2) Has No Joule Rating or Surge Current Limitations 3) HAS BEEN TESTED AND CERTIFIED BY UL TO THE MOST DEMANDING CLASSIFICATION OF A NEW GOVERNMENT SPECIFICATION; CLASS I, GRADE A. Which Means: UL PUT ONE THOUSAND 3000A, 6000V SURGES (this is the largest surge an interior environment can experience) THROUGH A UNIT (at 60 second intervals) AND DOCUMENTED NO FAILURE OR PERFORMANCE DEGRADATION OF ANY KIND WHATSOEVER.

i.e.: A Brick Wall Will Not Fail.

We know of no cord connected, MOV based surge protection device that has, or can pass this test.

A Brick Wall possesses UL's lowest Suppressed Voltage Rating (let-through voltage) of 330V. This is the lowest rating they will grant. In that test of one thousand 6000V, 3000A surges, UL NEVER SAW THE LET-THROUGH VOLTAGE EXCEED 290V. YOU CANNOT DO BETTER THAN THIS FOR A POINT-OF-USE SURGE PROTECTION DEVICE. Once again, we know of no other surge protection device that could come close to this performance level.

A Brick Wall is a current activated Series Mode device. Since it is not wired in parallel, nor voltage activated, it does not have to wait for the capacitors of the power supply to charge before it becomes effective. YOUR EQUIPMENT IS PROTECTED INSTANTANEOUSLY (and indefinitely).

These devices were engineered utilizing a current limiting/surge filtering technology. THEY DO NOT DIVERT ANY SURGE CURRENT TO THE GROUND WIRE. They Will Not Cause Your Computer System To LOCK-UP, CRASH OR MISOPERATE as a consequence of surge diversion. Your current surge "suppressor" will.

Powerline Filtering

In addition to all this, Brick Wall Surge FILTERS are the best AC powerline filters you can buy (that we have been able to find anyway). Industrial machinery, copiers, coffee makers, laser printers, fluorescent lights, refrigerators, etc., all cause powerline noise that can cause your computer to misoperate. A Brick Wall Surge Filter will make powerline noise related problems disappear.

You Can't Buy a Better Surge Protection/Powerline Filtering Device... Anywhere.

SO... HOW IMPORTANT IS YOUR SYSTEM?



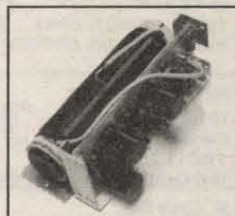
**BRICK WALL DIV.,
PRICE WHEELER CORP.**
1-800-528-0313

Fax: 1-800-528-6623 E-Mail: info@brickwall.com

Web: www.brickwall.com

Visa - MC - AMEX

ASK ABOUT OUR NEW IN-LINE UPS/SERVER PROTECTOR



Available in Modular Form

TEST EQUIPMENT for sale/wanted: RF, Microwave, video and fiber optic. Cable TV, Broadcast TV, satellite and related industries. Wavetek, Tektronix, Hewlett Packard and other manufacturers. Spectrum analyzers, signal level meters, sweep systems, TDRs, OTDRs, and much more. PTL Test Equipment, Inc. Phone 561-747-3647 FAX 561-575-4635.

TEK 2246 mod A 4 ch 100MHz scopes w/pouch, front cover and copy of service manual, \$725; HP 8901B/001/030/032/037 modulation analyzer, \$1,995; HP 8640B/003 signal generator, \$750. All plus shipping. John, 912-922-8244.

HEWLETT PACKARD model 4191A RF impedance analyzer with 16093D binding post fixture \$5,000; spectrum analyzer 141T, 8552B, 8554A 1.4GHz RF section \$875; 5517B laser head accepting offers; Fluke, as new 1921A true RMS voltmeter \$300; HP 8350A, sweep mainframe as new with new battery \$650. Psitech Plus 707-745-4804, www.psitech-plus.com

Don't miss a single issue!
Have Nuts & Volts delivered right to your door every month for only \$19 per year.
Call 1-800-783-4624

PICMASTER EMULATOR system, new, complete, all parts, documentation, boxes, w/16C63 probe, MPLAB software, registered w/Microchip, \$900 obo. 818-349-7920.

BOONTON 82AD modulation meter, \$650; Stabiline AC voltage monitor, \$650; Tektronix 492 spectrum analyzer, \$5,500; Tektronix R7844 400MHz scope, \$400; ESI 865A AC DC generator & detector with 250B impedance bridge, \$350; Wavetek SG 1170V signal generator, \$550; HP 4260A universal bridge, \$75; Sencore VA62 television analyzer, \$750; HP 8640 signal generator, \$550; Teledyne thermoelectric generator, \$650. Beyond Oil, 415-388-0838 or BeyondOil@compuserve.com

FEITEK PROVIDES repair, calibration and traceable certifications of test equipment. Free estimates. We buy, sell and trade all makes of test equipment. Visa and MasterCard accepted. Check out our inventory and specials at WWW.FEITEK.COM 2752 Walton Road, St. Louis, MO 63114, 314-423-1770.

POWER SUPPLY sale: California Instruments 1503T, \$1,250; electronic measurements TCR10S90, \$250; TCR20S50, \$250; TCR40S20, \$300; TCR150S7, \$350; Fluke 4265A, \$200, with GPIB, \$300; Fluke 4216A, \$150; HP 6253A, \$175; HP 6255A, \$225; HP 6267A, \$350; HP 6268B, \$550; HP 6269B, \$650; HP 6274B, \$750; HP 6299A, \$125; Lambda LK351FM, \$350; LK352, \$350; LK362, \$450; Sorenson SRL60-35, \$550; DCS40-25, \$350; HP 6002A, \$300. Coppes Enterprises, 520-749-8471, fax 520-760-7780.

ELECTRONIC EQUIPMENT over 60 instruments including: Fluke 332B, 845A, 335A, 540A, 382, 8024A; HP 735A, 745A, 746A, 8640B, 3336B, 8690A, 8707A, 355D/E, 3490A, 8620A, 3400A, 419A, 3455A, 5245L, 4333A, 5256A, 5328A, 432A, 415E, 8410B, 8743A, 5210A, 5326B, 5254A, 3490A; Ballentine 393; PM 1045, 1038; Tek 7603, 7403N, 2901A; GR 1232A, 1683; Epply 125; PRD 915B. Plus standard capacitors and inductors, fixtures, couplers, mixers, etc. Estate sale for us — unique opportunity for you. Soliciting reasonable bids. Don't miss this chance to get what you need at a good price. Hurry before it's gone. Call, write, or E-Mail for list. Ten day right-to-return. Contact: E-Mail: RgrGd@concentric.net Electronic Instruments, 4702 W. Lazy C Drive, Tucson, AZ 85745. 520-886-8488 or 520-743-0376.

SECURITY

SURVEILLANCE-COUNTERSURVEILLANCE: I buy and sell used equipment. Steve 410-879-4035.

QUAD MULTIPLEXER BLOW-OUT. JUST IN big load of color + B/W quads from American Dynamic+ Robot. AD-1473 real-time B/W quad reg. \$400, NOW \$100. AD-1474 4 cam B/W multiplexer \$150. AD-1480SL16 16 cam B/W multiplexer reg. \$600, NOW \$250. AD-1584SL16 16 cam COLOR multiplexer call for price. Robot video telephone transmitters 50-80% OFF. Robot quads + multiplexers 50-75% OFF. Burle waterproof metal camera housings reg. \$85, NOW \$25. Burle steel high security inside corner housings reg. \$250, NOW \$50. Burle auto-iris lenses TC-9908 8mm 1.2 reg \$70, NOW \$40. Burle 12 mm 1.4 auto-iris reg \$75, NOW \$40. TONS of Panasonic auto-iris lenses NEW=USED. Pan + tilts, receiver drivers, fiber optic equipment. WE'LL BEAT ANY PRICE! "I must be outta my mind." **PRO-VID SYSTEMS Co., Woburn, MA, 781-933-0827.** E-Mail: RicksVideo@Medial.NET



NEW! AS-1004, 2.4GHz transmitter & receiver with audio! Capable handling total of 4 wireless cameras, range: >300'. Built-in camera, 400 TV line. \$189 a pair @ 5 pcs., \$179 @ 10 pcs. Additional camera \$119 @ 10 pcs. Matco, Inc. 1-800-719-9605 Fax: 630-350-9546. E-Mail: nsales@mat-co.com Web site www.mat-co.com

Component Kits From Edlie The Kit King

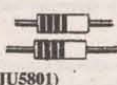
Hottest Edlie Kits



Each Kit comes complete with an educational explanation of the circuit. Build these useful kits and have! Fun Too! Each Kit comes with its own PC Board.

1/2 and 1/4 Watt Resistor Kit 200 for \$2.95

5% +10%
All Standard ohmages
All top Grade material



(JU5801)

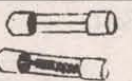
Precision Resistor Kit 100 for \$1.95

All 1% Resistors,
RN55, RN60, RN65 etc. (JU5803)



Fuse Kit

25 for \$1.95
Primarily from
Little Fuse, & Buss
Various types included. Various amps, slow
blow, standard, pigtailed etc. (JU4040)



Crystal Kit

15 for \$1.95
Can be CB, Transmitting,
Ham, business, marine etc. (JU5815)



Volume Control Kit

20 for \$2.95
Various ohmages to 10Meg
Some with switches. (JU5805)



Miniature Bulb Kit

10 for \$1.95
Can include such types as
PR6, 12, 219, 240, 222,
1847 Grain of wheat etc. (JU4041)



IC Grab Bag

15 for \$2.50
Including 7400 Series, CMOS,
Linears, etc. All Prime All
Guaranteed (JU5808)



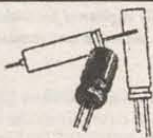
LED Kit

20 for \$2.50
Different colors, Red, Green
Yellow. Different shapes (JU5811)



Miniature Electrolytic Caps

25 for \$2.95
Axial, Radial
Leads, Mixed
Capacitances, and Voltages (JU5804)



Switch Kit

15 for \$2.95
Can be slide switches,
Rotary, Rockers, toggle
Switches, SPST,
DPDT, TPDT
All prime (JU5818)



#22 stranded Wire Kit.

4 rolls 50' ea.
For \$3.95
4 assorted colors an exceptional value
(JU2736)
Also Available in 4 Rolls of 100' for \$7.95
(JU2737)



Disc Capacitor Kit

60 for \$2.95
Various Capacitance's,
Various Voltages. NPO,
N750 etc. (JU5827)



Hardware Kit Only \$2.95

mixture of screws, washers,
Nuts, Bolts, and all sorts of good
Things (approximately 300-600)
(JU5813)



Semi Conductor Kit

25 for \$3.50
This kit contains an assortment
Of any of the following:
Triacs, SCRs, Rectifiers
Transistors (JU9561)



AM-FM Radio Kit (JU544)



This radio kit is a unique educationally oriented, radio kit designed to expand your understanding of basic radio theory. It is capable of receiving both AM and FM. The circuits are laid out in systematic order on an oversized PC Board so that the student can easily understand the flow of the radio signals from antenna to speaker. The radio kit PC has been so designed that no cabinet is necessary. A special bracket provides the necessary support to use the radio in any location. A manual providing theory, construction, testing, and alignment is included. After completing this course you will have a better understanding of AM/FM radio theory and operations. \$25.95

Voice Changer (80-105JU)

Your voice can be changed to add a vibrato, like those used to disguise secret witnesses. Or you may change your voice upward or downward: Women sound like men and vice versa. Includes a very RobotVoice As well. A microphone & speaker are included on the PC board; all that you need is a 9V-transistor battery. This is a very novel and entertaining circuit \$12.95

4 Train Sound Effects (80-910JU)

This Cob project will produce 4 very realistic user selectable sound effects that are ideal for model railroad. Throw any of the switches to produce a train whistle blowing 3 times, a train chugging along, a level crossing bell & the "clickety clock" of a train crossing a bridge. Kit includes all parts including speaker. Easy to assemble. Operates on 2.4 to 6VDC \$7.95

Telephone Bug (EK-35JU)

Our bug is only the size of a dime, yet transmits both sides of a telephone conversation to any FM radio. No battery needed. \$7.95

#20 STRANDED WIRE

KIT 4 ROLLS 50 ft each
Different Colors
For only \$5.95 (JU2740)



* Buy Any 5 Kits and receive A Free Resistor Kit *

Sand Ohm Power Resistor Kit

19 for \$2.50
5, 10, & 15Watts only 13¢ ea.
Different ohmages (JU5812)



IC Socket Kit

20 for \$2.50
May include 14 Pin, 16 Pin,
24 Pin & 29 Pin Sockets (JU2742)



Call or Write for a

Free

76 page Catalog

800 516 645-4722

Outside the US Please send

\$3.00

Mail your orders to
Edlie Electronics Inc.
2700 Hempstead Tpke
Levittown, N.Y. 11756
Order Tool Free
1-800-645-4722
In NYS 516-735-3330

Checks or Money order are accepted by mail.
No C.O.D. Shipping & Handling charge \$5.00 For the
continental United States All others including Canada,
Hawaii, Alaska, & P.R. must pay full shipping charges.
We Accept MC, Visa, & AE



fax Call 516-731-5125 For Information Call 516-735-3330



COUNTER-SURVEILLANCE=\$250 HRI
Electronic eavesdropping is unbelievably widespread! Are you sure you're safe? Learn how others (without prior experience) earn \$250 HR in the fascinating field of COUNTER-SURVEILLANCE! For FREE catalog call: 1-800-732-5000.



SALE! PS 102: Built-in pin hole CCD, lens size: 3.6mm. 5-1/2" (D) x 1.7" (H). \$79 @ 5 pcs., \$72 @ 10 pcs. Distributors welcome. Matco, Inc., 1-800-719-9605 Fax: 630-350-9546. E-Mail: nsales@matco.com Web site www.matco.com

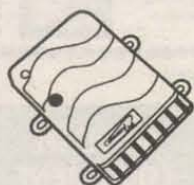


SPECIAL! IC 113: PIR motion detector with audio! W/ NO/NC alarm output. CCD camera with audio can be turned on by detector. 5-1/4" (L) x 2-3/4" (W) x 2" (D). \$89 @ 5 pcs., \$82 @ 10 pcs. Matco, Inc. 1-800-719-9605 Fax: 630-350-9546. E-Mail: nsales@matco.com Web site www.matco.com

8 CAMERA DUO-QUAD DISPLAY BLOW-OUT. 8 camera B+W 2 page hires. real-time quad w/2 video outputs. Selectable display quad/sequencer or both. These units are brand new discontinued American Dynamics AD1475A. Similar units in this magazine are twice the price. Not a China imitation. Industrial unit. Our reg. price \$350, **NOW \$175 EA.** While they last! Pro-Video Sys. 781-933-0827. E-Mail: RicksVideo@MSN.COM



NEW PRICING! QVS 104: Quad video system. Near real-time. 8.5" (W) x 2" (H) x 5.5" (L). \$149 @ 5 pcs., \$145 @ 10 pcs. Also available: 8-2 video auto-switcher, \$65 @ 5 pcs., \$59 @ 10 pcs. Distributors welcome. Matco, Inc., 1-800-719-9605 Fax: 630-350-9546. E-Mail: nsales@matco.com Web site www.matco.com



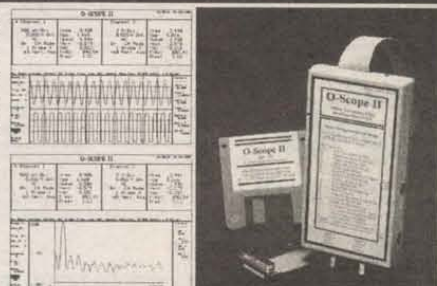
COMMAND LINK by Motorola. If you have access to a phone, you have access to your car! Locks and unlocks doors, starts vehicle, windows up or down, opens trunk, helps with stolen vehicle recovery, only \$249; retail \$500. Easy to install, VHS tape with order. Free booklet, call 770-616-5868 24 hrs.

Digital Storage Oscilloscopes

From \$99.00

ATC modules turn your PC into a full-function DSC, spectrum analyzer, logger, & DVM. Units DC to 50MHz. O-Scope II now in Windows 3.1, 95/98, NT and DOS.

O-Scope Ip \$189.
O-Scope II \$349.
Specialty probes call.



ATC is a stocking distributor for Pico Technology LTD which offers scope modules to 100MSPS, resolutions from 8 to 16 bit. Pico offers PC based data loggers from 1 to 22 channels, 8 to 16 bit and the Enviromental monitoring system.

Pico products - call

The **DFA-5**, low cost differential amplifier, cuts through common mode noise problems to reveal low voltage signals. With gains from 1X to 1000X and band widths from 20KHz to 1.2MHz, DFA-5 is the test accessory to help you work with signals from 5 Volts to 5 microVolts. Only \$129.00.

Serial Port Problems ???
Check out **Serial !!** Our lowest cost serial channel analyzer only \$99.00.

Allison Technology Corporation
2006 Finney Valley Rd., TX. 77471 U.S.A.
800-980-9806 or 281-239-8500
<http://www.atcweb.com> atc@accesscomm.net

MICRO VIDEO CAMERAS



MB-650PA - \$139.95
2.8mm Pinhole Lens.



MB-650UA - \$129.95
4.3mm Micro. Lens

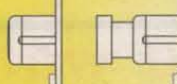


MB-750P - \$129.95
2.8mm Pinhole Lens.

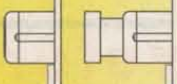


MB-750U - \$119.95
4.3mm Micro. Lens

MB-650a Series
• Built-In Audio
• 1.18" sq.
• 380 TV Line



MB-750 Series
• 1.25" sq.
• 420 TV Line



The Best, Smallest, Micro Cameras on the Market Today!
Call and Compare! We Match or Beat All Prices!

Panasonic Color Camera Sale



Micro Color MB-45CB: \$99.95

- Wide Voltage Range, 5-14 Volts!
- Small Footprint!
- Self contained ultra small package design for various applications.
- MCM PCB design for minimizing the size and improve durability.

Specifications: MB-45CB Color Camera
Pick-up device: 1/4" Interline transfer
Effective Pixels: 512 (H) x 496 (V)
Scanning System: 2:1 Interlace
525 lines - 60 fields
Frame per second: 30 frames
Synchronization: Internal
Video output: VBS, 1vpp 75 Ohms
Horizontal Res.: More than 330 lines
AGC: On fixed
White Balance: ATW fixed
Operating Temperature: 32°F to 104°F
Ambient conditions: Indoors
Lens: F2.8 Hor. Angle 45° - Ver. Angle 34°

Size: 1.25 x 1.25 sq. w/ Footprint

WIRELESS VIDEO

Compatible with AC or Battery

Wireless 4-Channel B/W & COLOR Cameras Available!

Wireless Observation System's
GFS-1001 (900MHz) - \$499.95
GFS-1001c (900MHz) - \$599.95
(900, 1.2 & 2.4 Ghz systems available.)

GFT-1001 \$189.95
Gives any camera the ability to be Wireless.



Transmits Over 1000 ft.

Our Smallest Video Camera



CMOS Camera CM-550u - \$69.95

Pin Hole Camera: CM-550p - \$69.95

LIPSTICK CAMERAS

These cameras are supplied with a PCM-1 Video/Power cable. The BNC connection is for standard video connection to a Monitor or VCR.



LP-850p \$139.95

LP-850i \$129.95

Length: 1.9"
Diameter: .91"

1-800-752-3571

Visit Polaris Ind. Web Site at:
<http://www.polarisusa.com>



Polaris Industries 470 Armour Drive NE • Atlanta GA 30324 • Tech Info: 404-872-0722 • FAX 404-872-1038

Prices, availability and specifications are subject to change without notice. Shipping and Handling are not included with price.

MOTORIZED 20K POTENTIOMETER

Precision made motorized pot by Shokai features a very compact gear reduction assembly with machined pot. The pot has a panel mount bushing with nut and has a long slotted shaft for a knob (if desired). Pot can be manually turned with shaft or automatically turned by applying any voltage from 3 to 12VDC to the motor. Reverse the polarity to cause the pot to turn in the opposite direction. This precision marvel is great for robotics, servo systems, remote control instrumentation, laboratory equipment, etc. Pot has 3 wires connected to it. Motor has 2 wires connected to it. Size about 1 1/2" x 1 1/2". Linear taper 20K rating. Brand new!

G9962 \$3.49 ea. Sale! \$1.99 ea.



12VDC OPERATED 15KV NEGATIVE ION GENERATOR

Compact negative ion generator cleans air of impurities and provides a fountain of fresh air. Negative ions are produced during a thunderstorm and these are the same type that this 2 1/4" x 1 5/8" x 7/8" module produces. Operates from 12VDC 12VDC to the red and black power input leads and a tremendous quantity of negative ions will be emitted by the needle assembly shown. These are brand new factory fresh prime units perfect for homes, cars, offices, etc.

G9695 \$12.95 ea. • 2/\$25.00



DELTA ELECTRONICS 12VDC MODEL DFB0412H MINIATURE FAN

Small fan to cool your hot microprocessor operates on 12VDC and is only 1 9/16" sq x 3/4" thick. Provides efficient cooling (only requires 100ma). Can even be operated from a 9V transistor radio battery! Brand new prime.

G1472 \$1.99 ea.



1.000MHZ OSCILLATOR

Precision oscillator operates on 5VDC and produces a stable 1.000MHz signal. Great for thousands of uses including frequency counters, timebase kits, calibration standards, etc. Only 4 leads to connect (5VDC in, and 1.000MHz out). Size only 3/4" x 1/2". Prime metal case unit at a blowout price!

G8160 \$1.00 ea. • 10/\$8.00 • 100/\$75.00 • 1,000/\$600.00

HIGH OUTPUT AMORPHOUS SILICON SOLAR PANEL

These high quality panels were made for the ocean buoys we sell. They are great for 2K emergency needs, charging car batteries or powering 12V equipment. Output in full sunlight is 20 volts open circuit and 485ma short current (tolerance $\pm 3\%$). Features totally encapsulated silicon solar cells on a metal frame which has an overall size of 19 1/2" x 14". The panel is totally waterproof and designed for outdoor use. The output power from the panel is on a 2 7/8" x 1 1/8" Dc, metal connector which extends out the bottom of the panel. By jumping a couple of pins on this connector you can transfer the output to the pigtail lead with connector that is on the top of the panel, however, it is important to remove the bottom connector. Prime powerful panel at a blowout price!

G1458 \$44.95 ea. • 2 for \$80.00



BIG DISPLAY 8 DIGIT CALCULATOR

Solar Powered calculator with large LCD Display that can tilt upwards to accommodate viewing. Large keys have all of the important functions—perfect for balancing your checkbook, calculating ohm's law, or just having an extra calculator around for when the need to calculate something arises. Brand new in manufacturer's box. Approximate Size: 5 7/8" x 7 1/2" x 1/2"

G1474 \$3.49 ea. Sale! \$2.99 ea.



FIBER OPTIC DISPLAY BUNDLE

Bundle of various length plastic fiber optics made for a multicolor light display. We didn't receive the light unit but we did get the fiber optic bundles that consist of about 70 small diameter plastic fibers cut at various lengths from about 3/4" up to about 8" long. The bundle terminates into a small metal crimp fitting which is where a multi colored light was to be connected. We placed one of our bright bi-polar LEDs next to the fitting and in a darkened room the end of each of the fibers glowed beautifully. Great experimenter item!

G1134 \$2.95 ea. Sale! 99c ea.

GREENPLUG® ELECTRICITY SAVER TYPE 1 FOR REFRIGERATOR/FREEZERS

Brand new highly sophisticated electronic device which contains special IC circuitry to help reduce electricity usage. Simple to use just plug into any standard 120V 3 slot AC outlet and then plug your refrigerator or freezer into the GreenPlug. The type 1 is designed for any 120VAC refrigerator or freezer with up to a 7amp (840watts max) draw manufactured before 1992. Not for use on models with LED digital displays. Brand new with instructions.

G9946 \$3.99 ea.



Write in 52 on Reader Service Card.

WE ALSO OFFER OVER 150 DIFFERENT ELECTRONIC KITS

ELECTRONIC GOLDMINE
PO Box 5408
Scottsdale, AZ 85261

<http://www.goldmine-elec.com>

NOTE: All items subject to prior sale. All prices expire 9-01-99

For Phone Orders Call: 800-445-0697

or Fax Your Orders to: (480) 661-8259

For a Free Catalog Call: (480) 451-7454

Foreign catalog request: send \$5.00

Minimum Order: \$10 (plus min. \$5 Shipping and Handling). We accept MasterCard, Visa and personal checks, however, we cannot accept personal checks on orders outside the U.S. Minimum Foreign Order Amount: \$50 (plus a minimum \$10 S&H)

DURACELL® NICKEL METAL HYDRIDE STARTAC® CELL PHONE BATTERIES

Made for all 6000 & 8000 series STARTAC phones these longer lasting NMH batteries do not suffer from memory effect problems like nicads do. Great for replacement on your 6000 or 8000 series STARTAC®. We have 2 types: the main battery and the auxiliary battery (which mounts on back and can add a tremendous amount of talk time). Both batteries are brand new bulk packed (not blister pack) and are available in steel grey only.

Main Battery (DR124 590mah) • G1467 \$19.95 ea.

Auxiliary Battery (DR125 1240mah) • G1468 \$23.95 ea.



CONVERTS PC MONITOR to SECURITY MONITOR. The VGA-801 accepts standard NTSC or PAL inputs for display on any existing VGA/SVGA computer monitor. Small compact size, 4-1/2" x 2-1/2" x 3/4". Over 600 lines of resolution, twice that of standard TV monitor! High quality audio output feeds speakers directly. Excellent grey-scale conversion; works well with B/W inputs. Power supply included; \$69 each. Dealers welcome. MATCO, Inc., 1-800-719-9605; Fax 847-619-0852; E-Mail: sales@mat-co.com Website: www.mat-co.com



B/W 430 LINE CCD CAMERA with optional black low-profile swivel adjustable enclosure. Pin hole or Std. lens type, 6, 8, and 12mm lens are available. 1/3" CCD, 3.6mm/F2.0 lens included; 9-14 VDC, 0.08 lux, IR sensitive; 1.27" x 1.27" x 0.5"D pinhole or 1" deep standard. Price @ 10 pcs., \$44 each. Enclosure: \$8; optional lens: \$18. Dealers welcome. MATCO, Inc. 1-800-719-9605. Fax 847-619-0852. E-Mail: sales@mat-co.com Website: www.mat-co.com

SATELLITE EQUIPMENT



FREE BIG dish catalog. Low prices! Systems, upgrades, parts, and "4DTV". Skyvision, 1010 Frontier Dr., Fergus Falls, MN 56537. www.skyvision.com Call 1-800-543-3025.

SATELLITE RADIO BOOK AND GUIDE. New book covers all Audio Services, SCPC, Subcarriers, FM Squared, Facsimile, Press Services, Weather Services. Simple how-to-receive instructions. \$16.95 plus \$3 Priority Mail. UNIVERSAL ELECTRONICS, 4555 GROVES ROAD, #12, COLUMBUS, OH 43232. 614-866-4605.

DSS BIBLE Volume 4. Published June 1999. All new information on 'H' card hacking FAQs, tier lists, Internet relay chat, automatic LNB disconnect, free-ware, scripts, ECM against H-cards, questions and answers, how 3M code works, H-card nanocommands, and much more. 160+ pages. Includes all known DSS and related software on CD-ROM as of June 1, 1999, \$76.45 ppd, USA. TELECODE 520-726-2833 <http://www.hackerscatalog.com> or <http://www.cinecam.com> or <http://www.technibooks.com>



BEST PRICING on 18" satellite TV systems for home and RV. DSS, DISH Network programming, multi-room viewing options, accessories. www.skyvision.com Call 1-800-543-3025.

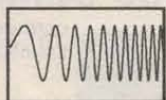
FREE FLYER on DBS files, hacking, hardware info. Bill 1-800-879-9657.



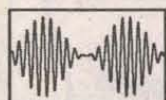
Telulex Inc. model SG-100A

New Features:
✓ 21.5 MHz
✓ .01 Hz steps
✓ multi-unit phaselock

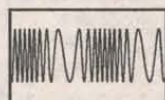
- **Synthesized Signal Generator**
Clean sinewaves DC-21.5 MHz with .001% accuracy! .01 Hz steps. DC Offset. RS232 remote control.
- **Arbitrary Waveform Generator**
40 Megasamples/Second. 32,768 points. 12 bit DAC



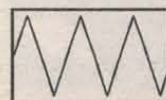
DC to 21.5 MHz linear and log sweeps



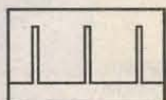
Int/Ext AM, SSB, Dualtone Gen.



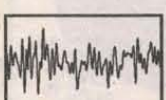
Int/Ext FM, PM, BPSK, Burst



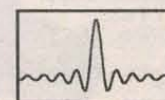
Ramps, Triangles, Exponentials



Pulse Generator



Noise



Arbitrary Waveforms



Unlimited Possibilities!

Telulex Inc.

2455 Old Middlefield Way S
Mountain View, CA 94043

Tel (650) 938-0240
Fax (650) 938-0241

<http://www.Telulex.com>
Email: sales@Telulex.com

LIGHT WORKS USA™

By Miller Engineering

Electroluminescence
Experimenters Kit!

\$22.95 plus \$3.00 S&H

This exciting kit is designed just for the experimenter! Kit includes one 1.7"x 3.75" white EL lamp that makes up to 6 EL lamps. Ready to run power supply that runs on two AAA batteries. Six color overlays and complete instructions and ideas on using this space age marvel.

Send To: Miller Engineering, P.O. Box 282,
New Canaan, CT 06840-0282

Tel. 203-595-0619 Visa & Mastercard accepted. Personal checks must clear first. www.microstru.com



1999 DSS SOFTWARE COOKBOOK 700+ CD-ROM COLLECTION: CLONING, REVERSE-ENGINEERING, PPV, ADULT, EMULATORS, DIAGRAMS, SCHEMATICS, PATCHES, PLANS, MUCH MORE. (SPECIAL: 1ST 700 ORDERS GET 700+ ADDITIONAL PROGRAMS!) WHOLESALE ONLY \$22 (BUY 2, GET 1 FREE!!!). DSS TEST CARD INFO SOURCE MANUAL \$10. VISA/MC/AMEX/COD/CHECKS/MO. BRINKER ENGINEERING LABS, USA. CALL NOW 352-429-5496.

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

DSS TEST CARD information. Call toll free, 1-888-416-7296.

DEALERS WANTED: Digital Satellite Systems for "free-to-air" programming. Wholesale prices. <http://www.dmsi.usa.com> 1-888-591-4416.

MILITARY SURPLUS ELECTRONICS

WANTED: ARC-5 & SCR-274N receivers and manuals. John Broussard, 312 Guilbeau, Breaux Bridge, LA 70517.

AUDIO — VIDEO — LASERS



ANTIQUE VIDEO TRANSFER SERVICE: transfer of any 2" quadruplex video tapes. Quad TV spots, features, medical, corporate, military, government, and university tape libraries TRANSFERRED TO VHS. Affordable. Phone/fax 415-821-7500. If no answer call 415-821-3359 or pager 415-245-8700.

ATV 2.2GHz to 2.7GHz wireless video data link module tuner & transmitter. 100mW. Picotronic, web: <http://members.aol.com/picotronic/atv.htm>

SONY PLAYSTATION MODCHIPS. Allows playing of CDR backups & imports. \$10 + \$3 shipping. 619-590-9320.

WANTED: PRO video equipment, VCRs, switchers, cameras, etc. Advanced Media 702-874-1911.



CONVERTS PC MONITOR to SECURITY MONITOR. The VGA-801 accepts standard NTSC or PAL inputs for display on any existing VGA/SVGA computer monitor. Small compact size, 4-1/2" x 2-1/2" x 3/4". Over 600 lines of resolution, twice that of standard TV monitor! High quality audio output feeds speakers directly. Excellent grey-scale conversion; works well with B/W inputs. Power supply included; \$69 each. Dealers welcome. MATCO, Inc., 1-800-719-9605; Fax 847-619-0852; E-Mail: sales@mat-co.com Website: www.mat-co.com

FREE LASER CATALOG. Helium-Neon, Argon, ruby, visible laser diode modules, lightshows, holography, laser pointers. Lowest prices. Midwest Laser Products, PO Box 262, Frankfort, IL 60423. 815-464-0085 www.midwest-laser.com

BROADCAST VIDEO equipment wanted: all types, new or old. Please call, Jon with info. 1-800-539-2859.

STEALTH MOD chips for Sony PlayStation. Now even your anti-mod games will work. Only \$9.95 ea. + \$3.35 shipping. Call Toll Free 1-888-467-6150. All credit cards accepted. www.computerconnectionusa.com

GAME WIZARD cartridge for PlayStation. Works like a mod chip and the best cheat cartridge all in one. It will use all the same cheat codes the others use. Only \$29.95 free shipping. Toll Free 1-888-467-6150 all credit cards accepted. www.computerconnectionusa.com



SYNC-A-LINKS 3-D Scopers™ digital color CCD cameras for stereoscopic imagery. At a reasonable cost. Phone or Fax 918-479-6451 or write to Sync-A-Link, PO Box 4, Locust Grove, OK 74352.

SYNC-A-LINK UNIVERSAL video sync generators. For more details phone or fax 918-749-6451 or write to Sync-A-Link, PO Box 4, Locust Grove, OK 74352.

Go Wireless With Our Modules

SILRX/TXM

SILRX — \$26.00 ea.
TXM — \$15.50 ea.

The TXM and SILRX modules are a transmitter and receiver pair which can achieve a one-way radio data link-up to a distance of 200m over open ground.

Both units are supplied in space-saving single-in-line packages and offer SAW controlled, wide band FM transmission/reception.

The modules are particularly suited to battery-powered, portable applications where low power and small size are critical design criteria.



TX2/RX2

TX2 — \$19.50 ea.
RX2 — \$38.50 ea.

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 multi-node wireless links in applications including car and building security, EPOS and inventory tracking, remote industrial process monitoring, and computer networking.

Because of their small size and low power requirements, both modules are ideal for use in portable, battery-powered applications such as hand-held terminals.



900 MHz

AVAILABLE JAN '99

RPC

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.



BiM

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.



Lemos International Co., Inc.

65 Southbridge Street, Auburn, MA 01501

Phone (508) 798-5004 ♦ Fax (508) 798-4782

www.lemosint.com ♦ lemosint@ma.ultranet.com

All products available in either 418 or 433 MHz

Write in 54 on Reader Service Card.

E-Math Pro Windows version!

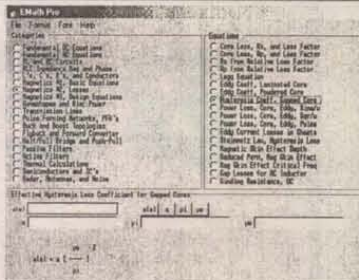
E-Math is the Essential Formula Tool for Engineers, Technicians, and Students.

Features

- Over 300 formulas
- Ability to rotate equations.
- Solve for any variable.
- Help for each equation.
- Win95, Win98, NT compatible

Formula Categories:

- Fundamental DC Formulas
- Fundamental AC Formulas
- RL and RC Circuits
- RLC Impedance Magnitude and Phase
- L's, C's, R's and Conductors
- Magnetics #1, Basic Equations
- Magnetics #2, Losses
- Magnetics #3, Design Equations
- Waves and Miscellaneous Power
- Transmission Lines
- Pulse Forming Networks
- Buck and Boost Topologies
- Flyback and Forward Converters
- Half/Full Bridge and Push-Pull Topologies
- Passive Filters
- Active Filters
- Thermal Calculations
- Semiconductors and Integrated Circuits
- Radar, Antennas and Noise



E-Math Pro Windows v1.0
\$49.95

Bytech Services

www.bytechservices.com

US Toll-free: 1-888-422-7521

Voice/FAX (360) 422-7520

Dealer and Distributor
inquiries — YES



Bytech Services

Write in 55 on Reader Service Card.

Nuts & Volts Magazine/July 1999 43

Soyo Super Socket 7
Mother Boards #SY5EMA
 MVP3 Over Clocks to 124 MHz - ATX
 Uses Pentium class CPU to 500 MHz
\$60.00 ea.



SCSI Hard Drives

New 2.1 Gig Seagate
\$60.00

New Micropolis 1.53 gig \$40.00
IBM 4 Gig WIDE Differential
\$100.00 ea.

Designer Mouse Special
3 button Serial Mice
10 for \$25.00 or
\$120.00 per case of 80



*** Color CCD Camera Project \$10.00 ***

Lots of MicroWave Goodies in Stock



Brand New Wavetek 907AF Frequency Generators
Range 7-12.4 GHz \$900.00

HP Direct Reading Frequency Meter
#R532A 26.5-40 GHz New \$350.00

We Buy Connectors * Contacts * Raychem

Electro Mavin

800-421-2442 or FAX 310-632-9867

E-Mail john@mavin.com

Visit Our Web Site for More Info and Specials

http://www.mavin.com/mavin.html

Mr. NiCd

JULY 99 SUPER SPECIALS!

THE BEST BATTERIES
IN AMERICA!

Packs & Charger for YAESU FT-50R / 40R / 10R:
 FNB-40xh (5w NiMH) 7.2v 650mAh \$41.95
 FNB-47xh (NiMH) 7.2v 1800mAh \$49.95
 FNB-41xh (5w NiMH) 9.6v 1000mAh \$49.95
For YAESU FT-51R / 41R / 11R:
 FNB-38 pack (5w) 9.6v 700mAh \$39.95
For YAESU FT-530 / 416 / 816 / 76 / 26:
 FNB-26 pack (NiMH) 7.2v 1500mAh \$32.95
 FNB-27s (5w NiMH) 12.0v 1000mAh \$45.95
For YAESU FT-411 / 470 / 73 / 33 / 23:
 FNB-11 pack (5w) 12.0v 600mAh \$24.95
 FBA-10 6-Cell AA case \$14.95
Packs for ALINCO DJ-580 / 582 / 180 radios:
 EBP-20ns pack 7.2v 1500mAh \$29.95
 EBP-22nh pk (5w) 12.0v 1000mAh \$36.95
 EDH-11 6-Cell AA case \$14.95
For ICOM IC-21A / T22-42A / W31-32A / T7A:
 BP-180xh pk (NiMH) 7.2v 2000mAh \$39.95
 BP-173 pack (5w) 9.6v 700mAh \$49.95
For ICOM IC-W21A / 2GXAT / V21AT (Black or Grey):
 BP-132s (5w NiMH) 12.0v 1500mAh \$49.95

For ICOM IC-2SAT / W2A / 3SAT / 4SAT etc:
 BP-83 pack 7.2v 600mAh \$23.95
For ICOM 02AT etc & Radio Shack HTX-202 / 404:
 BP-8h pack 8.4v 1400mAh \$32.95
 BP-202s pack (HTX-202) 7.2v 1400mAh \$29.95
For KENWOOD TH-79 / 42A / 22A:
 PB-32xh pack (NiMH) 6.0v 1000mAh \$29.95
 PB-34xh pack (5w NiMH) 9.6v 1000mAh \$39.95
For KENWOOD TH-78 / 48 / 28 / 27:
 PB-13 (original size) 7.2v 700mAh \$26.95
For KENWOOD TH-77, 75, 55, 46, 45, 26, 25:
 PB-6x (NiMH w/wh plug) 7.2v 1200mAh \$34.95

Mail, phone, & Fax orders welcome! Pay with
 Mastercard / VISA / DISCOVER / American Express
Call 608-831-3443 / Fax 608-831-1082

Mr. NiCd - E. H. Yost & Company

2211-D Parview Road, Middleton, WI 53562
CALL OR WRITE FOR OUR FREE CATALOG!
 Cellular / Laptop / Videocam / Commercial & Aviation packs too!
 E-mail: ehyst@midplains.net

LASER SHOW SYSTEMS AND COMPONENTS. Hobby and professional projectors. www.redline-lasers.com

ARGON LASER 70mW with power supply, ML, MM, air cooled. Also 10mW He-Ne with PS, smoke machine, 3 galvos, metal mirror mounts, beam splitters, mirrors, and more. Everything you need. Rwilemon@yahoo.com 205-274-0756, \$1,500.

ULTRATECH 1200 stepper 2 yrs. old, damaged optics. Good parts machine, offer! 760-736-4411.

PACIFIC 110W CO laser, Pacific, \$4,500; Powerlase 25 CO₂ 25W, \$600; Tascam 24 track data reel-to-reel recorder with remote console, \$12,000; 4 ea., AB International 1200C audio dual amp 1200 watt/chnl, \$400 ea.; GE 2,000W video theater projectors, \$4,500 ea. E-Mail: ed4surplus@aol.com San Marcos, CA. 760-736-4411.

CABLE PARTS & EVERYTHING. Best prices & quantity discounts. WE DON'T SELL BOXES. 1-800-MODULE-0.



EXPLOSIVE CABLE TV GRAB!
BRINKER ZAPPER/SNOOPER STOPPER combo module all in one! Buy wholesale factory-direct, no middleman. Let others get fined + zapped instead. 100% COMPATIBLE. Your order shipped NATIONWIDE immediately! **LIFETIME GUARANTEE!** VISA / M / C / A / M / E / X / C / O / D / M / O / CHECKS. ONLY \$10 (SPECIAL: 3/\$20 plus FREE DESCRAMBLER PLANS!). **SUPER ZAPPER MODULES (\$5).** **DESCRAMBLER SOURCES (\$5).** **FREE SHIPPING. OPEN 24 HOURS!** 352-429-5496. **BRINKER ENGINEERING LABS, USA.**

SONY PLAYSTATION MODCHIPS. Allows playing of CDR backups & imports. \$10 + \$3 shipping. 619-590-9320.

GENUINE UNMODIFIED JERROLD DPBB 7312. 1-800-804-8655. E-MAIL: CLEWIS7298@AOL.COM

CABLE BOX repairs and upgrade. Most models, warranty lowest prices. Call 214-695-5982.

DTV & DISH NETWORK INFORMATION (36 PAGES) only \$15. Mainline Electronics, Inc. Call toll-free 1-877-856-0923. Cable television supplies **DIRT CHEAP!** Plus descrambling plans for all systems, call 1-877-880-0197. WWW.MELECTRONICS.COM

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



NOTCH FILTERS 110, 108.5, 106.5, 97.5 75dB deep notch. \$19.95 ea., 1-5 qty. \$15.95 ea., 6-10 qty. \$11.95 ea., 11-20 qty. \$9.95 ea., 21 or more qty. Call 24 hr. order and information hot line 516-389-3536.

CABLE MART

BEST

PRICE,

QUALITY

GUARANTEED

SERVICE

800-646-6557



& C.O.D.

POSITIVE NOTCH filters. Channels available: 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, and 25, \$16 each. Channels 26, 27, 28, 29, 30, and 31, \$19 each. Channel 39 \$25 each. Order by single channel. Top quality non-tunable metal cylinder types. 75dB deep on notch. Need to block the video on a cable channel til the kids do their homework, order a negative notch filter from our company. We carry large stock on all channels. Visa, MasterCard, Discover and UPS COD. "The Filter Company" Quantity pricing on 5 or more. 100 pcs. \$7 each. Call 1-800-235-8080. On the web go to www.gofilters.com lots to see. Open 8am to 5pm Central Standard Time, Monday-Friday. All sales must comply with FCC 1996 cable act.

UNMODIFIED CABLE CONVERTERS. Zenith ST1600, ST1086, ST300, Panasonic 175, 145 vol. & non-vol. Regal RR-92 & RC 83, DP5, DP7, DRZ, 5503 VIP, SA 8580. Guaranteed low prices. Please call for more converters 405-631-1856.

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

PLAYSTATION MOD chips. Works with all models up to 750x. Color instructions. Seven wire hook up, does not come with wires. \$5 each, plus shipping charges. 10% discount for 10 or more. Call 703-741-0338 to place an order.

GENUINE UNMODIFIED JERROLD DPBB7312 FOR SALE 10 LOT MIN. CALL 708-715-6118.

WANTED: GENUINE RAW UNMODIFIED CABLE TV CONVERTERS. TOP CASH PAID. CALL 708-715-6118.

PICS, GALS READ if you've lost your masters. Programming service available. Call for info. Network Sales, 616-683-0500.

CABLE TV. Panasonic TZPC 175DG2, brand new, \$80 w/volume, 1 year warranty, minimum 10 pcs. any qty., plus all major brands available. Lowest price new/field pulls. E-Mail: OCALA@BELL SOUTH.NET phone: 1-800-929-1549 fax: 305-220-9396

CABLE CONVERTERS. DBS, remotes, schematics, etc., free flyer. Jake 419-385-3100.

PLANS: DESCRAMBLE CABLE FOR UNDER \$12. PLUS TWO FREE BONUSES. TOLL FREE 1-888-588-3715.

CABLE PARTS! Computer parts. Call for great prices or visit us on the Web: [HTTP://WWW.CB-Electronics.com](http://WWW.CB-Electronics.com) or call 1-800-436-8630.

PLAIN CONVERTERS: Brand-new, the most reliable in the market today. Philips ECG-TV-3000, 181-channel only \$75 ea.; Refurbish Panasonic TZPC-145, \$35; Panasonic-TZPC-175, \$39 minimum 10-lot, 1 full year warranty, same day shipping. 405-634-1535.

RAW CONVERTERS: We have the best quality to your cable needs. PI-5135 \$45 ea.; Zenith ST-1600 \$75; S/A 8590 (11-B) \$85 ea.; S/A 8590 (10-B) \$75 ea. Please call for others not listed. 405-634-1535.

ATTN. DEALERS: Are you a current dealer or just getting started? Buy factory direct & save. New 125 channel volume control converter, 800MHz tuner. Also available non-volume converters. Call for lot pricing. A & S Wholesale, 1-800-370-0801.

COMPUTER PARTS

www.lapazusa.com

MEMORY UPGRADES

1Mx9-70 SIMM	\$10
4Mx9-70 SIMM	\$19
1Mx32/36-70 72-pin SIMM (4MB)	\$10/15
2Mx32/36-70 72-pin SIMM (8MB)	\$19/25
4Mx32/36-70 72-pin SIMM (16MB)	\$35/49
8Mx32/36-70 72-pin SIMM (32MB)	\$65/80
64M(8x64) SDRAM /PC100 DIMM \$75/78	

VIDEO

1MB KIT (2-256x16) 2CAS SOJ/ZIP...	\$18/35
1MB KIT (2-256x16) 2WE SOJ/ZIP...	\$19/36

CACHE

64Kx1-15ns 22-DIP	\$5.50
32Kx8-25/20/15ns 28-DIP	\$3/2/2.50
64Kx8-15ns 32-DIP	\$6
128Kx8-15/20ns 32-DIP narrow	\$12 & up
128Kx8-15/20ns 32-DIP wide	\$12 & up

CPU

INTEL 486DX2-66 (5v) CPU	\$25
INTEL 486DX4-100 (5v kit) CPU	\$55
INTEL PENTIUM 83MHz OVERDRIVE	\$75
INTEL PENTIUM 133/166 CPU	\$45/50

MISC.

LBA CARD. Upgrade your hard drive beyond 540MB without the expense of a new Bios.	\$29.95
486DX4 KIT. Upgrade your old 5V 486 CPU with this kit: AMD DX4-100 CPU+5v Adaptor+CPU Fan.	\$85.00
MMX ADAPTOR. Allows 3v Pentium boards to accept MMX CPU. Adaptor for intel or Cyrex CPU.	\$30.00
PENTIUM MOTHERBOARD/SYSTEMS SPECIALS	
Pentium MB 133MHz Intel, 512K, 32MB RAM.	\$195.00
Pentium II - Intel Celeron 300A, ATX MB, 1.44 FDD, 2GB HD, 8MB Video, 56K Fax Modem, 30X CD ROM, Mid tower ATX case. Best value! \$595.00	
1-YEAR WARRANTY ON PARTS & LABOR	

PACKARD BELL

486 to Pentium motherboards

PRICES SUBJECT TO CHANGE WITHOUT NOTICE -- TERMS:
VISA/MC -- MINIMUM ORDER \$20 -- SHIPPING & HANDLING: \$7 MIN.
ORDER LINE: (800) 588-4199

LA PAZ ELECTRONICS INT'L
P.O. BOX 261095, San Diego CA 92196
TEL (619) 586-7610 FAX (619) 586-1482
e-mail: lapazusa@pobox.com

Write in 56 on Reader Service Card.

CABLE TV(MMDS) CONVERTER

Our converters are designed for your specific need

85 Ch Plain Converter, Ch-3, AFT/MFT
PG Lock, HRC/STD and Sleep Timer
Price: between \$29 - \$49

99 Ch Plain Converter, Ch-3, AFT/MFT
PG Lock, HRC/STD and Sleep Timer
Price: between \$49 - \$69

125 Ch Volume Converter, Ch-3/4 out
ACW/MFT, PG Lock, HRC/STD and Sleep Timer
Price: between \$59 - \$89

FREE BROCHURE
CALL (310)515-5085 or
FAX 1-800-579-5000

PCW Company

UNBELIEVABLE PRICES. We carry a full line of cable tools and equipment for all your cable needs. Also a wide variety of electronic parts & accessories, tools, diagrams, converters, step-by-step instructions, no raw parts, **full technical support.** 12pm-7:30pm EST 1-800-562-8442.

CABLE CONVERTERS. Original equipment with remote. Like new, ready to go. Lowest prices guaranteed. Limited models. Novicor Electronics, 412-833-0773.

ZENITH UNMODIFIED converters. ST 1000-288, \$16 ea. 10 lot min., ST 1086, \$25 ea. 10 lot min., ST 1600, \$59.95 ea. 10 lot min. Call 706-657-4445.

CABLE DESCRAMBLER plans!!! Plus two free bonuses: radar jammer plans & cable manual, \$14. 1-888-367-9972.

TOCOM UNMODIFIED 5503 cable converters, untouched, \$6 ea. 10 lot min. Call 706-657-4445.

BRAND NEW basic converters, 550MHz w/remote, \$19.95 ea. 10 lot min. Call 706-657-4445.

UNMODIFIED CABLE converters. SA 8590, \$39.95 ea. 10 lot min. Call 706-657-4445.

Subscribe to Nuts & Volts!
Call 1-800-783-4624

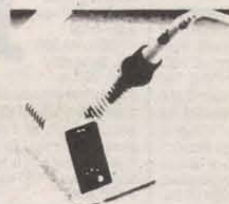
FOR THE BEST PRICES ON PROFESSIONAL TOOLS, CALL ELECTRO-TOOL



platt - Case - Deluxe Polypropylene. Chemical Resistant. Tools by CooperTools and others. 800T Case, complete with tools ... \$419.95
800T Case Only ... \$121.80

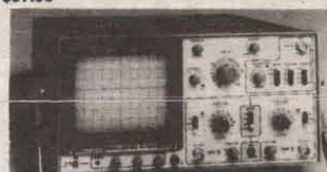


platt - Case - Cordura Exterior. Two exterior pockets & one literature pocket. 660ZT Case, complete with tools ... \$223.00
660ZT Case Only ... \$59.45
Optional Sperry meter #DM6510 as shown ... \$65.00



Weller WCC100 - Electronically controlled station, temperature adjustable from 350°F-850°F. Zero voltage circuit-safe for sensitive components, 40 Watt pencil ... \$97.90

OptiVISOR - Superior magnification, Optical Glass Prismatic lenses (not plastic). Select any one of (6) magnifications ... \$24.00



GoldStar - 20 MHz Dual Trace Oscilloscope OS-9020A-Large 6" rectangular, high sensitivity: 1mV/div, high accuracy: ±3%, stable, low-drift design, 8 divisions of displayed dynamic range and accurate, distortion-free waveform measurements ... \$372.00

Electro Tool, Inc.

9103 Gillman, Livonia, MI 48150
Customer Service: (734) 422-1221
ORDERS ONLY: 1 (800) 772-3455
FAX: (734) 422-3432

"Tools American Made."



TELEPHONE/FAX

PHONE SYSTEMS WANTED!!! We buy AT&T MERLIN, SYSTEM 25/75/85 and other AT&T phone systems. Please call for a quote or fax us your equipment list. **KEYWAYS, INC.**, 937-847-2300 or FAX 937-847-2350.

WHAT! YOU don't have TELECODE's 1999 24 page "HACKER CATALOG?" 520-726-2833. It's free this month! Surf Telecode's Hackers Catalog on-line at: <http://www.hackerscatalog.com>

C and H SALES COMPANY

2176 E. Colorado Blvd. • Pasadena, CA 91107

TOLL FREE:
1-800-325-9465

C & H SALES COMPANY HAS BEEN IN BUSINESS FOR OVER FIFTY YEARS.
WE'RE THE BEST SOURCE FOR GREAT BUYS ON ITEMS LIKE THESE - AND MORE!

ELECTRONIC COUNTER

HEWLETT PACKARD, Model 5328A. Universal counter. Usable to 100 MHz, 100 ns single shot resolution. Has frequency, period, period average, ratio, totalize, scale functions. A built-in digital voltmeter allows measurements of input voltages. Two input channels provide individual slope, polarity and level settings. Has 9 digit LED readout. Input power 100-240 VAC 48-66 Hz 100 VA max. Dimensions: 17" wide x 17-1/4" deep x 3-1/2" high.

Stock #TE9808

\$250.00



MILLIOMETER

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



ALTIMETER/BAROMETER

KOLLSMAN, #MC-2 MS28074-2. Scale type altimeter with barometric setting scale window. Altimeter scale range -1000 to 80,000 feet. Barometric range 28.1 to 31.0 inch of mercury. An adjustment knob is provided for scale setting to local altitude or barometric pressure. Has white numerals on a black background. Illumination is provided. Electrical input is rated 115 VAC 400 cycles. Pressure input port is female 7/16"x20 thread. Standard aircraft panel 3-1/8" mount. Dimensions: 2-17/64" sq. x 7-1/2" deep.

Stock #STOCK #IN9900

\$79.50



☒ Master Charge ☒ Visa ☒ American Express ☒ Discover

Call us first if you have surplus inventories of electronic, optical, or mechanical items for disposal

WE BUY & SELL!

Write in 57 on Reader Service Card.



CELLULAR CLONING COLLECTION. 1999 CELLULAR CLONING INFO BIBLE \$22, 1999 CELLULAR CLONING SOFTWARE COLLECTION \$33, 1999 CELLULAR SECRETS & PROGRAMMING MANUAL \$11. ALL 3 FOR \$44, WOW!! (SAVE \$22). FOR EDUCATIONAL/TECHNICIAN TESTING USE ONLY. (VISA/MC/AMEX/COD). OPEN 24 HOURS! 352-429-5496. BRINKER ENGINEERING LABS, USA.

12 HOUR fully automatic heavy duty professional **TELEPHONE RECORDER**, \$79 including shipping. Send check or money order to: **VAKIS**, 1402 Pine Ave., Niagara Falls, NY 14301.

COMPONENTS

SEE OUR ad on 4-channel 2.4GHz wireless system in the AdMart section on page 73. Matco, Inc.

RF TRANSISTORS, TUBES, SD1446, MRF455, MRF454, 2SC2290, 2SC1969, 2SC2166, 2SB754, TA7222AP, 2SC1947, TIP42C, KIA7217, MRF422, MRF448, MRF247, MRF317, SAV7, SAV17, 3-500ZG, 4CX250B, 572B, 3CX400A7/8874, 3CX3000A7, 4CX400A, silver mica caps, resistors, electrolytics, etc. Westgate 1-800-213-4563.

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



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

REFILL INKS FOR INKJET PRINTERS

Refill your old cartridge and save. All refill kits come with instructions and needed materials for refilling inkjet cartridges. Success guaranteed. Available for the following:

CANON BC-01, BC-02 CANON BJ10e, APPLE STYLEWRITER, BJ-200 Single Black Refill \$8.00, Triple Refill \$19.00. **CANON BJC-600 (BC-201)** Single Black or Single Colors (3 refills) \$8.00. **CANON BJ-130/300/330 & IBM Exec Jet (Cart #BJL481 & BJL442)** Black - 3-bottle kit \$22.00. **CANON BJC-210/240 (BC-05 Cart)** 3-color kit (3 refills each color for BC-05) \$24.00. **CANON BJC-4000** and **Apple Stylewriter 2400** Black 3-bottle kit (3 refills BC-20, 9 refills BC-21 black, 30 refills BC-11 black, 10 refills BC-10) \$19.00. **CANON BJC-4000/BJC70** and **Apple Stylewriter 2400** Tri-color kit - 6 refills each color for BC-21 or 15 refills each color for BC-11 \$24.00. **CANON BJC-800/820/880** 3-bottle kit (for BJL-643B) \$19.00. **CANON BJC-800/820/880** 3-bottle tri-color kit (Cart #BJL-643CMY) \$24.00. **EPSON STYLUS COLOR PRINTER** - (Cart S020034) Single Triple black \$19.00, Tri-color kit (Cart S020036) 2 refills each color \$24.00. **EPSON STYLUS COLOR II** - (S020047) Triple Black \$19.00 (S020049) Tri-color (2 refills each color) \$24.00. **EPSON STYLUS COLOR 400, 500, & 600** (S020093) Triple black (7 refills total) \$19.00. **EPSON STYLUS COLOR 200, 500** (S020097) Tri-color 3 refills each color \$24.00. **EPSON STYLUS COLOR 400, 600, 800, 1520** Tri-color (S020089) 3 refills each color \$24.00. **EPSON STYLUS 800/1000** (S020025) 3-refill kit, black, \$19.00. **HP DESKJET 500/550/560** (51608A, 51633A, 51626A) Black single refills \$8.00. **HP DESKJET 500/550/560** Black 3-bottle kit \$19.00. **HP DESKJET 500C/550C/560C** - Tri-color kit (5 refills each color) \$24.00. **HP DESKJET 1200C, DESIGNJET 650** (Cart #HP 51640B) Black Three pack (3 refills) \$19.00. **HP DESKJET 1200C/1600C, DESIGNJET 650** (Cart #HP 51640 C,M,Y). Tri-color kit (one refill each color) \$24.00. **HP DESKJET 600/660** (HP 51629A) Black three pack \$19.00. **HP DESKJET 600C/660C** (HP 51649A) Tri-color (5 refills each color) \$24.00. **HP DESKJET 855C/1600C** (HP 51645A) Black three pack \$19.00. **HP DESKJET 855C** (HP 51641A) Tri-color kit (2 refills each color) \$24.00. **HP DESKJET 720, 722, 890, OFFICE JET 1170 & 1175** (C1823A) Tri-color kit (2 refills each color) \$24.00. **HP PAINTJET and PAINTJET XL** (51606A) Black 3-bottle kit \$19.00. **HP PAINTJET and PAINTJET XL** (51606C) Tri-color kit \$24.00. **HP PAINTJET XL300** (C1645A & C1656A) Black 3-refill kit \$19.00. **HP PAINTJET XL300** Tri-color kit (1 refill each color) HP 51639C,M,Y \$24.00. **HP THINKJET, QUIETJET, KODAK DICONIX 150** (51604A or 92261A) black 5 refills \$9.00. **IBM/Lexmark/ExecJet/4076** (1380620) black 3-refill kit \$19.00. **IBM/Lexmark ExecJet IIC, WinWriter 150 C** (Cart #1380619) 4 refills each color \$24.00. **SNAP AND FILL SYSTEM** - Permits refilling HP 51626A (black for HP 500-series) and HP 51629A (black for HP 600-series) cartridges without making a hole in the cartridge. Consists of special cartridge holder, syringe, plastic tubing, and directions. **STARTER KIT** - with ink for 3 refills \$28.00. **EXTRA INK FOR SNAP & FILL SYSTEM** (black only) 4-oz. bottle \$18.00, 8-oz. bottle \$34.00. Specify whether for HP 51626A or HP 51629A.



HARD-TO-GET PRINTER RIBBONS

Gorilla Banana, Commodore 1525 \$8.00; Adam Coleco \$12.00; TI-850/855 \$6.00; Centronics 700 Zip Pack \$5.00; C. Itoh Prowriter Jr., Riteman C+/F+ \$6.00; Riteman Infomunner \$8.00; Commodore MPS-801 \$5.00; MPS-803 \$7.00; Decwriter LA30/36 \$4.00; Apple Scribe \$4.00; Mannisman Tally Spirit 80, Commodore 1526 \$5.00; Epson JX-80 4-Color \$14.00. Printronix P-1013 \$11.00; Star SJ144 color 3-pack \$29.00.

ALSO HEAT & TRANSFER RIBBONS AND PAPER FOR PRINTING T-SHIRTS.

Over 300 different ribbons in stock. All ribbons new, not re-inked. Fully guaranteed.

Order directly or send SASE for complete list.

Add \$4.00 per order shipping. California residents add 7.75% sales tax.

On ribbon orders over \$50.00 deduct 10% discount.

H.T. ORR Computer Supplies

249 Juanita Way, Placentia, CA 92870-2216

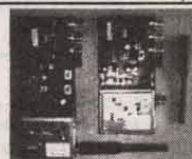
714-528-9822 • 800-377-2023 • FAX 714-993-6216

<http://www.extremeplay.com/occomp/orr.htm>

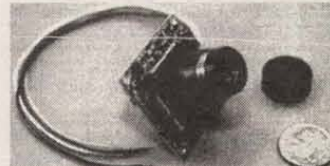
Write in 58 on Reader Service Card.

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

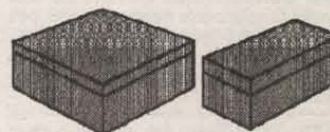
RESISTOR SACRIFICE: 10,000 quarter-watt metal and carbon film. One, two, and five %. 1 ohm to 10 megohms. **FIFTY** each of **TWO HUNDRED** different values. \$45 (less than one-half cent each). Hyatt Surplus, 371 N. Johnson Ave., El Cajon, CA 92020. Tel: 619-444-2434 fax: 619-444-1987.



2.4 GHz/1.2 GHz VIDEO TRANSMITTER & RECEIVER designed exclusively for HAM ATV bands. 8 switchable frequencies; F/SMA type connectors with two 1/4 wave rubber-duck antennas included; 100 mw output power. Receiver has greater than -80 dB sensitivity. Price \$119. Related camera, video, and security systems also available. Two additional audio channels can be used for digital data applications. Due to high response, please contact by E-Mail: info@4atv.com Website: www.4atv.com



B/W 430 LINE CCD CAMERA with optional black low-profile swivel adjustable enclosure. Pin hole or Std. lens type. 6, 8, and 12mm lens are available. 1/3" CCD, 3.6mm/F2.0 lens included; 9-14 VDC, 0.08 lux, IR sensitive; 1.27" x 1.27" x 0.5"D pinhole or 1" deep standard. Price @ 10 pcs., \$44 each. Enclosure: \$8; optional lens: \$18. Dealers welcome. **MATCO, Inc.** 1-800-719-9605. Fax 847-619-0852. E-Mail: sales@mat-co.com Website: www.mat-co.com



POCKET MINI-BOXES: Small plastic boxes. High quality, LOW COST! Low as \$0.49. Attention manufacturers! Great for products! 805-339-0702. www.ElectronicsUSA.com

Continued on page 58

In this article, we will configure, connect, adjust, and test the three-axis chopper driver built in last month's article.

turned on. As the computer boots, solid-state relays, if installed, may inadvertently activate spindle motors or stepper motors may move the mechanism in an uncontrolled manner. Read the cautions in the DANCAM document file before use.

Configuring the Software

1. Make sure the Vref voltage was adjusted as described in the previous article.
2. Connect a DB25 male to DB25 female cable with all pins wired straight through between the DOS-based computer and the controller's DB25 connectors.
3. Connect the 5V and 12VDC leads to the

by Dan Mauch

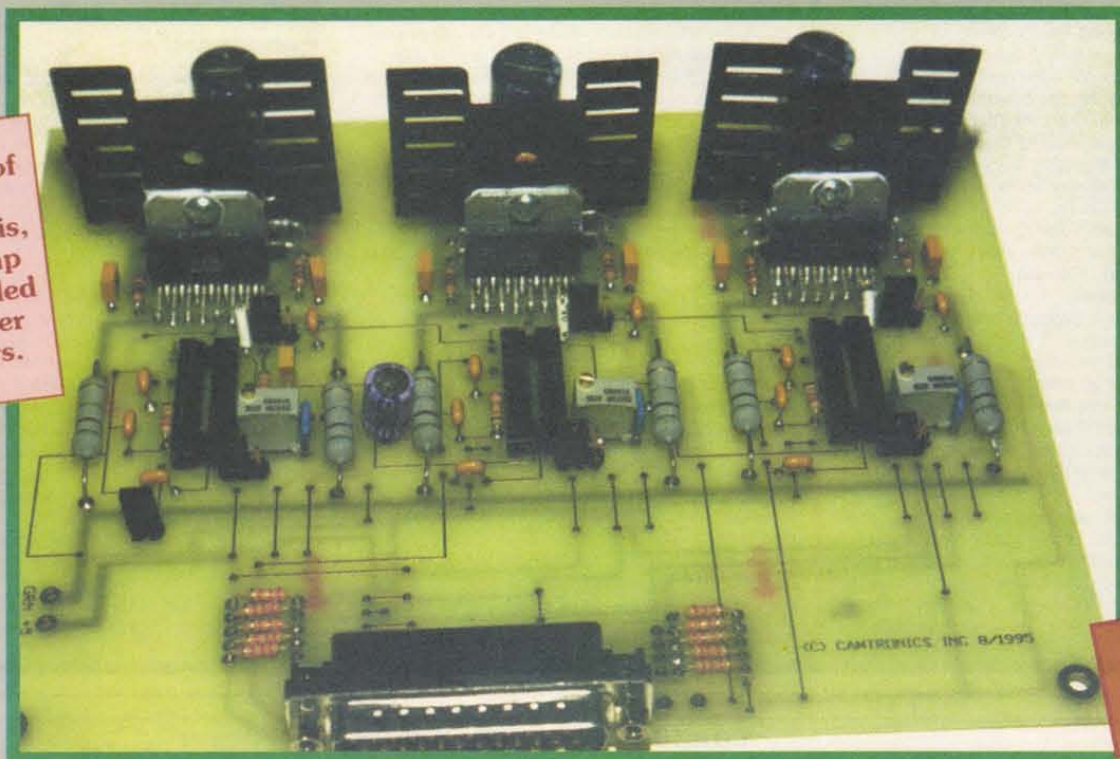
and install commands."

11. A new menu will pop up. With the parallel port cable connected to the three-axis controller, and three stepper motors connected to the controller, and 12VDC power supplied to the controller, press 1.

12. An installation instruction will ask what motor axis to test (X, Y, or Z). Select X. Then press Enter.

13. Another instruction will pop up and will request the PULSE WIDTH FACTOR. A table is provided on screen to give help. The default is 600. When you press ENTER, the X axis stepper

Picture of the three-axis, two-amp assembled chopper drivers.



Part
3

Three-Axis Chopper, Step Motor Controller for Computer Numerical Control (CNC) Applications

For testing, we will use Dancam, a shareware program available on the Internet at various sites. You can download it at www.metal-working.com in the shareware file area. We will use this program only to checkout the controller. In the next article, we will use a G code interpreter program called DeskNC. DeskNC will be used for all G code tool paths files, but Dancam does have some good applications and is available free for the downloading.

Cautions

Since the controller does not use optoisolators on the inputs, there is a remote possibility that something could go wrong and cause damage to your parallel port or computer. The purpose of the warning is that the author cannot control how each reader will build, connect, or use their controller thus, this possibility should be considered before connecting your computer.

Never connect or disconnect a stepper motor cable with Vm power on. It will cause an inductive spike that may damage the L298 driver chips. **Never probe connections with power on.** You may short out the L298 and burn out an H-bridge.

Never boot up a computer with the controller connected to the power supply that is

proper terminals for the X-Y-Z-axis. Use the pictorial for correct connections of the motor and logic sections of the controller. Do not use the power supply in your computer. Use a separate power supply. Remove the jumper from J-7 (All Windings Off) if installed.

4. Load the Dancam.exe program. (Use the DOS mode of your PC if you have Windows.)

5. From the main menu, select #4 and hit Enter. The program will ask: "Change the Dancam.cfg configuration file to adjust how the motors move."

6. Next, from the Installation menu, select #1. A new menu will pop up.

7. From the parallel port menu enter the motor drive board type. The default is "0." Press Enter.

8. On this same menu after the "0" is typed, it will ask you to enter the parallel port to use. Normally, you would enter LPT1. If the controller board doesn't work with this setting, you have the wrong port address. You may have to buy a \$20.00 parallel port board configured to run on hex address 378. LPT2 or LPT3 may be used if supported by your hardware.

9. Enter the number of pulses per motor request. This is always 1. Press Enter.

10. The main installation menu will now appear. Select #2. "Motor pulse width factor test

motor will run forward and backward. If the motor seems weak or just chatters, press S to slow it down until it runs strongly (about 1900 pwf on a 386-25). If it is slow but strong, then try speeding it up by pressing the F button on the keyboard. Press Control X when satisfied.

14. If you get a "SERVO MOTOR ERROR," or "LIMIT SWITCH IS OPEN" message, make sure that the out-of-range switch is in the correct position or jumper the yellow and white wires at the connector.

15. Set the PULSE WIDTH FACTOR for the Y and Z-axis similarly.

16. Press the Escape key until you are back at the main menu. The program will record the current configuration every time it goes to the main menu. If you make any temporary changes, make sure you change the values back to the original. Better yet, make a copy of the DANCAM.CFG file and store it separately for use if the installed copy is corrupted.

17. A tool path data file is included in the Dancam archive files downloaded from www.metal-working.com. At the main menu, enter 1 to select a Dancam file to be read. A new screen will pop up. Enter the path and file name. The program will try to home up the motors if the home setup menu was set to ON. If you don't have home switches, go back and shut the feature OFF for

now. Rerun the test tool path file and you should see the three motors moving to the instructions of the data file.

18. Always shut off the controller when not in operation.

19. Read the DANPLOT.DOC file in the DANCAM ZIP files for many other features and a detailed explanation of other uses for Dancam/Danplot program. Be sure to read the safety warnings and conditions for use of the program. Once you get up and operating, you will find that Dancam is a superb program.

Troubleshooting

If the motors don't run properly, here are some procedures for locating the problem.

1. Load Dancam onto the computer you intend to use for running the controller. Run Dancam in the "Move Motor Manually" mode without a stepper connected to the defective axis. Connect a voltmeter to phase A-a leads of the controller axis motor connector to be tested.

2. A voltage of 12VDC \pm 2V should be observed on the meter. Pulse the appropriate direction arrow one pulse at a time. After several pulses, it will change from +12 volts to a -12VDC. Check phase B-b similarly. If no voltage is present, check that the power is properly connected and, with the power off, check all solder joints and connections of the L298 and diodes. Correct as needed. If there is voltage on one phase but not on the other, a short circuit may have occurred and burnt out the L298. Replace if bad. A poor solder joint on the two-watt Rs sense resistors or the L298 leads can also cause improper voltages to be read at the motor connector.

3. DANCAM will give an error if the OUT OF RANGE switch is open or not connected. If this feature is not to be used at this time, then it will be necessary to jumper the yellow and white wires on the range limit switch connector. The error message provided by DANCAM will now disappear.

Suggestions

MONITOR the temperature of the L298 H-Bridge while testing the three-axis controller. With various stepper motors, the temperature of the L298 will vary. The L298s will run cooler while the motor is running than stopped. It is imperative that you monitor the temperature of the L298s while the motor is stopped using a low cost digital thermometer. They sell for about \$15.00 in an electronic supply store. Keep the L298 with heatsink below 125F. Always use a cooling fan. Make sure on higher amperage motors that you use a good fan across the heatsinks of the L298. Be sure to use a larger heatsink if you are running the L298 at the full two amps rating.

If the temperature exceeds 125F, then you must reduce the current to a level below that value. You'll be amazed that the motor will perform nearly as well at 1.5A as it does with two amps, but you may see a temperature drop of 15F. Alternatively, you can reduce the voltage motor supply voltage. The controller was designed to be used with a 12V computer power supply, but you can run it 18-24VDC. If the motor is designed to run on two amps, you will get excellent performance and higher speed using 24V at a current of 750mA.

Ground Noise

The three-axis controller was designed to run off a separate computer power supply. The logic ground and the motor ground are common. In applications where a higher Vm is required, this ground is not adequate. Thus, the X-axis will have more power than the Y or Z-axis. There is an easy solution. Solder a piece of 18 AWG (total of six) insulated wire from the ground side of each sense resistor (R4, R6, R18, R19, R10 and R11) to its motor supply ground connection (the black wire near the 470uF electrolytic capacitor). This will reduce/eliminate the noise causing false triggering of the sense lines and will allow you to use higher

Three-axis controller complete kit \$145.00

plus \$9.00 s/h

Three-axis PCB with plans \$25.00 plus \$4.00 s/h

DeskNC for DOS \$60.00 plus \$4.00 S/H

Send check or money orders to:

Camtronics, Inc
18230 130th Pl. N.E.
Bothell, WA 98011-3118

SOURCE

You may contact Dan Mauch at dmauch@seanet.com or visit his web page at www.seanet.com/~dmauch

voltage power supplies.

Y-Z Axis Lack of Power

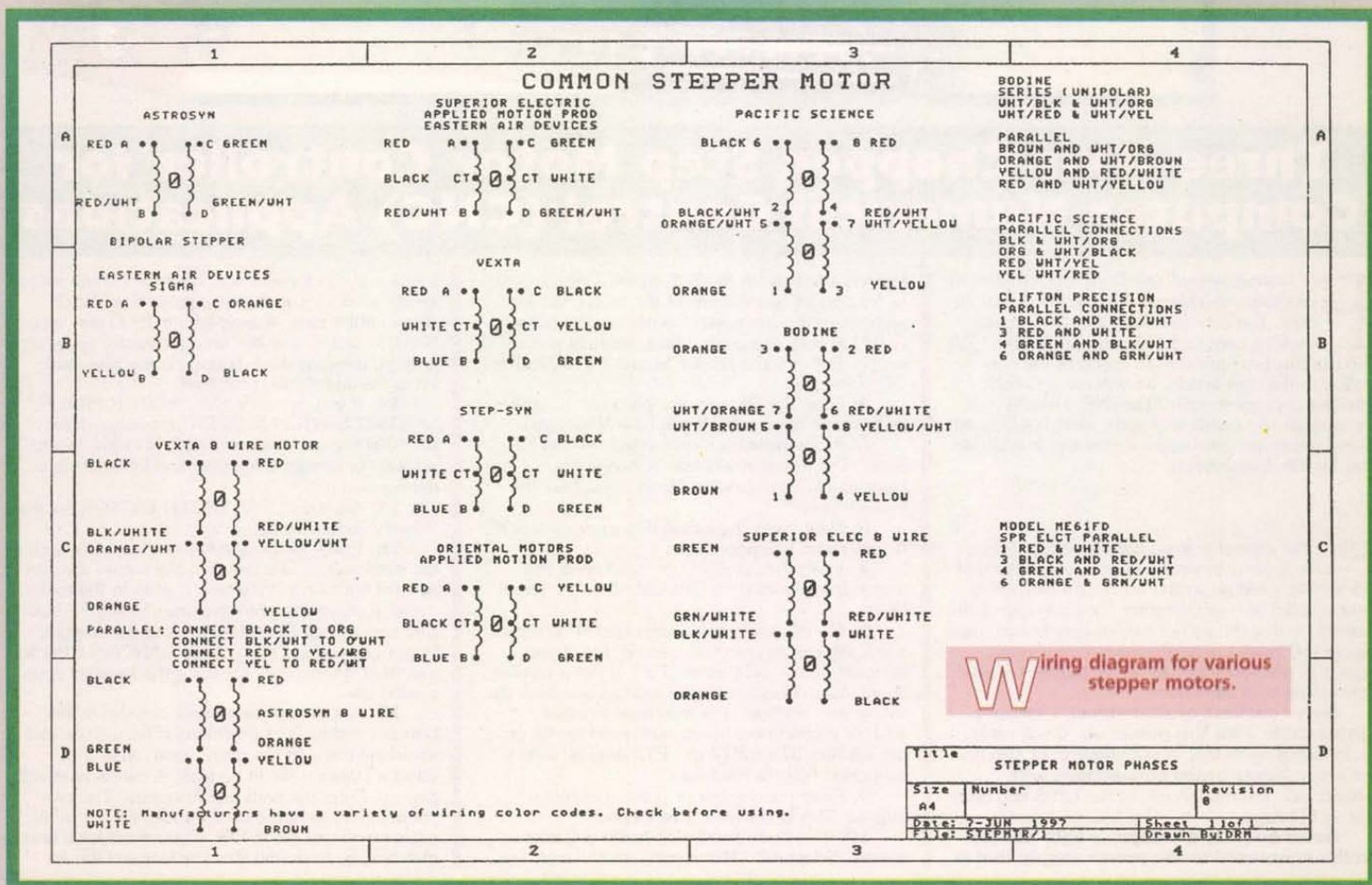
The lack of power on the Y and Z-axis, if noted, is attributed to one of three problems: a poor solder joint on the motor supply connections or a bad solder joint on the L298 to PC board. The last problem is that ground noise will cause the chopper to false trigger at a lower rating than planned. Correct by adding additional ground wires as described in the above paragraph.

Stepper Motors

Aschematic of many surplus stepper motors that I have seen in the past — and figured out what color wire did what — has been included in this article. Notice the extra black dot near the motor connection for some of the phases. These indicate the correct phasing for the stepper motor. Be aware that manufacturers of stepper motors often change the colors of wires for special orders. Use the schematic as a guide and always check before connecting to a controller.

Here are some general observations of stepper motors that I have made over the years:

* Low inductance stepper motors (<3 ohms per phase) ran faster on the same voltage power



supplies than high inductance stepper motors.

* A four-wire stepper motor of the same voltage and current rating will run faster than a six-wire motor used in the bipolar series configuration.

* The higher the motor power supply voltage, the faster the motor will run at higher pulse rates. Doubling the motor supply voltage will increase the maximum speed by about 50%.

* The higher the inductance rating of the motor, the slower its maximum speed will be with a given power supply. For example, a five-volt,

one-amp stepper motor will not run as fast as a one-volt, five-amp motor.

* A six-wire unipolar stepper motor connected in the bipolar series configuration will have more power at low speeds, but will have less power at high speeds.

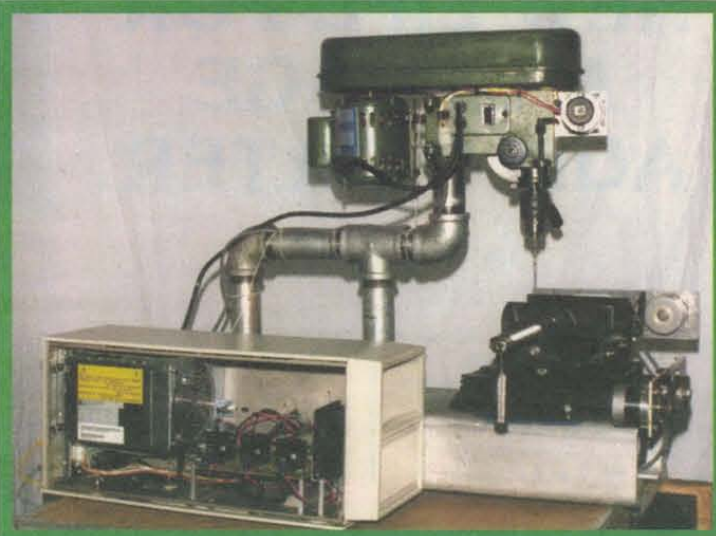
* A stepper motor only requires 75%-80% of the rated current. Stepper motors only draw full current when they are stopped or running very slowly. As the pulse rate increases, the coils can't charge fast enough therefore, they don't draw as

much current as when they are stopped. I often use a three-amp motor on my two-amp drivers with good results.

The next article will describe how to convert a low-cost desktop milling machine to CNC using the controller that was built in the last article. Until then, enjoy your three-axis controller. **NV**



Here is another three-axis chopper driver mounted in an old computer power supply case. This CNC controller runs a modified X-Y table used for routing/engraving. The power head is a 1/4hp 25,000 RPM ball bearing die grinder.



Picture of one of my first CNC projects that modified a low-cost bench drill press to CNC using the three-axis, two-amp drivers mounted in a surplus disk drive case. Notice the dual action of the fans for cooling.



You Win with Nuts & Volts

Subscribe today and be
automatically entered in our
new MONTHLY PRIZE
DRAWING!!!

May Prize Winners:
Carlos Negron
of Brooklyn, NY
Randy Jeseritz
of Granite Falls, MN

JULY DRAWING HOSTED BY
**ROGER'S SYSTEMS
SPECIALIST** (see page 37)

PLUSTEK OPTIC PRO 9630
SCANNER - \$169 VALUE

SPECIAL BONUS:
NETCOM (page 15)
WILL FURNISH PRIZES
MONTHLY!!

Contributors ...

Parallax (back cover) • **Corporate Systems Center**
(pages 2, 99) • **HSC** (page 3) • **Resources Unlimited**
(page 19) • **Timeline, Inc.** (page 81, May issue) • **Alltronics**
(page 29) • **Electro Mavin** (page 44) • **All Electronics**
(page 64) • **Roger's Systems Specialist** (page 37)
• **Electronic Goldmine** (page 42) • **MCM Electronics**
(page 31, June Issue) • **Velleman** (page 40, June Issue)

Check us out on the web!
<http://www.nutsvolts.com>

If you do not wish to order a subscription, but would like to be entered in our drawing, simply **send or E-Mail** your name, address, and telephone number, to NUTS & VOLTS, 430 Princeland Court, Corona, CA 91719, drawing@nutsvolts.com. No phone entries accepted. All orders/entries must be received by the last day of the month to be included in that particular month's drawing.

As a current, paid subscriber, you will be automatically entered each month in our drawing.

To Subscribe - Just fill in and mail the enclosed subscription card or call our toll free order line at **(800) 783-4624** with a Visa or MasterCard.

NOSTALGIA PROJECT

NEW LIFE FOR A VINTAGE AUDIO FILTER

by Ron Tipton



The converted filter dissipates much less heat, is lighter in weight and should be good for another 40 years service! Besides that, I think you'll find the conversion very easy.

Not long ago, I was in a local surplus electronics shop and I came across several Spencer-Kennedy model 302 tunable audio filters at a giveaway price. The model 302 has two independent filter sections, and either section can be used

as a lowpass or highpass. Both sections are continuously and independently tunable from 20 Hz to 200 kHz. By cascading the sections, you can either increase the lowpass or highpass roll-off rate or get a bandpass response.

These were manufactured during the 1950s and 60s and, of course, they use vacuum tubes. I have a copy of the original Operation and Maintenance Manual, so I quickly determined that two of the triode stages in each filter section were amplifiers and the other eight were cathode followers. This instrument would be ideal to "redesign" using integrated circuit opamps. I went back to the shop, bought two of them and got to work on the conversion.

A triode amplifier has a very high input impedance and a moderately high plate output impedance. The cathode followers also have a very high input impedance, an output impedance of about 300 ohms, and a voltage gain of about +0.9. Contrast this with modern high-gain opamps and you see how satisfying it is to have nearly "ideal" circuit building blocks!

For example, the LM310 voltage followers I used in this conversion have

a minimum voltage gain of +999 and a minimum input resistance of 10,000 megohms.

Three of the stages in each filter are simple RC (resistance-capacitance) filters in cascade with cathode followers (now IC voltage followers) to isolate each one from the next in line. The fourth stage is an RC "T" in a feedback amplifier, and this circuit took most of the redesign effort; I'll have more to say about this in the next section. All the frequency determining components — the Rs and Cs — were used intact; the redesign was in replacing the vacuum tubes.

The final PC board for each filter measures 1.5 by 8 inches, and consumes less than two watts. This is about the same amount of power used by just one tube heater in the original instrument. The converted filter dissipates much less heat, is lighter in weight and should be good for another 40 years service! Besides that, I think you'll find the conversion very easy.

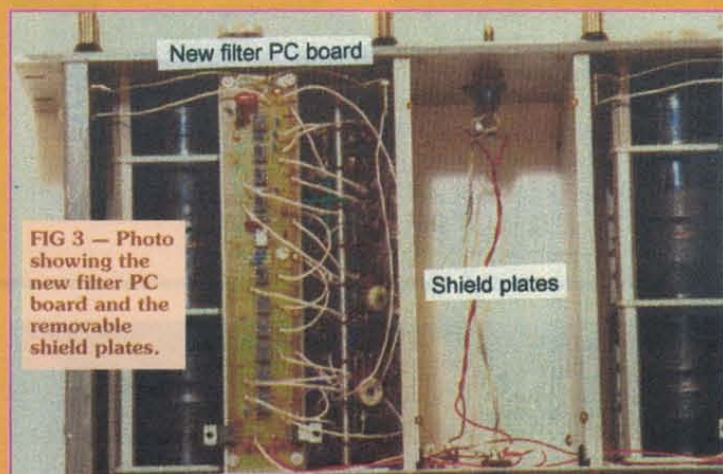


FIG 3 — Photo showing the new filter PC board and the removable shield plates.

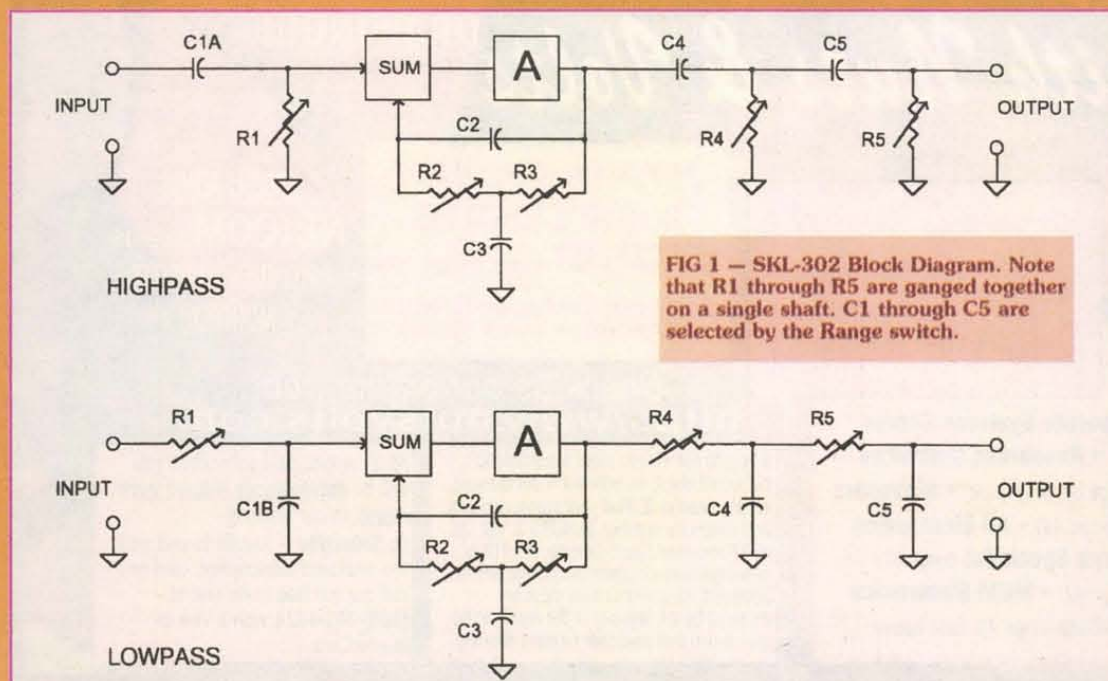


FIG 1 — SKL-302 Block Diagram. Note that R1 through R5 are ganged together on a single shaft. C1 through C5 are selected by the Range switch.

A BIT OF THEORY

Figure 1 shows the filter block diagram simplified by leaving out the input amplifier, the interstage voltage followers, and the output voltage follower. In lowpass mode, we have three passive sections (series Rs and shunt Cs) in series with the feedback amplifier section. In highpass mode, the passive sections become series Cs and shunt Rs but the feedback amplifier remains unchanged. We can see why this works by looking at its voltage transfer function. When normalized with respect to the cutoff frequency — f_0 — it is approximately:

$$\frac{e_{out}}{e_{in}} = \frac{\left[1 + j\sqrt{2}\frac{f}{f_0}\right] \left[1 + j\frac{f}{\sqrt{2}f_0}\right]}{\left[-\left(\frac{f}{f_0}\right)^2 + \frac{jf}{\sqrt{2}f_0} + 1\right]}$$

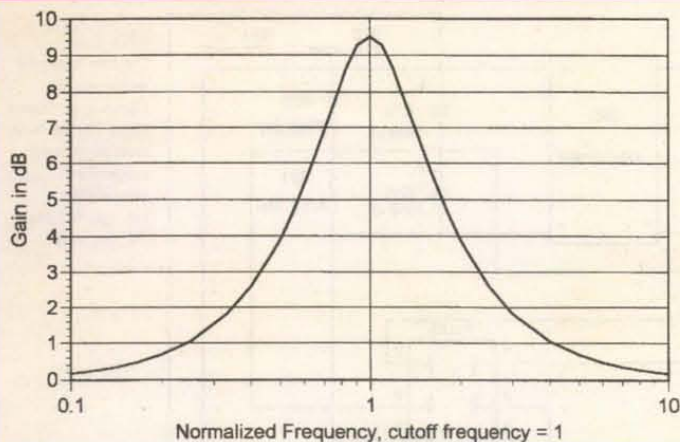


FIG 2 — Feedback amplifier response. Gain is 3 (about 9.5 dB) at cutoff frequency.

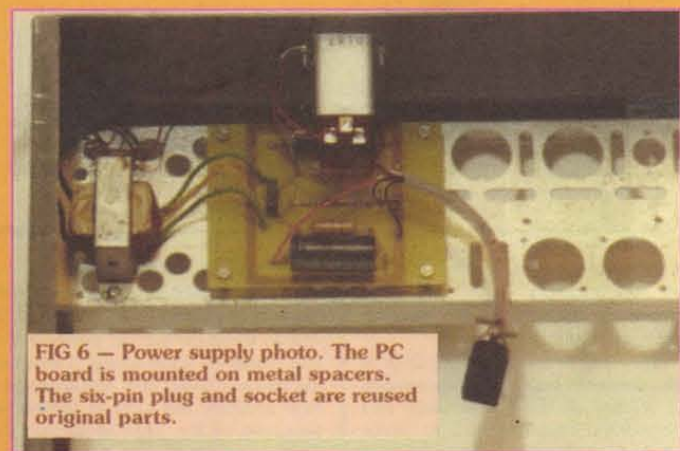


FIG 6 — Power supply photo. The PC board is mounted on metal spacers. The six-pin plug and socket are reused original parts.

Now, this looks a whole lot worse than it really is! By letting $f_0 = 1$, and then letting the f/f_0 ratio vary from 0.1 to 10, we get the curve shown in Figure 2. All the "j" operators drop out so the calculations can easily be done with paper and pencil or one of the many commercial or shareware math programs.

The curve in Figure 2 is very interesting because it's symmetrical about the cutoff frequency (when frequency is plotted on a logarithmic scale). This symmetry means that its response has the same effect in both the lowpass and highpass modes. This peaked gain at the filter's cutoff frequency flattens the passband and increases the attenuation slope past cutoff. Clever design!

R13 and R15 are adjusted for unity low frequency gain (in lowpass mode) and then R14 is adjusted for a gain of 3 (about 9.5 dB) at the cutoff frequency. One percent resistors are needed here and I laid out the PC board so two resistors can be used in series for each of these to make it easier to get the right value without a complete resistor stock.

I reused the original "V" (vacuum tube) numbers to identify the opamps. This made it easier to keep track of where I was when I was in the middle of the conversion.

V1A1 — one half of the LM6218 — is connected as a voltage follower. The input is capacitively coupled through C6 (1 uF) for good low frequency response. The LM6218 has a

low DC offset voltage (typically three millivolts), but the input bias current flows through input resistor R6. Since this current can be as large as 0.5 microampere, I set R6 to 100,000

Quality Used Test Equipment

90 DAY WARRANTY Parts & Labor - 10 DAY INSPECTION

HEWLETT PACKARD

11975A, 2-8GHz Amplifier	\$1750
214B, 10 MHz Pulse Generator, 200W Pulse/50 ohms	\$975
3325A-2, 21MHz Synth Func Gen, 40Vp-p, HPIB	\$1200
33320H, Prog Attn, DC-18GHz, 10dB range, 1dB steps	\$250
33322H, Prog Attn, DC-18GHz, 110dB range, 10dB steps	\$250
3403C, Digital RMS Voltmeter, 2 Hz-100 MHz	\$200
3421A-201/44462A, Data Acquisition Control Unit, HPIB	\$325
3455A, 6.5 digit Multimeter, HPIB	\$300
3456A, 6.5 digit Multimeter, HPIB, calibrated w/cert	\$450
3478A, 5.5 digit Multimeter	\$400
3488A, Switch/Control Unit	\$450
3852A, Data Acq/Control Unit	\$800
4274A, 5-1/2 digit LCR Meter, 100Hz-100KHz	\$2200
435A, Power Meter w/sensor cable	\$200
436A-02-022, Power Meter w/ sensor cable, HPIB	\$675
44462A/63A, 8 Chan MUX/2 Chan Actuator (3421A)	\$135
44702A, 13-Bit High-Speed Voltmeter (use w/3852A)	\$375
44711A, 24 Chan FET Multiplexer (use w/3852A)	\$175
44723A, 16-Chan Hi-Speed Sense/Control (use w/3852A)	\$200
44725A, 16-Chan General Purpose Switch (use w/3852A)	\$200
44728A, 8-Chan Relay Actuator	\$200
491C, Amplifier, 2 GHz-4GHz, 1 Watt, 30dB Gain	\$375
5183T, Digitizing O'Scope/Precision Waveform Recorder	\$1500
5316A, 100 MHz Counter, HPIB	\$225
5316B, 100MHz Counter, HPIB	\$275
5328A-011-021-030, 512 MHz Counter w/DVM, HPIB	\$275
5334A-060, 100 MHz Counter, front & rear input, HPIB	\$400
5334B, 100 MHz Counter, HPIB	\$500
5335A, 200 MHz Counter, HPIB	\$625
5335A, 200 MHz Counter, Oven Osc, HPIB	\$800
5342A, Microwave Counter, 18GHz	\$800
5342A, Microwave Counter, 18GHz, Oven Osc, HPIB	\$1100
6002A-01, Pwr Sup, 200 W, 0-50V @ 0-10A, HPIB	\$500
6034A, Dig Autoranging Pwr Sup, 60V/10A/200W, HPIB	\$700
6034A, Dig Autoranging Pwr Sup, 60V/10A/200W, HPIB	\$600
6110A (Harrison), Pwr Sup, 3KV @ 6mA	\$200
6236B, Tripple Pwr Sup, 0-6V @ 2.5A & (2) 0-20V @ 0.5A	\$275
6253A, Dual Pwr Sup, 0-20V @ 3A	\$275
6255A, Dual Pwr Sup, 0-40V @ 1.5A	\$350
6267B, Pwr Sup, 0-40V @ 10A	\$450
6268B, Pwr Sup, 0-40V @ 30A	\$600
6269B, Pwr Sup, 0-40V @ 50A	\$700
6284A, Pwr Sup, 0-20V @ 3A	\$100
6289A, Pwr Sup, 0-40V @ 1.5A	\$100
6294A, Pwr Sup, 0-60V @ 1A	\$100
6443B, Pwr Sup, 0-120V @ 2.5A (older blue color)	\$200
6515A, (Har), Pwr Sup, 0-1.6KV @ 5mA (cable kit incl)	\$200
69422A, Hi-Speed A/D Card (use w/6940B)	\$250
69501A, Resistance Programming Card (use w/6940B)	\$125
69602A, Timing/Pacer Card (use w/6940B)	\$150
7090A, Measurement Plotting System, HPIB	\$900
8160A, 50MHz Programmable Pulse Generator, HPIB	\$1800
8350B, Sweep Oscillator Mainframe	\$1800
8444A, Tracking Generator, 0.5-1300 MHz	\$400

8447A, RF Amp, 0.1-400MHz, 20dB gain, +6dBm out	\$325
85041A, Transistor Test Fixture Kit	\$1200
85131D, 3.5MM Test Port Cable Set (new) use on 8515A	\$800
8569B, Spectrum Analyzer, 0.01-22GHz	\$6800
8620C/86290A, Sweep Generator, 2-18GHz	\$1250
8660C/86632B/86603A, 2.6GHz Synth Sig Gen	\$2200
8717B-001-011, Transistor Bias Supply	\$500
8770A-K01, Sync Sys Interface (use w/8770A Arb Gen)	\$300
8903B-001, Audio Analyzer, 20 Hz-100 KHz, rear input	\$1800
9411B, Switch Controller, HPIB	\$675
E1407A, VXI A/B-C-Size Active Adapter	\$200

TEKTRONIX

013-series, 576/577 Curve Tracer Adaptor/Socket Set	\$300
1240-05/(4)D1's, Logic Analyzer w/ (2) P6460 probes	\$750
7A24, 400MHz Dual Trace Amplifier	\$225
AM503, Current Probe Amplifier	\$300
FG504, 400MHz Function Generator	\$350
P6133, 10X Probe, 150 MHz, use w/2400 series o'scopes	\$75
P6136, 10X Probe, 350 MHz, use w/2400 series o'scopes	\$100
P6452, Data Acquisition Probe (use w/DA50100)	\$150
P6460, Data Acquisition Probe (for 1240/1241 Analyzer)	\$150
PG502, 250 MHz Pulse Generator, use w/TM500 series	\$300
PS5010, Prog Tripple Pwr Sup, use w/TM5000 series	\$375
T922R, 15MHz O'Scope, Front & Rear Inputs	\$325
TDS460-1M, 350 MHz Digital O'Scope, 4-Channel, extra memory, includes 2 new P6138A probes & manuals	\$4800
TDS540A-1M, 500 MHz Digital O'Scope, 4-Channel, extra memory, includes 4 new P6139A probes & manuals	\$8200

MISCELLANEOUS

AstroMed ASC902, Medium Gain Amplifier Plug-in	\$100
Boonton 92BD, RF Millivoltmeter, 10KHz-1.2GHz	\$250
Cal Inst 850T-1, Oscillator Plug-in, 45Hz-10KHz	\$375
Dranetz 626, Line Disturbance Analyzer, w/PA-6002A, PA-6003, PA-6006, cables, and carrying case	\$500
EIP 545A-05-08, Microwave Counter, 10 Hz-18 GHz	\$700
Elgar 121B, AC Pwr Source, 0-130VAC @ 100W	\$350
EMI SCR150-5-OV, Pwr Sup, 0-150V @ 5A	\$350
Fluke 6010A, Synthesized Func Gen, 10Hz-11 MHz, GPIB	\$375
Fluke 8922A, Digital RMS Voltmeter, 2 Hz-11 MHz	\$400
Heise 711B, Digital Pressure Gauge, 0 to 30 PSI, .05%	\$350
Interface 553, Mil-Std-1553 Analyzer	\$1200
Keithley 614, Electrometer add \$130 for new 6011 probe	\$600
Kepec ATE150-3.5M, Pwr Sup, 0-150V @ 3.5A	\$300
Kepec BOP20-10M, Op Amp/Pwr Sup, +/-20V, +/-10A	\$300
MetOne Point-5, Particle Counter	\$400
Microdyne 1400-MR Telemetry Receiver w/Plug-ins	\$1200
Oram Power Supply, 0-270V @ 10A	\$475
PAR 128, Lock-in Amplifier, 0.5Hz-100KHz	\$475
RF Power Labs M102L, RF Amp, 30Hz-100MHz, 2W	\$450
Sorensen DCR20-115B, Pwr Sup, 0-20V @ 115A	\$600
Sorensen DCR60-45B, Pwr Sup, 0-60V @ 45A	\$650
Sorensen SRL40-25, Pwr Sup, 0-40V @ 25A	\$475
Wavetek 178, 50MHz Programmable Waveform Synth	\$900
Wavetek 271-02, 12MHz Pulse/Func Gen, GPIB	\$400



TEST EQUIPMENT PLUS

(520) 575-6967, FAX (520) 575-6936
3331 W. Bright Terrace, Tucson, AZ 85741



Write in 35 on Reader Service Card.

Miniature Transmitters and Receivers

2 Button / 3 Channel Transmitter

RF300T
1....\$22.95
5....\$19.95 ea
10....\$16.95 ea
RF300XT
1....\$25.95
5....\$22.95 ea
10....\$19.95 ea

- 300' (XT), 150' (T) Range
- Frequency: 318 MHz
- 59,049 Settable Security Codes
- 12 Volt Battery and Keychain Included
- Current Draw: 4.8 ma
- Fully Assembled in Case
- Dimensions: 1.25" x 2.0" x .5"
- Push both buttons for the 3rd Channel
- Slide Button Cover Included

- Alarm Systems
- Garage / Gate Openers
- Lighting Control

- Magic Props
- Medical Alert
- Monitoring Systems

- Industrial Controls
- Surveillance Control
- Motor Control

4 Button / 15 Channel Transmitter

RF304XT
1....\$27.95
5....\$24.95 ea
10....\$21.95 ea

- 250' Range
- Frequency: 318 MHz
- 6,561 Settable Security Codes
- 12 Volt Battery and Keychain Included
- Current Draw: 4.6 ma
- Fully Assembled in Case
- Dimensions: 1.35" x 2.25" x .5"
- Push combination of buttons to achieve up to 15 channels

2-4 Data / 3-15 Channel Receivers

RF300RL
RF300RM
1....\$27.95
5....\$24.95 ea
10....\$22.95 ea
RF304RL
RF304RM
1....\$29.95
5....\$26.95 ea
10....\$23.95 ea

- Compatible with 300/4 Transmitters
- 11-24 volts DC Operating Voltage
- 13 ma. Current Draw
- Latching (L) or Momentary (M) Output
- Kits Available (subtract \$5.00 ea.)
- Dimensions: 1.25" x 3.75" x .5"
- 2 (300) / 4 (304) Output Data Lines
- Binary to Dec / Hex Converter can achieve up to 15 channels

- Schematics Available
- Receiver Board Layout Available
- Custom Design Consulting Available

Visitect Inc.

(510) 651-1425 Fax: (510) 651-8454
P.O. Box 14156, Fremont, CA 94539

Email: Support@Visitect.Com
Visa / Mastercard, COD

Write in 34 on Reader Service Card.

ohms to minimize the offset from this source (100,000 ohms \times 0.5 microampere = 50 millivolts). In lowpass mode, the filter — including the output voltage follower — is DC coupled so all offsets appear at the output.

V1A2 — the other half of the LM6218 — is connected as an amplifier. It has unity gain except when the Range switch is set to HIGHPASS X10K. Then R11 (8250 ohms) is connected in series with R10 (10K ohms), increasing the gain to about 1.8 to make up for high frequency losses in the range switch and tuning potentiometer wiring. (This was done in the original circuit, too. The plate load resistor and cathode resistor were changed.)

Okay, enough theory. Let's get on with the conversion.

DISASSEMBLY

This first step is dismantling the unit and stripping out the unneeded parts. I'll pretty much walk you through this step-by-step as it's easier and less frustrating to do it right the first time. But before we start, I'm going to list the special tools you will need so take a look at Table 1.

First, remove the top and bottom cover plates by removing the six screws fastening the covers to the rear panel. The cover plates now slide out towards the rear — but they may not slide easily. The flanges on the side panels may be bent or dinged up enough to bind one or both covers. Work patiently and they will come out. A little bit of oil may help a lot.

Next, remove the four screws on each side panel that are closest to the front panel. The side panels, rear panel, and power supply are now free

from the front panel filter section. Disconnect the six-pin power plug and set the power supply assembly aside for now.

We'll work on the front panel filter section first, so remove and discard the tube shields and vacuum tubes. Remove and save the two shield plates identified in the photo in Figure 3. This will give you a bit more working room. Clip the power supply wires to each filter at the screw terminal block. Remove and save the two screws at each end of both vacuum tube subchassis and start to clip the wires connecting the subchassis to the long rotary switches.

Although most of the wires will be replaced anyway, try to clip close to

the subchassis as this seems to make wire identification easier later on. Remove and discard the wires from the input and output binding posts.

We need to reuse the 1-1/2 by 8 inch aluminum subchassis, so remove and discard all the components and tube sockets. They may be a bit grimy, so a good wash with soap, water, and a scrub brush may be in order.

You can remove and discard the power supply terminal block as we

won't reuse it. But the six-pin connector will be reused, so take your soldering iron and clean up its terminals, as well as those on the AC power switch and power-on lamp socket. I removed the bayonet-based bulb and soldered a high intensity red LED to the socket terminals so the LED sticks into the front panel jewel.

Using a couple of wooden blocks or such to clear the six-pin connector, position the filter section on your

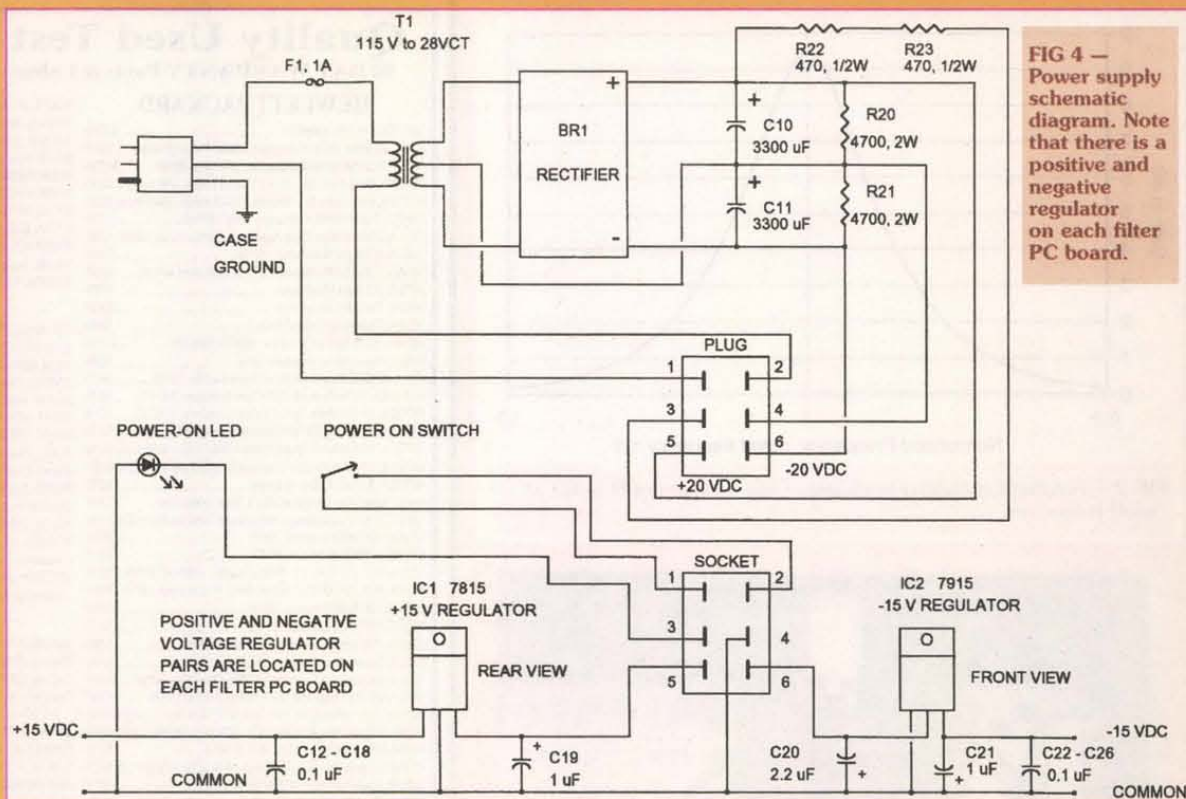


FIG 4 — Power supply schematic diagram. Note that there is a positive and negative regulator on each filter PC board.

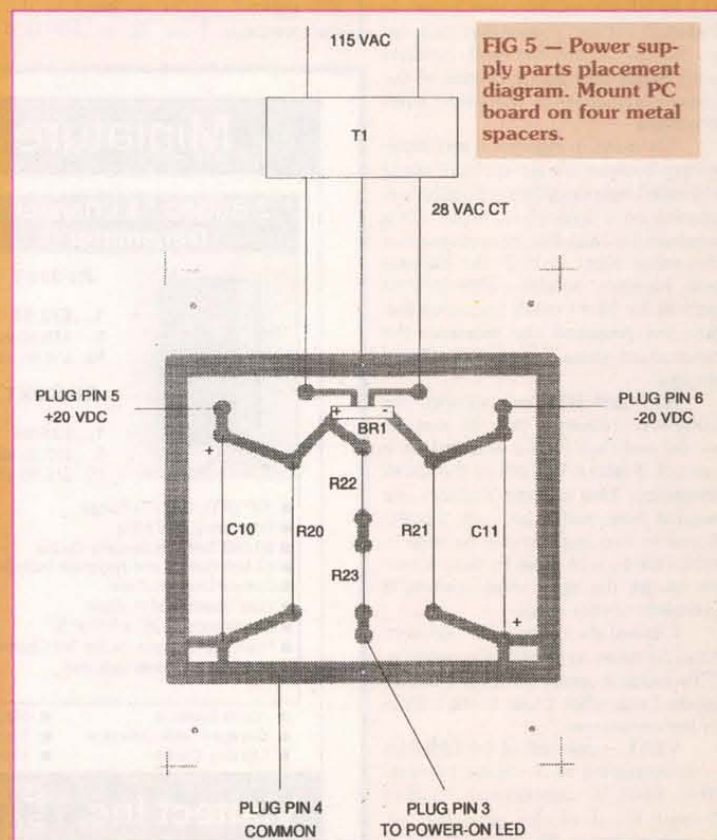


FIG 5 — Power supply parts placement diagram. Mount PC board on four metal spacers.

Go Wireless!!!
It's Easy:
\$9.95 ea.

Antenna input, TTL/CMOS output
TTL/CMOS input, RF output

418 MHz
433 MHz
(Actual Size)

Pin 1: Vcc
Pin 2: Gnd
Pin 3: Digital In
Pin 4: Antenna

Pin 1: RF Vcc
Pin 2: RF Gnd
Pin 3: Antenna
Pin 4, 5, 6, 8, 9: NC

Pin 10, 12, 15: Digital Vcc
Pin 11: Digital Gnd
Pin 13: Audio input/output
Pin 14: Digital Out

CONVERGENT, INC.
1-888-577-7285
http://www.convergentinc.com/rf
716 River Crest
Leander, TX 78641
Credit Card & COD orders accepted

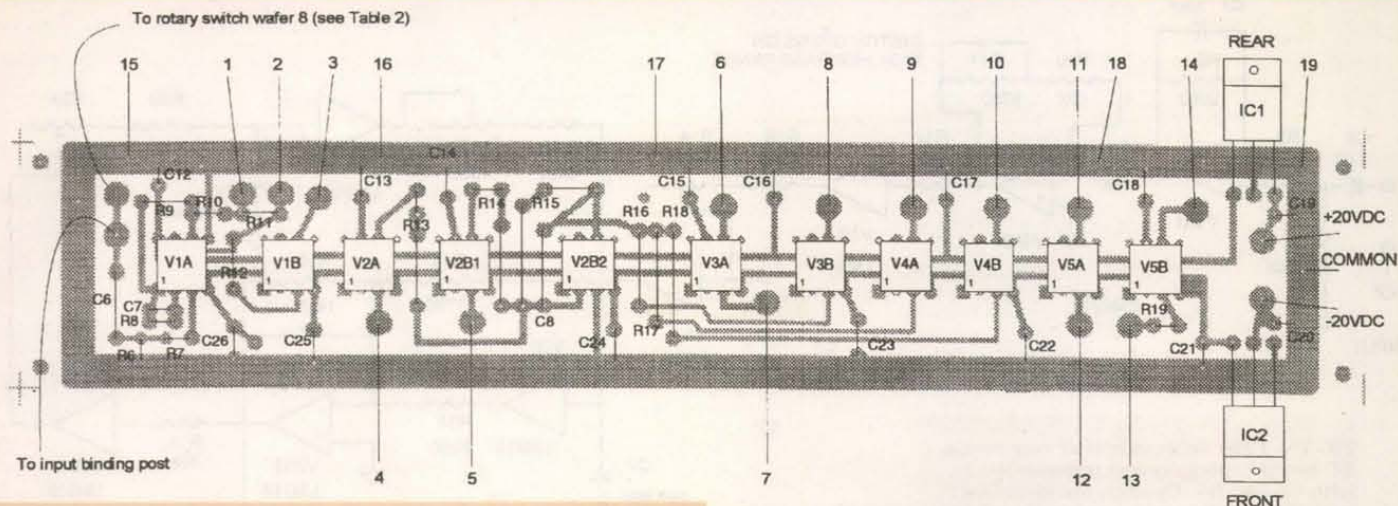


FIG 8 — Filter parts placement diagram. Off-card numbers are Range switch connections; see Table 2.

bench with the front panel up. Tune both filter frequency dials to "2" and then carefully remove and save the two plastic hairlines over the tuning dials.

Insert your flat 3/8-inch open end wrench between the front panel and the vernier tuning mechanism to hold it still while you remove its retaining nut. (Yes, it does take a fairly thin wrench.) During this, and the next few steps, be careful not to move the tuning dial or potentiometer position.

Using your 1/16-inch Allen wrench, carefully loosen the two set screws on each tuning dial and remove the dials. Then remove the range selector knobs with a 5/64-inch Allen wrench. Remove the retaining nut from the range selector switch bushing. Now the front panel can be removed by taking out the six large oval or binder head screws and the screws that go into the 1/4 by 1/4 inch support bars.

As soon as the front panel is off, replace both tuning dials. Even though the hairline isn't there, try to align the dial with the "2" under where the hairline would be. It may help to look at the set screw marks on the potentiometer shaft.

Spread a fairly thick layer of newspaper on your bench or table and carefully lay the filter section on it. Using a pair of needle-nose pliers, unhook the springs that hold the three protective covers on each potentiometer. Remove the covers. Take a can of spray contact cleaner and apply a generous amount to the inside of each pot section and both range switches. Move the tuning dial through its range and the rotary switch to all its positions. All these contacts have been around a long time and probably need a good cleaning! Now would be a good time to refresh the front panel too with soap, water, and your scrub brush.

When the contact cleaner has mostly evaporated, replace the potentiometer covers by hooking the spring ends into the eyelets with your needle-nose pliers. Carefully set the unit back on its blocks so the front is again up and adjust the tuning dials so the "2" would again be under the hairline.

Remove the tuning dials and

replace the front panel and its hardware — don't forget the nuts on the range switches. Use your 3/8-inch open end wrench to adjust and then hold the vernier mechanism while you tighten its retaining nut. The thin plate behind the tuning dial should extend about 1/16 inch into the vernier. Well, that's it for now. Set this unit aside while we rebuild the power supply.

POWER SUPPLY

Remove and save the two screws on each side that hold the power supply chassis to the side panels. Remove and discard everything on the power supply chassis — the new power supply is almost trivial compared to this original maze of components! The bare chassis can probably use a scrub up before you mount the new parts.

Assemble the power supply PC

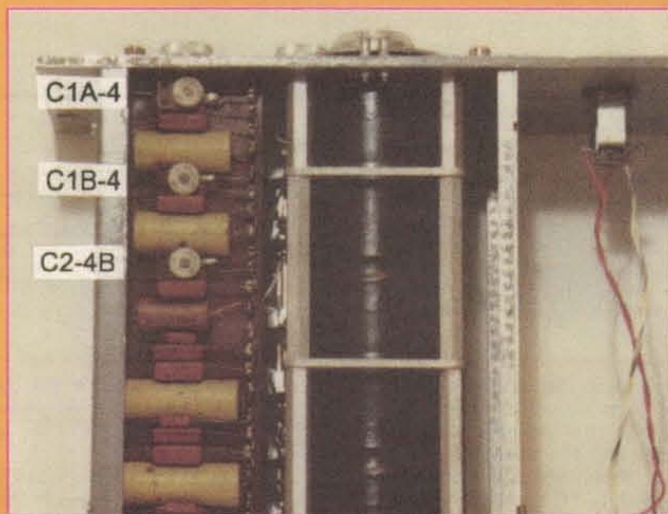


FIG 11 — Trimmer capacitor identification for Range X10K adjustments. Top of photo is the filter front panel.

ALFA ELECTRONICS

HIGH QUALITY TEST EQUIPMENT

Visit www.alfaelectronics.com for complete info

Call 1-800-526-2532 for Order and Free Catalog

DMM	LCR/COUNTER	FLUKE	SPECIALTY
DMM-899 (\$179.00): true rms, AC/DC (V, A), Ω , bar graph, freq, capac, dBm, logic, diode	CAP-15 (\$49.95): 3 1/2 digit, 0.1pF-20mF, 9 Ranges, 0.1pF resolution, zero adjustment	12B \$ 94.95	• AC Current Probe \$34.95
DMM-23T (\$99.95): 4 1/2 digit, true rms, high resol (10uV, 10mA, 10m Ω), hFE, diode, contin	LCR-24 (\$119.95): 0.1uH-200H, 0.1pF-2000uF, 0.01G-20M Ω , diode test, New Model	70-III \$ 99.00	• DC/AC Current Probe \$79.95
DMM-20 (\$74.95): AC/DC (V, A), Freq, contin, Capac, Induct, Ω , hFE, diode, duty cycle	LCR-131D (\$219.95): autorange, 0.1uH-10k Ω , 0.1pF-10mF, 1m Ω -10M Ω , Q Factor, serial/parallel, 120Hz/1kHz testing mode	73-III \$125.00	• Mini AC Clamp \$59.95
DMM-122 (\$59.95): DC/AC (V, A), Ω , hFE, diode, capacitance, freq, logic, continuity	PC-1200 (\$129.95): 1.25GHz counter, Handheld, 8 digits display, 10ppm accuracy, sensitivity 5mV (130-350MHz), 50mV (440MHz)	75-III \$155.00	• AC Clamp w/temp \$89.95
DMM-123 (\$44.95): DMM + capacitance, DC/AC (V, A), Ω , hFE, diode, continuity		77-III \$173.00	• DC/AC Clamp \$109.95
DMM-10 (\$19.95): 3 1/2 digit, DC/AC V, Ω , hFE, diode, signal output(+3V, -0.5V, 50% duty)		79-III \$195.00	• Thermometer \$69.95-\$89.95

Single Output DC Power Supplies	Triple Output	AUDIO/RF/FUNCT. GEN.
• Constant current, constant voltage mode	• Independence of Tracking operation	RF Generator • SG-4160 (\$124.95) 100kHz-150MHz sine waves in 8 ranges
• Short Circuit and overload protected	• Parallel to double current output (PS-8102 & PS-8103 only)	• SG-4162AD (\$229.95) with 6 digit counter
Analog Meters Display	Triple Output (Analog display)	Audio Generator • AG-2601 (\$124.95) 10Hz-1MHz, 0-8Vpp sine, 0-10Vpp square wave
PS-303 (\$159.00) 30V/3A	PS-8102 (\$399.95) 30V/3A/30V/3A	• AG-2603AD (\$229.95) with 6 digit counter
PS-305 (\$219.95) 30V/5A	PS-8103 (\$489.95) 30V/5A/30V/5A	Function Generator • FG-2100A (\$154.95)
PS-8112 (\$399.95) 60V/5A	Digital Display	• FG-2100B (\$154.95) 0.2Hz-2MHz, 5mV-20Vpp
PS-1610 (\$289.00) 16V/10A	PS-8202 (\$499.95) 30V/3A/30V/3A	• FG-2103 (\$329.95) Sweep 0.5Hz-5MHz
PS-8107 (\$399.95) 30V/10A	PS-8203 (\$549.95) 30V/5A/30V/5A	

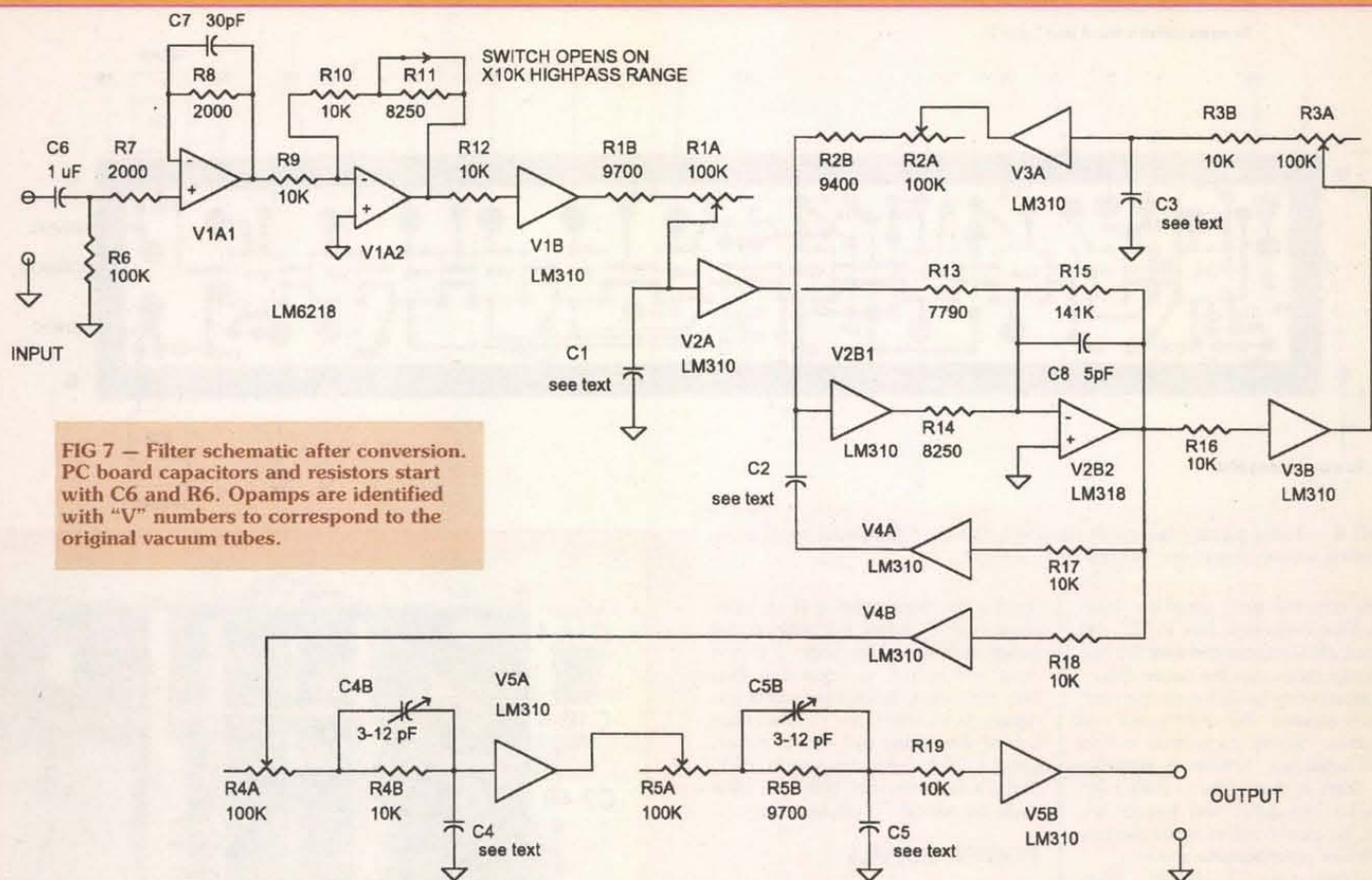
GWINSTEK

DC POWER SUPPLIES

20 MHz Scope	100MHz Cursor	Triple Output	Single Output	Programmable	FUNCTION GENERATOR	BENCHTOP DMM
• OS-620 \$304.95	• OS-6103 \$1199.95	• 2 variable out 0-30V, 0-3A	• Const voltage, current mod	• Auto serial/parallel (PPT ser)	FG-8015G (\$157.95)	DM-8034 (\$179.95) 3 1/2 digit
• Most economical scope	• Cursor Readout & meas	• One fixed 5V, 3A output	• Voltage regulation <0.01%	• Auto track (PPT series), IEEE-488.2 and SCPI compatible command set	• 0.02Hz-2MHz	• AC/DC (V, A), Ω , diode
• Dual CH/X-Y operation	• Dual CH / Delay sweep	• Auto track, serial, parallel	• Current regulation <0.2%	• PPS-1860G (\$1,149.95) 18V/6A	• Sine/Square/Tri/Pulse/Ramp	DM-8040 (\$339.95) 3 1/2 digit
• 1 mV/div sensitivity	• 10 panel setting memory	• Const. volt, current mode	PS-1830 (\$198.95) 18V/3A	• PPS-3635G (\$1,149.95) 36V/5A	FG-8020G (\$209.95)	• ACV to 50kHz, true rms
• Z-axis input, CH1 output	• Time base auto-range	• 4 analog or 2 digital display	PS-1850 (\$214.95) 18V/5A	• PPT-1830G (\$1,499.95) 18V/3A	• 0.02Hz-2MHz w/counter	DM-8055G (\$889.95) 5 1/2 digit
• TV syn, ALT trigger	• Z-axis modulation input	• 2-axis modulation input	PS-1830D (\$214.95) 18V/3A	• PPT-3635G (\$1,499.95) 36V/5A	• 0.05Hz-5MHz w/counter	• 0.006% accuracy, GPIB
• 2 probes (x1, x10)	• 2 probes (x1, x10)	• 2 probes (x1, x10)	PS-1850D (\$244.95) 18V/5A	• INT/EXT AM/FM mod	• 0.2Hz-2MHz, 5mV-20Vpp	• dBm, auto, REL, min/max

ALFA ELECTRONICS P.O. BOX 8089 PRINCETON, NJ 08543-8089 TEL: (800) 526-2532 / (609) 897-1135 FAX: 609-897-0206 E-mail: sales@alfaelectronics.com Call / Write / Fax / Email for FREE CATALOG Visa, MC, AMEX, COD, PO Accepted, OEM Welcome. 1 Year Warranty (2 Years for GW/Instek)

Write in 37 on Reader Service Card.



board using the schematic (Figure 4) and parts placement diagram (Figure 5). Note the polarity of the diode bridge and filter capacitors C10 and C11. Mount the power transformer, T1, and the PC board as shown in the Figure 6 photo. The PC board is mounted on 3/8- or 1/2-inch metal spacers.

I replaced the power cord and fuse holders with an IEC-type power connector (with built-in fuse) for compatibility with the rest of my test equip-

ment. If you prefer a built-in line cord, I suggest you replace the old one as it is sure to have had a lot of use and abuse.

The wire lengths to the female six-pin connector aren't critical. You'll want the connector body about four inches from the front edge of the PC board.

This would be a good time to rewire the AC power switch and power-on LED so you can test the power supply. The LED should light

and the unloaded DC voltages (which will go to the filter PC board regulators) should measure about ± 21 volts.

FILTER REASSEMBLY

Assemble the two filter PC boards using both schematics (Figures 4 and 7) and the parts placement diagram (Figure 8). Insert the voltage regulators so about 1/8 inch of lead is on the foil side and solder. Bend the leads away from the PC board and dress both reg-

ulators parallel to the board so the regulator bodies will clear the bottom cover plate when it is replaced. Pay special attention to the orientation of the regulators and the polarities of the tantalum capacitors, C19, C20, and C21. I suggest installing the regulators, tantalum capacitors, and 0.1 μF bypass capacitors, and then checking for ± 15 volts on each board. You can temporarily connect the filter board to the power supply to verify you have the correct voltages before installing the remaining components.

The PC board is laid out with enough clearance so you can use IC sockets if you prefer. Stray capacitance is already so large in the existing potentiometer and rotary switch wiring that any added by the sockets is negligible. I used 1/16-inch eyelets for all off-card connections, but stake-in terminals would work, too.

After you have completed the boards, clean off the solder flux and carefully inspect for cold solder joints and bridges. These are much easier to find and fix now before you install the boards.

The completed filter board is used as a drilling template. Orient a 1-1/2 by 8 inch subchassis so the bent lip with the 45-degree bevel is facing up and to your left. Place the PC board on the subchassis with the components up and the voltage regulators closest to you. Now mark through the five mounting holes. Carefully center punch and drill each hole with an 1/8-inch drill. Deburr the holes and place a 4-40 x 5/8 inch machine screw in each hole pointing up. Secure it with a 1/4-inch long threaded spacer. Place the PC board on the protruding screws

Subscribe to Nuts & Volts today and be automatically entered in our monthly prize drawing!! See ad page 49 for details!!



\$39.00

20-lot



- ✓ Call for other models
- ✓ One stop shop
- ✓ Same day shipping
- ✓ One full year warranty

Centurion: CF-3000
(Brand New)
True, 99-Channel

\$49.00

20-lot

**Intek Electronic
Systems
405-634-1535**

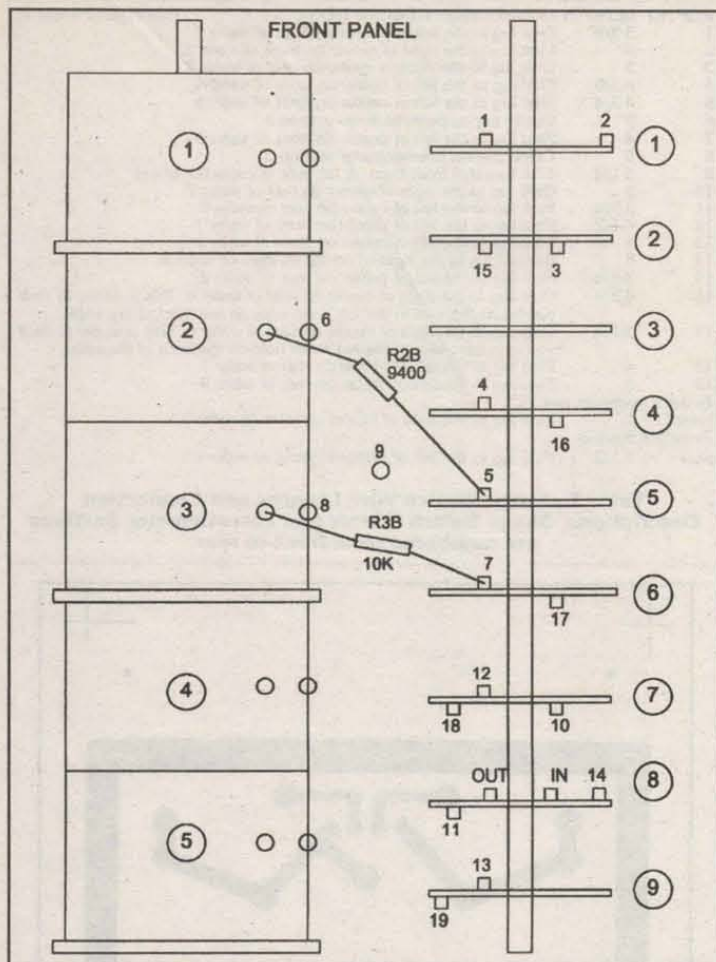


FIG 9 — Range switch and potentiometer wiring detail. Use this drawing with Table 2 for wire lengths and connection descriptions.

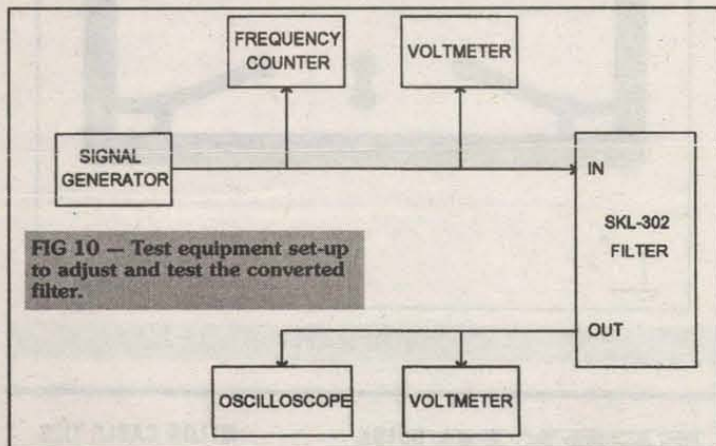


FIG 10 — Test equipment set-up to adjust and test the converted filter.

until later to mount the board assemblies gives you more working room.)

I found it easier to cut and solder the new interconnecting wires to the potentiometers and range switches before installing the PC boards. The drawing in Figure 9 along with Table 2 gives the wire lengths and connecting points. I used AWG 22 stranded wire which worked fine.

Resistors R1B, R4B, and R5B are already soldered to the range switch. I soldered R2B (9400 ohms) between the upper lug of potentiometer section 2 to range switch point 5 (see Table 2), and R3B (10,000 ohms) between the upper lug of potentiometer section 3 and range switch point 7. ("Upper" here means the lug closest to you

when you are making these connections.) These are the only two components not on the new PC board that you have to reconnect.

When all the wires are in place, fasten each filter subchassis to the front and rear panels with a 6-32 machine screw, lock washer, and nut. Use the lower hole (of the two original holes) in the panels and the right side subchassis hole. This is easier to do if you orient the subchassis vertically to get the nuts started. Then position the subchassis horizontally (component side up) and tighten the screws. The subchassis is so light in weight that one screw at each end works okay.

Remove the PC board retaining nut on the right side at the front panel.

Unicorn Electronics

1142 State Route 18
Aliquippa, Pa. 15001

www.unicornelectronics.com

Components & More!

Celebrating our 17th Year Of Service !!

DIODE/TRANSISTOR TESTER KIT

This dynamic tester allows checking of transistors & diodes in circuit. Identifies NPN or PNP transistors. Checks all types, small or large power. Identifies anode or cathode of diodes.

STOCK#	1-9	10-24	25+
DT100K	24.99	23.74	21.37

SINGLE TURN TRIMPOT

- 1/2 Watt
- 10% Tolerance
- 3/8" Square
- TO-5 Grid
- Top Adjustment
- Bourns 3386P or equal

STOCK#	DESCRIPTION	1-24	25-99	100+
PO150	50 ?	.59	.56	.50
PO1100	100 ?	.59	.56	.50
PO1500	500 ?	.59	.56	.50
PO11K	1K ?	.59	.56	.50
PO12K	2K ?	.59	.56	.50
PO15K	5K ?	.59	.56	.50
PO110K	10K ?	.59	.56	.50
PO120K	20K ?	.59	.56	.50
PO150K	50K ?	.59	.56	.50
PO1100K	100K ?	.59	.56	.50
PO1200K	200K ?	.59	.56	.50
PO1500K	500K ?	.59	.56	.50
PO11M	1 Meg ?	.59	.56	.50

ANTI-STATIC FOAM CLEANER

A thick, foaming cleaner for use in static sensitive applications. Safe for plastics and fiberglass. Use on computer cases and all office equipment. Also cleans soft fabrics. 5 oz. aerosol can.

STOCK#	1-9	10-24	25+
SB1102	1.99	1.89	1.70

FM MICROPHONE KIT

Transmit your voice on any FM radio. Range up to 1000'. Case included.

STOCK#	1-9	10-24	25+
K30	15.99	15.19	13.67

ANTI-STATIC CLEANER

General purpose cleaner for use in static sensitive applications. Safe for plastic and fiberglass. 1.75 oz. non-aerosol bottle.

STOCK#	1-9	10-24	25+
SB1101*	.99	.94	.85

HEAT SINK

• Thermalloy # 6073
• TO-220 type
• .75" square x .375" high

STOCK#	1-24	25-99	100+
HS1001	.19	.18	.16

PEAKING COIL

• TDK # H301CLR391
• 390 ph
• .375" diameter

STOCK#	1-24	25-99	100+
SB1037	.15	.14	.13

ORDER TOLL FREE! - 1-800-824-3432 • FAX ORDERS - 724-495-7882
NO SHIPPING CHARGES !!!

41 WATT SWITCHING

- Input - 115/230V
- Outputs - +5V @ 3.75 Amps
+12V @ 1.5 Amp
-12V @ .4 Amp
- Size - 5.25" W x 7" L x 2.50" H

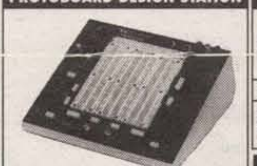
STOCK#	1-9	10-24	25+
PS1003	9.99	9.49	8.54

11 PIECE COMPUTER TOOL KIT

- 11 piece kit containing:
- 3/16" & 1/4" nut driver
 - 3 prong parts retriever
 - Tweezer
 - 3/16", 1/4", #1 & #2 phillips reversible screwdriver
 - T-10 & T-15 reversible screw driver
 - 14-16 pin IC inserter
 - 1/8" flat screwdriver
 - Black vinyl zippered case

STOCK#	1-9	10-24	25+
TK1100	19.99	18.99	17.09

PROTOBOARD DESIGN STATION



- The total design workstation including expanded instrumentation, breadboard and power supply
- Ideal for analog, digital and micro processor circuits
- 8 logic probe circuits
- Function generator with continuously variable sine, square, triangle wave forms, plus TTL pulses
- Triple power supply offers fixed 5 VDC supply plus 2 variable outputs - +5 - 15 VDC and -5 - 15 VDC
- 8 TTL comp. LED indicators, switches
- Pulses
- Potentiometers
- Audio experimentation speaker
- Multiple features in one complete test instrument saves hundreds of dollars needed for individual units
- Unlimited lifetime guarantee on breadboard sockets

STOCK#	1-9	10-24	25+
PB503	299.99	284.99	256.49

SLIDE DIP SWITCHES

- SPST
- 50 VDC @ 100 ma
- Numbered switches
- 100" spacing

STOCK#	DESCRIPTION	1-24	25-99	100+
SW4S	4 Position	.59	.56	.50
SW5S	5 Position	.59	.56	.50
SW6S	6 Position	.59	.56	.50
SW7S	7 Position	.59	.56	.50
SW8S	8 Position	.59	.56	.50
SW10S	10 Position	.69	.66	.59
SW12S	12 Position	.69	.66	.59

RCA JACK

- PC Mount
- Vertical or rt. angle
- Metal body

STOCK#	1-24	25-99	100+
CORCA	.19	.18	.16
CORCARA	.19	.18	.16

PADLE SWITCH

- SPDT/off-on
- 3 amps @ 125 VAC
- Solder tail
- 9/16" x 7/8" mounting

STOCK#	1-24	25-99	100+
SW1004	.39	.37	.33

PROTOLAB

A state of the art electronics lab for your PC. You can build & experiment with actual circuits, choosing from an unlimited number of components. Then, analyze your circuits with built-in high-tech instruments. This complete electronics lab simulates thousands of dollars worth of parts and instruments. Plus you get a unique experiment book. Easy to use, menu driven, mouse controlled circuits come alive on your screen. You can't blow your 'lab' because it's fool-proof & safe on your PC!

STOCK#	1-9	10-24	25+
PROTOLAB	49.99	47.49	42.74

PRINTER CLEANING KIT

- Contains:
- 100 ml safety solvent spray
 - 10 G.P. wipes
 - Static reducing cloth
 - Disposable gloves
 - Brush

STOCK#	1-9	10-24	25+
SB1108*	1.99	1.89	1.70

EPROMS

STOCK#	1-24	25-99	100+
2732A-20	5.49	5.22	4.70
2764-20	5.39	5.12	4.61
2764-25	4.49	4.27	3.84
2764A-20	3.49	3.32	2.99
2764A-25	2.99	2.84	2.56
2764-15	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	2.79	2.65	2.39
27C020-15	3.49	3.32	2.99
27C040-12	5.49	5.22	4.70
27C080-12	10.99	10.44	9.40

CHOKE

- Postage stamp type
- .375 W x .500 H
- 10 ph @ 0.5 A

STOCK#	1-24	25-99	100+
SB1070*	.12	.11	.10

Write in 39 on Reader Service Card.

Nuts & Volts Magazine/July 1999 55

(These resistors are reused from the original circuit.)

R1A, R2A, R3A,	
R4A, R5A	Variable resistor, 5-gang, each section 100K ohms
R1B, R5B	9700 ohms, 1%, carbon film or metal film
R2B	9400 ohms, 1%, carbon film or metal film
R3B, R4B	10K ohms, 1%, carbon film or metal film

(These resistor are on the new filter PC board.)

R6	100K ohms, 1%, 1/4 watt, metal film
R7, R8	2K, 1%, 1/4 watt, metal film
R9, R10, R12, R16,	
R17, R18, R19	10K ohms, 1%, 1/4 watt, metal film
R13	7790 ohms, 1%, 1/4 watt, metal film
R11, R14	8250 ohms, 1%, 1/4 watt, metal film
R15	141K ohms, 1%, 1/4 watt, metal film
R20, R21	4700 ohms, 5%, 2 watt, carbon film
R22, R23	470 ohms, 5%, 1/2 watt, carbon film

PARTS LIST

CAPACITORS

(These capacitors are reused from the original circuit.)

C1A-1, C1B-1	0.0536 uF, 1%, paper	Range X10
C1A-2, C1B-2	5350 pF, 1%, mica	Range X100
C1A-3, C1B-3	505 pF, 1%, mica	Range X1K
C1A-4, C1B-4	47 pF, 1%, mica in parallel with 5-25 pF ceramic trimmer	Range X10K

C2-1	0.0493 uF, 1%, paper	Range X10
C2-2	4930 pF, 1%, mica	Range X100
C2-3	493 pF, 1%, mica	Range X1K
C2-4	20 pF, 1%, mica in parallel with 5-25 pF ceramic trimmer	Range X10K

C3-1	0.117 uF, 1%, paper	Range X10
C3-2	0.0117 uF, 1%, mica	Range X100
C3-3	1150 pF, 1%, mica	Range X1K
C3-4	115 pF, 1%, mica	Range X10K

C4-1	0.117 uF, 1%, paper	Range X10
C4-2	0.0117 uF, 1%, mica	Range X100
C4-3	1150 pF, 1%, mica	Range X1K
C4-4	104 pF, 1%, mica	Range X10K

C5-1	0.0493 uF, 1%, paper	Range X10
C5-2	4930 pF, 1%, mica	Range X100
C5-3	493 pF, 1%, mica	Range X1K
C5-4	36.5 pF, 1%, mica	Range X10K

(These capacitors are on a new PC board.)

C6	1 uF, 10%, polyester
C7	30 pF, 5%, mica or COG ceramic
C8	5 pF, 5%, mica or COG ceramic
C9	not used
C10, C11	3300 uF, 35 volts, axial lead electrolytic
C12 - C18	0.1 uF, 25 volts, ceramic
C19, C21	1 uF, 35 volts, tantalum electrolytic
C20	2.2 uF, 25 volts, tantalum electrolytic
C22 - C26	0.1 uF, 25 volts, ceramic

SEMICONDUCTORS

LED	High-brightness red LED power-on indicator
BR1	Diode bridge, 2A, 50 volts
IC1	LM7815 +15 volt regulator
IC2	LM7915 -15 volt regulator
V1A	LM6218 opamp
V1B, V2A, V2B1,	
V3A, V3B, V4A,	
V4B, V5A, V5B	LM310 voltage follower
V2B2	LM318 opamp

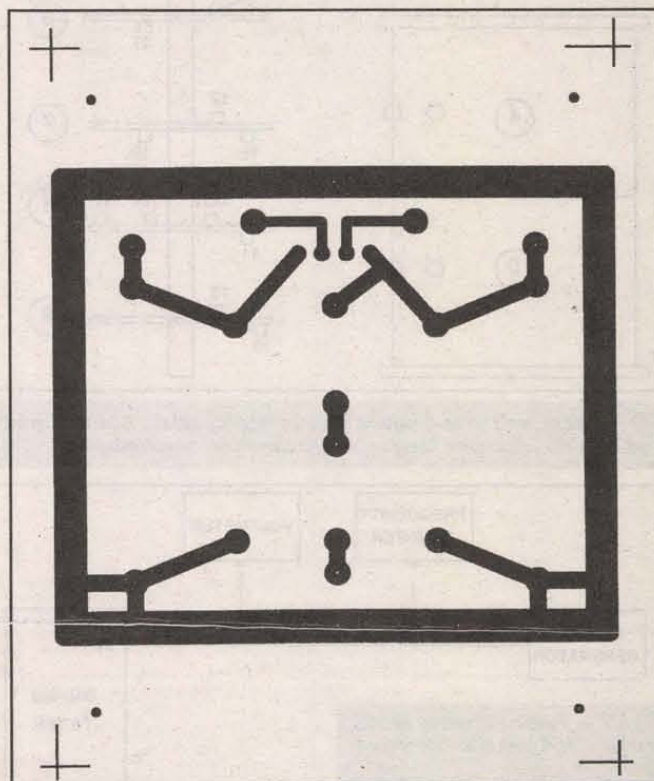
MISCELLANEOUS

T1	Power transformer, 115 VAC primary to 28 VAC center-tapped secondary, 300 mA Stancor P-8602 or equal.
	IEC-type AC power connector with fuse or new built-in line cord
	PC boards, hardware, wire, and solder.

The following items are available from **TDL Electronics, 5260 Cochise Trail, Las Cruces, NM 88012. 505-382-8175, FAX 505-382-8810.** Set of three PC boards (two filter boards and one power supply board), \$23.00 postpaid in the US and Canada.

REF NO	LENGTH	CONNECTION DESCRIPTION	(see Figures 8 and 9)
1	3-3/8"	First lug to the left of center on front of wafer 1	
2	4	First lug to the right of center on front of wafer 1	
3	5	Only lug to the right of center on rear of wafer 2	
4	4-3/8	First lug to the left of center on front of wafer 4	
5	4-3/4	First lug to the left of center on front of wafer 5	
6	5	Center lug on potentiometer section 2	
7	4	First lug to the left of center on front of wafer 6	
8	5	Center lug on potentiometer section 3	
9	5-1/4	12th terminal from front on left side of capacitor board	
10	5	Only lug to the right of center on rear of wafer 7	
11	3-3/4	First lug to the left of center on rear of wafer 8	
12	4-1/2	First lug to the left of center on front of wafer 7	
13	4	First lug to the left of center on front of wafer 9	
14	5	Second lug to the right of center on front of wafer 8	
15	3-5/8	First lug to the left of center on rear of wafer 2	
16	4-3/4	Only lug to the right of center on rear of wafer 4. This is easier to do if you insert the wire in the lug stake hole on the front of the wafer.	
17	3-1/4	Only lug to the right of center on rear of wafer 6. This is easier to do if you insert the wire in the lug stake hole on the front of the wafer.	
18	4	First lug to the left of center on rear of wafer 7	
19	5	First lug to the left of center on rear of wafer 9	
To input eyelet on new PC board		9	First lug to the right of center on front of wafer 8
To output binding post		7-1/2	First lug to the left of center on front of wafer 8

Table 2 - Range Switch Wire Lengths and Connection Descriptions. Range Switch Wafers and Potentiometer Sections are numbered from front to rear.



POWER SUPPLY

EZ-EP DEVICE PROGRAMMER - \$169.95

Check Web!! -- www.m2l.com

Fast - Programs 27C010 in 23 seconds

Portable - Connects to PC Parallel Port

Versatile - Programs 2716-080 plus EE and flash (28, 29) to 32 pins

Inexpensive - Best for less than \$200

• Correct implementation of manufacturer specified algorithms for fast, reliable programming.

• Easy to use menu based software has binary editor, read, verify, copy, etc. Free updates via bbs or web.

• Full over current detection on all device power supplies protects against bad chips and reverse insertion.

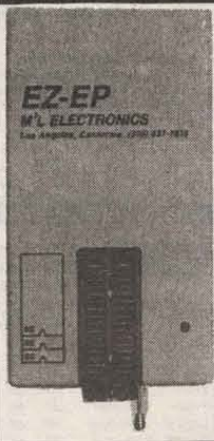
• Broad support for additional devices using adapters listed below.

Available Adapters

EP-PIC (18C5x, 81, 82, 71, 84)	\$49.95
EP-PIC64 (18C62-5, 72-4)	\$39.95
EP-PIC12 (12C50x)	\$39.95
EP-PIC17 (17C4x)	\$49.95
EP-51 (8751, C51)	\$39.95
EP-11E (68HC11 E/A)	\$59.95
EP-11D (68HC71103)	\$39.95
EP-16 (16B1 EPROMs)	\$49.95
EP-Z8 (Z86E02, 3, 4, 6, 7, 8)	\$39.95
EP-SEE2 (93x24x25x85x)	\$39.95
EP-750 (87C750, 1, 2)	\$59.95
EP-PEEL (IC22V10, 18V6)	\$59.95
EP-T651 (68C1051, 2051)	\$39.95
EP-PLCC (PLCC EPROMs)	\$49.95
EP-SOIC (SOIC EPROMs)	\$49.95
EP-TSOP (TSOP EPROMs)	\$59.95

M²L Electronics

970/259-0555
Fax: 970/259-0777
250 CR 218
Durango, CO 81301
CO orders please add 7% sales tax.
<http://www.m2l.com>



EDSYN® 951SX PROFESSIONAL SOLDERING STATION

True Temperature Control
Static Safe
Meets MIL-SPEC DOD2001B
UL Listed
70 Watt Heating Element
Made in America

List Price
\$249.97
Your Price
\$76.00



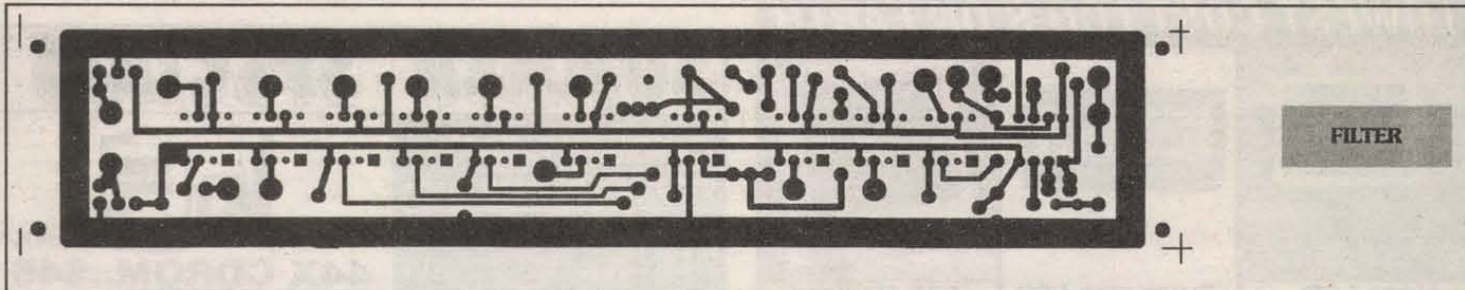
NYLON CABLE TIES

UL Recognized
MIL-SPEC Rated
Made in America

Size	Per 1000
4" Natural	\$4.50
4" Black UV	\$5.00
5.5" Natural	\$8.00
5.5" Black UV	\$8.50
8" Natural	\$11.00
8" Black UV	\$12.00



Sales tax and shipping charges will be added to all orders. Prices subject to change without notice.
1A Sales-560 N. Moorpark Road, Suite 311-Thousand Oaks-CA-91361
888-651-9502, Fax 888-651-9503, www.1asales.com, 1asales@earthlink.net



Place a solder lug on the screw and replace the nut. Run a length of AWG 20 solid bus bar from the input common binding post through the solder lug to the output common binding post.

Connect a short piece of hookup wire (about an inch) between the solder lug and one of the common PC board eyelets or terminals. Solder all these connections. Now connect all the free wire ends to the PC board (see Figure 8).

Finally, there are a few components attached to the Range switch which should be clipped out: both 5-25 pF trimmer capacitors connected between wafers 1 and 2; the 56K, 1/2 watt resistor on wafer 1; the 100K, 1/2 watt resistor connected between wafers 8 and 9; and the 47K, 1/2 watt resistor connected between wafers 4 and 6.

This completes the wiring, so you can replace any missing hardware and reconnect the power supply to the filter section. But leave the top and bottom covers off for now.

ADJUSTMENT

Adjustment affects only the high range (X10K), so if you are going to use the filter for just audio frequencies (less than 20 kHz), you are done! To calibrate the X10K range, set up the equipment shown in Figure 10. Set the filter range switch to HIGHPASS X10K and the frequency tuning dial to "4." Set your signal generator to 40 kHz, 2 to 3 volts RMS output.

Now adjust C2-4B (see Figure 11) for maximum output. Then adjust C1A-4 for an output of about -3 dB below the input level.

The passband response on the high range won't be quite flat, but this adjustment is about the best you can do. Now set the filter range switch to LOWPASS X10K and adjust C1B-4 for an output about -1.75 dB below the input.

PERFORMANCE

The converted filter pretty well meets or exceeds the original specifications. Because of the shielding provided by the original mechanical layout coupled with my use of separate voltage regulators on each filter board, the signal coupling between filters is lower than the noise level. Each filter can be used independently. Broadband output noise with the input open is about 500 microvolts RMS.

A measured lowpass response for a single filter and a cascade pair is graphed in Figure 12. (To cascade the filters, simply connect Output 1 to Input 2 and set the Range and Tuning the same.) The maximum attenuation

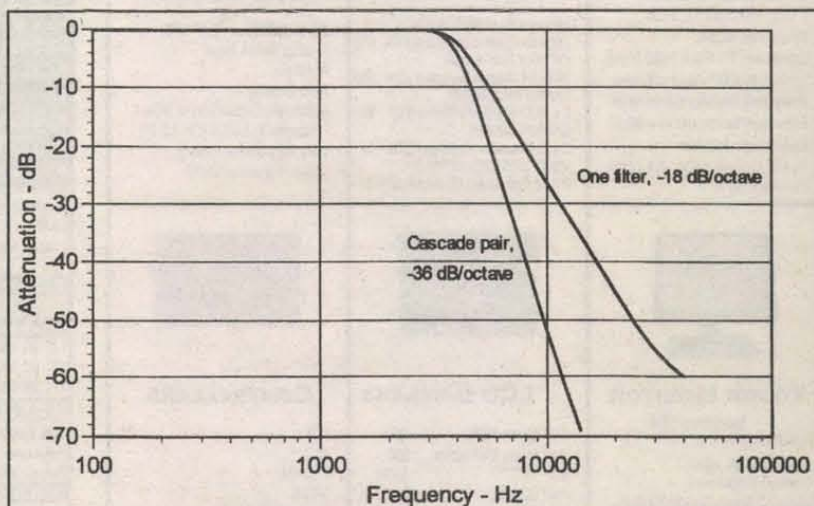
FIG 12 — Lowpass response for one filter and cascade filter pair; cutoff frequency = 4,000 Hz.

you can measure is limited by the filter's noise level and the spectral purity of your signal generator. Harmonic distortion on the input signal will show up as reduced filter performance. This is especially true when you are trying to make measurements less than 60 dB or more below the input level.

Output impedance is typically less than one ohm over the audio frequency range and the output can be shorted without damage. The filter will drive a moderate capacitive load; I haven't had any problems driving small diameter coaxial test cables. A long cable run at high frequencies might be a problem but you can put a 50- to 100-ohm resistor in series with the center conductor to settle it down.

You can also use the cascaded pair as a bandpass filter. For example, to get a passband centered at 1000 Hz, set Filter 1 to HIGHPASS X100 and Filter 2 to LOWPASS X100.

If you set both Tuning dials to



1. Thin, flat, 3/8 inch open end wrench for frequency dial vernier mechanism.
2. 1/16 (0.0625) inch Allen (hex) wrench for frequency dial.
3. 5/64 (0.078) inch Allen (hex) wrench for range selector knob.
4. Can of spray contact cleaner.

Table 1 - Special Tools Needed to Perform the Filter Conversion

"10," you will get a narrow passband but the gain at 1000 Hz will be down -4 to -5 dB. Tuning Filter 1 (the high-pass) to a lower frequency and Filter 2 (the lowpass) to a higher frequency will

increase the center frequency gain at the expense of a wider passband.

Overall, I'm very satisfied with the converted filter's performance and I think you will be too! **NV**

MOUSER

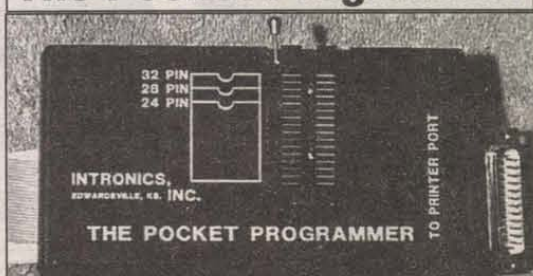
ELECTRONICS

Distributor of Electronic Components Fax: 817-483-8899

- Wire and Cable •
- Connectors • Resistors
- Potentiometers •
- Capacitors • Diodes
- Transformers • Inductors •
- Switches • Fuses • Knobs
- Hardware • Equipment
- Semiconductors
- Tools

(800) 348-6873 www.mouser.com

The Pocket Programmer



The portable programmer that uses the printer port of your PC instead of an internal card. Easy to use software that programs E(P)rom, Flash & Dallas Ram. 27(C)/28(C)/28F/ 29F/29CXXXX & 25XX series from 16K to 8 Megabit with a 32 pin socket. Adapters available for Pic, MCU's 874X, 875X, 40-Pin X 16 & Serial Eprom's, PLCC, 5-Gang, 82/74 Prom's and Eprom Emulator to 32K X 8.

Only \$129.95

Same Name, Address & Phone Number for 16 Years....
Now isn't that Amazing?

Intronics, Inc.

Box 13723 / 612 Newton St.

Edwardsville, KS 66113

Tel. (913) 422-2094

Fax (913) 441-1623 Visa / Master Charge / Amex

Add \$5.00 COD

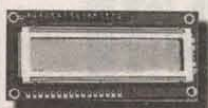
Add \$4.00 Shipping

LOWEST COST LCD'S ON EARTH



VIDEO LCD

4 Inch Video NTSC \$150
Sharp P/N 4LU4E
Composite NTSC & RGB Input
12:00 OR 6:00 Viewing Angle
Integrated Backlight & Inverter
Extended Temp: -10 to +60 C
Brightness: 260 nits
Power Consumption: 4.3 Watts
Contrast: 50 to 1



CHARACTER LCD

OPTREX DMF-500SSN-EW
240 x 64 Graphic EL Backlit STN \$30
OPTREX DMF-500SN
240 x 64 Graphic Reflective STN \$30
SANYO DM2023-7G1
2 x 20 Character Reflective STN \$8
SHARP LM20A21
2 x 20 Character Reflective STN \$8
VIKAY 2035TND NOTW-D
2 X 16 Character LED Backlit STN \$8



LCD MONITOR

10.4" DSTN or 12.1" TFT
Analog SVGA Input
Autosync
Auto Sizing
Automatic Expansion of VGA
images to SVGA (On 12.1")
Very Aggressive Pricing
Starting under \$500!



TOUCH MONITOR

EarthVue 10.4
10.4" VGA TFT
Analog VGA Input
105 Nit Brightness
RS-232 Touch Screen Option
Only 9.9"W x 7.7"H x 1.5"D
Ideal For Factory Automation
Fully Articulating Ball Mount
Only \$1095 With Touch



LCD DISPLAYS

6.3" Mono STN \$60
9.4" Mono Reflective \$60
8.4" TFT \$250
9.4" DSTN \$150
10.4" TFT \$350
10.4" DSTN \$240

NoteBook Screens
340 Models in Stock
Obsolete Screens Stocked
Hard To Find LCD? Call!



CONTROLLERS

ISA
PCI
PCI/104
NTSC
Analog VGA
Complete LCD Kits with LCD,
Controller & Cable Starting
under \$200



EARTH

Computer Technologies

"The World Leader In LCD Recycling"

Ph: (949) 361-2333 Fax: (949) 361-2121
<http://www.flat-panel.com>

Write in 59 on Reader Service Card.

SUMMER SPECIALS

SUPER SAVING UPGRADE KIT

M BOARDS WITH CPU, 8MB AGP & SOUND:

K6-2 300 Mhz MMX	\$149
K6-2 350 Mhz MMX	\$169
K6-2 380 Mhz MMX	\$189
K6-2 400 Mhz MMX	\$199
K6-2 450 Mhz MMX	\$239
K6-3 400 Mhz MMX	\$349
Pentium II Celeron 333 w 128Kcache	\$169
Pentium II Celeron 400 w 128Kcache	\$219
Pentium II 350 MMX	\$269
Pentium II 400 450 MMX	\$369 Scall
Pentium III 450 500 MMX	\$425 call

CASES WITH POWER SUPPLIES

MED TOWER CASE PREMIUM.....	\$29
ATX MED TOWER CASE PREMI.....	\$49

FLOPPY

1.44 Mitsumi	\$ 18.95
--------------	----------

MONITORS

14" 28 108 N-I, Low Radiation.....	\$119
15" 28 1024x768 N-I, Low Rad.....	\$135
17" 28 1280x1024 N-I, Low Rad.....	\$229

KEYBOARDS

104 Keyboard.....	\$10
Keytronic.....	\$19
Focus 2000.....	\$call

VGA CARDS

SVGA 1MB ISA.....	\$35
PCI 1MB/2MB/4MB.....	\$1422/29
PCI OR AGP 4MB.....	\$29
PCI OR AGP VGA 8MB.....	\$39

BANSHI 16MB.....	\$135
VOODO II 12MB.....	\$119

ANY OTHER VGA CARDS..... \$CALL

CONTROLLER SCSI

DIAMOND FIRE PORT 40.....	\$95
---------------------------	------

Adaptec 2940/2940UW/2940UZW..... \$149/169/379

MODEM/FAX MODEM

33.6K Voice Modem/ Fax Modem.....	\$26
56K Voice Modem/ Fax Modem.....	\$29
US ROBOTIC 56K Modem.....	\$89
ISDN.....	\$CALL



44X CDROM..\$45

Orders & Price

Tel: (800) 899 6430

44X Bundle

\$69

40X Speed CD
16 Bit Sound Card
with Wavetable.

Amplified Speakers 80W

For ALL kinds of Drives, Sound Cards
Speakers and CD Titles: \$Call

HARD DRIVES SPECIALS

4.3GB..\$125	6.4GB..\$139	8.4GB..\$155	10GB..\$175
13.5GB..\$215	17GB..\$289	21GB..\$355	any other CAL

IBM 6X86

300MMX

Motherboard
CPU, 8MB AGP
VGA & SOUND

\$129

Will beat any price

Resellers

Dealers

Welcome

All Systems carry

3 years Parts &

5 years Labor

Warranty.

Lifetime Tech

Support

us out

No Minimum Charge No Hidden Charge.

Prices subject to change without notice.

15% Restocking fee for Non Defective Items.

Orders of \$950 or more, ground shipping free,

except for Cases, Monitors, Keyboards and F.Drives.

Simm Memory

LOW \$\$\$

Will beat any price

Resellers

Dealers

Welcome

CREDIT CARDS OK

MasterCard

VISA

Govt.P.O. C.COD.

Terms:

No Minimum Charge No Hidden Charge.

Prices subject to change without notice.

15% Restocking fee for Non Defective Items.

Orders of \$950 or more, ground shipping free,

except for Cases, Monitors, Keyboards and F.Drives.

AMD K6-2

350 MMX

Motherboard
CPU, 8MB AGP
VGA & SOUND

\$179

Will beat any price

Resellers

Dealers

Welcome

CREDIT CARDS OK

MasterCard

VISA

Govt.P.O. C.COD.

Terms:

No Minimum Charge No Hidden Charge.

Prices subject to change without notice.

15% Restocking fee for Non Defective Items.

Orders of \$950 or more, ground shipping free,

except for Cases, Monitors, Keyboards and F.Drives.

EVERYDAY LOW PRICES

www.bisme.com

BISME COMPUTERS OUTLET 906 N Carpenter Rd, Suite A, Modesto, CA 95351

Write in 60 on Reader Service Card.

Handbook of Radio and Wireless Technology, by Stan Gibilisco \$44.95
10% discount to Nuts & Volts subscribers. Call 800-783-4624 to order using Visa or MasterCard.

WEBBOOKS OFFERS discount prices on technical/engineering books plus free assistance to authors. Please visit us at <http://webbooks.net>



UNDERGROUND, HACKING, SNEAKY 1999 BRINKER MASTER CATALOG! 3,300+ PRODUCTS FOUND NOWHERE ELSE! 95% OF PRODUCTS ARE \$3!! CATALOG (30+PAGES) \$10 (FIRST 500 CALLERS: FREE \$25 GIFT CERTIFICATE!!) OPEN 24 HOURS! 352-429-5496. BRINKER ENGINEERING LABS, USA.

WANTED: ELECTRONICS hobbyist magazines from 1970-1979. Popular Electronics, Radio-Electronics. Call Shawn, 650-846-8208, maxweb@pacbell.net

Programming and Customizing BASIC Stamp Computers. By well known author Scott Edwards, originator of the *Nuts & Volts* Stamp Applications column. Only \$34.95. 10% discount to *Nuts & Volts* subscribers. Call 800-783-4624 to order using Visa or MasterCard.

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

TORMET'S ELECTRONICS BENCH REFERENCE is now at REV03. More laser, op-amp and Tesla coil circuits. New optics and statistics pages. Check the web site at www.ohio.net/~rtormet/ index.htm or send \$19.95 + \$2.50 postage to RMT Engineering, 6863 Buffham, Seville, OH 44273.

WHAT! YOU don't have TELECODE's 1999 24 page "HACKER CATALOG?" 520-726-2833. It's free this month! Surf Telecode's Hackers Catalog on-line at: <http://www.hackerscatalog.com>

ROBOTICS

ROBOT BOOKS.COM visit our web site for reviews of robotics books, plus robot kits, toys, movies, and magazines! www.robotbooks.com

Continued from page 46

MICROCONTROLLERS



PIC MICROCONTROLLER PROGRAMMER KIT. Super value at \$19.95 + \$4.95 shipping. See our web site for the complete range of PICs that can be programmed. Includes PCB, parts and instructions. P16PRO shareware must be downloaded from the web. Amazon Electronics, tel 1-888-549-3749. Lots of other products. www.electronics123.com

68HC11, 80C552 and 8031 microcontroller boards. Uploader, assembler and compiler software included. See our products at: www.tecel.com

WIN \$500 USD cash dontronics.com

SELL PICSTART 16B1 and 16C programmers, complete. Both for \$50 post-paid in US. Ron, 505-382-3173, www.zianet.com/tld

ANTIQUE ELECTRONICS

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

CRYSTAL SETS. Parts, plans, books, kits. Largest source in the world. Catalog \$2. MIDCO, PO Box 222288, Hollywood, FL 33022.

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

AVIATION ELECTRONICS

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

PUBLICATIONS

Discount electronics books. See the NV Bookstore ad on page 91.

ARobot KIT from Arrick Robotics uses the BASIC Stamp II. Quality metal construction. Easy to assemble and very expandable. \$235. <http://www.robotics.com/arobot>

H-BRIDGE MOTOR controllers, 12VDC, 35A average, 50A peak PWM out. Forward, reverse, ramp-up and ramp-down on acceleration/deceleration. Current foldback when hot, reverse polarity protected, conformal coated, regenerative braking, compact, approx. 3.75"x5.5". \$25 & S&H. 570-735-5053. <http://members.tripod.com/~divelec>

68HC11, 80C552 and 8031 microcontroller boards. Uploader, assembler and compiler software included. See our products at: www.tecel.com

www.futurerobots.com ROBOTS are coming soon to our homes. Most of the technology is now here, as well as the need. Read technical papers and construction articles for active security systems.

ROBOTS WANTED: Dead or alive, whole or parts. Marvin (Iowa Precision), Gemini, RoPet, Hubot, RB5X, Newton SynPet, ComroTot, ELAMI, ITSABOX, HeathKit (HERO JR, 1, 2000, or Arm Trainer), AndroBots (TOPO, BOB, Fred, and Andromed), Rhino, Maxx Steele, Omnibots, etc. Also looking for robot prototypes, options, and literature, will pay cash. Please E-Mail rdorr@bizserve.com Call 810-777-1313 or write to: Robert Doerr, 26308 Cubberness, St. Clair Shores, MI 48081.

3 AXIS stepper motor controller. 2 amp per phase, 5 inputs, 4 outputs, controlled by parallel port, \$95. <http://members.aol.com/stepdrives>

S.A.M. ROBOT kit. Build this great looking small robot with your servos, microcontroller, and sensors. Or buy servos, wheels, controllers, and sensors from us for a complete project. Visit <http://www.smallrobot.com> for details.

PLANS - KITS - SCHEMATICS

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

200+ ELECTRONICS PROJECTS. Build for pleasure or make 100% (or more) profits reselling printed plans. \$1 (refundable) for catalog & dealer info. MATCO-A5, PO Box 509, ROSEVILLE, MI 48066-0509.

HOVERBOARDS, JETPACKS, LIGHT-SABERS. Plans, schematics, and kits for over 100 incredible devices. \$3 for catalog. Future Horizons, PO Box 125, Marquette, MI 49855. www.futurehorizons.net



CIRCUIT BOARDS. Low-cost, precision-made PC boards from your CAD program files (no photoplots required). Single and double-sided with contour routing. Ideal for RF/analog/digital prototypes. Full details at <http://www.pcbmilling.com> E-Mail: feedback@pcbmill.com FAX: 703-818-0071.



TERRIFIC TIMEPIECES! LED binary clock. LED digital clocks, other kits! Free catalog! WPC, 805-339-0702. www.ElectronicsUSA.com

HEATHKIT COMPANY is selling photocopies of most Heathkit manuals. Only authorized source for copyright manuals. Phone: 616-925-5899, 8-4 ET.



ELECTRIC POWER METER STOPPER MAKES METER RUN SLOWER, STOP, OR EVEN REVERSE! COMPLETE PLANS \$10, SOLD FOR EDUCATIONAL PURPOSES ONLY. (VISA/MC/AMEX/COD) OPEN 24 HOURS! 352-429-5496 BRINKER ENGINEERING LABS, USA.

World's Smallest TV Transmitters

We call them the "Cubes"... Perfect video transmission from a transmitter you can hide under a quarter and only as thick as a stack of four pennies - that's a nickel in the picture! 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 unit goes 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 make 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 & Audio Transmitter Cube.....\$149.95
C-2001, High Power Video Transmitter Cube.....\$179.95
C-3001, High Power Video & Audio Transmitter Cube.....\$229.95

CCD Video Cameras

Top quality Japanese Class 'A' CCD array, over 440 line resolution, not the off-spec arrays that are found on many other cameras. Don't be fooled by the cheap CMOS single chip cameras which have 1/2 the resolution, 1/4 the light sensitivity and draw over twice the current! The black & white models are also super IR (Infrared) sensitive. Add our invisible to the eye, IR-1 illuminator kit to see in the dark! Color camera has Auto gain, white balance, Back Light Compensation and DSP! Available with Wide-angle (80°) or super slim Pin-hole style lens. Run on 9 VDC, standard 1 volt p-p video. Use our transmitters for wireless transmission to TV set, or add our IB-1 Interface board kit for audio sound pick-up and super easy direct wire hook-up to any video monitor, VCR or TV with A/V input. Fully assembled, with pre-wired connector.

CCDWA-2, B&W CCD Camera, wide-angle lens.....\$69.95
CCDPH-2, B&W CCD Camera, slim fit pin-hole lens.....\$69.95
CCDC-1, Color CCD Camera, wide-angle lens.....\$129.95
IR-1, IR Illuminator Kit for B&W cameras.....\$24.95
IB-1, Interface Board Kit.....\$14.95

Mini Radio Receivers

Imagine the fun of tuning into aircraft a hundred miles away, the local police/fire department, ham operators, or how about Radio Moscow or the BBC in London? Now imagine doing this on a little radio you built yourself - in just an evening! These popular little receivers are the nuts for catching all the action on the local ham, aircraft, standard FM broadcast radio, shortwave or WWV National Time Standard radio bands. Pick the receiver of your choice, each easy to build, sensitive receiver has plenty of crystal clear audio to drive any speaker or earphone. Easy one evening assembly, run on 9 volt battery, all have squelch except for shortwave and FM broadcast which has handy SCA output. Add our snazzy matching case and knob set for that smart finished look.

AR-1, Airband 108-136 MHz Kit.....\$29.95
FR-1, WWV 10 MHz (crystal controlled) Kit.....\$34.95
FR-1, FM Broadcast Band 88-108 MHz Kit.....\$24.95
FR-6, 6 Meter FM Ham Band Kit.....\$34.95
FR-10, 10 Meter FM Ham Band Kit.....\$34.95
FR-146, 2 Meter FM Ham Band Kit.....\$34.95
FR-220, 220 MHz FM Ham Band Kit.....\$34.95
SR-1, Shortwave 4-11 MHz Band Kit.....\$29.95
Matching Case Set (specify for which kit).....\$14.95

Tiny FM Transmitters



Gosh, these babies are tiny - that's a quarter in the picture! Choose the unit that's best for you. FM-5 is the smallest tunable FM transmitter in the world, picks up a whisper 10' away and transmits up to 300'. Runs on tiny included watch battery, uses SMT parts. FM-4 is larger, more powerful, runs on 5-12 volts, goes up to a mile. FM-4.5 operates in standard FM band 88-108 MHz. FM-6 is crystal controlled in 2 meter ham band, 146.535 MHz, easily picked up on scanner or 2 meter rig, runs on 2 included watch batteries. SMT (surface mount) kits include extra parts in case you sneeze & lose a part!

FM-4MC, High Power FM Transmitter Kit.....\$17.95
FM-5, World's Smallest FM Transmitter Kit.....\$19.95
FM-6, Crystal Controlled 2M FM Transmitter Kit.....\$39.95
FM-6, Fully Wired & Tested 2M FM Transmitter.....\$69.95

Super Pro FM Stereo Transmitter

Professional synthesized FM Stereo station in 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 freq with Up/Down buttons, big LED display. Input low pass filter gives great sound (no more squeals or swishing from cheap CD inputs!) Limiters for max 'punch' in audio - without over mod, LED meters to easily set audio levels, built-in mixer with mike, line level inputs. Churches, drive-ins, schools, colleges find the FM-100 the answer to their transmitting needs, you will too. Great features, great price! Kit includes cabinet, whip antenna, 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, Pro FM Stereo Transmitter Kit.....\$249.95
FM-100WT, Fully Wired High Power FM-100.....\$399.95

FM Stereo Radio Transmitters

No drift, microprocessor synthesized! Excellent audio quality, connect to CD player, tape deck or mike mixer and you're on-the-air. Strappable for high or low power! Runs on 12 VDC or 120 VAC. Kit includes case, whip antenna, 120 VAC power adapter - easy one evening assembly.

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

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

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

RF Power Booster

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

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

FM Station Broadcast Antenna

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

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

AM Radio Transmitter

Operates in standard AM broadcast band, set to clear channel in your area. AM-25 'pro' version is synthesized for stable, no-drift frequency and is settable for high power output where regulations allow, typical range of 1-2 miles. Entry-level AM-1 has tunable transmit oscillator, runs FCC maximum 100 mW power, expected range 1/4 mile. Both accept line-level inputs from tape decks, CD players or mike mixers, run on 12 volts DC. Pro AM-25 includes AC power adapter, matching case and bottom loaded wire antenna. Entry-level AM-1 has an available matching case and knob set for a finished, professional look. High level modulation for low distortion.

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

NEED LARGE, precision wound coils for vehicle detectors, alarms, loop antennas, proximity detectors, metal locators, direction finders, security gates or other projects? We also sell tubes and AM radio signal boosters which improve reception. Send \$2 for details (refundable with purchase). Fala Electronics-V, POB 1376, Milwaukee, WI 53201.

VOICE CHANGER: PCB with all board mounted components plus speaker. (Watch for our N&V article.) New price \$9.95 postpaid in US. MicroMethods, PO Box 909, Warrenton, OR 97146. 503-861-1765 jdennon@seasurf.com

RAMSEY Binocular Special

Wow, did we nab a deal on these first rate binoculars! Absolutely identical to a famous big name brand here in Rochester, NY - but without their name. Well made with fully coated optics, super nice rubber armored housing over hi-alloy aluminum, includes lens cleaner cloth, neck lanyard and carry case. 4 styles: roof prism 10x25 (10 power, 25 mm), 10x25 high performance roof prism ruby coated objective lens model for demanding use in bright sun, 10x25 high-end BAK-4 lens, porro prism ruby coat with TacGrip housing, and Ultra-View 10x50 porro prism ruby coats. First quality, yet at a close-out price on the exact same units as the 'Trademark' units - but at half price!

BNO-M, 8x21 Mini Monocular.....\$14.95
BNO-1, 10x25 Roof Prism Binoculars.....\$24.95
BNO-1EX, 10x25 Ruby Coated Porro Prism.....\$29.95
BNO-2, 10x25 TacGrip Ruby Coat Porro Prism.....\$59.95
BNO-6, 10x50 Ultra-View Ruby Coat Porro Prism.....\$69.95

World's Smallest FM Radios

Everyone who sees one of these babies says they just gotta have one! Super cute tiny FM radios have automatic scan/search tuning, comfortable ear bud earphones and we even include the battery. The pager style unit looks like a shrunken pager and even has an LCD clock built-in. You will be amazed at the crystal clear amazing sound! That's a quarter in the picture for size comparison - pretty tiny, huh?

MFMT-1, World's Smallest FM Radio.....\$11.95
PFMR-1, Pager Style LCD Clock & FM Radio.....\$12.95

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

Call for our Free Catalog! See our complete catalog and order on-line with our secure server at:

www.ramseyelectronics.com

RAMSEY ELECTRONICS, INC.
793 Canning Parkway Victor, NY 14564

Order Toll-free: 800-446-2295

Sorry, no tech info, or order status at this number
For Technical Info, Order Status
Call Factory direct: 716-924-4560

ORDERING INFO: Satisfaction Guaranteed. Examine for 10 days, if not pleased, return in original form for refund. Add \$6.95 for shipping, handling and insurance. Orders under \$20, add \$3.00. NY residents add 7% sales tax. Sorry, no CODs. Foreign orders, add 20% for surface mail or use credit card and specify shipping method.



ELECTRICITY — STOP BUYING IT!
Legally reduce \$150 monthly bills to as low as \$15. Make FANTASTIC money showing friends, neighbors how! FREE INFO! 1-800-668-1878.

CIRCUIT BOARDS made from your artwork. Quick turn, low rates. Atlas Circuits, PO Box 892, Lincolnton, NC 28092. 704-735-3943.

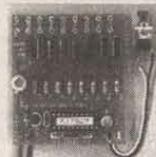
AWESOME KITS: voice changers, levitators, lasers, solar robots, and more! Catalog \$1. LNS Technologies, PO Box 67243, Scotts Valley, CA 95067. www.techkits.com

PALM PILOT never replace batteries again. Simple modification charges batteries in cradle. For Palm Pilots up to IIIx. \$10. Mark Lopez, 22689 Silver Dollar, Corona, CA 91719.

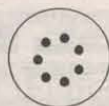
Don't miss a single issue of Nuts & Volts. SUBSCRIBE TODAY! Call 1-800-783-4624 and use your Visa or Mastercard.



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

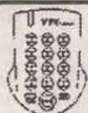


RUNNING LIGHTS KIT. Ideal for Christmas decorations etc. 8 LEDs switch on in 10 push button selectable patterns. 8 speed levels for a total of 80 combinations. Includes PCB, parts and instructions. \$15.95 + \$4.95 shipping. Can operate light bulbs with 8x TRIACS (\$6 extra). Amazon Electronics Tel 1-888-549-3749. Lots of other products. www.electronics123.com



RF DETECTION DISK \$15.00

Are you being bugged? Curious about the RF near your radios? Ever wonder how much wave you get from your microwave? This little unit illuminates into blinking mode when near any RF. Cell phones, PCS phones, cordless phones, hand held transceivers — they all activate the detection disk. (Don't worry, your unit in standby mode won't activate the disk — transmissions and incoming calls cause it to blink!) Compact RF disk can be worn on a neck chain, attached to your key ring, hung from your rear view mirror, or shoved in your pocket until you want to use it! Detects RF 1 Mhz to 2.5 Ghz, and is only activated at close range. Uses a CR-2032 battery — yes, it is included! (Light may be hard to see in bright areas.)



Itty Bitty Phone \$29.95

Did you ever wish for an incredibly small hands-free telephone that keeps your computer desk clear. Gateway's Got It! This little touch-tone phone can sit on your desk, counter top, or even be stuck to your computer monitor! Measuring only about 61mm x 48mm, it is even small enough to fit in your pocket! The detachable earset features a single earbud and a mini boom mic for lightweight hands-free operation. Handy redial and flash buttons too! Mini phone includes detachable ear piece/boom mic, modular phone cord, plastic hang tab, and instructions.

MANUALS — SCHEMATICS WANTED

WANTED: SCHEMATICS/manuals for Elgar IPS1100 UPS. John Altstatt 650-949-1266.

MISCELLANEOUS ELECTRONICS FOR SALE



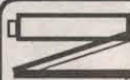
SOLAR-POWERED FAN HAT. Baseball type hat with solar powered fan. Great for sports fans, golfers, etc. Available in red or blue. \$19 plus \$2.00 shipping. CA residents add 7.75% sales tax. Visa/MC/Disc/Amex OK. H.T. Orr Computer Supplies, 249 Juanita Way, Placentia, CA 92670. 714-528-9822, 1-800-377-2023, FAX 714-993-6216.

ELECTRONIC PARTS: LOW, LOW PRICES! Phone, fax, E-Mail for free flyer. Hoffman Industries, 853 Dundee Ave., Elgin, IL 60120. Ph: 847-622-8201, Fax: 847-622-8202, E-Mail: hoffind@aol.com Web site http://hoffind.com

HIGH QUALITY TOOLS AND STAINLESS STEEL HARDWARE. European and American screwdrivers, nut-drivers, pliers, hex-keys, balldrivers, and more! Wiha, Bondhus, and Knipex. Stainless cap screws, machine screws, nuts, washers, U-bolts, and eyes. Free catalog. Robert Mink Import-Export, Box 6437V, Fair Haven, NJ 07704. Telephone or fax 732-758-8388. E-Mail: w2tv@csi.com



ANAHEIM WIRE PRODUCTS. DISTRIBUTOR OF ELECTRICAL WIRE AND CABLE since 1973. Items available from our stock: Hook up wire, Automotive primary wire, GXL, SXL, Plenum cable, Teflon wire, Multi-conductor cable, Irradiated PVC, SO-CORD, Mil-Spec wire, Building wire, Welding cable, Battery cable, Telephone wire, Shrink tubing, Cable ties, Connectors. Wire cut & strip to specs. If interested, please call 1-800-626-7540, FAX: 714-771-5043. Visa/MC/Amex. SEE US ON THE INTERNET: http://www.anaheimwire.com OR E-Mail: info@anaheimwire.com



SONY COLOR CAMERA \$105.00

Gateway's got a color video camera that is compact, comes with its own collapsible/removable stand, and a wall pack power supply and cable for a very affordable price. Camera provides composite NTSC (US Standard) video output that can be fed to a VCR, TV video input jack, or PC video capture card. Features a built-in microphone, and two RCA jacks on the rear of the camera provide convenient outputs for audio and video. Requires 4.5 VDC (use the supplied wall pack rated at output 4.5 VDC input 115 VAC 60 Hz, or experiment — it might be possible to operate from a battery supply for portable use.) Camera measures approx. 3-1/2"x2-5/16"x1" lens adds 3/8" to the length. Perfect for computers, ATV, and those new ham video units!



Solar Panel 12v 100mA \$19.95

Perfect for charging batteries, powering projects, light-duty emergency back-up, and other solar fun applications. These panels are framed and feature red and black alligator clip leads for easy attachment of most applications. approximate dimensions: 5.5" x 12.25" x 0.75"



NO TAN LINES!!! AMAZING MINI MICRO FM RADIO! \$7.50

Much lighter than a heavy jam box with really good sound! This tiny radio (1.5"x1.06"x0.38") has a seek button, reset control, and an on/off switch. Personal listening has never sounded better! Ideal for ballgames, studyhall, and workouts. Battery and nugget style earphones included. Perfect for listening on the beach...compact to fit easily on even the skimpiest swimsuit, and no bulky headset means no tan lines around your ears!

4 inch color video monitor \$195.00

Mini LCD monitor is great for RV use (add a camera and you can watch the rear of your vehicle as you back-up — nifty reversing switch adjusts the image on the display for exactly this use!) Requires 12 VDC, and includes a power cable with an auto cigarette lighter plug for car use. Mounting stand also included! Measures approx. 5.7" x 4.1"x1.6", with a 4" color display. Inputs for both video and audio — great for camcorder playback viewing, and the kids will love it when you include your VCR in the family vacation plans!



www.gatewayelex.com

THE FINE PRINT: PRICES SUBJECT TO CHANGE WITHOUT NOTICE * GATEWAY IS NOT RESPONSIBLE FOR PRINTING ERRORS * MASTERCARD, VISA AND DISCOVER ACCEPTED * YES, WE'LL TAKE YOUR CHECK — SORRY, NO C.O.D.'s * \$10 MERCHANDISE MINIMUM ON MAIL ORDERS * SUPPLY OF SOME ITEMS IS LIMITED * PRICES DO NOT INCLUDE SHIPPING * UPS GROUND SHIPPING/HANDLING WITHIN THE CONTINENTAL U.S. (ITEMS REQUIRING ADDITIONAL AMOUNTS ARE NOTED)...\$5.00 FOR THE FIRST ITEM, \$0.50 FOR EACH ADDITIONAL ITEM. RESTOCKING CHARGE MAY BE ASSESSED ON RETURNED ITEMS. * YOU'RE JUST JEALOUS BECAUSE THE VOICES ARE TALKING TO ME AND NOT YOU!



8123 PAGE BLVD * ST. LOUIS, MO 63130 * (314)427-6116
9222 CHESAPEAKE DR. * SAN DIEGO, CA 92123 * (619)279-6802
2525 FEDERAL BLVD. * DENVER, CO 80211 * (303)458-5444
MAIL ORDERS CALL TOLL-FREE 1-800-669-5810
FAX ORDERS (314)427-3147



CALL FOR a free electronics catalog or visit our web site at www.bgmicro.com/ B.G. Micro, PO Box 280298, Dallas, TX 75228. Order line 1-800-276-2206.

NUCLEAR ELECTRONICS (NIM, CAMAC), PMTs, optics, high vacuum, and high voltage components and equipment. Guaranteed quality at reasonable cost. OE Technologies, Box 703, La Madera, NM 87539. Ph: 505-583-2482, Fax: 505-583-9190, E-Mail: oetech@newmexico.com <http://www.oetech.com>

NEW, USED, and "as is" Radio Shack items. Software, printers, computers, books, parts for R/C cars, etc. Free list. B and B Enterprises, 208 S. Pulaski St., Baltimore, MD 21223. 410-566-5388.

FREE FLYER on DBS, cable TV, phones, credit cards, schematics, health items. Bill 1-800-879-9657.

AUTOMOTIVE PC scan tools 96+ except Ford. Free browser. \$122 assembled, \$102 kit, student -50%. www.obd-2.com

SOLAR ELECTRIC SUPPLIES: All manner of solar electricity available here. 64 watt panel, \$319. 120 watt panel, \$589. Flexible 5 watt, \$89. Controllers start at \$39.95. Inverters, shunts, racks, mounts, etc., solar roofing shingles. Visit www.planetarypower.com 1-877-SOLAR-PV.

MISCELLANEOUS ELECTRONICS WANTED

WANTED: BALANCING machines & vibration analyzing equipment manufactured by the following: Spectral Dynamics, Hofmann, Bentley Nevada, Schenck, IRD Mechanalysis, Gishott. Contact Mike Park at E.T. Balancing, 12823 Athens Way, Los Angeles, CA 90061. 310-538-9738, FAX: 310-538-8273.

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

DEC EQUIPMENT WANTED!!! We are buying DEC systems, boards, terminals, drives and peripherals. Also Scientific Micro Systems (SMS), DSD, Datability, Dilog, other DEC compatibles, and Computer Output Microfilm (COM) units. Please call for a quote or fax us your equipment list. We buy, sell, and trade. **KEYWAYS, INC.**, 937-847-2300 OR fax 937-847-2350.



WANTED: EXCESS ELECTRONIC COMPONENTS, BOARD-LEVEL COMPONENTS; ICs, MEMORY, TRANSISTORS, DIODES, CAPS, RELAYS, ETC. CALL LA PALMA SEMICONDUCTOR, 714-523-8892 FAX 714-523-8898.

HIGHEST PRICES PAID: I will pay the following prices for Western Electric tubes: 211A/D/E new \$300, used \$175; 212A/D/E new \$750, used \$275; 274A/B (engraved base) new \$250, used \$200; 300B (engraved base) used \$550; 422A new \$50, used \$25; 437A new \$50, used \$25; and many more. Also buying Western Electric, and other audio tube and equipment literature. Call or send us your list. Toll free tel/fax: 1-888-715-8823. Don Singerhouse/Singerhouse Sound, LLC, PO Box 321, New Richmond, WI 54017. E-Mail: singtube@frontiernet.net

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

WANTED: TUBE HiFi/commercial amps, preamps, corner/horn speakers. Altec, Marantz, McIntosh, Western Electric, etc. 405-737-3312 fax 405-737-3355.

WANTED: GEN-RAD 1265A DC power supply, 1266A AC power supply, 1633-PJ range extension, General Radio experimenter publications, 610-932-4019.

Closing Date For Next Issue — July 5th

WANTED: TUBES, radios, transmitters, receivers, gyros, bearings, connectors, relays, lamps, synchros. Hyness Company, 709B Delair Road, Cranbury, NJ 08512-4212. Phone: 609-395-1116, FAX 609-395-1117.

WANT USED or surplus DC motor controls or adjustable frequency AC drives, 1/2 HP and up. DC motors fractional to 3 HP. C. Woodruff, 5507 55th Ave. S., Seattle, WA 98118. Voice/Fax 206-723-8487.

EDUCATION

RF OSCILLATOR DESIGN. Learn to design RF oscillators from a pro. 90 page course presents the knowhow of oscillator analysis, simulation and design with breadboard experiments. Requires AC/DC and some calculus. \$39+\$6 S&H. RFLS, PO Box 9185, Gaithersburg, MD 20898-9185.

Continued on page 81

Tired of Expensive Inkjet Cartridges ? Save 90% on Inkjet Inks !

Printer	# of Refills		Cost/Refill		Kit Price	
	Black	Color	Black	Color	Black	Color
HP 500 Series, 400, Officejet 300, 350, Fax	7	14	4.71	2.85	32.95	39.95
HP 600 Series, Officejet 500, 570, 600	7	14	4.71	3.21	32.95	44.95
HP 820C, 855C, 870C, 1000C, 1150C, Copier 120, 210	6	10	6.67	4.00	39.95	39.95
HP 720C, 722C, 712C, 880C, 890C, 895C 1120C, 1170C	6	10	6.67	4.50	39.95	44.95
Canon BJ-10, 200, 210, 240, 250 Apple SWriter 1200, 1500	14	20	2.15	2.00	29.95	39.95
Canon BJC-4000 Series, C2500, C3000, C3500, C5000	60	60	0.50	0.67	29.95	39.95
Apple StyleWriter 2400, 2500						
Canon BJC-600, 610, 620 Apple SWriter Pro	20	13	1.50	3.07	29.95	39.95
Epson Stylus Color, Color Pro, Pro XL	12	12	2.50	3.33	29.95	39.95
Epson Stylus Color II, IIs, 1500 (Black)	15	15	2.00	2.66	29.95	39.95
Epson Stylus Color 500, 200	20	17	1.50	2.35	29.95	39.95
Epson Stylus Color 400, 600, 800, 850, Photo	20	17	1.50	2.65	29.95	44.95
Lexmark JP 1000, 1020, 1100, ExecJet II, IIC, Medley 4C	10	17	3.00	2.35	29.95	39.95
Lexmark JetPrinter 5700, 5000, 7000, 7200, 3200	15	17	2.67	2.35	39.95	39.95
Compaq IJ700, IJ900, Xerox XJ9C	15	17	2.67	2.35	39.95	39.95
Xerox Home Center 450C, XJ6C Inkjet	22	12	1.36	3.33	29.95	39.95

SAVE 30 - 50% on New Compatible Cartridges!

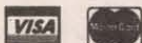
Printer	BLACK	COLOR
	CARTRIDGE	CARTRIDGE
Canon BJC-4000 Series, C2500, C3000, C3500, C5000	\$5.50	\$12.95
Apple StyleWriter 2400, 2500	\$5.50	\$12.95
Canon BJC-600, 610, 620 Apple StyleWriter Pro	\$4.95 (9cc)	\$4.95 @ (9cc)
Hi-Capacity Canon BJC-600, 610, 620	\$5.95 (15cc)	\$5.95 @ (12cc)
Canon BJC-70, BJC-80	\$9.95 (3-pak)	\$14.95 (3-pak)
Epson Stylus Color, Color Pro, Pro XL	\$12.00	\$19.00
Epson Stylus Color II, IIs	\$14.00	\$19.00
Epson Stylus Color 500, 200	\$14.00	\$19.00
Epson Stylus Color 400, 600, 800, 850, 1520, Photo	\$14.00	\$19.00
Epson Stylus Color 440, 640, 740	\$14.00	\$19.00

- BULK Inks, Refill Accessories
- Glossy card stock & Coated Paper
- School & Government PO's Welcome
- 2 - 3 Day Shipping

Quality Inks for:
HP • Epson • Lexmark
Canon • Apple • DEC

Inkjet

Southwest



Call or see us online!

Monday - Friday
8:30 - 5:30 PST 11:30 - 8:30 EST

www.inkjetsw.com

(480) 668-1069 Fax

1-800-447-3469

(480) 668-0959

Events CALENDAR

JULY 1999

JULY 3

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

KY - TOMPKINSVILLE - Hamfest. The National Guard Armory, Hwy. 163 N. Talk-in: 146.775 repeater. Monroe County ARC, David Welch K4PL, 502-678-5784. J. Bunch, 502-678-5784. E-Mail: dwelch@glasgow-ky.com

NC - SALISBURY - Hamfest. Firecracker Hamfest. Civic Center. Rowan ARS, Ralph Brown WB4AQK, 704-636-5902. E-Mail: rbrown@salisbury.net

PA - LEHMAN - Wilkes-Barre Hamfest. Luzerne County Fairgrounds, Rte. 118 (I-81 Exit 47B to Rt. 309 to Rt. 415 to Rt. 118), 8am. FCC Exams. Talk-in: 146.52 & 146.61. Murgas ARC, Stan Perry KE3TC, 570-735-2385; E-Mail: slperry@epix.net Bob N3FA, 570-288-3532.

JULY 4

PA - BRESSLER - Firecracker Hamfest. Emerick Cibort Park, Penn St. 8am. VE Exams. Talk-in: 146.16/76 & 146.52 simplex. Harrisburg ARC, Richard Bordner W3NJB, 717-939-4825. E-Mail: n3njb@aol.com

JULY 9-10-11

CANADA - MANITOBA - BRANDON - Hamfest. International Peace Garden, Dave Snyder VE4XN, 204-728-2463. E-Mail: dsnyder@mb.sympatico.ca

JULY 10

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

CANADA - ONTARIO - MILTON - Hamfest. Burlington ARC, Alan Montgomery VE3FCJ, 905-332-5282. E-Mail: ontariohamfest@canada.com Web: http://www.bigwave.ca/~ve3fcj/barc/flyer

GA - GAINESVILLE - Hamfest. Lanierland ARC, Ken Parrish KN4QO, 770-867-9833. E-Mail: kn4uo@mindspring.com

IN - INDIANAPOLIS - ARRL Central Division Convention, Rick Ogan N9LRR, 317-251-4407. E-Mail: oganr@in.net

MD - BRUNSWICK - Hamfest. Mid-Atlantic DX & Repeater Assn., Roy Bates N2CSQ, 301-834-9351. E-Mail: MADRA@qsl.net

ME - UNION - Hamfest. Fairgrounds. Pen-Bay ARC, Will Chadwick WC1W, 207-785-2739. E-Mail: wilchad@tdewater.net

MI - PETOSKEY - Swap & Shop. Emmet County Fairgrounds, US 31, 2 bks W of 131, 8am-1pm. VE Exams. Talk-in: 146.68 (-). Straits Area ARC, Tom W8IZS, 616-539-8459; Dirk K8BJK, 616-348-5043. E-Mail: kg8bjk@qsl.net

MO - KANSAS CITY - Midwest Division Convention. Bob Roske WA0CLR, 816-436-0069. E-Mail: wa0clr@worldnet.att.net

NY - BATAVIA - Hamfest. Genesee fairgrounds. 6am-3pm. Talk-in: W2RCX 147.285+, "Gram," Harold Hay, 716-343-2844. E-Mail: wa2abq@aol.com

TX - TEXAS CITY - Hamfest. Tideland ARS, Joe Wileman AA5OP, 409-945-6794

WI - EAU CLAIRE - Hamfest. Eau Claire ARC, Jim Staats KG9MV, 715-838-9108. E-Mail: kg9mv@aol.net Web: http://www.ecarc.org

WI - OAK CREEK - Swapfest. American Legion Post 434, 9327 S. Shepard Ave. 6:30am-2pm+ CDT. Talk-in: 146.52 (W9TXE). South Milwaukee ARC, Inc., 414-762-3235

JULY 11

IL - PEOTONE - Hamfest. Will County Fairgrounds. Talk-in: 146.94. Kankakee Area Radio Society, Billie Kerouac KF9IF, 815-939-7548. E-Mail: dkbb@megsnet.net Web: http://www.geocities.com/capecanaveral/hanger/5711

NY - PATCHOGUE - Hamfest. 9am-2pm. VE Exams 12pm. Talk-in: K2TFC (East) 147.025 repeater (PL 91.5). Mid-Island ARC, Mike Grant N2OX, 516-736-9126. E-Mail: globalcm@erols.com Web: http://www.qsl.net/mid-islandarc/hamfest.html

OH - BOWLING GREEN - Hamfest. County Fairgrounds. 8am-1pm. VE Exams 9am. Talk-in: 147.18+ or 444.475 PL 77.0 Hz. Wood County ARC, Bob Boughton N1RB, 419-354-1811. E-Mail: boughton@bgn.net.bgsu.edu Web: http://bravels.bgsu.edu/~boughton/wcarc.html

PA - KIMBERTON - Valley Forge Hamfest. Fire Co. Fairgrounds, Rt. 113 (S of Rt. 23), 8am. Mid-

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.

Atlantic ARC, Bill Owen W3KRB, 610-325-3995. E-Mail: hamfest-info@marc-radio.org

PA - PITTSBURGH - Hamfest. Northland Public Library, 300 Cumberland Rd. 8am-3pm. Talk-in: 149.09 W3EXW. North Hills ARC, H. Rey Whanger W3BIS, 412-828-3694 (ph & fax). E-Mail: w3bis@freeweb.com Web: http://nharc.pgh.pa.us/

JULY 16-17-18

MT - EAST GLACIER - Montana State Convention, Darrell Thomas N7KOR, 406-453-8574. E-Mail: n7kor@mcn.net

Web: http://www.tatech.com/hamfest/

JULY 17

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

CO - LOVELAND - Superfest. Larimer County Fairgrounds, 700 Railroad Ave. 8am-2pm. Talk-in: 145.115- or 146.85. Northern CO ARC, 970-352-5304

LA - SLIDELL - Hamfest. Ozone ARC, Ronald Riviere WB5CXJ, 504-882-5067

NC - CARY - Mid-Summer Swapfest. Cary Community Center, 404 Academy St., Chapel Hill Rd. & Academy St. VE Testing. Talk-in: 147.15+ & 147.15. Cary ARC, POB 53, Cary, NC 27512; include SASE.

NY - FRANKFORT - Hamfest. Utica ARC, Bob Decker AA2CU, 315-797-6614. E-Mail: ktmd@borg.com

OH - WELLINGTON - Hamfest. Lorain County Fairgrounds. 8am-2pm. VE Exams. Talk-in: 146.10/70. Northern Ohio ARS, John Shaaf KC8A0X, 216-696-5709. E-Mail: kc8a0x@qsl.net

PA - SALEM TOWNSHIP - Hamfest. Beach Haven Carnival Grounds (I-80 Exit 36 or 38 N to US-11), 8am. VE Exams. Talk-in: 145.130 (PL 77.0) & 146.52 simplex. Jonestown Mountain Repeater Assn., Charlie Hooker AD3L, 570-864-2571 or fax 717-864-2377; Rich N3YGL, 570-784-0488; Mike K3EVQ, 570-752-1334; Walter N3JAJ, 570-822-0180. E-Mail: chooker@epix.net

TX - DENISON - North Texas Hamfest '99, Wilmer O. Kinsey WB5DCU, 903-893-5872. E-Mail: wb5dcu@gte.net

Web: http://homel.gte.net/wb5dcu/nortex99.html

JULY 18

IL - SUGAR GROVE - Hamfest. Waubesa Community College, Rt. 47 at Harter Rd. (5 mi NW of Aurora). 8am. VE Exams. Talk-in: W9CEQ - 147.210 (+) PL 103.5/107.2 - AFAR repeater. Fox River Radio League, James Von Olnhausen N9JZC, 630-879-3042. E-Mail: n9jzc@amsat.org

Web: http://www.frrl.org/hamfest.html

MA - CAMBRIDGE - Flea at MIT. Albany and Main Sts. 9am-2pm. Talk-in: 146.52 & 449.725/444.725 W1XMR PL 114.8 (2A). Nick Altenbernd KA1MQX, 617-253-3776 (9-5). Web: http://web.mit.edu/w1mx/www/swapfest.html

MO - WASHINGTON - Hamfest. Zero Beaters ARC, Dave Neal N0PNP, 314-532-2477 days, 314-458-3254 eves. E-Mail: Dave Neal@msn.com

Web: http://zbarc.usmo.com/

NJ - AUGUSTA - Hamfest. Sussex County ARC, Dan Carter N2ERH, 973-948-6999. E-Mail: n2erh@email.com

Web: http://www.scarcnj.org

OH - VAN WERT - Hamfest. Van Wert County Fairgrounds, US Rt. 127 S. 8am-3pm. VE Exams. Talk-in: 146.85 (-). Van Wert ARC, Bob Barnes WB8LPY, 419-238-1877. Bob K8BIAF, 419-795-5763. E-Mail: barnesr@bright.net

Web: http://www.bright.net/~barnesr/w8fy.html

JULY 22-23-24-25

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@megsnet.net

www.computercentralshows.com

Five Star Productions

810-890-0988 E-Mail: jeff@fivestar

www.fivestarshow.com

Georgia Mountain Productions

706-838-4827.

E-Mail: gamtpro@blrg.lds.net

georgiamountain.com

Gibraltar Trade Center, Inc.

734-287-2000. Taylor, MI.

IA - CEDAR RAPIDS - Central States VHF

Society Conference. Sheraton Four Points Hotel.

Al Groff KOVM, E-Mail: KOVM@rf.org

Web: http://www.csvhs.org

JULY 23-24

FL - MILTON - Hamfest. Milton ARC, Dean Clark

WB6KUF, 850-626-9752.

E-Mail: acordc@worldnet.att.net

OK - OKLAHOMA CITY - Ham Holiday '99.

Oklahoma State Fair Park (Hobbies, Arts & Crafts

Bldg.), intersection I-40 & I-44, 5-8pm Fri., 8am-

5pm Sat. Talk-in: 146.82. Central Oklahoma

Radio Amateurs, Thomas Webb WA9AFM.

E-Mail: n1pn@swbell.net or tmwebb@telepath.net

Web: http://www.geocities.com/heartland/7332

JULY 23-24-25

AZ - FLAGSTAFF - Hamfest & ARRL AZ State

Convention. Norm Martin KC7FNK, 520-297-

9562. E-Mail: arcathill@aol.com

Web: http://www.hamsrus.com

JULY 24

FL - LANTANA - Flea Market. Next to Pizza Hut,

6170 S. Congress Ave. 7am-12pm. Talk-in:

147.045. The Major Armstrong FM Assn., Jeff

Beals WA4AW, 561-586-5120. At West W4SDC,

561-641-8244

NH - NASHUA - Hamfest. Res Ctr Church. NE

Antique RC 617-923-2665

OH - CINCINNATI - Hamfest. Diamond Oaks

Career Dev. Campus, 6375 Harrison Ave. VE

Exams. Talk-in: 146.67 & 146.925. OH-KY-IN

ARS, Dana Laurie WA8M, 513-761-7388.

E-Mail: wa8m@aol.net

Web: http://www.qsl.net/k8sch

JULY 24-25

SD - CLEAR LAKE - Hamfest. Deuel County

ARC, Don Clifford N7AXW, 605-876-2671.

E-Mail: drc@tactel.com

JULY 25

CA - SANTA ANA - Swapmeet. ACP parking lot.

Mary Russ W4-558-8813

MD - TIMONIUM - Hamfest. Timonium

Fairgrounds, York Rd. off I-695, I-83. 8am. VE

All listing information should be sent to:

Nuts & Volts Magazine

Events Calendar

430 Princland Court

Corona, CA 91719

Phone 909-371-8497

Fax 909-371-3052

E-mail events@nutsvolts.com

Gibraltar Trade Center, Inc.

810-465-6440. Mt. Clemens, MI.

KGP Productions

1-800-631-0062, 732-297-2526.

E-Mail: kgp@mail.com

MarketPro, Inc., 201-825-2229

http://www.marketpro.com

MarketPro, Inc., 301-984-0880.

E-Mail: md@marketpro.com

http://saamarketpro.com

Narisaam Computer Show

770-663-0983.

E-Mail: narisaam@aol.com

Web: http://www.showsale.com

Northern Computer Shows

978-744-8440

E-Mail: inquiries@ncshows.com

Web: ncshows.com

Peter Trapp Computer Shows, 603-

272-5008. Web: www.petertrapp.com

Exams. Talk-in: 147.030 (+) & 224.960 (-) &

448.325 (-). Baltimore Radio Amateur TV Society,

410-461-0086. E-Mail: brats@smart.net

Web: http://www.smart.net/~brats

OH - HAMDEN - Hamfest. 8am-2pm. Firefighters

Bldg., East Railroad St. VE Exams 10am. Talk-in:

147.105. Vinton County ARC, Chuck Boyer 740-

384-5238. E-Mail: cboyer@zoomnet.net or Gary

Bowden 740-384-3213.

JULY 30-31-AUGUST 1

OR - PORTLAND - Pacific Northwest DX

Convention. Willamette Valley DX Club, Al Rovner

K7AR, 360-256-7437 E-Mail: alanr@pacifier.com

Web: http://www.qsl.net/wvdx

JULY 31

IN - HUNTINGTON - Hamfest. Huntington County

440 Repeater Group, Ray Tackett KC9DZ, 219-

786-0029 or 219-786-0057.

E-Mail: rtackett@ctlnet.com

KY - BOWLING GREEN - Hamfest. American

Legion Post 23, 208 Dishman Ln. VE Exams.

Talk-in: K4LOL 147.33. Kentucky Colonels ARC,

Fred Painter, KA4CFW, 502-842-3193.

E-Mail: ka4cfw@mindspring.com

Web: http://kcarc.premiernet.net

NC - WAYNESVILLE - Hamfest. Haywood County

Fairground. Western Carolina ARS, Carl Smith

N4AA, 828-683-4251. E-Mail: wcarc@dxpub.com

NV - RENO - Hamfest. Sierra Nevada ARS, Bill

Masie K7NHP, 775-246-3756.

E-Mail: macm.ncsmasie@juno.com

OR - BASTON - Hamfest. 9am-3pm. VEC

Exams. Talk-in: K7CCH repeater, 146.610 MHz

(600 no PL). Coos County ARC, Brian Howard

W7MLT, 541-572-5623. E-Mail: w7mlt@usa.net

AUGUST 1999

AUGUST 1

IN - ANGOLA - Hamfest. Land of Lakes ARC, Bill

Brown WD9DSN, 219-475-5897.

E-Mail: sharon.l.brown@gte.net

OH - RANDOLPH - Hamfest. Portage County

Fairgrounds. 8am-4pm. VE Exams. Talk-in:

Nuts & Volts Magazine/JULY 1999 63

Events CALENDAR

145.39 600 MHz. Portage ARC, Joanne Solak KJ30, 330-274-8240. E-Mail: jsolak@apc.net Web: http://parc.portage.oh.us

VA - BERRYVILLE - Winchester Hamfest. Clarke County Ruritan Fairgrounds. 6am. VE Exams. Talk-in: 146.82 (-) W4RKC repeater. Shenandoah Valley ARC, Guy Avey W3INT, 540-678-9970; Jane Barb KD4IET, 540-955-1745. E-Mail: ibarb@visualink.com Web: http://www.vvalley.com/svarc/hamfest or http://www.visualink.com/shenvalleyarc

AUGUST 6-7

TX - AUSTIN - Texas State ARRL Convention. Austin ARC, Austin Repeater Org & Texas VHF-FM Society, Joe Makeever W5HS, 512-345-0800.

E-Mail: jomak@ibm.net Web: http://www.repeater.org/summerfest/

AUGUST 6-7-8

SD - WATERTOWN - Dakota Division Convention. Lake Area Radio Klub, Jerry Hegg NOJH, 605-886-7151. E-Mail: n0jh@dailypost.com

AUGUST 7

CA - CHICO - Hamfest. Golden Empire ARS, Muriel Pope K6QSK, 530-342-4765. E-Mail: k6gsk@w6rhc.org

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

IL - CARLINVILLE - Hamfest. Macoupin County

Fairgrounds, Rt. 4, I-55 exit 60. 7am-12pm. Talk-in: 146.82 or 443.400+ 103.5PL. Macoupin County ARC, Tim Jones 217-627-2355, KA9VIV. E-Mail: jester25@cnet.net. Jim Pitchford N9LQF, E-Mail: esda@cnet.net

IL - QUINCY - Hamfest. Western Illinois ARC, Jim Funk N9JF, 217-336-4191. E-Mail: jfunk@adams.net Web: http://www.qsl.net/s9awe

ME - ST. ALBANS - Hamfest. Snow Mobile Club. Howard W1SBI, 207-876-3702

MI - TAWAS - Hamfest. Iosco County AR Enthusiasts, John Hanley KA8AIR, 517-756-2845. E-Mail: ka8aip@centuryinter.net

MO - SPRINGFIELD - Hamfest. Southwest Missouri ARC, Karen Thorpe N0TDW, 417-889-6775. E-Mail: n0tdw@juno.com

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

NY - WEEDSPORT - Hamfest. Auburn ARA, Joe Kahler WA2NGX, 515-364-5135. E-Mail: htx@usa.net

OH - COLUMBUS - Hamfest. Aladdin Shrine Facility. 8am-3:30pm. VE Exams. Talk-in: 147.24 receive/147.84 transmit. Voice of Aladdin ARC, Jim Morton KB8KPJ, 614-846-7790

PA - MATAMORAS - Hamfest. Tri-State ARA, Dave W2DRH, 914-856-2529; Ray WY2D, 914-856-1733; Rich K3BBC, 570-559-7401

AUGUST 7-8

WA - SPOKANE - ARRL Eastern WA Section Convention. University High School, 10212 E. 9th Ave. Sat: 9am-5pm, Sun: 8am-12pm. VE Exams. Neil Gallup N7LVO, 509-928-7442. E-Mail: n7lvo@cnet.com Betsy Ashleman N7WRQ, 509-448-5821. E-Mail: n7wrq@aol.com Web: http://www.iewa.com/~n7utg

AUGUST 8

IA - AMANA - Hamfest. Cedar Valley ARC, Wayne Kolosik K1OFE, 319-393-4224. E-Mail: k1ofe@usa.net

IL - PEOTONE - Hamfesters Hamfest. Will County Fairgrounds. Tom Davis KB9NUQ, 708-210-9548; David Brasel NF9M, 708-448-0580. E-Mail: n7gn@aol.com or tdavis@internetplus.net

OH - LISBON - Hamfest. Triangle ARC, Mike Mays KB8JNM, 330-386-6021. E-Mail: mike.mays@usa.net Web: http://www.qsl.net/tarc

OH - MARTINS FERRY - Hamfest. Triple States RAC, Ralph McDonough KBAN, 740-546-3930. E-Mail: kb8an@aol.com Web: http://www.qsl.net/tsrac

AUGUST 14

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

NY - WESTMORELAND - Hamfest. Rome RC, Jack Roux KB2TXR, 315-336-1391

OH - NELSONVILLE - Hamfest. Sunday Creek AR Federation, Russell Ellis N8MWK, 740-767-2226. E-Mail: scarf@hocking.edu

WV - HUNTINGTON - Hamfest. Tri-State ARA, Dwight Smith WB8JPJ, 304-522-7865 eves; 304-523-6675 days. E-Mail: wb8jpj@arll.net E-Mail: tara.amateur.radio@juno.com

AUGUST 15

CO - GOLDEN - ARRL Colorado State Convention. Jefferson County Fairgrounds, 15200 W. 6th Ave. (Indiana Exit). 8:30am-2pm. Denver Radio Club, Bob Lindell N0VIX, 303-422-0610. E-Mail: KB0QAB@arll.net

IN - LAFAYETTE - Hamfest. Tippecanoe County Fairgrounds. Talk-in: W9REG 147.135/443.775. E-Mail: KB0QAB@arll.net

MA - CAMBRIDGE - Flea at MIT. Albany and Main Sts. 9am-2pm. Talk-in: 146.52 & 449.725/444.725 W1XM/R PL 114.8 (2A). Nick Altenbernd KA1MQX, 617-253-3776 (9-5). Web: http://web.mit.edu/w1xm/www/swapfest.html

MI - JACKSON - Hamfest. Jackson Community College. VE Exams. Talk-in: 146.88 W8JXN. Cascades ARS, Dennis Byrne KC8JLZ, 517-522-4058. E-Mail: byrmeda@voyager.net

NJ - BAYVILLE - Hamfest. Jersey Shore ARS, Bob Murdock W2XNJ, 732-269-6379. E-Mail: JARSFEST@aol.com Web: http://members.aol.com/jarsfest/jarsfest.html

NY - DEPEW - Hamfest. Hearstone Manor, 333 Dick Rd. Lancaster ARC, Luke Calliano N2GDU, 716-634-4667. E-Mail: lcalliano@freeweb.com Web: http://hamgate.sunnyer.edu/~larc/Gre

OH - WARREN - Hamfest. Trumbull County JVS School, Educational Hwy. Warren ARA, Frank Fitzhugh KD8KJ, 330-652-0452. E-Mail: kd8kj@onecom.com Ray Sollinger N8HRZ, 330-652-5028. E-Mail: n8hrz@onecom.com

PA - YORK - Swapfest and Auction. York VO Tech School, Pauline Dr. (1 blk S of I83 Exit 6, Rt 745). Talk-in: 146.865. Swap Fest, John Salony (Ph) 717-741-1780; Greg Towson (fax) 717-741-0874. Gene Warner E-Mail: ad3e@arll.net

WA - NORTH SEATTLE - Antique Radio Swap Meet. Shoreline Museum Parking Lot, N. 175th & Linden Ave. 9am-1pm. Puget Sound Antique Radio Assn., 425-747-1323 or 206-546-5495. Web: http://www.eskimo.com/~bhagen/psara.html

AUGUST 21

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

CANADA - MANITOBA - AUSTIN - MARM Hamfest. Dave Snyder VE4XN, 204-728-2463.

ALL ELECTRONICS

C O R P O R A T I O N

QUALITY PARTS

FAST SHIPPING

DISCOUNT PRICING

CALL, WRITE, FAX or E-MAIL For A Free 96 Page CATALOG. Outside the U.S.A. send \$3.00 postage.

MINI-RIGHT ANGLE GEARHEAD MOTOR WITH CIRCUIT CONTROL

Omron # R2DG-41 Built-in control circuits allow this motor to be used in a continuous or a pulsed mode. In continuous mode the final drive gear turns at 22-45 RPM (3-6 Vdc). In the pulsed mode the final drive gear turns one revolution each time the controller is momentarily pulsed. The motor assembly is 1.75" x 1.25" x 0.5" overall. The nylon final gear is 0.62 diameter and has a little nipple slightly off-center to which a small push-rod could be attached. Motors are in good condition, removed from equipment. Hook-up instructions included.

CAT# DCM-110 **\$7.50 each**
10 for \$60.00

ENCLOSED SWITCHING POWER SUPPLY

Voltek Corp # SPEC7188B Input: 100 - 240 Vac Outputs: +5 Vdc @ 3.70 A, +12 Vdc @ 0.65 A, -5 Vdc @ 0.05 A, +5 Vdc Trickle @ 0.1 A. Metal encased switching supply. Standard three-prong IEC socket power input. 7 conductor, Molex-type connector output. 9" x 2.1" x 1.36". UL recognized. Removed from new equipment.

CAT # PS-27 **\$3.50 each**

3000 MCD ULTRA-BRIGHT RED LED

Everlight # 383URC-2/TR1-C(R) Red, "Ultra-bright" T 1 3/4 LEDs "Tape-and-lead" parts. These are 5 mm diameter water-clear LEDs that light bright red at 20 ma.

CAT# LED-50 **2 for \$1.00**
100 for \$35.00
1000 for \$250.00

INCREDIBLY LOW PRICE! Sony Color Video Camera with Audio

Sony# CCX-Z11/S1. Brand new color video camera with audio. Ideal for surveillance or video conferencing. Good-looking, compact design, only 3.5" X 2.33" X 1.05". Adjustable lens. On-off power switch. RCA jacks for video and audio outputs. Includes 4.5 Vdc power supply, output cables and adjustable desktop camera stand which can easily be used as a wall or ceiling mount bracket. Get one now...at this price they won't last.

CAT# VC-1100 **\$90.00 each**
3 or more \$85.00 each

12 Volt Lamp and Socket

A great lamp assembly for display or special effects lighting. Consists of a removable 12 volt wedge base bulb # 921, 12C21CP wedge base lamp that draws 1.2 Amps. Assembly is 2.6" X 0.95" X 0.75". 19" pigtail leads. Large quantity available.

CAT# LMP-7 **\$1.25 each**
10 for \$10.00 • 100 for \$70.00

"Hi-8" Video Cassette

SONY Hi-8 Top quality, metal particle 120 minute video cassettes. Used for a short time, then bulk-erased. Each cassette has its own plastic storage box.

CAT # VCU-8 **\$3.00 each**
10 for \$28.00 • 100 for \$250.00

ORDER TOLL FREE

1-800-826-5432

MAIL ORDERS TO:
ALL ELECTRONICS CORP.
P.O. BOX 567
VAN NUYS, CA 91408-0567

FAX (818) 781-2653 • INFO (818) 904-0524
INTERNET http://www.allcorp.com/
E-MAIL allcorp@allcorp.com

NO MINIMUM ORDER • All Orders Can Be Charged to Visa, Mastercard, American Express or Discover • Checks and Money Orders Accepted by Mail • Orders Delivered in the State of California must include California State Sales Tax • NO C.O.D. • Shipping and Handling \$5.00 for the 48 Continental United States • ALL OTHERS including Alaska, Hawaii, P.R. and Canada Must Pay Full Shipping • Quantities Limited • Prices Subject to change without notice.

MANUFACTURERS - We Purchase EXCESS INVENTORIES... Call, Write, E-MAIL or Fax YOUR LIST.

Events CALENDAR

E-Mail: dsnydal@mb.sympatico.ca Web: <http://www.mbn.net/mb.ca/~donahue/a.ustin.html>
IN - WARSAW - Hamfest. Kosciuszko County Fairgrounds. 8am-2pm. VE Exams. Hoosier Lakes Radio Club, Loren Melton WB9OST, 219-858-9374 eves. E-Mail: WB9OST@WAVEONE.NET
IN - OAKLAND - Flea Market. American Legion Hall, 65 Oak St. 8am-Noon. Talk-in: 147.49/146.49 out & 441.175 in/446.175 out & 146.52 simplex. Ramapo Mountain ARC, Tony Cassera N2KDZ, 973-839-3564.
 E-Mail: acassera@intac.com

NY - ITHACA - Hamfest. Tompkins County Airport. Talk-in: 146.97 (600). Tompkins County ARC, David Flinn W2CFP, 607-533-4797.
 E-Mail: dave@starlink.com
 Web: <http://www.compcenter.com/~tcarc>
VA - VINTON - Hamfest. William Byrd High School, Washington Ave. 9am-3pm. VE Exams. Roanoke Valley ARC, Mike Marsh KF4MUB, 540-389-3056. E-Mail: mikemk4mub@aol.com Web: <http://ourworld.compuserve.com/homepages/ficu> pp/rvarc.htm

WA - LONGVIEW - Hamfest. Cowitz County Expo Center, Fairgrounds. 9am-1pm. Talk-in: 147.26+ K7VZV repeater. Lower Columbia ARA, Bob Morehouse KB7ADO, 360-422-6076 (after 6pm wkdays). E-Mail: kb7ado@aol.com Web: <http://www.qsl.net/nct/p/>

AUGUST 21-22

AL - HUNTSVILLE - Convention. Von Braun Center. Sat: 9am-4:30pm, Sun: 9am-2:30pm. Southeastern Division, Scotty Neustadter W4WW, 256-880-8004. E-Mail: scotty@hiway.net.
NM - ALBUQUERQUE - Duke City Hamfest. Marcus Lieberman KM5EH, 505-836-1724. Fax: 505-352-6154. E-Mail: bucknml@lobo.net Web: <http://www.qsl.net/dchf>

AUGUST 22

KS - SALINA - Hamfest. Central Kansas ARC. Ron Tremblay WA0PSF, 785-827-8149. E-Mail: tremblay@midusa.net
MI - CORUNNA - Hamfest. Genesee County RC, Mid MI Wireless Assn., Lapeer ARC, Shiawassee ARA & Bay Area ARC, Rosemary Podsiadlik NB0HY, 517-288-4145
MO - ST. CHARLES - Hamfest. St. Charles ARC, Ken Flesher KB0VLN, 314-428-4383. E-Mail: kflesher@aol.com
 Web: <http://www.qth.com/wb0hsl/>
NE - OMAHA - Hamfest. AK-SAR-BEN ARC, Gerry Gross WA6POZ, 402-895-7367. E-Mail: wa6poz@aol.com Web: <http://www.qsl.net/k0usa>
NJ - MULLICA HILL - Hamfest. Gloucester County ARC, John Schumacher N2AWD, 215-238-4955. E-Mail: schumacher@kyw.com Web: <http://users.snip.net/~gradywhite>
NY - YONKERS - Hamfest. Yonkers ARC, John Costa WB2AQL, 914-969-6548. E-Mail: wb2aul@aol.com

AUGUST 27-28

LA - NEW ORLEANS - New Orleans International DX Convention, Don Boudreau W5FKX, 504-737-9733. E-Mail: dboudr@lsuic.edu Web: <http://www.ngnrf.org/~w5ru/>

AUGUST 27-28-29

CT - ENFIELD - Convention. Harley Hotel, 1 Bright Meadow Blvd. (off Rt. 5), Eastern VHF/UHF Society, Bruce Wood N2LIV, 516-265-1015. E-Mail: w2lv@ntpl.net E-Mail: bdwood@erols.com Web: <http://uhavax.hartford.edu/~newswhf>

AUGUST 28

KS - CHANUTE - Hamfest. Chantane Area ARC, Charlie Ward WD0AKJ, 316-431-6402
WV - WESTON - Convention. West Virginia State AR Council, Dick Fowler N8FMD, 304-623-9479. E-Mail: n8fmd@neumedia.net

AUGUST 28-29

FL - SARASOTA - Computer Show. Municipal Auditorium. Frank Cox 941-954-0202

AUGUST 29

IL - WOODSTOCK - Hamfest. Tri-County Radio Group, Bob Grosse N9KXG, 708-944-0500. E-Mail: N9KXG@quality-enterprises.com Web: <http://quality-enterprises.com/torg/>
PA - NEW KENSINGTON - Swap/Flea Market. Skyview Radio Society Club House. Bob 724-727-2194
TN - LEBANON - Hamfest. Short Mountain Repeater Club, Patsy Pierce K3PAT, 615-395-4488.

SEPTEMBER 1999

SEPTEMBER 4

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
CANADA - ONTARIO - CARP - Hamfest. Ottawa ARC, Jim Cummings VE3XJ, 613-446-1225. E-Mail: fleamarket@carc.net Web: <http://carc.net/fleamarket>

SEPTEMBER 4-5

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

SEPTEMBER 11

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves
DE - DOVER - Hamfest. Kent County ARC, Larry Roll K3LT, 302-678-4841. E-Mail: yodoc@aol.com or k3lt@magpage.com
IN - SPENCER - Hamfest. Owen County ARA, Kathryn Smith K9INQ, 812-829-2140
ME - WINDSOR - Hamfest. Fairgrounds. AARA,

Frank N1ITR, 207-623-9217
MO - COLUMBIA - Hamfest. Good Time Country, 5551 S. Hwy. 63, 8am-2pm. VE Exams. Central Missouri Radio Assn., Bruce Odle, 3315 Berrywood Dr., Ste. 101, Columbia, MO 65201
NY - BALLSTON SPA - Hamfest. County Fairgrounds. 7am-3pm. VEC Exams. Talk-in: WA2UMX 146.40/147.00 & 147.84/147.24. Saratoga County RACES Assn., Darlene Lake N2XQG, 518-587-2385 E-Mail: lake@capital.net
PA - ERIE - Hamfest. Franklin Twp. Firehall. VE Exams, 9am, Franklin Center Methodist Church, Rt. 98. Talk-in: 146.01/61. Radio Assn. of Erie, Dr. Tom McClain N3HPR, 814-833-1640. E-Mail: TEM@ERIE.NET Web: <http://www.erie.net/~n3nj/hamfest.htm>
WA - GRAHAM - Tacoma Electronics

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

SEPTEMBER 11-12

FL - MELBOURNE - Hamfest. Auditorium. Platinum Coast ARC, Tim Madden K4ITG. E-Mail: k4itg@msn.com
KY - LOUISVILLE - ARRL KY State Convention. Bullitt County Fairgrounds, 165 (South 25 min.). Greater Louisville Hamfest Assn., Herbert Rowe W4WQD, 812-282-7007 or 812-948-0037 (commercial), 502-935-7197 or 606-284-9090 (FleaMkt/TailGate) E-Mail: wd4xl@juno.com Web: <http://www.thepoint.net/~glha/>



RAINBOW KITS



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

FLASHING SAFETY LIGHT

• Push ON / Push OFF switch.
 • Flashes 3 times on 2 AAA batteries.
 • Great for kids, bike riders and joggers.
 • Keep in car for emergencies.
 • Tough ABS case with belt clip
 • Size: 1 3/8" x 2 1/4" x 1 1/8"
BFL-3 BUILT \$6.95
 2 for \$9.95



WIDE BAND PRE-AMP Uses PCB and surface mount technology for better performance. Use this for scanners, HT's, Frequency counters, Satellite Receivers. It amplifies low-level (weak) signals. If the signal is extremely low, two amplifiers can be used in a series.
 • 1MHz to 2.5 GHz 2.8dB NF
 • 1dB compression-OdBm
 • Gain: 1MHz- 20dB to 2.5GHz-6dB
 • Power requirement: 12v @ 6Ma
WBA-6 KIT \$19.95



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

TV NOTCH FILTERS FOR CHANNELS 2 thru 22 ONLY



Our TV filters eliminate unwanted TV channels or interference that alters both sound and video with a BEEP BEEP BEEP. Works on cable channels (2 thru 22) only.
 NOTE: All TV Filter Kits are sold for educational purposes only. You must obtain permission from your local cable company before using these filters on your cable system.
DF-222 KIT \$14.95

FM STEREO TRANSMITTER



Have your own FM radio station. Any stereo signal you plug into the FMST-100 transmitter kit will be transmitted to any FM radio tunable from 76 to 108MHz FM. Plug in your CD player, tape deck and have a wireless link to any FM radio, within 200 ft. Listen to your CD while mowing the lawn. Transmit from your car to your camper, or through an auditorium. Transmit music on one channel sing on the other. Compatible with any audio system. Clarity is excellent, approx. 40dB stereo separation. Length of antenna determines distance of transmission. Comes complete with left & right input level control as well as a crystal for left & right stereo separation. ANTENNA NOT INCLUDED 9V Battery operation.
FMST-100 SIZE: 1.5" x 1.6" KIT \$29.95
 Cabinet SIZE: 1.5" x 2.5" x 3" \$8.95

RAINBOW MINI-LIGHT Super Bright Flashlight

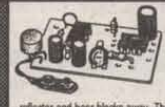
• LED's don't burn out!
 • Battery lasts for years!
 • If you have your keys, you'll have a flashlight!
 • Replaceable battery!
 • Better buy 2, your wife is going to take yours!
 Lights up a complete bedroom at night
 Red MLR \$9.95 each
 Yellow MLB \$9.95 each
 White MLV \$12.95 each
 Infrared MLI \$12.95 each



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



BUSY PHONE LIGHT
 Add this little kit to any or all of your telephones. When one phone is used a red LED will light on the other extension. This lets everyone know when your computer module is in use. Power requirement 9V DC. Size: 1.1" x .8"
TEL-LITE KIT \$9.95



SUPER SNOOPER BIG EAR
 Listen through walls, hear conversations across the room. Add a parabolic reflector and hear blocks away. The BIG EAR can be hidden about anywhere. Makes an ultra sensitive intercom. Can be used as a 1.5W AMP. We supply a mini-electret mike in the kit. Power requirement 6 to 12v DC. SIZE: 1.75" x 1"
AA-1 BUILT \$29.95 KIT \$10.95



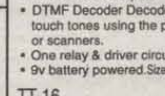
STROBE LIGHT
 Do you need an attention getter, warning light, or flashing light for model airplanes? Then this kit is for you. Use it as an emergency light for your auto, radio tower, even use it on your bicycle. Has a variable flash rate. Power requirement 6 or 12v DC. Size 3.5" x 1.9"
ST-1 KIT \$11.95



AUDIO PREAMP
 Boost your microphones output up to line level! Plug your mic into our AP-1 and drive your amp, to full capacity. Connect an AP-1 to a pair of amplified speakers, plug your mic in and you have an instant PA system. Requires 6 to 12v DC. Size: 1.75" x 1"
AP-1 KIT \$9.95



16 TONE DECODER
 Sweet 16 tone decoder operates great over phone lines, radios or scanners.
 • 16 TTL Level Outputs
 • DTMF Decoder Decodes 16 different touch tones using the phone, radios, or scanners.
 • One relay & driver circuit on board.
 • 9v battery powered. Size: 2.3/4" x 2 1/8"
TT-16 KIT \$34.95



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



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



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



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



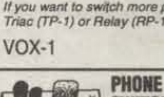
DIGITAL THERMOMETER
 The DT-3 kit will turn your digital volt ohm meter into an accurate digital thermometer with .1 degree resolution. Measure temperatures from -40° to 250°F. The remote sensor is .25" sq. and can be mounted many feet from the meter. Power requirement 9V DC. SIZE: 2" x 1.35"
DT-3 KIT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



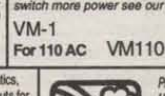
CAPACITANCE METER
 This kit will turn your digital volt meter into a capacitance meter. Turn that junk box of unmarked capacitors into a fortune of usable parts. Measure capacitors from <2.2pF to 2.2uF. Power requirement 9V DC. SIZE: 1.80" x 2"
CA-1 KIT \$12.95



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



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



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



Please add sufficient postage First US \$5.50 Canada \$7.50 Additional LB. Add \$1.00 US FUNDS ONLY. We will accept telephone orders for Visa or Mastercard
Electronic Rainbow Ind., Inc.
 6227 Coffman Rd. Indianapolis, IN 46268
 CALL 317-291-7262 FAX 317-291-7269
 INTERNET: www.rainbowkits.com

HOW TO PLACE A CLASSIFIED AD

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

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

RATE PER WORD

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

WORDS IN BOLD AND/OR ALL CAPS

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

PHOTOS, DRAWINGS, AND BOXES

A photo or drawing may be run at the top of your classified ad for an additional **\$10.00** (1" depth max.) for camera-ready art. No wording is allowed in this area. Add a one-time charge of **\$5.00** to enlarge, reduce, or duplicate line

art, or **\$8.00** for halftone of photographs. To **BOX** your ad, include an additional **\$50.00** for copy-only ads, or **\$75.00** for ads with art or photos.

FAXING IN AD COPY

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

DEADLINE

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

IMPORTANT INFORMATION

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

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

10. Ham Gear For Sale	80. Test Equipment	120. Components	155. Manuals/Schematics Wanted
20. Ham Gear Wanted	85. Security	125. Microcontrollers	160. Misc. Electronics For Sale
30. CB/Scanners	90. Satellite Equipment	130. Antique Electronics	170. Misc. Electronics Wanted
40. Music & Accessories	95. Military Surplus Electronics	135. Aviation Electronics	175. BBS & Online Services
50. Computer Hardware	100. Audio/Video/Lasers	140. Publications	180. Education
60. Computer Software	110. Cable TV	145. Robotics	190. Business Opportunities
70. Computer Equipment Wanted	115. Telephone/Fax	150. Plans/Kits/Schematics	200. Repairs/Service

ADVERTISER'S INDEX

1A Sales	56	Davilyn Corp.	77	La Paz Electronics Int'l.	45	Ramsey Electronics, Inc.	59
Abacom Technologies	81	DeMar Electronics	74	Lemon-Pladd, Inc.	39	R.E. Smith	72
ABC Electronics	94	Digital Products Company	73	Lemos International Co., Inc.	43	Resources Un-Ltd.	19
ACP Super Store	36	DMD Systems Recovery, Inc.	74	Linear Systems	17	Roger's Systems Specialist	37
ActiveWire, Inc.	73	Earth Computer Technologies	58	Lynxmotion, Inc.	12	Saelig Company	34
Advanced Educational Systems	28	Edlie Electronics, Inc.	40	M2L Electronics	56	SAM Electronics	18
Alfa Electronics	53	EDS	33	Matco, Inc.	73, 74	Sam's Electronics	90
All Electronics Corporation	64	E.H. Yost & Co.	44	Meredith Instruments	88	Scott Edwards Electronics, Inc.	81
Allison Technology Corporation	41, 72	Electro Mavin	44	Metric Equipment Sales, Inc.	83	Seabird Technical	74
Alltech Electronics	35	Electro Tool, Inc.	45	microEngineering Labs	17	Sescom, Inc.	73
Alltronics	29	Electronic Goldmine	42	Micromint	24	Shreve Systems	78
American Innovations, Inc.	35	Electronic Products	73	Midland Technologies	73	SiGEM	73
AM Research, Inc.	23	Electronic Rainbow Ind., Inc.	65	Miller Engineering	43	Skycraft Parts & Surplus, Inc.	36
Andromeda Research	11	Electronix Corp.	27	Modern Communications	79	Square 1 Electronics	22
Antique Radio Classified	74	EMAC, Inc.	25	Mouser Electronics	57	SuperCircuits	33
AST Global Electronics	80	EPS	74	Mr. NiCd	44	Surplus Traders	72
Astro Too	74	Equipment Management Technology	12	MSC Electronics	74	Techniks, Inc.	72
Aventrade	72	ExpressPCB	23	Netcom	15	Technological Arts	89
Aviation Components Corp.	73	Foss Warehouse Distributors	72	Norcomm	31	Telulex, Inc.	42
BasiConcepts, Inc.	16	Gateway Electronics, Inc.	60	Northwest Cable & Connector Co.	89	Test Equipment Plus	51
Baylin Publications	27	General Device Instruments	72	Optoelectronics	4	The RF Connection	34
Bilocon Corp.	74	Glentech, Inc.	72	Parallax, Inc.	Back Cover	Timeless Products	36
Bismar Computers Outlet	58	Halted Specialties Co.	3	PARAMAX, INC.	69	TNR Technical, Inc.	73
Black Feather Electronics	9	Howard Electronic Instruments, Inc.	38	Patco Service, Inc.	88	Transistor Network	74
Brick Wall Div., Price Wheeler Corp.	39	H.T. Orr Computer Supplies	46	PCW, Inc.	45	Unicorn Electronics	55
Bytech Services	43	Information Unlimited	26	Phelps Instruments	87	Upstate Games	74
C & S Sales, Inc.	75	Inkjet Southwest	61	Pioneer Hill Software	83	USI Corp.	25
C and H Sales Company	46	Intek Electronic Systems	54	Plans-Kits Unlimited	73	V&V Mach. & Equipment, Inc.	72-74
Cable Mart	44	Intersoft	35	Polaris Industries	41	Vesta Technology, Inc.	73
Circuit Etching Technics	22	Intronics, Inc.	57	Power Quality, Inc.	73	Viking International	39
Circuit Specialists, Inc.	98	Jade Products, Inc.	72	Prairie Digital, Inc.	74	Visitect, Inc.	51
Communications Surplus	73, 74	Jam RF	90	Pulsar, Inc.	9	Weeder Technologies	94
Convergent, Inc.	52	JK microsystems	74	P.V. Power Corp.	74	Western Test Systems	20-21
Corporate Systems Center	2, 99	Junkware.com	73	Quality Kits	73	Wholesale Cable	11
Cunard Associates	24	J-Works, Inc.	16	R & S Surplus	84	Worldwide	72

AMATEUR RADIO & TV

Alltronics	29
Astro Too	74
Communications Surplus	73, 74
Convergent, Inc.	52
Gateway Electronics, Inc.	60
Intersoft	35
Jade Products, Inc.	72
Lemos International Co., Inc.	43
Matco, Inc.	73, 74
Norcomm	31
Ramsey Electronics, Inc.	59
The RF Connection	34

ASSEMBLY SERVICES

Bilcocon Corp.	74
----------------	----

BATTERIES/CHARGERS

1A Sales	56
Aventrade	72
Cunard Associates	24
E.H. Yost & Co.	44
Jade Products, Inc.	72
Mr. NiCd	44
Power Quality, Inc.	73
TNR Technical, Inc.	73

BUSINESS OPPORTUNITIES

Intek Electronic Systems	54
--------------------------	----

BUYING ELECTRONIC SURPLUS

ABC Electronics	94
Alltech Electronics	35
Aviation Components Corp.	73
Black Feather Electronics	9
C and H Sales Company	46
Earth Computer Technologies	58
EPS	74
Equipment Management Technology	12
Intek Electronic Systems	54
Metric Equipment Sales, Inc.	83
Roger's Systems Specialist	37
Skycraft Parts & Surplus, Inc.	36

CABLE TV

Cable Mart	44
Foss Warehouse Distributors	72
Modern Communications	79
PCW, Inc.	45
Sam's Electronics	90
Timeless Products	36
Wholesale Cable	11
Worldwyde	72

CB/SCANNERS

Norcomm	31
USI Corp.	25

CCD CAMERAS/VIDEO

Black Feather Electronics	9
Circuit Specialists, Inc.	98
Matco, Inc.	73, 74
MSC Electronics	74
Polaris Industries	41
Ramsey Electronics, Inc.	59
Resources Un-Ltd.	19
Seabird Technical	74
SuperCircuits	33
USI Corp.	25

COMPONENTS

1A Sales	56
Aviation Components Corp.	73
BasiConcepts, Inc.	16
Circuit Etching Technics	22
Communications Surplus	73, 74
Convergent, Inc.	52
Electronic Goldmine	42
Electronic Products	73
EPS	74
La Paz Electronics Int'l.	45
Linear Systems	17
Pulsar, Inc.	9
SIGEM	73
Skycraft Parts & Surplus, Inc.	36
Unicom Electronics	55
Visitec, Inc.	51

COMPUTER

Hardware	
ACP Super Store	36
ActiveWire, Inc.	73
Allison Technology Corp.	41, 72
Alltech Electronics	35

AM Research, Inc.	23
Bisme Computers Outlet	58
Brick Wall Div., Price Wheeler Corp.	39
Bytech Services	43
Corporate Systems Center	2, 99
DMD Systems Recovery, Inc.	74
Earth Computer Technologies	58
Electro Mavin	44
General Device Instruments	72
Halted Specialties Co.	3
La Paz Electronics Int'l.	45
Northwest Cable & Connector Co.	89
Power Quality, Inc.	73
Roger's Systems Specialist	37
Shreve Systems	78
Techniks, Inc.	72
Upstate Games	74

Software

AM Research, Inc.	23
Bisme Computers Outlet	58
Bytech Services	43
Electronix Corp.	27
Pioneer Hill Software	83

Microcontrollers / I/O Boards

Advanced Educational Systems	28
AM Research, Inc.	23
BasiConcepts, Inc.	16
Bisme Computers Outlet	58
Bytech Services	43
Convergent, Inc.	52
EMAC, Inc.	25
JK microsystems	74
Junkware.com	73
La Paz Electronics Int'l.	45
Lemon-Pladd, Inc.	39
Micromint	24
Parallax, Inc.	Back Cover
PARAMAX, INC.	69
Prairie Digital, Inc.	74
R.E. Smith	72
Scott Edwards Electronics, Inc.	81
Square 1 Electronics	22
Technological Arts	89
Vesta Technology, Inc.	73

Printers/Printer Supplies

H.T. Orr Computer Supplies	46
Inkjet Southwest	61

DESIGN/ENGINEERING SERVICES

ExpressPCB	23
Midland Technologies	73
Plans-Kits Unlimited	73
Prairie Digital, Inc.	74
Pulsar, Inc.	9
V&V Mach. & Equipment, Inc.	72-74

EDUCATION

Advanced Educational Systems	28
BasiConcepts, Inc.	16
Electronix Corp.	27
EMAC, Inc.	25

EVENTS/SHOWS

ACP Super Store	36
SAM Electronics	18

KITS

Alltronics	29
C & S Sales, Inc.	75
Digital Products Company	73
Earth Computer Technologies	58
Edlie Electronics, Inc.	40
Electronic Goldmine	42
Electronic Products	73
Electronic Rainbow Ind., Inc.	65
EMAC, Inc.	25
Gateway Electronics, Inc.	60
Information Unlimited	26
Inkjet Southwest	61
Jade Products, Inc.	72
Lemon-Pladd, Inc.	39
Miller Engineering	43
Plans-Kits Unlimited	73
Quality Kits	73
Ramsey Electronics, Inc.	59
Scott Edwards Electronics, Inc.	81
SIGEM	73
USI Corp.	25
Weeder Technologies	94

LASERS

Information Unlimited	26
Meredith Instruments	88
Resources Un-Ltd.	19
Unicom Electronics	55

MISC./SURPLUS

1A Sales	56
All Electronics Corporation	64
Alltech Electronics	35
Aviation Components Corp.	73
Black Feather Electronics	9
C and H Sales Company	46

FIND
what you need . . .

FAST
BY PRODUCT
OR
CATEGORY

Communications Surplus	73, 74
DeMar Electronics	74
Electronic Goldmine	42
Electronic Rainbow Ind., Inc.	65
EPS	74
Equipment Management Technology	12
Halted Specialties Co.	3
Linear Systems	17
Power Quality, Inc.	73
Resources Un-Ltd.	19
Shreve Systems	78
Skycraft Parts & Surplus, Inc.	36
Surplus Traders	72
Unicom Electronics	55
Viking International	39
Visitec, Inc.	51
Weeder Technologies	94

PROGRAMMERS

Andromeda Research	11
Electronic Products	73
General Device Instruments	72
Intronics, Inc.	57
M2L Electronics	56
microEngineering Labs	17
Upstate Games	74

PUBLICATIONS

Antique Radio Classified	74
Netcom	15
Plans-Kits Unlimited	73
Mouser Electronics	57
Square 1 Electronics	22
Transistor Network	74

RF TRANSMITTERS/RECEIVERS

Abacom Technologies	81
---------------------	----

ROBOTICS

Astro Too	74
Lemos International Co., Inc.	43
Lynxmotion, Inc.	12
PARAMAX, INC.	69
SuperCircuits	33

SATELLITE

Baylin Publications	27
SIGEM	73
Worldwyde	72

SECURITY

American Innovations, Inc.	35
Information Unlimited	26
Intersoft	35
Lemos International Co., Inc.	43
Matco, Inc.	73, 74
MSC Electronics	74
Norcomm	31
Polaris Industries	41
SuperCircuits	33
Visitec, Inc.	51

SOLAR EQUIPMENT

P.V. Power Corp.	74
------------------	----

STEPPER MOTORS

Alltronics	29
PARAMAX, INC.	69

TELEPHONE

Digital Products Company	73
Telulex, Inc.	42
Weeder Technologies	94

TEST EQUIPMENT

ABC Electronics	94
Alfa Electronics	53
Allison Technology Corp.	41, 72
AST Global Electronics	80
Astro Too	74
C & S Sales, Inc.	75
C and H Sales Company	46
Circuit Specialists, Inc.	98
Davilyn Corp.	77
Digital Products Company	73
DMD Systems Recovery, Inc.	74
EDS	33
Electro Tool, Inc.	45
Equipment Management Technology	12
Glentech, Inc.	72
Howard Electronic Instruments, Inc.	38
Intronics, Inc.	57
J-Works, Inc.	16
Metric Equipment Sales, Inc.	83
Optoelectronics	4
Phelps Instruments	87
Pioneer Hill Software	83
Prairie Digital, Inc.	74
R & S Surplus	84
Saelig Company	34
Seabird Technical	74
Sescom, Inc.	73
Telulex, Inc.	42
Test Equipment Plus	51
Western Test Systems	20-21

TOOLS

C & S Sales, Inc.	75
Electro Tool, Inc.	45
Howard Electronic Instruments, Inc.	38
Lemon-Pladd, Inc.	39
Patco Service, Inc.	88
The RF Connection	34

WIRE/CABLE & CONNECTORS

Northwest Cable & Connector Co.	89
Roger's Systems Specialist	37
The RF Connection	34

AMATEUR ROBOTICS

NOTEBOOK

by Robert Nansel

A problem robot builders always face is knowing when to say a robot is done. I've been working on Breadbot for over a year now, and every time I think I'm just about done with it, a new project idea comes along. That's how I got started with the wheel encoder project a couple months ago. All I wanted to do was to make Breadbot reliably go in a straight line so I could experiment with some simple obstacle avoidance algorithms, and now, three months later, I am still working on it.

Last month, I showed how to build the encoder boards, and this month, I had planned to do software for tracking the speed and direction of each wheel. In order to write the code, I first needed to allocate I/O bits for the four new inputs, A and B

channels for both left and right wheels. The DT101 Breadbot already uses two outputs for the servos and three inputs for the bumper switches, leaving only three I/O lines free on port B. A problem.

Strapped for I/O

The easiest solution would have been to steal an I/O line or four from port A, but I didn't want to do that because port A is dedicated to RS-232 (asynchronous) and I2C (synchronous) serial communications on the SIMMStick. I'm not using them for anything yet, but I want to keep the option open.

The next idea I considered was to reduce from three to two the number of input lines used for the bumpers. One straightforward way to do this is to rewire the front

bumper so that it uses the left and right inputs together to indicate a forward bump when both left and right inputs are switched low. This is the way the Parallax GrowBot does it, and it works fine. The left and right whiskers would still operate as before, but a leftward bump on the front bumper would read the same as a left whisker bump, and likewise for the right whisker. For obstacle avoidance, though, it's desirable to have more, not less, directions of touch sensitivity, so I scrapped that idea. Then, too, this method would have left no unassigned I/O bits for adding, say, a magnetic compass sensor; another project I'd like to do before I retire Breadbot.

I looked for ways to expand the number of I/O lines available. There are several ways to go about this. You can be tricky and make each I/O

line do multiple duty by creating a scanning matrix. For instance, if you want 16 switch inputs (for a keypad, say), you can use eight I/O lines; four outputs and four inputs arranged in a 4x4 scan matrix that, with a little software, will scan and debounce the 16 switches. With a little more cleverness, you can also use such a matrix to do simultaneous keypad input and LED output (this is how calculators work). Scanning doesn't save any I/O lines for fewer than nine switch inputs, however, a 3x3 matrix gets you nine I/O and costs six, a 4x4 gets you 16 and costs eight, and a 5x5 gets you 25 and costs 10.

Another way to hang multiple switches on a single digital I/O is to create a simple A/D converter with a capacitor and various resistors — one resistor for each switch input. You periodically set the pin to be a

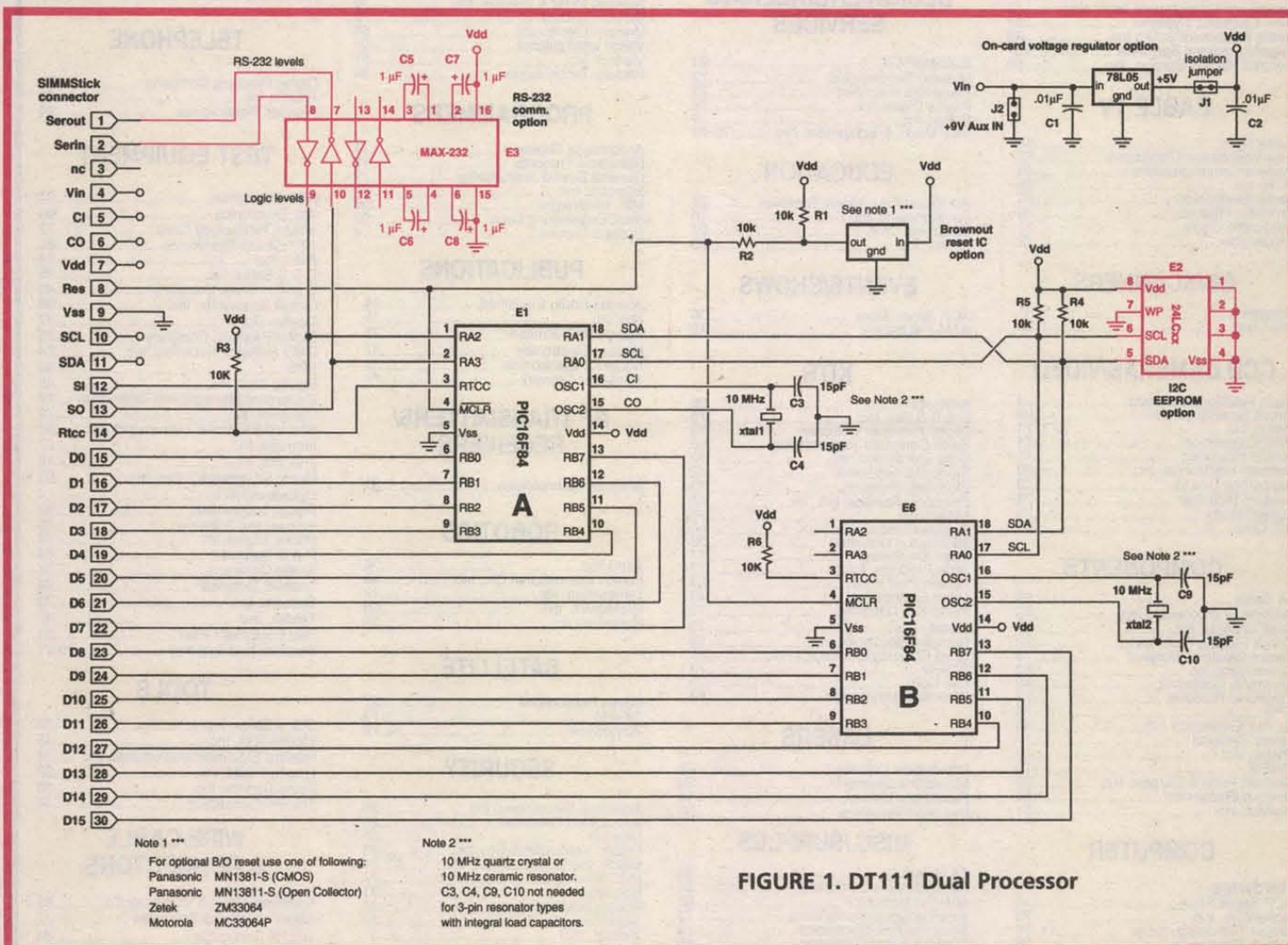


FIGURE 1. DT111 Dual Processor

momentary output LOW to dump the charge out of the timing capacitor, then revert to a high-impedance input. You then time how long it takes the capacitor to charge up to a logic-1 threshold. This time will vary depending on which resistors are switched out of the circuit. Using this method, you can get as many as four switch inputs on one digital I/O. An MCU with a built-in A/D converter will allow you to distinguish perhaps eight different switches on one analog input. These A/D methods aren't easy to apply and tend to be noise-prone, but if you have only one free I/O pin it can be a lifesaver.

Corruption and Blue Smoke

Having eliminated the tricky ways to expand I/O without really expanding I/O, I then looked at the more traditional approach of adding extra hardware to create new I/O lines. There are two broad ways to do this, which I'll classify as the decoded register and shift register methods.

For the decoded register method, you set aside one group of I/O bits to act as a bus to which you wire the inputs of latches, the outputs of tri-state buffers, or the outputs of a multiplexer. Another group of bits is then used to select which register will latch the output data, or which data source — multiplexer or tri-state buffer — will be allowed to drive the bus with input data.

For example, with eight MCU pins allocated as a four-bit bus, three dedicated chip select lines, and a data strobe, you get three four-bit ports, 12 bits altogether — a gain of four bits. Your software has to ensure that only one of the chip select lines is ever active at one time or you'll wind up writing to more than one output port (which may or may not matter), or attempting to read from more than one input port (which does matter because when two or more buffers attempt to drive the same data line with different logic levels, the least that can happen is data corruption and the worst is blue smoke).

If you wire a 3-8 address decoder — a 74HC138, say — to the chip select lines, then you can access eight four-bit ports. For the cost of one chip, you eliminate the possibility of more than one port being selected at a time, and you more than double the potential number of I/O bits from 12 to 32 (though you still have to add enough latches or buffers to handle those extra bits). You can use this same idea when you have 12 MCU I/O lines available to give up to eight byte-wide ports — 64 bits total.

When you have less than eight MCU I/O lines, a bit-addressable latch can be a particularly elegant solution. A 74HC259 eight-bit addressable latch uses five output lines — one data, three select, and one strobe — to produce eight output bits.

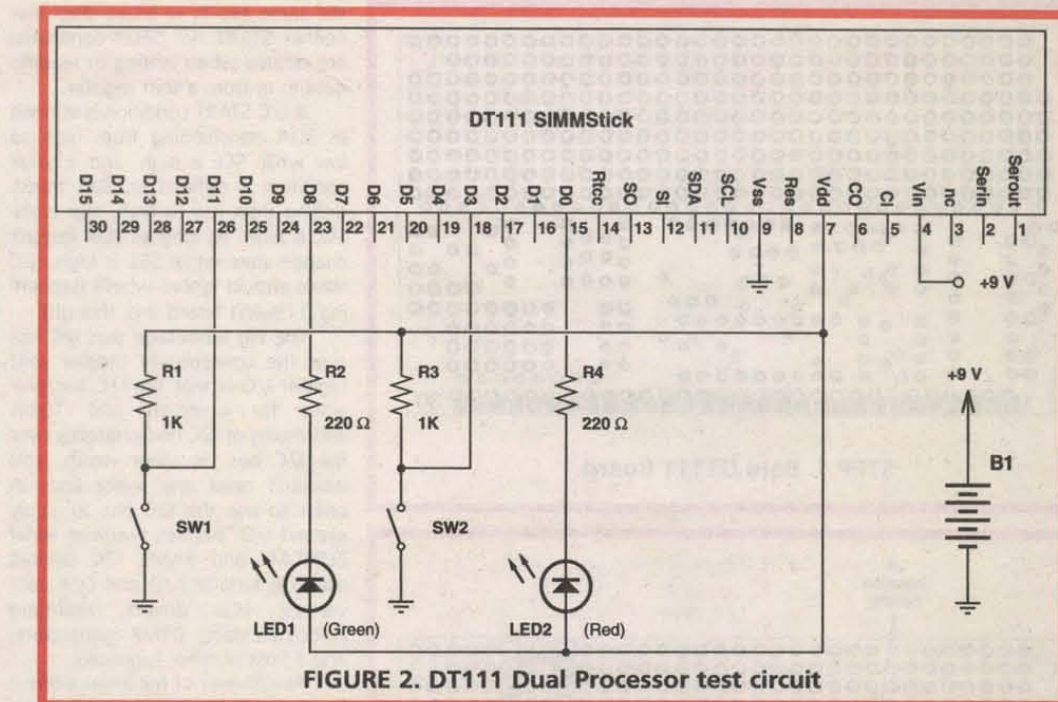


FIGURE 2. DT111 Dual Processor test circuit

Likewise, a 74HC251 — a tri-state data selector/multiplexer — gives the equivalent system for input; four MCU outputs drive the select lines and enable, and one input reads the data. You can dispense with the enable line provided: 1) You have only one HC251 connected to the input bit; and 2) You wait to read the input bit until after you've output the appropriate select code. In this last case, you get eight inputs from three outputs and one input line.

A Two-Bit Solution

The above multiplexer scheme would have solved my immediate need for four more inputs and would have left me with one multiplexed input and two MCU I/O lines to spare.

I didn't go this route, though, because it would have forced Breadbot's encoder inputs to share a port with the bumper sensors, and that means the software would have to be a little more complex to sort these separate functions out. This is a small detail, but I find it's easier to write software for systems where the hardware separates different I/O functions onto separate ports.

My ideal solution would give Breadbot eight or more new inputs while using no more than three MCU I/O lines in the process. This brings me to the other broad approach to I/O expansion: the shift register.

Shift registers can operate with as few as two I/O lines, serial data (SDA), and shift clock (SCL), though most applications will require a third

line to latch the data into either the input or output register. I could have used a 74HC164 — a parallel-load eight-bit shift register — to get eight new inputs while leaving three lines free on port B.

The DT101 SIMMStick has two pins already dedicated to the SDA and SCL functions, RA1 and RA0, respectively (see my Feb '99 column), so I could even free up two more bits on Port B (one would still be needed to latch the input data). These pins are meant to be used with the Inter-Integrated Circuit bus (IIC or I2C, pronounced "I-squared-C").

Using SDA and SCL with a shift register needn't mean sacrificing I2C functionality, however, all that is necessary for shift registers and I2C-compatible EEPROMs to coexist on

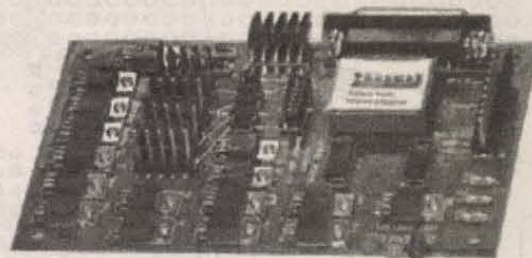
ADDRESSABLE STEPPER MOTOR CONTROLLER

Part Number: JWP1X-1A

\$199.95

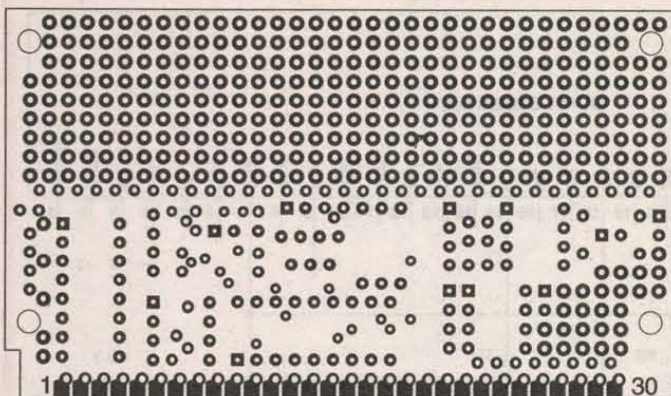
The PARAMAX stepper motor controller is a PC parallel port based addressable controller capable of simultaneous operation of 4 uni-polar stepper motors ranging in voltages from 5 to 12 volts at up to 2 amps per phase. The PARAMAX stepper motor controller includes 8 digital inputs with a data throughput rate of 500k bytes per second. Using the unique PARAMAX addressing method, up to 256 controllers can simultaneously function from a single parallel port. The programming package includes libraries that allow you to create applications both under Windows and DOS. Included libraries are: C++, Pascal, Delphi, Basic and utilities for DOS and Windows.

Also available at:
FORD ELECTRONICS, INC.
(714) 521-8080

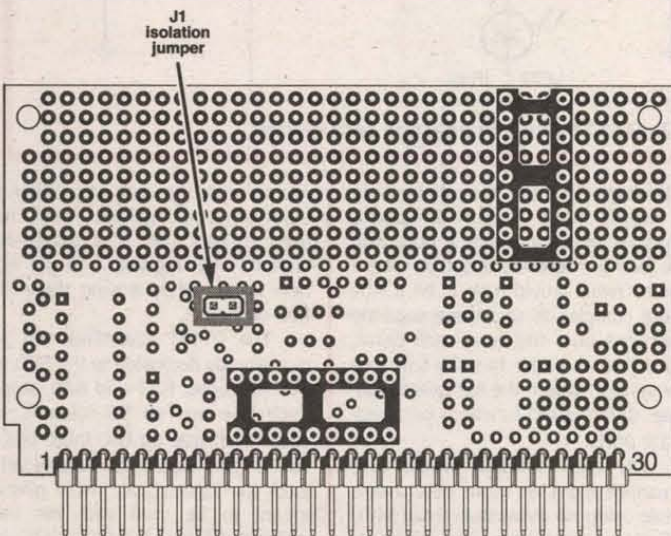


PARAMAX INC.
(800) 473-8080

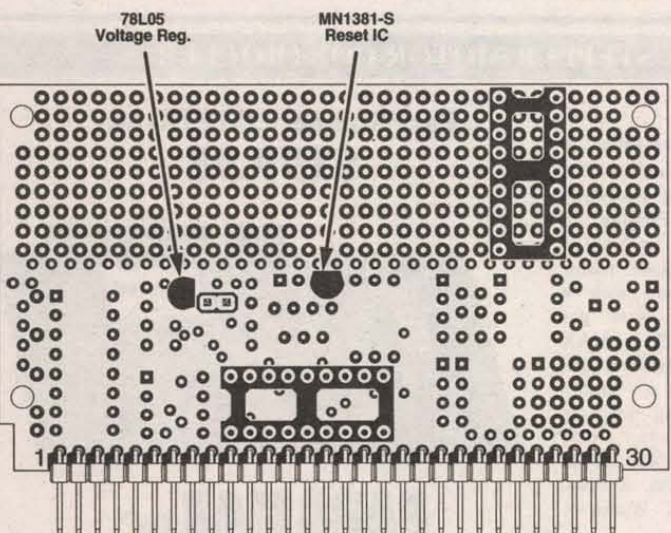
Come and visit us on the internet at:
www.paramax.net



STEP 1. Bare DT111 Board.



STEP 2. Install headers and sockets.



STEP 3. Voltage regulator and Reset IC.

the same bus is to make sure that neither START nor STOP conditions are created when writing or reading data to or from a shift register.

A I2C START condition is defined as SDA transitioning from high to low while SCL is high, and a STOP condition is defined as SDA transitioning from low to high, also while SCL is high. As long as SDA doesn't change state while SCL is high, I2C slaves should ignore what's happening (I haven't tested this, though).

The big advantage that I2C has over the conceptually simpler shift register I/O is that the I2C bus provides for seven-bit and 10-bit addressing of I2C nodes directly over the I2C bus. In other words, you wouldn't need any select lines in order to use the I2C bus to vastly expand I/O. Besides two-wire serial EEPROMs and RAMs, I2C devices available include A/D and D/A converters, LCD drivers, real-time clock/calendars, DTMF generators, and a host of other functions.

An I2C part of particular interest here is the Philips PCD8584, which is a remote eight-bit I/O expander. It comes in a 20-pin package and provides an eight-bit bidirectional I/O port interfaced to the I2C bus. I have not yet used this part, but it looks like it would also do the job the plain shift register would do (and then some).

Biting the Bullet

After going through all of the above expansion options, I finally settled on a different approach altogether (of course). I chose to build a new dual-processor controller board for Breadbot. I did this for two reasons: First, the DT101 board doesn't have a prototyping area big enough to include even a 14-pin DIP, so I would have to add a whole other board or hack a daughter board onto

the DT101. Second, I've been planning to offload sensor processing and path planning to its own MCU anyway.

Using two processors allows me to group the motor control and feedback functions in one MCU, and the bumper sensing and navigation functions in the other MCU. To keep things from getting out of hand, though, I decided to stay with the basic DT101 architecture. This is made trivial by using a DT111 — Don McKenzie's double-height version of his DT101. The DT111 is electrically identical to the DT101, the only difference being the addition of a generous one-inch prototyping area to the top of the board. This prototyping area is where the circuitry for a second PIC16F84 goes (see Steps 1 through 6).

Figure 1 is the schematic for this new dual-processor board. MCU A and MCU B share Vdd, Gnd, SDA, SCL, and Reset, but each has its own crystal oscillator circuitry and I/O pins. Port B of MCU A is already wired to D0 through D7 of the SS-Bus, and I wired port B of MCU B to the remaining I/O lines of the SIMMstick, D8 through D15.

I could have eliminated the second 10-MHz crystal and its associated capacitors by driving the OSC1 input of MCU B with OSC2 of MCU A (CO, "Clock Out", SS-bus pin 6), but I wanted to keep the processors as independent as possible. Using independent oscillator sections allows either processor to shut down without affecting the operation of the other.

The important thing to remember is that a dual processor project is not twice as difficult as a single processor; it's more like four times as hard — especially if you don't go into the project with ease-of-debugging in mind. Figure 2 is a simple test cir-

Item	Description	Vender	P/N
C1,C2	0.01 μ F 50WV, 5%, polyester	Digi-Key	P4582-ND
C4,C5,			
C9,C10	15 pF 5% monolith ceramic cap	*	P4839-ND
C5*,C6*			
C7*,C8*	1 μ F, 16 V tantalum	*	P2105-ND
D1*,D2*	Schottky diodes (see DT111 docs)	*	11DQ03-ND
E1,E6	10 MHz PIC16F84 MCU	*	PIC16F84-10/P-ND
E2*	24LCXX I2C EEPROM		
E3*	RS-232 level converter	*	MAX232CPE-ND
E4*	Real Time Clock option (see DT111 docs)		
E5*	ADC/DAC option (see DT111 docs)		
J1,J2*,			
J5-J7*	2-pin single row straight pin header	*	929647-02-36-ND
J3*,J4*	4-pin single row straight pin header		
	* J1-J7 above are cut from 36-pin pin header		
J8	30-pin single row, RA pin header	*	S1111-30-ND
R1,R2,R3,			
R4,R5,R6	10k ohm, 1/4 W, 5%	*	10KQBK-ND
RVD	Reset Voltage Detector, 4.5V, CMOS	*	MN1381-S-ND
PCB	DT111 SIMMstick Wirz Elex DT111		
VR1	+5V positive regulator, 100 mA, TO-92	Digi-Key	NJM78L05A-ND
XTAL1,			
XTAL2	10 MHz crystal, HC49/US case	*	X422-ND
XTAL3	32.768 KHz (referred to as "XTAL2" in DT111 docs)		
Misc:			
	8-pin DIP IC sockets*	Digi-Key	ED3308-ND
	16-pin " " "	*	ED3316-ND
	18-pin " " "	*	ED3318-ND
	Shorting jumper (to isolate +5V from Vdd)	*	SPC02SYAN

* Optional components; see text & figures.

cuit, and the program listings testAB.asm, testA.asm, and testB.asm are the code I used to troubleshoot operation of the board.

Building the Board

Step 1: Familiarize yourself with the DT111. If you built the DT101 board (Amateur Robotics Notebook, Feb '99), then there's nothing new here except the "sea of pads" prototyping area. The diagram shows the location of all the pads. The rest of assembly proceeds in an order that allows you to do V.R.O.C. (Voltage + Reset + Oscillator + Com-munications) testing with a minimum of fuss. When doing continuity checks, it's a good idea to highlight each circuit node checked on a photocopy of the schematic.

Step 2: Solder in the 30-pin right-angle header (J8) and two 18-pin IC sockets. For now, the socket for MCU B should just be tacked in place by soldering the four corner pins since wire connections still need to be made to most of the pins.

Next, install a two-pin straight header (J1). After soldering J1, flip the board over and cut the trace between its pads with a hobby knife. This modification allows you to isolate the on-card voltage regulator from Vdd so there won't be a conflict if you use the DT001 SIMMstick programmer. Remove the jumper from J1 before you place the board in the programmer (and don't forget to replace it when you are testing your board).

Step 3: Install the voltage regulator and reset controller in the orientations shown. Test the regulator by apply +9V to Vin (SS-Bus pin 4) and ground to Vss (SS-Bus pin 9). You should measure +5V on Vdd (SS-bus pin 7) and pin 14 of MCU A.

Step 4: Install resistors. R1-R5 are simply soldered in place and their leads trimmed, but R6 requires a little more work. The top lead in the diagram should be bent over on the solder side of the board to contact pin 3 of MCU B's socket, then soldered and trimmed. The lower lead should be bent to hold it in place until it's wired in Step 5.

Install the capacitors. Solder C1-C4 and trim their leads. As seen from the wiring side (Step 5), bend the left-hand leads of C9 and C10 so they contact each other; solder and trim. Leave

the right-hand leads free for now. Test the reset IC. With Vdd at +5V, you should see a voltage close to +5V on Res (SS-Bus pin 8) and pin 14 of MCU A. Now adjust Vin downward while observing the voltages on Vdd and Res. When Vin drops below about 7.5V, you'll see two things: First, Vdd will gradually begin to drop below +5V; Second, once Vdd reaches about 4.5V, Res will suddenly drop down close to 0V.

If you increase Vin at this point, Res will stay low at first, but once Vdd rises above the hysteresis threshold of the reset IC, Res will snap high again. If you don't observe this reset behavior, then try testing the voltage at the junction between R1 and R2 while you vary Vin. If you still don't see it, try probing the middle lead of the reset IC to make sure you see Vdd. Check your solder connections and that everything is installed properly. Only after exhausting all other possibilities should you conclude that the reset IC is malfunctioning.

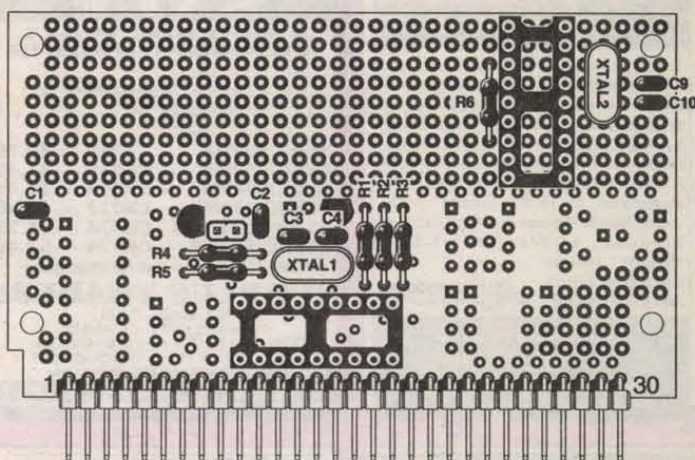
Next, install the 10 MHz crystals. XTAL1 needs no special attention, but you'll need to insulate the bottom of XTAL2's case so it won't short to any of the pads it covers. I used a couple layers of cellophane tape. I poked two holes in each layer of tape with the leads of the crystal and stuck the tape strips to the bottom of the crystal case. Then I trimmed around the edge of the case to remove the excess tape.

Referring to the Step 5 diagram, install the crystal, then bend the free leads of C9 and C10 as shown. C9's free lead should contact both the upper lead of the crystal and pin 16 of MCU B. C10's free lead should contact the lower crystal lead and pin 15 of MCU B. Since you've insulated the crystal from the pads, you don't have to worry if you solder the leads to all the pads they cover, just as long as C9's leads don't short with C10's.

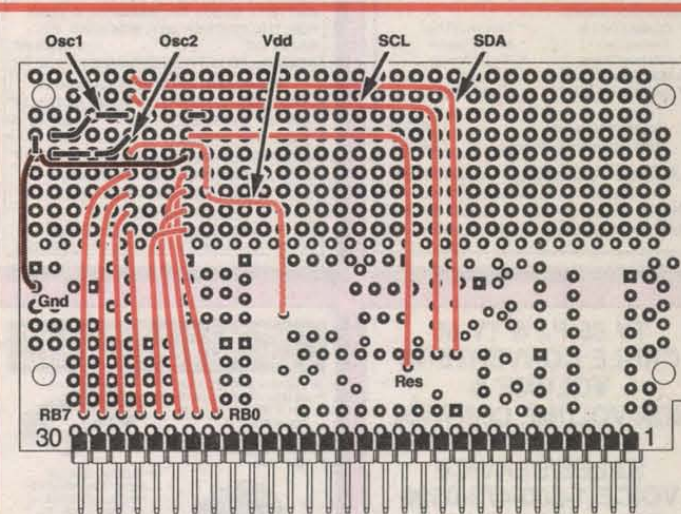
Step 5: Wire MCU B using 30-gauge wire wrap wire. First do ground, then Vdd. Check for continuity of Vdd and Vss to pins 14 and 5, respectively. Next, wire RB0-RB7 to the row of pads above SS_Bus pins 23-30. Finally, wire Res, SCL, and SDA as shown.

Everything Checks

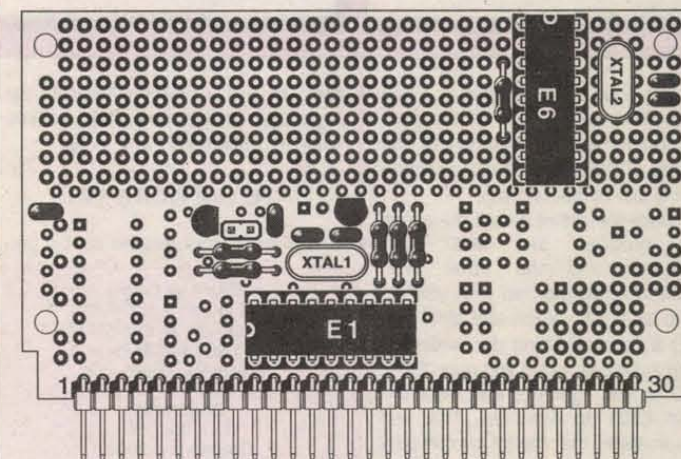
TestAB.asm is the first testing program to use. Program two PIC16F84 chips with this code and plug them into their sockets. On a breadboard, wire up the switches and LEDs of the test circuit and plug the DT111 in. TestAB lights LED1 when you close SW1, and LED2 should light when you close SW2. LED1 and LED2 should be completely independent. If nothing works, try testing with only one MCU. If one section works but the other doesn't, try swapping MCUs. If swapping chips swaps which section works, then you may have an MCU that isn't programmed properly. Otherwise check voltage and reset;



STEP 4. Discrete components.



STEP 5. Processor B wiring.



STEP 6. Install MCU A and MCU B.

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

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

A/D CONVERTERS with SERIAL OUTPUT

Tiny (1.75"x1.41") fully assembled and tested printed circuit board includes two 8-bit A/D converters and one digital input. Up to 16 units addressable (DIP switch setting) totalling 32 converters on a single serial port. Output is ASCII encoded bit count (0 to 255) at 2400 BPS via RJ-11 interface. Fully programmed PIC16C71 installed in IC socket. Sample software in BASIC included. Requires 8-28Vdc At 1-2mA.
\$49.95. Optional DC adapter \$19.95.
Add \$5.00 shipping.



Tele: 847-891-2584
Fax: 847-891-2587
www.glentech-rf.com

SURPLUS SALE

1,000,000 WALL TRANSFORMERS



3VDC/100MA	.... CX099	.... \$0.75
6VDC/100MA	.... CS039	.... \$1.45
9VDC/100MA	.... CR314	.... \$1.45
12VDC/200MA	.... CS033	.... \$0.99
13.5VAC/400MA	.... CR574	.... \$1.29
24VDC/500MA	.... CR174	.... \$3.40

Min 1000/type - Call for other types

SURPLUS TRADERS

PO Box 276,
Albany, VT 05440
Tel: (01) 514-739-9328
Fax: (01) 514-345-8303
http://www.73.com/w

FREE CATALOG!

PROGRAMMERS

ADVANTECH EETOOLS NEEDHAM'S DATA I/O ICE TECHNOLOGY HIO SYSTEM GENERAL CHROMA MODULAR CIRCUIT TECHNOLOGY XELTEK



CALL ADVANTECH LABTOOL 629 ICE TECH MICROV 550 EETOOLS ALLMAX 409 EETOOLS MEGAMAX 509 EETOOLS MEGAMAX 369 MOD-MCT-EMUPAR 249 XELTEK SUPERPRO II P 145 XELTEK ROMMASTER II 479 MOD-MCT-EMUPA 739 STAG ORBIT-32

599 EETOOLS SIMMAX 795 CHROMA SIMMSP 279 MOD-MCT-EMUPAR 49 EPROM 1G TO 512K 69 EPROM 1G TO 1MEG 99 EPROM 4G TO 1MEG 199 EPROM 16G TO 1MEG 89 EPROM 1G TO 8MEG 129 EPROM 4G TO 8MEG 250 EPROM 8G TO 8MEG



General Device Instruments

Sales 916-393-1655 Fax 916-392-4949
Web www.generaldevice.com E-Mail iddevice@best.com

BATTERY — YUASA



Sealed Lead-Acid/Gel-Cell
12V: 7AH \$19, 2.3/4AH \$16
18AH \$39, 1.2AH \$13
6V: 4AH \$9, 10AH \$13

Quantity Discounts Available
Call for other models

Aventrade

4518 Temple City Blvd., Temple City, CA 91780
Tel. 626-286-0118 Fax 626-287-9618
E-Mail: sales@aventrade.com
www.aventrade.com

Serial Port Problems ???

No heavy, aging serial protocol analyzer available? Use **Serial** to turn your PC into a test tool for asynchronous serial communications. **Serial** uses your PC serial ports to capture data, control and time stamps to give you what's needed to develop or debug your serial communications.

- Captures Data & Control lines
- Autobaud Detect
- Millisecond Timing
- Extensive Manual
- Contextual Help
- Block Transmit
- Trigger Strings
- Full Duplex Monitoring

Serial with manual US\$99.00
Full Duplex monitor cable US\$40.00

Allison Technology Corporation
2006 Finney Valley Rd., Rosenberg, TX 77471
800-980-9806 or 281-239-8500, Fax 281-239-8006
http://www.atcweb.com atc@atccomm.net

JUNE SPECIAL SAVE \$10.00

SHIELDED LOOP RECEIVER

30M, 40M KITS W/ ANTENNA.
VERY SENSITIVE. HAS HIGH IMMUNITY TO QRN & LOCAL AM BROADCAST.. \$92.50 PP

12/14V PULSE BATTERY TESTER

(LEAD ACID). ATTACH THE BATTERY & PUSH THE BUTTON TO DETERMINE IF THE BATTERY NEEDS RECHARGING. A MUST FOR THE GLIDDER SET, BOATERS, ETC. BASIC KIT \$55.50 PP

ASSEMBLED WITH ENCLOSURE \$106.50 PP

MARCONI ANTENNA 700W 50 Ω

THE BEST "LITTLE" LOW BAND ANTENNA

80M: 67' OVERALL \$47.45 PP

160M: 130' OVERALL \$54.45 PP

CODE PRACTICE OSCILLATOR... \$23.45 PP

SEND FOR FREE CATALOG

1-800 JADE PRO (523-3776)

www.jadepro.com/

email: jadepro@jadepro.com

JADE PRODUCTS E. HAMPSTEAD NH 03826-0368

CABLE SECRETS!!!

This ad has been
CENSORED!

Want to know why?

Visit us at <http://www.worldwyde.com>

- Find out how "Test" Devices work
- Installation of "Test" Devices
- Descrambling Methods Explained
- Detailed Construction of "Test" Devices

Includes plans and source code

Complete source code \$79.95

Code for individual boxes \$29.95

DSS SECRETS — Vol. 2

Instructions on programming DSS access cards. This is the most current information on the market! Includes software, plans, and hardware sources. Book & CD-ROM.

Get this before they censor it too!!

DSS Secrets Vol. 2 \$49.95

VISA • MasterCard • American Express

To order, call Worldwyde • 1-800-773-6698

21365 Randall Street • Farmington Hills, MI 48336

Visit us on the web at www.worldwyde.com

Build Your Electronics Library At A Price You Can Afford!

Check out the
HOT DEALS at the
Nuts & Volts Bookstore!!
(See ad page 91.)

As a paid subscriber, you'll
get 10% off the listed price!!

TV 85 PJ & TV 86 CABLE CONVERTERS VOLUME & NON-VOLUME CONTROL

SALES/SERVICE
VOICE 1-800-473-0506
FAX 1-800-488-0525

FOSS
WAREHOUSE
DISTRIBUTORS
285 Schenck St.
N. Tonawanda, NY 14120
www.fossw.com

CUSTOM PLASTIC PARTS

- MODELS (WOOD AND RESIN). TO EVALUATE YOUR PARTS BEFORE COMMITTING TO MANUFACTURE A MOLD.
- MOLD DESIGN AND BUILDING.
- PRODUCTION OF INJECTION MOLDED PARTS. NO ORDER TO SMALL OR TO BIG.
- VERY COMPETITIVE ON HIGH LABOR PARTS.



We also have manual low pressure machines for injection molding of very small runs or prototypes of parts up to 2 oz. At a surprisingly low price.

USA Office: V&V Mach. And Equip. Inc.
Tel. (216) 397-8101, Fax. (216) 397-6220.
Please send blue prints or samples to:
Marketing Tech. S.A. • Alamo 93, 4 Pisco • Sta. Monica, Tlal. • Eco. De Mexico 54040 • Tel. 011 (525) 361-3351.
Fax. 011 (525) 361-5096. AT • N. VICTOR M. MCNDOWZA
e-mail: marketech@infocel.net.mx

PCB's in Minutes From LaserPrint!*

8 1/2" x 11" Sheets

- Or Photocopier Use household iron to apply.

PnP BLUE or PnP WET

For High Precision Professional PCB Layouts

1. LaserPrint
2. Iron-On
3. Peel-Off
4. Etch

Adds an Extra Layer of Resist for Super Fine Lines on Std Clad Bds

20Sh \$30/40Sh \$50/100Sh \$100 Blue/Wet (No Mix)

Sample Pack 5 Shs Blue + 5 Shs Wet \$20

VISA/MC/PO/CH/MO \$4 S&H - 2nd Day Mail

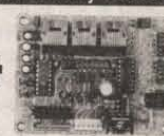
Technics Inc. P.O. Box 463 Ringoes NJ 08551

(908) 788-8249

100% Money Back Guarantee-Dealer Inquiries Invited

Convert RS-232 to RS-485 or TTL/CMOS for Only \$49.00

Communicate up to 4,000 feet, at up to 1 MEGA-BPS, full or half duplex, up to 32 units on one serial link, with 31 jumper options for flexible configuration, LED indicators.



COMMUNICATIONS CONVERTER

- FULL SCHEMATIC AND DOCUMENTATION
- FULL FAMILY OF MODULAR DESIGNS
- RS-485/RS-422 REMOTE I/O MODULE KITS
- NETWORK SOFTWARE AND SOURCE CODE
- AUTOMATIC OR RTS UNITS AVAILABLE
- RJ-11/12 CONNECTORS OR TERMINAL STRIP
- TURN YOUR PC INTO A DISTRIBUTED DATA ACQUISITION AND CONTROL SYSTEM

R.E. SMITH
(513) 874-4796

4311 TYLERSVILLE RD. • HAMILTON, OHIO 45011
www.rs485.com

you may have a wiring error or a bad solder joint somewhere in the non-functioning section. Also, check the polarity of the LED in the bad section (it may just be backwards).

Once the circuit passes the above test, program one MCU with testA.asm and the other with testB.asm. Plug the chip with testA in it into MCU A's socket, and testB into MCU B's socket. Using the same test setup as before, when you press SW1, LED2 should light up, and SW2 will cause LED1 to light up. This test demonstrates that the MCUs can pass simple data back and forth to each other. If the test fails, make sure you've programmed each MCU with the appropriate software, then check

the SDA and SCL wiring. Measure the logic levels present on each line as you close and open SW1 and SW2.

Are we done yet?

Make no mistake, this is a big pro-

ject, so it will take a couple months to present it all.

In the next couple months, I'll nail down the encoder code and show the details of I2C master/slave routines so the processors can talk to each other. Once the I2C routines

are done, it will be easy to add additional I2C-networked processors as the need arises.

And there's even room for a few more MCUs on the board ... NV

Digi-Key Corp.
701 Brooks Ave. South
Thief River Falls, MN 56701-0677
1-800-344-4539
<http://www.digikey.com>

DonTronics
P.O. Box 595
Tullamarine 3043
Australia
Tel: 613+9338-6286
Fax: 613+9338-2935
dontronics.com

(SIMMStick PC boards, development systems, & software)

I2C links:

www.s2.semiconductors.philips.com/i2c/
www.ping.be/~ping0751/i2cfaq/i2cfaq.htm
www.mcc-us.com/i2chowto.htm

Microchip Technology, Inc.
Tel: 1-888-628-6247, 602-786-7200
Fax: 602-899-9210

www.microchip.com
(PIC chips, PICSTART development systems, MPASM assembler, MPASM simulator, I2C serial EEPROMs)

Wirz Electronics SIMMSticks
P.O. Box 457
Littleton, MA 01460-0457
Tel: 1-888-289-9479
Fax: 978-448-0196
www.wirz.com

Resources mentioned in this article



GPS Design Kit — \$379

The design kit SGM5000K is a complete and immediately usable means of evaluating the SIGEM GPS receiver module and high performance GPS antenna, which are included in the kit. Software running on the GPS receiver module communicates to a user supplied computer via NMEA 0183 formatted messages. Advanced PC software provides map integration and a demonstration of tracking. Provision has been made for DGPS inputs.

SIGEM Inc.
50 Hines Road
Kanata, Ontario
Canada K2K 2M5
Tel: (613) 271-1601 (Can)
(541) 923-3733 (USA)
Fax: (613) 271-1896

SIGEM

Web: www.sigem.ca
Email: info@sigem.ca

PCBs
PER SQIN
\$100.00 SETUP
WE SPECIALIZE IN SINGLE SIDED, 1 OZ, PC75

9c

PCB LAYOUT
PER COMPONENT PIN \$100.00 MINIMUM

59c

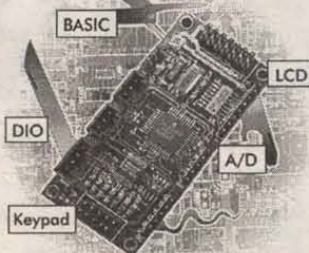
ENGINEERING DIAGRAMS
PER COMPONENT PIN \$100.00 MINIMUM

39c

V&V MACH. & EQUIP. INC. (HOUSTON, TX OFFICE)
PH (281) 397-8101 FAX (281) 397-6220
MARKETING TECH. S.A. (MEXICO/PLANT)
PH 011 (525) 361-3351 FAX 011 (525) 361-5996

SBC2000-074

RS-232



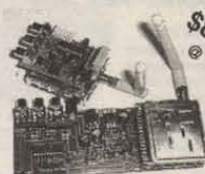
Versatility starting at \$64 each.

Voice: 303.422.8088 Fax: 303.422.9800

www.sbc2000.com

Vesta Technology, Inc.

2.4 GHz Wireless Transmitter & Receiver



\$89/pair
@ 50 pcs

2.4 GHz ~ 2.48 GHz User Selectable
Over 700' Range and 4 Chl Auto-scan
NTSC, PAL, Composite video B/W or Color
2 Audio Inputs may be used for digital data
Customizations including battery packs
and Special Frequencies

Matco Inc.

(800)440-0299 or (800)719-9605
www.mat-co.com

Telecom Hardware/Software Developers

STOP using your phone lines to test and demonstrate your telecom devices. Our affordable telephone line simulators offer authentic USA dial tone, busy signals, ringing, and exceptional speech quality.



RING-IT! TELCO SIMULATOR
• Single Line (two RJ-11 Jacks)
• LED Display
• DTMF Operation
• Automatic Ring-up Mode
• **\$325** (\$149 kit available)

PARTY-LINE TELCO SIMULATOR

• Six Extensions
• Caller-ID (Name/Nbr)
• Distinctive Ringing
• **\$425** (\$199.95 kit avail)



Digital Products
COMPANY

134 Windstar Circle
Folsom, CA 95630 USA
Tel: 916-985-7219
Fax: 916-985-8460

VISA

<http://www.digitalproductsco.com>

LCD Terminal \$99



Re-Programmable
LCD 240 x 64 EL Backlit
RS-232 Port
1200 Baud Modem
8051 Compatible Microcontroller
192K Low Power Static Memory
Infrared Transmitter
Niacad Battery Pack
QWERTY Keyboard
FM SCA Data Receiver

Junkware.com

<http://www.junkware.com>

PC BOARD SERVICES

PCB Design Layout

Thru Hole

SMT

Multilayer

PCB FABRICATION

In-house Prototypes

Single and Double Side

Plate Thru Hole

ASSEMBLY

Thru Hole

Small Project Specialists

Serving Engineers and Hobbyists
for 16 Years

MIDLAND TECHNOLOGIES

800-726-8871 Voice

406-586-0300 FAX



Power Quality Inc.

800-255-5545

Fax: 520-344-8847

Heavy Duty Surge Suppressor

Plug Strips, 6 outlet, circuit breaker,
Case of 25 in individual boxes. \$50/case

HP Power Supplies, HP6260B

current is 0-50A,\$200

UPS, 250va to 3 kva, functional and
nonfunctional Please call

Power Conditioners, Oneac, TLC,
Teal, Sola, various sizes Please call

Please visit our website for complete details

www.powerqualityinc.com

GPS Antennas

Magnet Mount Antenna
+28 db gain
\$54.95

Trimble Placer 300
Unit with built in Antenna
\$89.95

Trimble Magnet Mount
+ 30 db gain
\$69.95

Communications Surplus

713-526-8000 or 1-877-878-6GPS
ishafer@flash.net Fax to 713-522-6309

New!

ActiveWire™USB Simple USB Interface



- Internet Browser Script-able
- 24 MHz CPU core with USB
- Firmware downloadable via USB
- 16 bit parallel I/O
- Expandable add-on boards
- New firmware and scripts available from website

\$59 plus shipping

ActiveWire, Inc.

www.activewireinc.com

ph(650) 493-8700 fx(650) 493-2200

QUALITY KITS

#1 Source for Electronic Kits

Great selection of Hi-Fi AUDIO Kits,
PSUs, Transmitters, Oscilloscopes,
PIC Programmers, and much more.

Toll Free Order Line:

1-888-464-5487

Secure On-Line Ordering
www.qkits.com

Call 613-544-6333 for free catalog

North American Kit Distributor

49 McMichael St., Kingston, ON
K7M 1M8, CANADA

Aviation Components Corp.

28 Hunting Hills Drive
Landenberg, PA 19350

We buy and sell:

- Relays
- Switches
- RF Components
- All MIL-SPEC
- Electro-Mechanical Devices
- Resistors
- Circuit Breakers
- Semiconductors
- ICs

Home Office (sales)

610-255-3761 • FAX 610-255-3548

Morrisville Office (purchasing)

215-295-3507 • FAX 215-295-8633

E-Mail: aviationcomp@earthlink.net

For more info check out our website:

<http://home.earthlink.net/~aviationcomp/>

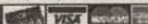
Program PICs in Basic Complete kit to get started!

\$115.95



Includes:
Compiler, Programmer, PIC, Cable & Batteries

ORDER



Electronic Products

(248) 515-4264 Fax: (413) 825-0377

www.elproducts.com

NEED BATTERIES!!
batterystore.com
TNR Technical, Inc.
301 Central Park Drive
Sanford, FL 32771
1-800-346-0601

Plans-Kits Unlimited

PLANS KITS PARTS OVER 120,000 PLANS

**LASERS MASERS EMP TESLA
RAIL & COIL GUNS JAMMERS
ULTRASONICS HIGH VOLTAGE
PLASMA & ION GUNS HERF
MIND CONTROL NUCLEAR
PHREAKING BIO-ELECTRONIC**

IF WE DON'T HAVE IT, WE'LL GET IT..

<http://www.plans-kits.com>

AD SPECIAL!!! RUBY & SAPPHIRE SURPLUS RODS
FOR HIGH POWER CUTTING LASERS. 1/8" x 3" L
FLAT ENDS, MATTE FINISHED, SURPLUS MILITARY.
\$12.00 + \$15/H EA. CHECKS, CASH, MONEY ORDER.

PLANS-KITS UNLIMITED: (BASE FOR CATALOG)
1839-D WEST VISTA WAY #515, VISTA CA 92083

GREAT
FOR TEST FUTURE
BUILDING



LAB-1
(1.5" x 2.0" x 0.75")

FREE!

PHONE, FAX, WRITE
OR E-MAIL WITH YOUR
MAILING ADDRESS
MUST MENTION
OFFER "LAB199"

PREPUNCHED END PANELS
ALSO AVAILABLE
9 BOX SIZES
25 PREPUNCHED
END PANELS

ALSO IN STOCK AT:
JENSEN TOOLS: 800-436-1194
MCA ELECTRONICS: 800-543-4330
TECH AMERICA: 800-442-7271

ALL ALUMINUM CONSTRUCTION LOW COST
OFFER GOOD ONLY IN THE 48 STATES. ENDS DECEMBER 30, 1999. LIMIT ONE
REQUEST PER CUSTOMER. MAILED 1ST CLASS, ALLOW 1-2 WEEKS FOR DELIVERY

ORDERS 800-834-3457 • FAX 800-551-2749
OFFICE 702-565-3400 • FAX 702-565-4828
www.sescom.com • info@sescom.com

SES, INC. 2100 WARD DR., HENDERSON, NV 89015
SES, INC. is not responsible for inadvertent typographical errors
and prices and specifications are subject to change without notice.

CALL TOLL FREE

(800) 292-7711
Orders Only

Se Habla Español

C&S SALES

Excellence in Service

CALL OR WRITE
FOR OUR
FREE

64 PAGE CATALOG!
(800) 445-3201

Digital Multimeters

Elenco Model M-1740



\$39.95

- 11 Functions:
- Freq. to 20MHz
 - Cap. to 20µF
 - AC/DC Voltage
 - AC/DC Current
 - Beeper
 - Diode Test
 - Transistor Test
 - Meets UL-1244 safety specs.
- Model M-2780 - \$24.95
(9 functions)

Elenco Model LCR-1810



\$99.95

- Capacitance .1pF to 20µF
- Inductance 1µH to 20H
- Resistance .01Ω to 2000MΩ
- Temperature -20°C to 750°C
- DC Volts 0 - 20V
- Frequency up to 15MHz
- Diode/Audible Continuity Test
- Signal Output Function
- 3 1/2 Digit Display

Fluke 87III



\$299

Features high performance AC/DC voltage and current measurement, frequency, duty cycle, resistance, conductance, and capacitance measurement.

Series II (limited qty.)
\$289

Generators and Counters

Elenco Sweep Function Generator with built-in frequency counter Model GF-8036



\$225

This sweep function generator with counter is an instrument capable of generating square, triangle, and sine waveforms, and TTL, CMOS pulse over a frequency range from 0.2Hz to 2MHz.

20MHz Sweep / Function Generator with Frequency Counter Model 4040

\$399



- 0.2Hz to 20MHz
- AM & FM modulation
- Burst Operation
- External Frequency counter to 30MHz
- Linear and Log sweep

BK PRECISION

10MHz Model 4017 **\$309**

5MHz Model 4011 **\$239**

Elenco Handheld Universal Counter Model F-2800



\$99

- Sensitivity:
- <1.8mV @ 100MHz
 - <8mV @ 300MHz
 - <8mV @ 10Hz
 - <100mV @ 2.4GHz

Features 10 digit display, 16 segment and RF signal strength bargraph. Includes antenna, NiCad battery, and AC adapter.

Elenco RF Generator with Counter (100kHz - 150kHz) Model SG-9500



Features internal AM mod. of 1kHz, RF output 100MV - 35MHz. Audio output 1kHz @ 1V RMS. SG-9000 (analog, w/o counter) \$119.95

B&K Frequency Counter Model BK-1875



.1Hz - 2.8GHz
3 Channels
\$189

Sensitivity:

- <0.8mV @ 100MHz
- <6mV @ 300MHz
- <7mV @ 1GHz
- <100mV @ 3GHz

Ultra sensitive synchronous detector bargraph and RF strength.

Elenco 10Hz - 1MHz Digital Audio Generator Model SG-9300

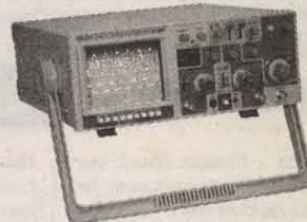


\$175

Features built-in 150MHz frequency counter, low distortion and sine/square waves. SG-9200 (w/o counter) \$119.95

Elenco Oscilloscopes

Free Dust Cover and 2 Probes



S-1325	25MHz	Dual Trace	\$325
S-1330	25MHz	Delayed Sweep	\$439
S-1340	40MHz	Dual Trace	\$475
S-1345	40MHz	Delayed Sweep	\$569
S-1360	60MHz	Delayed Sweep	\$749
S-1390	100MHz	Delayed Sweep	\$995

DIGITAL SCOPE SUPER SPECIALS

DS-203	20MHz/10Ms/s Analog/Digital	\$695
DS-303	40MHz/20Ms/s Analog/Digital	\$995
DS-603	60MHz/20Ms/s Analog/Digital	\$1295

Four Functions in One

Elenco Model MX-9300



\$459.95

Features:

- One instrument with four test and measuring systems:
- 1.3GHz Frequency Counter
- 2MHz Sweep Function Generator
- Digital Multimeter
- Digital Triple Power Supply - 0-30V @ 3A, 15V @ 1A, 5V @ 2A

Elenco Educational Kits

Model AR-2N6K



2 Meter / 6 Meter
Amateur Radio Kit
\$34.95

Model AM/FM-108K



Transistor
Radio Kit
\$29.95

Model AK-700



Pulse/Tone
Telephone Kit
\$15.95

Model AK-870



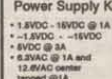
Radio Control Car Kit
• Solderless
• 7 Functions
• Radio Control
Included
\$24.95

Model M-1005K



Digital Multimeter Kit
• 18 Ranges
• 3 1/2 Digit LCD
• Transistor Test
• Diode Test
\$19.95

Model XP-720K



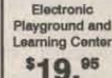
Power Supply Kit
• 1.8VDC - 18VDC @ 1A
• 1.8VDC - 18VDC
• 8VDC @ 2A
• 6.2VAC @ 1A and
12.6VAC center
tapped @ 1A
\$54.95

Model XK-150



Digital / Analog
Trainer
\$89.95

Model EP-50



Electronic
Playground and
Learning Center
\$19.95

Tekk Radios

Pro-Sport FRS Two-Way Radio Model PRO-SPORT+

\$79 each

\$149.95
Set of 2

- 14 Channels
- Battery Monitor
- Key Lockout
- Monitor Button
- Lightweight
- Palm Sized
- Large LCD Display
- Removable Belt Clip
- Removable Antenna
- Two Radio Call Tones
- Busy Channel Lockout
- Accessory Connector
- Highly Water Resistant

Talk up to
2 miles!



PRO SPORT Model
\$109.95 set of 2

Miscellaneous

Elenco Technician Tool Kit Model TK-1500

\$49.95

28 tools plus a DMM contained in a large flexible tool case with a handle ideal for everyone on the go.



Elenco Quad Power Supply Model XP-581



4 Fully Regulated DC Power Supplies in One Unit
4 DC voltages: 0.5V - 5V @ 3A, 12V @ 1A, 12V @ 1A
1 Variable - 2.5V - 25V @ 2A
\$89.95

Dual-Display LCR Meter w/ Stat Functions B&K Model 678



\$219.95
Auto/manual range
Many features
with Q factor
High Accuracy

Guaranteed Lowest Prices

UPS SHIPPING: 48 STATES 5%
OTHERS CALL FOR DETAILS
IL Residents add 8.25% Sales Tax

SEE US ON THE WEB

C&S SALES, INC.

150 W. CARPENTER AVENUE
WHEELING, IL 60090
FAX: (847) 541-9904 (847) 541-0710
<http://www.cs-sales.com>



15 DAY MONEY BACK GUARANTEE

2 YEAR FACTORY WARRANTY

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

Questions & Answers

TECH FORUM

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

QUESTIONS

Editor's Note - Please check our web site at www.nutsvolts.com for more questions that were not printed due to lack of space.

I need some information about speech recognition systems.

I have been thinking about designing one myself, but cannot come up with the circuitry or programming needed for a custom system. The specifications I'm looking for are speaker independence, large word memory, background noise filter, single or phrase-form commands, and easy to interface to a computer, BASIC Stamp, or stand-alone.

7991 **Kirk Olson**
via Internet

I need information on building a variable frequency drive for a single phase motor. I would like to build one to adjust the speed on a wood turning lathe.

7992 **W. Billett**
via Internet

I need a data sheet on the UM3750 IR encoder, decoder IC. The single-button transmitters are readily available, cheap and, I hear they can be converted to receivers, with minimal additional parts, a photo transistor, and buffer, etc.

Search of the net gets me a kit out of Australia, but no data sheet. The Taiwan manufacturer appears to be a chip foundry and has no data on their web site.

Electronic Goldmine, sells the transmitters for \$2.00 each.

7993 **Brian Chesire**
Tucson, AZ

I am a novice wanting to set up a remote, wireless, CCD miniature video cam surveillance system for some remote property, about two blocks away, with some housing and other obstacles in the way.

Is there a manual I can buy, or site, where I can find instructions on doing so? Including the set up specific parts that would be needed, and an explanation of the various terms and jargon i.e., "410 lines CCD, 0.3 lux, AGC, 4mm 78 FOV lens" (taken randomly from *Nuts & Volts* ad).

Is there also a publication, etc.

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

that rates these types of items for quality, compatibility, etc? I have tried comparing various items on my own, but find the great differences in ability, price, etc. overwhelming.

7994 **Dave Medina**
San Diego, CA

I just bought an NEC Silentwriter 97 printer at a garage sale, and I'm looking for a fuser lamp (stamped Minolta VK-1). Any ideas as to where I can get one? NEC only sells the complete fuser assembly (very expensive).

7995 **Larry Cowgill**
via Internet

I am interested in obtaining a Gauss meter to measure emissions of electric appliances, buildings, fields, etc. Can someone give me some sources?

7996 **Siegfried J. Hattler**
Pasadena, CA

I have an 800 number on which I would like to deliver an approximately three-minute message to callers, with a hang up or disconnect at the end of the message. The machine would not accept any incoming messages. Any ideas?

7997 **via Internet**

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

7998 **Geoff Fors**
Monterey, CA

I changed out the video head on my VHS VCR. The picture had contained unremovable [by cleaning the head] horizontal noise lines. This resulted in a picture that was normal on the bottom third of the screen. The top two-thirds of the picture was half-washed, blurry, with about 20 snake-like waves moving up the screen.

What is the cause and remedy to this problem?

7999 **Frank Piernick**
via Internet

ANSWERS

ANSWER TO #5991 - MAY 1999

I have a 1/2 HP water pump 115V 12.4 amp start, 6.2 amp run. My 1850 watt generator will not start the pump.

I also have a small 800 watt generator that I would like to parallel to get more wattage. Coleman says it can't be done, is this true? Can anyone give me any way of doing it?

Synchronizing two generators, while not impossible, would be a large and tricky project.

The outputs would have to be in phase, and the smaller unit electronically governed to keep its RPM in very close step with the larger unit. If one slipped out of phase, it would be bad.

All this trouble and risk of damaging both generators, and you wouldn't even be doubling the power available.

The initial surge for starting a 1/2 HP induction motor is short, but very large, on the order of tens of amps. This surge cannot be accurately measured with anything slower than an oscilloscope.

There are some things you can do that will give the 1850 watt generator a fighting chance to start your pump. The reason the generator won't start the pump is that the starting current is higher than the generator can supply. When the motor is switched on, it loads down the output of the generator. The output of the generator also is supplying the field winding, which draws at least 1/10 of the output power of the generator, and the power available for the field winding drops, which, in turn, further reduces the output voltage and also the field voltage...

The heavy load also reduces the RPM of the engine, further lowering the output. All at the very time you would want the field voltage to increase, or at least stay the same. This effect can be reduced by adding a large capacitor across the field.

I have done this with a 3000 watt generator, and it helped make it possible to start my 1-1/2 HP air compressor.

ANSWER INFO

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

QUESTION INFO

TO BE CONSIDERED FOR PUBLICATION

All questions should relate to one or more of the following:

- 1) Circuit Design
- 2) Electronic Theory
- 3) Problem Solving
- 4) Other Similar Topics

INFORMATION/RESTRICTIONS

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

HELPFUL HINTS

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

The other key to that trick is an unloader valve, but with a water pump, you don't need to worry about that. The capacitor required is about 1/2 to one Farad.

A larger generator needs a larger capacitor, smaller could get by with less. The capacitor supplies the power to the field while the temporary overload keeps the field taps below the normal voltage.

A side benefit that I found, is that the capacitor also cleans up waveform of the output voltage. My generator has a 40-volt field. With a higher

TECH FORUM

field voltage, a smaller capacitor is required, with lower, a larger.

There is a voltage squared factor in the calculation for stored energy, so the capacitance required for the same effect depends highly on the voltage.

1 watt hour = 3,600 Joules.
(1KW hour = 3,600,000 Joules)

V = volts

C = capacitance in Farads

J = Energy in Joules

Using the equation: $J/[V * V] = C$

For example, 40V with 1600 Joules:

$1600/[40 * 40] = 1.0 \text{ Farad}$

If the field was 80V and you want to store 1600 J:

$1600/[80 * 80] = .25 \text{ Farad}$

If the field was 20V and you want to store 1600J: $1600/[20 * 20] = 4.0 \text{ Farad}$

The field winding is usually fed from a lower voltage tap in the output windings. The taps go to a rectifier to make DC for the field. The DC is usually fed to the rotating field by a pair of slip rings. If you put a voltmeter on the wires to the slip rings, you can measure the field voltage with no

load and a near full load.

The voltage should be lower with the full load. The higher of these voltages is the working voltage required for the large capacitor.

You may notice the output of the generator will come up a little slower when started, due to having to charge the capacitor, but this should not be a problem.

Another way to help the motor start is what is called reduced voltage starting. This is particularly helpful when the starting surge is seconds long. Instead of feeding 100% of the generator voltage to the pump motor, use a transformer or variac to get about 50-70% of the output voltage.

This reduces the overload so that the generator's field does not collapse, and actually gets more power to the motor. The transformer or variac should be rated to handle the running power of the motor, and will survive the short term starting overload.

After the motor is up to speed, a second switch, or time delay relay can transfer the motor to full voltage.

I use this setup to run a 12" radial arm saw (about seven-second spin-up time) off the same 3000 watt generator. Without this setup, my generator would lose RPM with the throttle full open, and the output

would drop below 60V on the unloaded phase!

A final addition is to power factor correct the inductive load of the motor by paralleling AC rated motor run capacitors across the AC line to the motor. The lagging current drawn by a motor further multiplies the negative effect on the field of the generator.

PFC is the hardest to do, because you need a dual trace oscilloscope to monitor the voltage and current waveforms, and add capacitors to get the closest to unity power factor (current and voltage waveforms in phase) possible without causing harmonic distortion. The inputs to the scope require a step down transformer for the voltage, and a current transformer for the current.

Do not try to use the scope directly connected to the generator.

Of course, when trying to start these motors, nothing else should be drawing power from the generator. I have a current-sensing relay that shuts off all other loads automatically when one of the big motors is switched on, but this is strictly for convenience.

I have also recently acquired a Type 4 green plug from Electronic Goldmine, and it performs a soft start for motors up to 20 amps. I

have not yet tried it with the generator, but it might just do the job, and for about \$10.00, it might be worth a try. The down side is that the soft start ramp is fixed, and whether it works or not will depend on both the motor and the generator.

David Tiefenbunn
via Internet

ANSWER TO #W69917 - JUNE 99

Where can I obtain the Motorola MC 34017 IC? Is it still produced?

The data sheet for the MC34017 can be found at Motorola's site at: <http://www.mot-ps.com/books/d1136/pdf/mc34017rev0a.pdf>

I did not find any discontinuation notices in my search of their site.

As of mid-June, the MC34017 is available from these two distributors (according to their web sites).

Union Electronic Distributors,
1-800-648-6657; www.unionel.com,
\$2.16 each. **America II,** 1-800-288-1187; <http://www.americaii.com/a2i/a2ihome.html> (no quote)

Tim Godfrey
Via Internet

ANSWER TO #6991 - JUNE 1999

I have three motion security lights outside. When I use my ham transmitter in the evening, it puts all

Davilyn
CORP.

13406 Saticoy Street
North Hollywood, CA 91605
800-235-6222
818-787-3334 • F-818-787-4732
[HTTP://WWW.Davilyn.com/Electronics](http://WWW.Davilyn.com/Electronics)



SEXTANT

Aircraft or marine navigation. No case. \$50



SINGER CSM-1 COMMUNICATIONS SERVICE MONITOR



RF signal source: 0 to 600MHz in 100MHz steps plus 100Hz vernier. RF output: 110 to 0 dBm, built-in oscilloscope monitor. Inputs: RF, detected, vertical, horizontal, AM/FM.

Outputs: audio, tone, RF. Functions: generate 2mV to 2mV. AGC: manual or auto. \$295

BOX \$15



FIBERGLASS, WATERPROOF

Exterior size (L) 14-1/2" x (H) 9-3/4" x (W) 14-3/4"

- HP 200CD Oscillator \$95
- HP 312B Selective Voltmeter \$695
- HP 331 Distortion Analyzer \$249
- HP 400E Voltmeter \$325
- HP 412A Voltmeter \$95
- HP 415E Voltmeter \$125
- HP 3435A Multimeter \$295
- HP 1860A Generator \$2,800
- Krohn-Hite Model 4300A Oscillator \$395
- PRD Type 2020 Vector Voltmeter w/sampling heads \$250
- Systron Donner Spectrum Analyzer Consists of tuning unit Model 809-1, display unit Model 712-1 \$1,995
- Watkins Johnson WJ-8628-4 Receiver \$8,500

MORGAN DATA SYSTEMS MODEL 8609

Constant voltage or current power supply voltage range: 0 to 50 volts. Current range: 0 to 1.5A. Readout: 3 digit with 0.1 volt and 1mA current resolution. Regulation: linear. Input voltage: 115V/220V. Adjustments: voltage and current has remote control adjustment capability. NEW. Price: \$95



TELEGRAPH KEYS

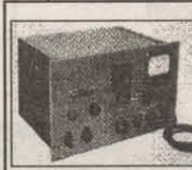
Unique item for military collectors. J37 telegraph key, new in original government package. \$49.95



HP 180A SCOPE (MIL SPEC AN/USM-281A)

Includes vertical plug-in 1801A (PL1186), horizontal plug-in 1821A (PL1187). Tested. \$195

Manual Reproduction: 15



TS-723A SPECTRUM ANALYZER

Frequency range 20Hz to 20KHz. Noise measurement — full scale 300 microvolts, minimum -75dBm, frequency -10Hz to 20KHz. Power supply — 115V/230V, 50 to 100Hz, 90 watts. \$95

JONES MODEL 1600-1 TACHOMETER



Instrument tachometer centrifugal mechanical tach measures RPM scale 0-500 RPM, coupling shaft 1/8" accessories, various size rubber tipped drive couplings, case new. Also Jones Model 1600-7 RPM scale 0-11,000 RPM w/accessories.

New \$35/ea. or 2 for \$50

HP 8640B SIGNAL GENERATOR OPT 003



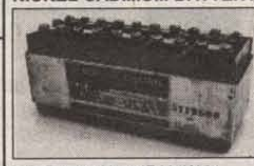
CONDITION CODE "A"

Frequency: 500KHz to 512MHz. Indicates to 1024MHz. Requires external frequency doubler for 1024MHz (supplied with unit). Readout can be used as a frequency counter. Accuracy: 6.5 digits expandable to X10 and X100. Output: 145dBm to +19dBm (0.5 to 512MHz). Modulation: AM, FM, pulse, 400 and 1KHz, 1mV to 1V internal. Has input and output of modulation sources.

GREAT PRICE

\$1,095

NICKEL CADMIUM BATTERY



G.E. Catalog No. 42B004KA01. Nominal volts 12 rated capacity 4.0Ah, wt. 5 lbs. NEW \$55

LAMBDA LK344A-FM POWER SUPPLY

Front panel voltage and current meters. Convection-cooled, no blower. Voltage adjustable from 0 to 60 VDC at a maximum current of 4A. Regulation 0.015% or 1mV. Line or load. Series/parallel operation. Remotely programmable by voltage or resistance. Less than 500µV RMS ripple. Constant current/constant current.

NEW PRICE: \$395

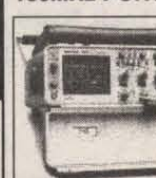


AN/URM-120 50 OHM THRU-LINE RF WATTMETER



Frequency range: 2MHz to 1000MHz. Power range: 10 watts to 1000 watts. USWR≤1.08 to 1. Use three plug-in coupler elements (included). CU-753 2 to 30MHz 50 to 100 watts CU-754 25 to 250MHz 10 to 500 watts CU-755 200 to 1000MHz 10 to 500 watts. Connector: Type N. Case included. Size: 7"Wx6-5/8"Hx7-1/5"D. Weight: 6.5 lbs. Price: \$395

TEKTRONIX 2336YA DUAL TRACE 100MHz PORTABLE OSCILLOSCOPE



Vertical: DC to 100MHz band with 5 mV per div. to 5V per div. maximum sensitivity of 2mV/div. Horizontal: Time Base A: 0.05 uS/div. 0.5 sec/div. X10 to 5 ns/div. Time Base B: 0.05 uS/div. to 50 mS/div. X10 to 5 ns/div. Has digital readout of delta time, delayed sweep, and XY input div. \$795



CT SYSTEMS 3000B SERVICE MONITOR

\$2,500 \$1,995

TECH FORUM

the lights on.

Any ideas to prevent this?

You didn't specify what bands you are transmitting on, how much power you are transmitting, or the distance between the motion sensor

lights and your antenna.

I can make some general recommendations, though.

First, I assume you have made sure your station is operating within the RF exposure guidelines from the FCC. If your radiation is exceeding the

power density limits for maximum permissible exposure, it will be difficult to adequately shield the motion sensor lights.

You should re-check your grounding at the transmitter and the antenna. Re-check your SWR, since a

high SWR can cause feedline radiation. If the feedline runs near the lights, try to move it away, especially if it is not coaxial.

If your power density is reasonable, and you are operating in the higher bands, you might try putting

ANSWERS TO #59910 - MAY 1999

I have an underground 110VAC line that has a cut and is causing the 15 amp breaker to trip every so often. How can I tell where the cable is cut and shorting out without digging up the 6" deep wire?

#1 Rent a TDR (time domain reflectometer). These devices are designed for such things. You might be able to detect it with a "Fox and Hound" locator device.

Breck Ricketts
via Internet

#2 Yes, it is possible to locate wire faults without digging up the whole cable.

A time domain reflectometer (TDR) will locate a serious fault as long as you know the propagation velocity of the cable. You probably don't have access to a TDR, but with a fast scope (100 MHz) and a fast pulse generator (5ns rise time), you can fake one that will locate a fault to a couple feet. I go into more detail, but there are other problems.

The first problem is the high impedance nature of the fault. If the fault is only 30K most of the time, there won't be a big reflection (less than 1%). You will have better luck with a solid short (that would trip the breaker). The AC impedance mismatch is probably larger, so a TDR might work.

The big problem is your installation violates the National Electrical Code (NEC). The wire should be buried 18 inches deep (not 6 inches). It's time to dig the cable up and replace it — since it is not deep enough, it probably isn't a suitable cable either. Use a trenching shovel (about 4 inches wide) instead of a regular (9 inch) shovel — it saves a lot of work and 18 inches is deep.

Although you can use a direct burial cable, I would use PVC conduit. Above ground boxes have special requirements for anchorage (e.g., two conduits must enter the box to prevent the box from spinning), and I think you must use metal conduit ground portion if the conduit holds the box up. Your library will have a copy of the NEC, but it is difficult to read.

Gerald Roylance
Mountain View, CA

#3 There are numerous manufacturers of cable fault equipment. The TDR (time domain reflectometer) is a favorite.

In an over-simplified example, it sends a pulse and measures the time it takes to return. The propagation characteristics of the cable must be known, and this distance to the fault can be determined. It's expensive test equipment. And unless your buried cable is very expensive or very

long, not worth it to even consider renting one. Your local power company probably has the right equipment to do this test.

Another approach worth a try, would be to apply voltage to the cable. Connect one lead of an AC reading DVM to a good ground. Attach the other lead to a probe and travel the length of the buried cable, inserting the probe periodically (taking care not to plunge it into the buried cable, of course).

If there is leakage due to the break in the cable (most likely a section of missing insulation as well), you may be able to detect a higher leakage voltage near the fault. Using two probes separated by some distance might work as well, if the length of your buried cable precludes easily grounding the meter.

Another approach would be to apply a good strong audio signal (tone for instance) to the cable and use sensitive high impedance headphones in place of the meter. The louder the tone, the closer you are to the "leak."

As a note, outdoor circuits should protect the user by a ground fault current interrupter (GFCI). It's designed to trip the circuit if excessive leakage current is detected to ground.

Rick Nelson
Newport News, VA

We accept Visa,
Mastercard, AmEx,
and Discover

Attention: Gearheads

www.shrevesystems.com

To Order Call 1-800-227-3971

Fax: 318-424-9771



PowerMac 7200
75 Mhz PPC 601
4 168 pin DIMM slots
Build your own Mac!
\$99 Brand New!



Peltier Junction
with heat sink
1 3/16" x 1 3/16"
\$10 each or 3 for \$25



Texas Instruments
Color Composite
Display
Great for Surveillance
Refurbished \$99

Apple IIE Logic Board



\$19



LC Power Supply
+5V, -5V, +12V Output
\$5 New

Global Village Bronze

External Modem
2400 Bps/9600 Fax

\$1 Each



CMS Tower SCSI Case

Holds 4 5.25 full height drives

\$99



Logic Boards

Q610 Logic **\$99**
Q660 Av Logic
Q650 Logic
Q800 Logic
Q840 Logic **No Processor**



MacAllly ADB Keyboard



\$10

PDA Genuine
Leather Carry
Case
Let your palm
pilot lead the life
of luxury!

Power Supplies

Apple IIE \$59
Apple IIGS \$69
Mac IICX, CI \$99
Mac II, X, FX \$49
Mac IISI \$49
Q610, 660AV, 6100 \$149

Newton 130

Without Lid **\$199**
Newton Carry Bags \$19
Newton Fax Modems \$19
16 MB Flash Cards \$79
20 MB Flash Cards \$99
24 MB Flash Cards \$129

RAM

1 MB 30 Pin 4 For \$1
4 MB 72 Pin 2 For \$5



Clarix Works
3.0 For
PC/Mac
EDOCs **\$29**

Miscellaneous

Apple 8 bit Video Card \$19
LaserWriter IINT \$299
Apple ADB Keyboard \$19
1.44 Super Drive \$49
Clone ADB Mouse \$19
Quicktake 100 Camera \$149
Bernoulli 90 MB EXT \$10



Membrane
Track Pad for
laptop **\$2**

**\$25 minimum
order**

Shreve Systems
1200 Marshall St
Shreveport, La 71101

Returns subject to a 15% restocking fee.
Prices are subject to change without notice. We accept Visa,
Mastercard, AmEx, Discover

TECH FORUM

ferrite beads on the power lines going to the lights. They strongly absorb RF, with the frequency range depending on their size. Below 10 MHz, the size can get rather large, though.

All Electronics has a selection of snap-on ferrite beads that are easy to add to existing wires.

It is possible that the lights are just a bad design. It would be inconvenient, but you might consider trying a different brand. Higher quality devices might have better internal shielding.

Tim Godfrey
Via Internet

ANSWER TO #W69919 - JUNE 99

I would like to examine the proper use of the 8052 microcontroller, using the C language, not BASIC or assembly. Is there any such system available?

There are many companies that sell C compilers for the 8051 family which includes the 8052. This is a "legacy" eight-bit microcontroller that is still popular. There are many specialized variants available from several vendors.

Some of the leaders in the 8051 family C compiler market are: Keil www.keil.com, Franklin Systems www.fsinc.com, Archimedes Software www.archimedesinc.com, and Avocet Systems www.avocetsystems.com

If you are looking for something free, visit the SDCC site at www.geocities.com/ResearchTriangle/Forum/1353

You should also visit www.8052.com for more Internet resources on the 8052.

Tim Godfrey
Via Internet

ANSWER TO #59914 - MAY 1999

I need share-ware or free-ware to do:

1. Low end drafting (CAD).
2. Programming flow-charting.

There is a shareware program called PCDCAD which can perform

the functions Mr. Cameron needs. I have a copy of it and since it is share-ware, if Mr. Cameron supplies me with a disk and SASE, I would be happy to make a copy and send it to him.

I could also use a flow-charting program such as he describes and if

he should find one, I would appreciate if he could send me a copy under the same conditions.

Howard Mark
Mark Electronics
21 Terrace Avenue
Suffern, NY 10901
hmark@j51.com

ANSWERS TO #4993 - APR. 1999

I have a 1 MHz oscillator. Can anyone come up with a circuit that will provide outputs at 100 KC, 200 KC, and 500 KC.

The circuit shown is a 4017 set-up to divide the input frequency depending on the switch setting. If the switch is set to Qz (pin 4), the input is divided by two.

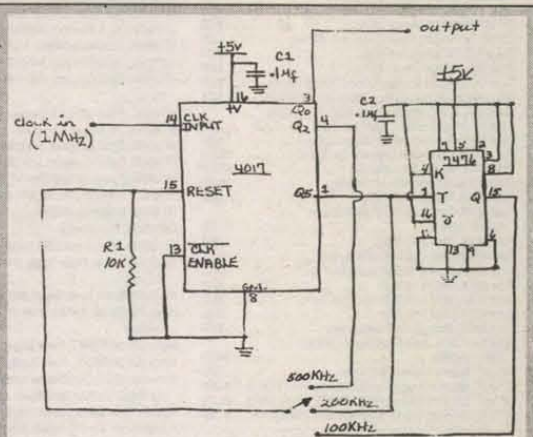
The JK flip-flop is one-half of a 7476 set-up to divide the 200 KHz output of the 4017 to give a 100 KHz output.

Resistor R1 holds the reset line low until it receives a logic high signal causing it to reset. You probably can build this circuit on perfboard. If you do, be careful with the layout.

Keep the wires as short as possible, keep your power supply wires separated, and use bypass capacitors C1 and C2 on the ICs.

The input and output connectors can be mounted on the front of the enclosure and the switch can to. The parts are easy to obtain and very inexpensive.

The circuit can be run off of a battery or a power supply. If the circuit is going to be used on a fairly consistent basis, you might be better off using a power supply.



Frequency Divider

Dennis Gifford
Henagar, AL

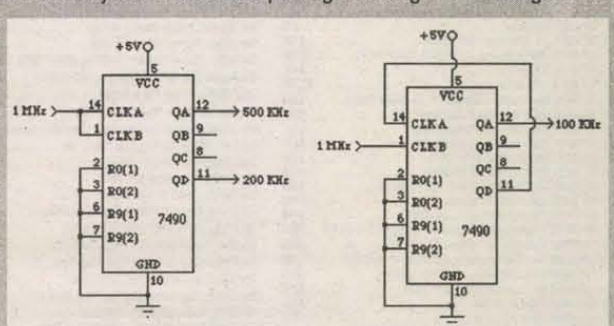
ANSWERS TO #4993 - APR. 1999

Two 7490s can be used as illustrated, to divide a 1 MHz signal down to 500 KHz, 200 KHz, and 100 KHz.

The 7490 counter is actually a divide-by-two and a divide-by-five in the same package. Putting a 1 MHz signal into

CLK A generates a 500 KHz signal at QA (divide-by-two). Putting a 1 MHz signal into CLK B generates a 200 KHz signal at QD (divide-by-five). Putting the 1 MHz signal into CLK B and connecting QD to CLK A puts out a 100 KHz signal with a 50% duty cycle at QA.

(Going through CLK A first and connecting QA to CLK B will also produce a 100 KHz signal, but with a 20% duty cycle.) Be sure to ground the RO (1), RO (2), R9 (1), and R9 (2) pins. Watch out for power and ground as they are not in the usual TTL locations on the chip.



Ron Tinkham
Gainesville, FL

Converters ★ Remotes ★ Converters ★ Remotes ★ Converters ★ Remotes

Modern Communications • (405) 691-0594 TEL & FAX

Converters

Converters:

	10	50	100
Panasonic: TZPC-175	\$49.00	\$45.00	\$39.00
Panasonic: TZPC-145	\$45.00	\$39.00	\$35.00
Centurion CF-3000 (NEW)			
True 99 Channel	\$65.00	\$60.00	\$55.00
Regal: CR-83	\$39.00	\$35.00	\$32.00

Remotes:

Jerrold: 400, 450, 550	\$4.50	\$4.00	\$3.75
CFT: 2XXX	\$4.95	\$4.50	\$4.25
S/A: 175, 475	\$4.95	\$4.50	\$4.25
S/A: 8600 Display	\$4.95	\$4.50	\$4.25
Panasonic: 170, 175	\$4.95	\$4.50	\$4.25
Zenith (ALL)	\$4.95	\$4.50	\$4.25
Pioneer (ALL)	\$4.95	\$4.50	\$4.25
Tocom 5503-VIP	\$4.95	\$4.50	\$4.25
4-in-1 Universal	\$5.95	\$5.50	\$5.25



Parts, Parts, Parts

	10+	50+	100+
PIC16C622	\$3.15	\$2.95	\$2.75
PIC16C54RC/P	\$2.15	\$1.95	\$1.75
PIC16C56RC/P	\$2.15	\$1.95	\$1.75
Micro 68H705C8P	\$6.50	\$6.15	\$5.95
4 MHz (Resonator 2 pins)	\$0.45	\$0.40	\$0.35
4 MHz (3 pins)	\$0.45	\$0.40	\$0.35
Crystal: 117, 119	\$3.75	\$3.50	\$3.25
18 pin IC Socket	\$0.15	\$0.12	\$0.10
Toggle Switch on/on	\$0.95	\$0.85	\$0.75

Call for Larger Quantity Quotes

Remotes

Converters ★ Remotes ★ Converters ★ Remotes ★ Converters ★ Remotes

AST GLOBAL ELECTRONICS

24529 STATE HWY. 408, CAMBRIDGE SPRINGS, PA 16403
VOICE 814-398-8080 • 1-888-216-7159 • FAX 814-398-1176

VIEW COMPLETE LISTING AT:
<http://www.astglobal.com>

IF WE DON'T CARRY IT ... WE'LL FIND IT
QUICKLY ... AT REASONABLE PRICES.

B&K 3020, Sweep/Function Generator, 2MHz (Sine, Square, Triangle).....	\$175
ESP 545, Microwave Counter 18GHz.....	\$500
ESI DP1311, Variable Resistor, 100K max 1K/Step.....	\$75
Fuke 332B, DC Voltage Standard.....	\$350
Fuke 332A, Voltage/Current Calibrator.....	\$400
Fuke 540B, Transfer Standard w/ASA-2 Voltage Plug-in.....	\$475
Fuke 845AB, Null Detector/Micro Voltmeter 1uV-1000VDC.....	\$375
Fuke 850A, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1mVDC, 0.5VAC, 1uV Resolution.....	\$75
Fuke 3308A, Constant Current/Voltage Calibrator.....	\$325
Fuke 5100B, Multifunction Calibrator, Opt. 0305.....	\$2,800
Fuke 5100B, Multifunction Calibrator.....	\$2,700
Fuke 5200A, Programmable AC Calibrator.....	\$1,000
Fuke 5215A, Precision RF Signal Generator.....	\$800
Fuke 6070A, Synthesized RF Signal Generator 200KHz-520MHz.....	\$1,400
Fuke 8000A, DMM 3-1/2 Digit.....	\$50
Fuke 8050A, DMM 4-1/2 Digit w/Battery Pack.....	\$145
Fuke 8050A, DMM 4-1/2 Digit w/Battery Pack.....	\$145
Fuke 8050A, DMM 5-1/2 Digit.....	\$275
Fuke 8050A, DMM 4-1/2 Digit w/Battery Pack.....	\$100
Fuke 8800A, DMM 5-1/2 Digit.....	\$125
Fuke 9010A, Micro System Troubleshooter.....	\$375
Gigatronix 6061A, Synthesized Signal Generator 10KHz-1050MHz.....	\$2200
HP 141T, Spectrum Analyzer Mainframe.....	\$475
HP 141T, Spectrum Analyzer w/552A/553B, 1KHz-110MHz.....	\$1,000
HP 141T, Spectrum Analyzer w/552B/553B, 1KHz-110MHz.....	\$1,200
HP 141T, Spectrum Analyzer w/552B/553A, 20Hz-300KHz.....	\$1,100

INVENTORY REDUCTION SALE PRICES SLASHED UP TO 50%

HP 141T, Spectrum Analyzer w/552B/553A, 1KHz-1.2GHz.....	\$1,700
HP 141T, Spectrum Analyzer w/552B/553A, 10MHz-18GHz.....	\$1,900
HP 1807R, Scope Mainframe.....	\$550
HP 204B, Oscillator, 5Hz-12MHz, 5V RMS.....	\$100
HP 204C, Oscillator, 5Hz-12MHz, 5V RMS.....	\$125
HP 214A, Pulse Generator, 0.5V-100V.....	\$200
HP 334A, Distortion Analyzer.....	\$275
HP 339A, Distortion Analyzer w/low Distortion Oscillator.....	\$950
HP 350D, Attenuator.....	\$75
HP 400E, AC Voltmeter, 10Hz-10MHz.....	\$150
HP 400F, RMS Voltmeter, 20Hz-4MHz, 100uV-300V.....	\$175
HP 415E, SWR Meter.....	\$100
HP 427A, LCZ Meter.....	\$170
HP 432A, Power Meter w/Cable/BNC, 0.1-18GHz Sensor.....	\$350
HP 432A, Power Meter w/Cable/Sensor.....	\$150
HP 435A, Power Meter w/Cable/Sensor.....	\$100
HP 435A, Power Meter w/Cable/Sensor.....	\$475
HP 458B, Test Oscillator, 10Hz-10MHz.....	\$125
HP 458B, Test Oscillator, 10Hz-10MHz.....	\$125
HP 458A, Oscillator, 10Hz-10MHz, 90dB Attenuator.....	\$195
HP 1630D, Logic Analyzer w/ports.....	\$550
HP 3312A, Function Generator, 1Hz-13MHz.....	\$490
HP 3325A, Programmable Frequency Synthesizer 1Hz-32MHz.....	\$950
HP 3330A, Automatic Synthesizer, 20Hz-13MHz.....	\$295
HP 3400A, True RMS Voltmeter, 10Hz-10MHz, 1mV-300V.....	\$275
HP 3403C, True RMS Meter, AC/DC/Hz 100MHz.....	\$200
HP 3403A, RF Voltmeter, 50uV-3V, 1.2GHz.....	\$250
HP 3455A, DMM 5-1/2 Digit.....	\$250
HP 3456A, DMM 6-1/2 Digit.....	\$325
HP 3466A, DMM 4-1/2 Digit, AC/Battery, 5 Function.....	\$175
HP 3478A, DMM 5-1/2 Digit.....	\$250
HP 3551A, Portable Transmission Test Set.....	\$550
HP 3575A, Digital Phase Gain Meter 1Hz-13MHz.....	\$500
HP 3580A, Spectrum Analyzer, 9Hz-50KHz, LED Readout.....	\$850
HP 3580A, Spectrum Analyzer, 9Hz-50KHz, Mechanical.....	\$850
HP 3581A, Wave Analyzer, 15Hz-50KHz.....	\$300
HP 3770A, Amplitude/Delay Distortion Analyzer.....	\$300
HP 3779B, Primary MPX Analyzer.....	\$500
HP 3781B, Pattern Generator.....	\$250
HP 5316A, Counter, 100MHz, HPIS.....	\$350
HP 5328A, Counter, 100MHz w/MDM/Opt. 021.....	\$200
HP 5328A, Counter, 500MHz.....	\$250
HP 5334A, Counter, 100MHz, Opt. 010 Oven.....	\$500
HP 5340A, Counter, 18GHz (noise).....	\$600
HP 5345A, Counter, 500MHz.....	\$450
HP 5345A, Counter, 500MHz.....	\$200
HP 58307A, VHF Switch.....	\$100
HP 6112A, Power Supply, 40V @ 5A (metered).....	\$150
HP 6202B, Power Supply, 40V @ 75A (metered).....	\$150
HP 6203B, Power Supply, 7.5V @ 3A (metered).....	\$150
HP 6205B, Power Supply (dual), 0-40V @ 3A, 0-20V @ 8A (metered).....	\$175
HP 6206B, Power Supply, 0-60V @ 1A (metered).....	\$200
HP 6206B, Power Supply, 10V @ 100A (metered).....	\$300
HP 6206B, Power Supply, 40V @ 3A (metered).....	\$200
HP 6208A, Power Supply, 40V @ 8A (metered).....	\$200
HP 6289A, Power Supply, 0-40V @ 1.5A (metered).....	\$175
HP 6294A, Power Supply, 0-60V @ 1A (metered).....	\$200
HP 6011A, Pulse Generator, 1Hz-20MHz.....	\$175
HP 6013B, Pulse Generator, 1Hz-50MHz.....	\$275
HP 6015A, Pulse Generator, 1Hz-50MHz 30V.....	\$400
HP 8019A, Rate Generator (1GHz) w/8092A Delay Generator (1GHz) w/8093A Output Amp w/1401A & 1404A.....	\$1,000
HP 8165A, Programmable Sig Source, 1mHz-50MHz.....	\$1,450
HP 8180A, Data Generator.....	\$350
HP 8350B, Sweep Oscillator Mainframe.....	\$1,550
HP 8410B, Network Analyzer Mainframe.....	\$200
HP 9411A, Frequency Converter, 11-18GHz.....	\$250
HP 9411A01B, Frequency Converter, 11-18GHz.....	\$375
HP 8414A, Polar Display.....	\$225
HP 8443A, Tracking Generator, 1KHz-110MHz.....	\$275
HP 8446B, Auto Prescaler, 1.8-18GHz.....	\$350
HP 8557A/180TR, Spectrum Analyzer, 0.1-350MHz.....	\$650
HP 8601A, Sweeper Generator, 1-110MHz.....	\$400
HP 8614A, Signal Generator, 800-2400MHz, AM/FM Leveled.....	\$300
HP 8616A, Signal Generator UHF, 1.8-4.5GHz, +10-120dB, AM/FM.....	\$300
HP 8620C, Frame w/8622B Sweeper, 0.1-2.4GHz.....	\$1,150
HP 8624D, RF Plug-in, 5.9-9.0GHz.....	\$225
HP 8640B, Signal Generator, 5-1050MHz, Opt. 020001 or 003.....	\$1,800
HP 8640B, Signal Generator, 5-512MHz, Opt. 001 or 003.....	\$700
HP 8660C, Frequency Synthesizer w/86603A/86601A/86632B.....	\$2,500
HP 8743A, Reflection Test Set, 2-12.4GHz.....	\$200
HP 8901A, Modulation Analyzer.....	\$800
HP 59030A, DIA Converter.....	\$125
HP 59501A, HP-IB Isolated DIA Converter.....	\$100
Kepco ATE15-50M, Power Supply, 0-15V @ 50A (metered).....	\$500
Kepco ATE55-5M, Power Supply, 55V @ 5A (metered).....	\$350
Kepco BVP100-4M, Bi-Polar Power Supply, 0-100V @ 4A (metered).....	\$375
Kepco JOE 36-15MVP, Power Supply, 0-36 @ 15A (metered).....	\$275
Kepco JOE 36-3MVP, Power Supply, 0-36 @ 3A (metered).....	\$175
Krohn-Hite 3202R, Dual Channel Tunable Filter, 20Hz-2MHz, High Pass, Low Pass Band Reject.....	\$200
PG506A, Calibration Generator Plug-in.....	\$500
Poland SPNH, Signal Generator, 20Hz-200Hz.....	\$275
Poland SPNL, Signal Generator, 1Hz-600KHz.....	\$200
Rascal Dana 9303, True RMS RF Level Meter.....	\$200
Rockland 1022F, Dual HiLo Filter.....	\$125
Rockland 5100, Synthesizer, DC-2MHz, 201 Hz Resolution.....	\$275
Sencore SC61, Scope (100MHz) w/No Probes, Dual Trace.....	\$750
Sencore SC61, Scope (100MHz) w/Probes, Dual Trace.....	\$400
Sencore SC3100, Waveform Analyzer (like new).....	\$1,800
Sencore TVAS2, Video Analyzer.....	\$1,100
Sencore VG91, Universal Video Generator.....	\$1,200
Sorenson DCR-80-5A, Power Supply, 80V @ 5A (metered).....	\$375
SRL 112B, PLOPRF Synthesizer.....	\$75
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, 0.01Hz-1MHz.....	\$175
Tek PG501, Plug-in Pulse Generator, 5Hz-50MHz.....	\$175
Tek PS501-1, Plug-in Power Supply Triple.....	\$150
Tek PS503A, Plug-in Power Supply Triple.....	\$175
Tek TG-502, Plug-in Optical Impulse Generator (unused).....	\$500
Tek T922, Scope (15MHz), Dual Trace, nice.....	\$175
Tek TMS03, Power Module, 3 Slot.....	\$125
Tek TMS04, Power Module, 4 Slot.....	\$150
Tek TMS06, Power Module, 6 Slot.....	\$125
Tek 7A16A, Plug-in (225MHz), Single Trace Amp.....	\$75
Tek 7A18, Plug-in (75MHz), Dual Trace Amp.....	\$50
Tek 7A19, Plug-in (600MHz), Single Trace Amp.....	\$100
Tek 7A26, Plug-in (200MHz), Dual Trace Amp.....	\$75
Tek 7B50A, Plug-in (150MHz), Time Base.....	\$100
Tek 7B53A, Plug-in (100MHz), Dual Time Base.....	\$50
Tek 7B70, Plug-in (200MHz), Time Base.....	\$100
Tek 7B80, Plug-in (400MHz), Delayed Time Base.....	\$125
Tek 7B92A, Plug-in (500MHz), Dual Time Base.....	\$125
Tek 7D11, Plug-in Digital Delay.....	\$125
Tek 7D13, Plug-in DMM 3-1/2 Digit.....	\$100
Tek 7D15, Plug-in Counter/Timer, DC-225MHz.....	\$175
Tek 7L13, Spectrum Analyzer, 100KHz-1.8GHz.....	\$1,200
Tek 7S11, Plug-in Sampling Unit.....	\$125
Tek 134, Current Probe Amp.....	\$75
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 (200MHz), Dual Trace.....	\$625
Tek 485, Scope (500MHz), Dual Trace.....	\$700
Tek 492, Opt. 2 Spectrum Analyzer 50KHz-21GHz.....	\$3,400
Tek 520A, NTSC Vectorscope.....	\$375
Tek 2213, Scope (60MHz), Dual Trace.....	\$450
Tek 2215, Scope (60MHz) Dual Trace.....	\$450
Tek 2235, Scope (100MHz) Dual Trace.....	\$650
Tek 2247A, Scope (100MHz) Dual Trace w/Counter/Timer/Volmeter.....	\$1,550
Tek 2336, Scope (100MHz) Dual Trace.....	SPECIAL \$525
Tek 2445, Scope (150MHz), 4-Channel Cursor Readout.....	\$1,100
Tek 2445A, Scope (150MHz), 4-Channel Cursor Readout.....	\$1,400
Tek 2465, Scope (300MHz), 4-Channel Cursor Readout.....	\$1,600
Tek 7104, Scope (1GHz), Dual Trace.....	\$1,200
Tek 7603, Scope Mainframe (100MHz).....	\$150
Tek 7704A, Scope Mainframe (250MHz).....	\$150
Tek 7904, Scope Mainframe (500MHz).....	\$225
Wavelek 145, Pulse/Function Generator, 0.001Hz-5MHz.....	\$300
Wavelek 185, Lin Log Sweep Generator, 0.001Hz-5MHz.....	\$300
Wavelek 288, Synthesized Function Generator, 20Hz-20MHz (unused).....	\$900
Wavelek FG3B, Sweep/Function Generator 2Hz-100KHz (unused).....	\$200

TECH FORUM

ANSWERS TO #6994 - JUNE 1999

When replacing the 6JS6C final tubes in the Model 101FT, Yaseu says they should be replaced with matched pairs. Does anyone know how to use unmatched pairs?

Years ago, Yaseu came out with a modification to do this.

#1 I believe you are mistaken about using unmatched pairs of tubes. What Yaseu said was that if

ANSWERS TO #5999 - MAY 1999

Am looking for a four pin 6 VDC logic buzzer that is controlled by a ca555 chip. The circuit is from an in-ground mole chaser that emits sequenced buzzing to annoy moles.

#1 A part number would have been helpful in finding a suitable substitute.

All Electronics Corp., P.O. Box 567, Van Nuys, CA 91408-0567; <http://www.allcorp.com> E-mail: allcorp@allcorp.com has the following which may work in your application.

STAR #CMB-12 fits standard 14-pin DIP socket. CMOS compatible. Operates on 7-17 VDC has a trigger terminal that activates with a 1mA load and produces 70dB at 20cm. The catalog number is SBZ-7 and the price is \$1.00. The dimensions are 0.9" x 0.62" x 0.67" and this is a square four-pin device. The minimum voltage listed is seven volts, but it may operate at six volts. I can't say for sure.

They have several other types of buzzers, as well as piezo and sound transducers that you may be able to adapt to your application. Their catalog is free, there is no minimum order and shipping is generally only \$5.00. Give them a call at 818-904-0524 and request a catalog or visit their website.

Robert Turner
Via Internet

#2 International Components Corp., has four models available that are low trigger current four-pin buzzers. Model BR2818L-06 has the following characteristics:

Voltage range: 4-8VDC (rated voltage 6VDC), maximum current: 30mA, sound output: 75dB at 100cm, frequency: 400 ±50 Hz.

International Components Corp., 105 Maxess Rd., Melville, NY 11747. Phone: 1-800-845-9154 fax: 516-293-4983.

Dennis Gifford
Henagar, AL

ANSWERS TO #49915 - APR. 1999

Would it be possible to add a 3.5" disk drive to my old IBM 3270 PC, model 16 with 640 KB, it has a 5-1/4 disk drive that uses double density, double sided floppies. What would I need in the way of hardware if it can be done?

#1 There is a combination internal disk drive that allows one to insert either 5-1/4" or 3-1/2" floppy diskettes.

The EPSON SD880 fits in the same slot as an ordinary 5-1/4" drive, is compatible with DOS 3.3 (or higher), and is very easy to install. Its JAMECO part number is 115810, and it costs \$71.95 plus shipping and handling.

You can order from: Jameco Electronics, 1355 Shoreway Rd., Belmont, CA 94002-4100. Voice: 650-592-8097, fax: 650-592-2503.

Thomas Ng
San Jose, CA

#2 Of course, you can put a 3.5" drive in your older computer. But, depending on your computer, you might need equipment other than the drive itself. Unless your computer's case has a 3.5" drive bay, you will need a 3.5" Drive Mounting Kit. This is a frame that fits in a "half height" (5.25") drive bay and provides space for a 3.5" drive.

Now, to actually hook it up to the computer, the floppy cable needs a connector that fits the drive. If your

cable has both a "card edge" type connector (the one your current floppy uses) and a small rectangular connector with two rows of small holes, (Molex type?) you're all set. But, if it only has the "card edge" connectors, you will need either a new cable (cheap, and widely available) which has both connectors, or an adapter that gives a 3.5" drive the "card edge" that the older connector can use.

This adapter is often included with the Drive Mounting Kit. (Hence the Kit in the name). A look through Nuts & Volts or the Internet will find each of these products from multiple vendors for no more than \$5.00.

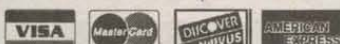
Amos Bieler
via Internet

#3 All you need is a new floppy controller board. Assuming your PC has ISA slots, JDR Microdevices (www.jdr.com) sells an eight-bit, four-drive "intelligent" floppy controller that can handle all PC floppy formats from 5.25" 360K to 3.5" 1.44M.

The board's JDR part number is MCT-FDC-HD4, has a price of \$29.99, and comes complete with ribbon interface cables.

Just replace your existing floppy controller card with the new controller card, make sure your DOS version is 3.2 or higher, and you will be reading/writing 3.5" floppies in no time.

Ken Simmons
Auburn, WA



• 60-DAY WARRANTY
• 10-DAY RIGHT OF RETURN
• SATISFACTION GUARANTEED

you wanted to use another brand of tubes, because of the different inter-electrode conductance, you needed to change a capacitor affecting neutralizing of the radio.

If you try to use unmatched pairs, one of the tubes will pull more current than the other and if it exceeds the rating for that tube, it will fail early.

Vaughn Wilson
Atwater, CA

#2 NW2M has a Web page that looks to contain every piece of information you might ever want on the FT-101.

His section on the 6JS6C does not mention "matched pairs," but he does explain that tubes made by manufacturers other than the original manufacturer used by Yaesu (NEC), have slightly different specifications.

As a result, C125 should be changed from a 100pF 1000VDC mica capacitor to a 10pF 1000VDC mica capacitor, if you're using another brand.

The page goes on to describe the neutralization procedure and warns about the high voltages present on these parts. The URL for the page is <http://www.qsl.net/nw2m/ft101.html#tubes>

Tom Tillander
Bay Village, OH

Continued from page 61

BUSINESS OPPORTUNITIES



COUNTER-SURVEILLANCE=\$250 HR! Electronic eavesdropping is unbelievably widespread! Are you sure you're safe? Learn how others (without prior experience) earn \$250 HR in the fascinating field of COUNTER-SURVEILLANCE! For FREE catalog call: 1-800-732-5000.

DEALERS WANTED: Digital Satellite Systems for "free-to-air" programming. Wholesale prices. <http://www.dmsi.usa.com> 1-888-591-4416.

JOIN ME and make money as a Computer Consultant. Very modest investment provides you with the tools to learn and earn extra income immediately. Only requirements, honesty and a desire for success. For information visit: <http://www.handtech.com/tcweb/Regis> click on business opportunity or write to regis@inav.net

REPAIRS — SERVICES

PICS, GALS READ if you've lost your masters. Programming service available. Call for info. Network Sales, 616-683-0500.

(E)EPROM PROGRAMMING done quickly and economically. One day turn around typical. Simple copy \$3 per device. Also prototyping, design, and consulting services available. Call or send SASE to: **Luzer Electronics, 4023 North Bayberry, Wichita, KS 67226. 316-687-2127, FAX 316-687-3103.**

CABLE CONVERTER REPAIR: Quality repair service for all name brands. If you're tired of the runaround you're getting from the company you purchased it from, or they're out of business. Give us a call for fast and courteous service. Have model and problem ready. Sorry no box, chip, or IL repairs. **Highview Engineering 815-245-3735** or E-Mail: HIGHENG1@AOL.COM ask for George.

WELD ALUMINUM WITH PROPANE! EZ, INEXPENSIVE, STRONG. DETAILS: WEEKS, 36 CAROLINA ST., TAYLORS, SC 29687. 1-800-547-WELD(9353) FAX 864-244-6349. <http://www.dura-fix.com>

ENGINEERING CONSULTING. Product development from conceptual to manufacturing stages. Digital, analog, and RF expertise. Microcontroller designs for HC05xx, HC11xx, and PIC families. Software design for IBM PC, XILINX and Altera FPGA design. In-house schematic capture and PWB. Hicks Electronic Design, PO Box 7366, Loveland, CO 80537-0366. Toll Free 1-888-849-6792 E-Mail: steve@hicksengineering.com website: www.hicksengineering.com

PRINTED CIRCUIT design by professional with 30+ years: conventional, multilayer, downhole, fine line. Prototype and production fabrication. Reverse engineer existing 2-layer board. www.circuit-applied-tech.com call toll free 877-236-3223.

PC BOARDS REPAIRED. Prices start at \$5. Minimum 5 of one type. Network Sales, 616-683-0500.

PLAYSTATION MOD chips. Works with all models up to 750x. Color instructions. Seven wire hook up, does not come with wires. \$5 each, plus shipping charges. 10% discount for 10 or more. Call 703-741-0338 to place an order.

PC BOARD ASSEMBLY. Thru hole only. Small or large quantities OK. Call Network Sales. 616-683-0500.

2-WAY RADIOS repaired. Specializing in Motorola portables. Flat rate plus parts. All work guaranteed. FCC licensed 25 years. Fast turnaround. Call Ed at Coral Radio 954-796-9590.

"Encyclopedia of Electronic Circuits" by R. Graff



ONLY \$39.95

An extensive library of 1,000 circuits from the bestselling, six-volume "Encyclopedia of Electronic Circuits."

As a paid subscriber to **Nuts & Volts**, you'll receive **10% off the list price!!**

(See ad on page 91 for ordering details and other titles currently available.)

Serial in, graphics out. Almost too easy.

These serial displays take RS-232 at 2400 or 9600 baud and produce stunning text and graphics on a supertwist LCD screen. See our complete line at www.seetron.com. All models are in stock for immediate delivery.

G12032 120x32-pixel LCD



- Same size as 2x16 text LCD
- Editable font(s) in 4 sizes
- Up to 6 screens in EEPROM
- Easy terminal protocol

(3.2 x 1.4 in.)



G12864 128x64-pixel LCD

- Large, sharp LCD
- Editable font(s)
- Up to 14 screens in flash
- Separate text, graphics layers
- DB9 connector built in
- AC adapter jack built in
- Easy terminal protocol

(3.7 x 2.8 in.)

www.seetron.com

Scott Edwards Electronics, Inc. • ph 520-459-4802 • fx 520-459-0623 • nnw@seetron.com

RF Data Modules



AM TRANSMITTER

- Small size: 17.78 x 11.43mm
- CMOS/TTL input
- No adjustable components
- Low Current. 4mA typical.
- 418MHz or 433.92MHz OOK
- Simple to integrate - simply add antenna, data and power
- Range up to 250ft.
- Wide supply range, 2-14Vdc
- SAW controlled - stability
- Also available in DIL package

AM-RTS \$12.10



AM RECEIVER

- Compact size: 38.1 x 13.7mm
- On-board data recovery. CMOS
- Low current. 2.4mA typical
- 2kHz data rate. CMOS/TTL output
- 5Vdc operation
- On 418MHz or 433.92MHz (4xx)
- No adjustable components
- Patented Laser Trimmed component
- High stability
- Sensitivity: -105dBm
- Available also in 0.8mA version

AM-HRR3-4xx \$10.95



FM TRANSCIVER

- Only 23 x 33 x 11mm
- Up to 40k bps data rate
- 19200 baud with ASCII
- Up to 500ft. range
- 5v operation
- 0.25mW into 50
- 418 or 433MHz FM
- Fast 1ms enable
- Direct interface to 5V CMOS
- Auto TX/RX changeover

BIM-4xx-F \$87.36

RS232 TRANSCIVER MODULES



- 4,800 to 38,400 bps half duplex
- 3-wire RS232 interface
- μ Controller with user EEPROM
- RS232 interface protected to $\pm 15kV$
- Data packetizing performed by user
- Auto TX/RX changeover
- 418 MHz and 433MHz versions
- Range up to 500ft. (0.25mW ver.)
- 0.25mW & 10mW versions
- Reset switch and status LED's
- 7.5-15V dc via DB9 connector, 20mA

BIM-4xx-RS232 \$139.30



Transceiver..... RTcom-4xx..... \$247.90
Transmitter..... RTcomTx-4xx..... \$ 87.15
Receiver..... RTcomRx-4xx..... \$105.52



ABACOM
TECHNOLOGIES



Tel: (416)236-3858
Fax: (416)236-8866
www.abacom-tech.com
abacomtech@compuserve.com

EL Light:

by TJ Byers

Playing In The Dark

Last fall, Nokia ran a TV commercial where the stadium lights went dark just as the game-beginning football was kicked off, only to land who knows where. The spectators rose to the occasion by turning on their Nokia cell phones and pagers, causing their handheld screens to glow a soft blue-green. The combined light from thousands of these devices was enough for the game to proceed. A bit far-fetched? Sure, but it shows the widespread use of electroluminescent (EL) lamps.

Once a laboratory curiosity, EL lamps have found their way into everything from wristwatches to cell phones to computers to flat-screen TVs. In fact, you'll find them just about anywhere where an evenly illuminated flat area is wanted, whether that area measures 1/4 or 100 square inches. Most often they're used to backlight an LCD (liquid-crystal display) screen — in other words, watches to computers.

In this application, the EL lamp is mounted directly behind the LCD display where the light makes its way through the display and is viewed from the front (Figure 1). The LCD structure has the ability to rotate polarized light as it passes through the molecular layers of the LCD material which, in turn, generates characters and images.

EL lamps are everywhere, from cell phones to laptops. Here's how they work, and how to make them work in your projects.

An EL provides the illumination needed to read that display in total darkness, aboard a plane, or in an office environment — at a considerable power savings over LED and other backlighting methods.

So, how do they work and how can they work for you? Read on.

EL Basics

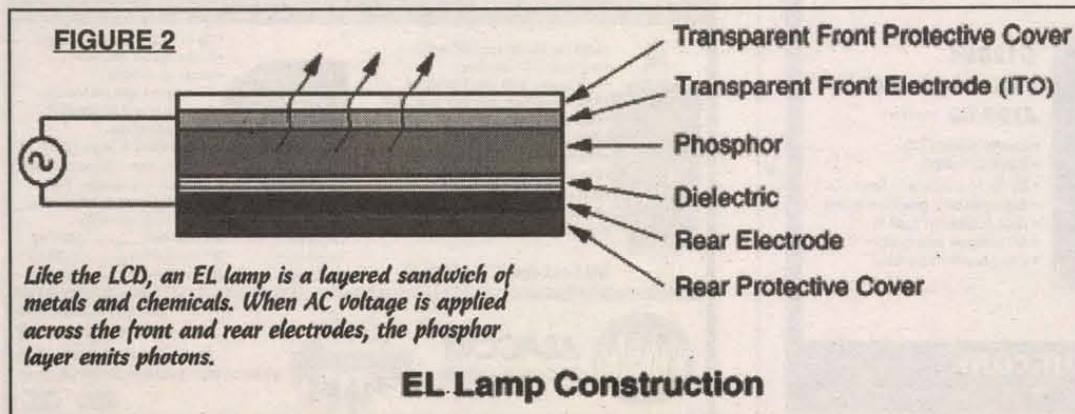
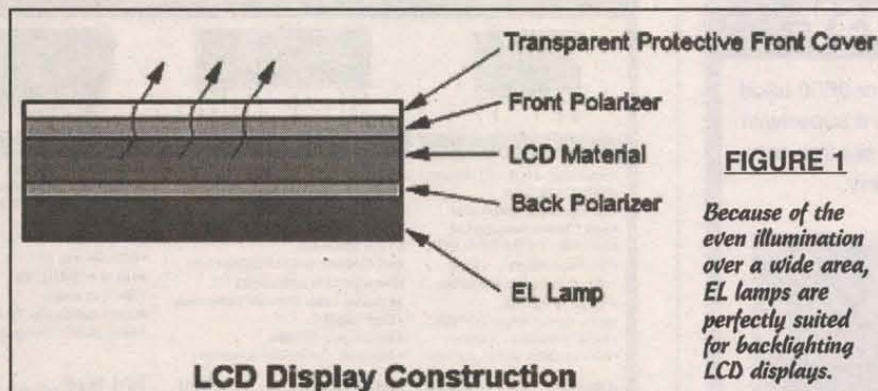
EL lamps are based on research done by Prof. G. Destriau — a French physicist — in 1936. Destriau suspended a zinc-sulfide powder on an insulator (oil on

ceramics) and, for other reasons, applied an AC voltage. To his amazement, the mixture glowed — as in it didn't blow up or create a bomb. He noted it. (Actually, it glows naturally in the dark if saturated with a heavy dose of sunlight. I know — had a jug of it that I used as a night light as a kid.) But that's where his discovery stayed, in the lab notes, until the late '50s, when research on the effect was revived and magazines like *Popular Science* forecast it to be the "light" of the future wherein large EL panels would light hallways and kitchens. While rooms with lighted walls that change color at the flick of a switch (as it did in the movie *Forbidden Planet*) never came to pass, the EL lamp did.

Today's EL panels have two conductive electrode layers: a clear top layer (typically of tin oxide) and a bottom opaque layer (often aluminum). Sandwiched in between the top and bottom conducting layers is phosphorus (Figure 2).

When an alternating voltage is applied across the electrodes, the electrons of the phosphor absorb energy as the electric field intensifies (goes from zero volts to +V). This increase in field intensity kicks the phosphor's electrons from their resting valence band into a higher conduction-energy band. As the electric field decreases (the voltage goes from +V to zero volts), the energy states relax, and the electrons fall back to the valence band, giving up their absorbed energy as a photon. During the downward transitions, the EL lamp gives off light.

By using different phosphors, the energy-band levels can be



modified to change the color and brightness of the emitted light. Larger band gaps pump up the electrons more than lower band gaps. Electrons with higher energy levels lean toward the blue part of the spectrum, whereas lower energy electrons lean toward the red. Typical phosphor compounds include zinc sulfide, calcium sulfide, and strontium sulfide laced with magnesium, samarium, and europium.

Powering An EL Lamp

EL lamps require a high voltage to knock those electrons around — a lot of voltage, in fact, generally in the range of 40 to 200 volts RMS. Ironically, the mass market for these lamps are battery-powered devices, like wrist-watches and cell phones, which run off of 1.5- and 3-volt batteries. Generating these high AC-voltages from a battery is a design issue all by itself, and the meat and potatoes of this article.

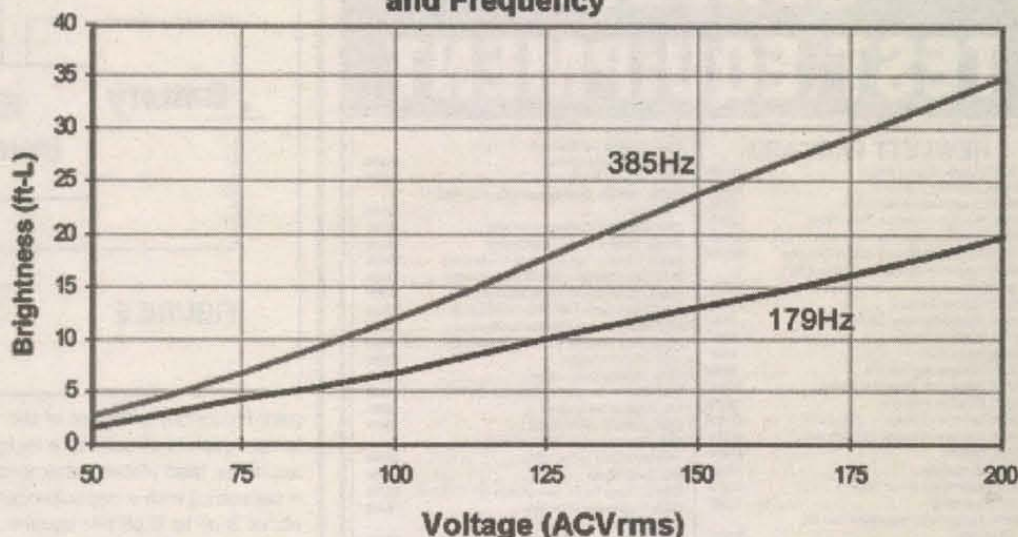
The two biggest variables in EL light output are the applied peak-to-peak voltage and its frequency. The brightness of the lamp is directly proportional to both (Figure 3). As the output voltage and/or the frequency increases,

the brightness of the lamp also increases. Typical LCD backlight EL lamps operate at 120VAC and 400 Hz.

It takes a special type of voltage converter to provide this voltage. Until recently, it was done using a resonating-transformer inverter. Unfortunately, it's difficult to match the transformer's reso-

Brightness versus Voltage and Frequency

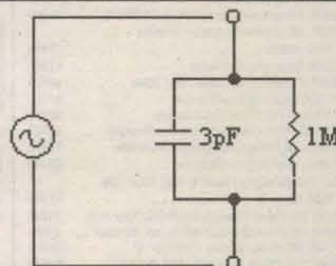
FIGURE 3



The brightness of the EL lamp is dependent on both the applied AC voltage and its frequency.

FIGURE 4

Electrically, an EL lamp is a leaky capacitor with a value of 3 pF to 6 pF per square inch.



Turn Your Multimedia PC into a Powerful Real-Time Audio Spectrum Analyzer

Features

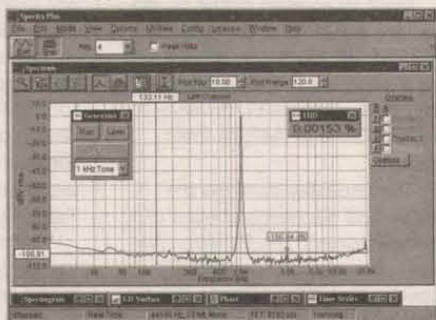
- 20 kHz real-time bandwidth
- Fast 32 bit executable
- Dual channel analysis
- High Resolution FFT
- Octave Analysis
- THD, THD+N, SNR measurements
- Signal Generation
- Triggering, Decimation
- Transfer Functions, Coherence
- Time Series, Spectrum Phase, and 3-D Surface plots
- Real-Time Recording and Post-Processing modes

Applications

- Distortion Analysis
- Frequency Response Testing
- Vibration Measurements
- Acoustic Research

System Requirements

- 486 CPU or greater
- 8 MB RAM minimum
- Win. 95, NT, or Win. 3.1 + Win.32s
- Mouse and Math coprocessor
- 16 bit sound card



Priced from \$299

(U.S. sales only — not for export/resale)

DOWNLOAD FREE 30 DAY TRIAL!

www.spectraplus.com

PHS Pioneer Hill Software
24460 Mason Rd.
Poulsbo, WA 98370
a subsidiary of Sound Technology, Inc.



Spectra Plus
FFT Spectral Analysis System

Sales: (360) 697-3472

Fax: (360) 697-7717

e-mail: pioneer@telebyte.com

Write in 73 on Reader Service Card.

Metric
Equipment Sales, Inc.

800-432-3424

Fax: 510-264-0886

www.metricsales.com

RENT • BUY • SELL
Yes, we will buy your surplus equipment!

Scopes, Meters, Analyzers, Power Supplies, Signal Generators, Counters, Recorders and more

Hewlett-Packard, Tektronix, Fluke, Dranetz, TTC, Anritsu, Wavetek, Keithley, and more

Test & Measurement Instruments

Over 7000 Models • 6-Month Warranty

Save 30-90% • 5-Day Free Trial

Write in 72 on Reader Service Card.

Nuts & Volts Magazine/JULY 1999 **83**

SURPLUS TEST EQUIPMENT

HEWLETT PACKARD

11729B, Carrier Noise Test Set	\$3000
11975A, Amplifier, 2-8GHz	\$2000
16500A, Logic Analyzer Mainframe	\$750
3312A, Function Generator, 1Hz-13MHz	\$700
3325A, Synthesizer/Function Generator	\$1000
3325A/01/02, Synthesizer/Function Generator	\$1500
3335A, Frequency Synthesizer, 200Hz-81MHz	
w/Opt. 01	\$4500
339A, Distortion Analyzer	\$1000
3456A, Digital Multimeter, 6.5 Digits	\$800
3478A, Digital Multimeter	\$700
3488A, Switch Control	\$600
3551A, Transmission Test Set	\$600
3575A, Phase Gain Meter 1Hz-13MHz	\$1000
3581C, Selective Voltmeter	\$800
3582A, Spectrum Analyzer, 0.02Hz-25.5KHz	\$1600
3585A, Spectrum Analyzer, 20Hz-40.1MHz	\$5500
4342A, O-Meter	\$1800
435B, Power Meter	\$500
436A, Power Meter w/Opt. 022	\$1000
437B, Power Meter	\$1800
4935A, Transmission Impairment Test Set	
w/Opt. 003	\$1100
5087A, Distribution Amplifier	\$1000
5316B, Universal Counter	\$1000
5328B, Universal Counter	\$1000
5335A, Frequency Counter, Opt. 01/20	\$850
5340A, Frequency Counter w/Opt. 01/02/011	\$1000
5342A, Microwave Frequency Counter,	
10Hz-18GHz	\$900
5355A, Frequency Converter	\$1000
5386A, Frequency Counter, 10Hz-3GHz	\$2000
54100A, Digitizing Oscilloscope	\$1700
54100D, 1GHz Digital Oscilloscope	\$2700
54110D, 1GHz Color Digitizing Oscilloscope	\$2500
54120A, Digitizing Oscilloscope Mainframe	\$5750
54201D, Digitizing Oscilloscope	\$2650
6011A, Autoranging Power Supply, 20V/120A,	
1000 Watt	\$1200
6012A, DC Power Supply, 0-60V/0-50A, 1000 Watt	\$1200
6034A, DC Power Supply, 0-60V/0-10A, 200 Watt	\$1000
6274B, DC Power Supply, 0-60V, 0-15A	\$1250
6475C, DC Power Supply, 0-110V, 0-100A	\$3500
6632A, DC Power Supply, 0-20V, 0-5A, 100 Watt	\$1000
778D, Dual Directional Coupler	\$400
8013B, Pulse Generator	\$750
8082A, Dual Pulse Generator, 250MHz	\$1200
8112A, 50MHz Pulse Generator	\$4000
8116A, 50MHz Pulse/Function Generator, Opt. 001	\$4000
8165A/002, Programmable Signal Source w/AM	\$2200
8347A, RF Amplifier, 100KHz-3GHz	\$2500
8350A, Sweep Oscillator Mainframe	\$1000
8350B, Sweep Oscillator Mainframe	\$1500
83522A, Sweeper Plug-in, 0.1-2.4GHz, w/Opt. 02	\$4000
83540A, RF Plug-in, 2.0-8.4GHz	\$2000
83540A/002, RF Plug-in, 2-8.4GHz	\$2500
83545A, Oscillator Plug-in, 5.9-12.4GHz	\$1750
8411A/018, Frequency Converter, 11 to 18GHz	\$500
8494H, Programmable Attenuator (unused)	\$800
8495H, Programmable Attenuator (unused)	\$600
8501A, Storage Normalizer	\$1000
8505A, Network Analyzer w/8501A & 8503A	\$4000
8510B, Network Analyzer w/Opt. 010	\$13,000
8554B, RF Spectrum Analyzer Plug-in,	
500KHz-1250MHz	\$800
8558B, Spectrum Analyzer Plug-in, 100KHz-1500MHz	\$1500
8562A, Spectrum Analyzer, 1KHz-22GHz	\$17,000
8566A/B, Spectrum Analyzer, 100Hz-22GHz	\$16,000
8569B, Spectrum Analyzer, 10MHz-22GHz	\$7000
8640A, Signal Generator, 0.5-512MHz	\$700
8640B, Signal Generator, Opt. 002, 5-1024MHz	\$2100
8640B, Signal Generator, Opt. 1, 2	\$2200
8654A, Signal Generator, 10-520MHz	\$450
8656A, Signal Generator, 100KHz-900MHz	\$1700
8656B, Signal Source, 0.1-2500MHz	\$2500
8660C, Synth. Signal Generator w/Opt. 1 & 100	\$1000
8660C, Synth. Signal Generator w/Opt. 1/5/100	\$1200
8660D, Synthesized Signal Generator	\$4000
86603A, RF Plug-in, 1-2600MHz w/Opt. 02	\$950
8662A, Signal Generator, 10KHz-1280MHz	
w/Opt. 001	\$17,500
8663A, Synthesized Signal Gen., 100KHz-2560MHz	
w/Opt. 001 & 002	\$33,000
8672A, Synth. Signal Gen., 2.0-18.0GHz	\$4500
8672A, Synth. Signal Gen., 2GHz-18GHz, w/Opt. 08/5000	
8748A, S-Parameter Test Set w/Opt. 026	\$1350
8756A, Scalar Network Analyzer	\$1500
8757A, Scalar Network Analyzer,	
10MHz-60GHz	\$4000
8970A, Noise Figure Meter	\$4500

TEKTRONIX

1503, TDR Cable Tester w/Opt. 04 Recorder	\$1550
2215, 60MHz Oscilloscope	\$500

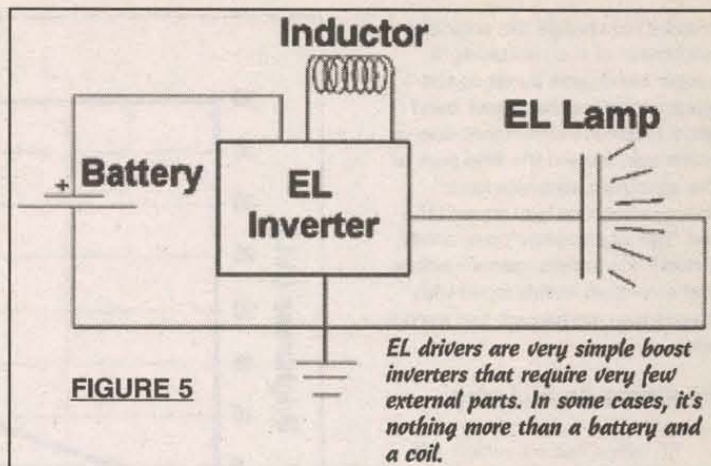
2236, 100MHz Oscilloscope	
w/Counter/Timer/DMM	\$1000
2246, 100MHz Oscilloscope	\$1600
2247A, 100MHz Oscilloscope w/Counter/Timer/	
Voltmeter	\$2500
2337, 100MHz Oscilloscope w/DMM	\$1650
2430A, 150MHz Digital Oscilloscope	\$2850
2432A, 300MHz Digital Storage Oscilloscope	\$3000
2445, Four Channel 150MHz Oscilloscope	\$1500
2445A, 150MHz Four Trace Oscilloscope	\$1850
2465, Four Channel 300MHz Oscilloscope	\$2500
2467, Four Channel 350MHz Oscilloscope	\$3000
2467B, Four Channel 400MHz Oscilloscope	\$6000
2630, Fourier Analyzer	\$2500
465B, 100MHz Oscilloscope	\$450
466, 100MHz Storage Oscilloscope w/DMM4	\$800
475A, 250MHz Oscilloscope	\$800
492P, Programmable Spectrum Analyzer,	
50KHz-21GHz w/Opt. 1/2/3	\$8000
576, Curve Tracer	\$2750
577/02, Curve Tracer, Non-storage w/177 Fixture	\$1750
7020, Programmable Digitizer	\$400
75L3, Spectrum Analyzer, 20Hz-5MHz,	
w/Opt. 025 Tracking Generator	\$1850
7L12, Spectrum Analyzer, 100KHz-1.8GHz	\$1500
7L18, Spectrum Analyzer Plug-in, 1.5-18GHz	
Capable of 60GHz with Mixers	\$2500
7S12, TDR/Sampler	\$450

**VISIT OUR WEBPAGE AT
WWW.RSSURPLUS.COM**

AFG5101, Arbitrary Function Generator	\$1500
CG5001, Programmable Calibration Generator	\$4000
DSA602, Digitizing Signal Analyzer	\$6000
PG506, Calibration Generator Plug-in	\$600
TM5003, Three Slot Power Mainframe	\$450
TM5006, Six Slot Power Mainframe	\$550

MISCELLANEOUS

Acme Elect. PS2L1000, Electronic Load	\$850
Datron 1061A, 6.5 Digit Autocal Multimeter, DC Only	\$700
Datron 1062, 6.5 Digit Autocal Multimeter, DC/AC/Ohms	\$900
EIP 545A, Microwave Frequency Counter	\$800
EIP 548A, Frequency Counter, 10Hz-26.5GHz	\$2000
EIP 548B, Frequency Counter, 10Hz-26.5GHz	\$3250
EIP 578, Source Locking Frequency Counter	\$2500
Electro-Metric EMC 11 MK IV, Interface Analyzer,	
16Hz-50KHz	\$2000
Electro-Metric EMC 30 MK IV, Interface Analyzer,	
10KHz-1GHz	\$5000
Electro-Metric NTR-51C, Receiver	\$1250
Fuke 5101B/03, Calibrator	\$3000
Fuke 5200A, AC Voltage Calibrator w/5205A Amp	\$1850
Fuke 7261A, Universal Counter/Timer,	
0Hz-125MHz	\$350
Fuke 8010A, Digital Multimeter	\$175
Fuke 8012A, Digital Multimeter	\$175
Fuke 8050A, Digital Multimeter	\$250
Fuke 8502A, Digital Multimeter, DC Only	\$225
Fuke 8520A, Digital Multimeter	\$350
Fuke 8600A, Digital Multimeter	\$65
Fuke 8810A, Digital Multimeter	\$250
Fuke 8840A, Digital Voltmeter w/Opt. 059	\$600
Gigatronics 910, Frequency Syn., 0.5-26GHz	\$5000
Keithley 195A, Digital Multimeter	\$700
LeCroy 9424, 350MHz Oscilloscope	\$3500
Marconi 2019A, Signal Gen., 80KHz-1040MHz	\$2200
Polard 1105E-FT, Signal Generator, 0.8-2.4GHz	\$400
Sorensen DCS40-25, DC Power Supply, 40V/25A	\$750
Trans. Devices DLR400 15 3500A, Dynamic Load	\$1500
Trans. Devices DLP 50-60-1000A, Electronic Load	\$800
Trans. Devices DLPV 130-110-1000	
Electronic Load	\$950
Vaihallia 2703, AC Voltage Standard	\$2350
Vaihallia 4150ATC, Digital Ohmmeter	\$750
W & G DA-30, Protocol Analyzer	\$3000
W & G SNA5, 50Hz-3.2GHz Spectrum Analyzer	\$5000
Wavetek 171, 2MHz Synth. Function Generator	\$450
Wavetek 172, Programmable Signal Source	
w/Opt. 01/02	\$1500
Wavetek 178, Automatic Synthesizer	\$1700
Wavetek 650, Precision 2MHz Variable	
Phase Synthesizer	\$1550
Wavetek 859, 50MHz Programmable Pulse Gen.	\$800
Wavetek 2001A, Sweep Generator, 1-1400MHz	\$450
Wavetek 3000-200, Signal Generator	\$900
Wavetek 8003, Precision Scalar Analyzer,	
10MHz-40GHz	\$2000
Wavetek 8501, Peak Power Meter	\$2000
Wiltron 560-7550, RF Detector, 10MHz-18.5GHz	\$300
Wiltron 560-7550, RF Detector, 10MHz-26.5GHz, Opt. 2	\$400



EL drivers are very simple boost inverters that require very few external parts. In some cases, it's nothing more than a battery and a coil.

nant frequency with that of the EL lamp, which is effectively a leaky capacitor (two plates separated by a dielectric) with a capacitance of about 3 pF to 6 pF per square inch and a parallel resistance that can range from 50k to 1.5M per square inch (Figure 4). Moreover, the part count was high, the transformer bulky, and the circuit less than reliable.

EL Driver ICs

Recognizing the need for a small, reliable inverter to power the burgeoning use of EL lighting in handheld devices, the semiconductor industry rushed in to fill the void. Today, the typical EL lamp inverter consists of a single IC chip — some as small as an apple seed — flanked by an inductor and a capacitor. As you can see in Figure 5, nothing could be simpler.

Most integrated circuit EL drivers are made up of three basic elements: an oscillator, an inductor, and a switched H-bridge. Here's a look inside a typical EL driver (Figure 6), the SP4422A from Sipex.

The oscillator controls the charge and discharge phases of the inductor and the EL lamp. An external capacitor connected between pins 7 and 8 sets the frequency of the oscillator, which is adjustable between 32 kHz and 400 kHz. The suggested frequency

is 90 kHz — typically a 100 pF capacitor. Alternatively, the frequency can be set from an external source by removing the capacitor and applying a squarewave to pin 8. The oscillator frequency is then divided by flip-flops to generate two control signals.

One of the signals clocks a switch that applies voltage across the inductor. When the switch is closed, current flows through the inductor and builds up a magnetic field. The amount of current is determined by the inductance and DC resistance of the coil. It's important that the current never reaches saturation, which is set by the design and construction of the coil.

If the current exceeds inductor saturation, excess heat will be generated and the efficiency will decline. In general, smaller inductors that can handle more current are more desirable. As the value of the inductor increases (and the DC resistance decreases), the oscillator frequency should be increased to prevent saturation. In fact, the design of the inductor is so critical that the IC vendor often provides a list of acceptable values (see Table 1).

When the switch is opened, the field collapses and the energy in the inductor is forced to flow through the H-bridge. In the case of the SP4422A, the H-bridge consists of a pair of SCRs that act as

Table 1. Recommended Coils For EL

Inductor DC Resistance Value	Mfg. Part Number	Manufacturer
20mH 65	CH5070AS-203K-006	CTC Coils
10mH 80	LQN6C103M04	muRata
10mH 32	DS1608C-106	Coilcraft
9mH 41	MD735L902B	Hitachi Metals
5mH 19.8	MD735L502A	Hitachi Metals
4.7mH 35	LQN6C472M04	muRata
4.7mH 13	667MA-472N	Toko
3.9mH not available	CLS62-392K	Sumida
680uH 2.2	DS1608C-684	Coilcraft
560uH 14.5	LQH4N561K04	muRata
330uH 8.2	LQH4N331K04	muRata
220uH 5.4	LQH4N221	muRata



R & S Surplus

1050 E. CYPRESS STREET, COVINA, CA 91724

(626) 967-0846 • FAX (626) 967-1999



high-voltage switches. The SCRs are alternately turned on and off by the second clock signal, which is 1/32 the frequency of the inductor's switching frequency. While the SCR is conducting, a charge builds up across the EL lamp, as the inductor dumps charge after charge into the lamp. The resultant waveform is shown in Figure 7.

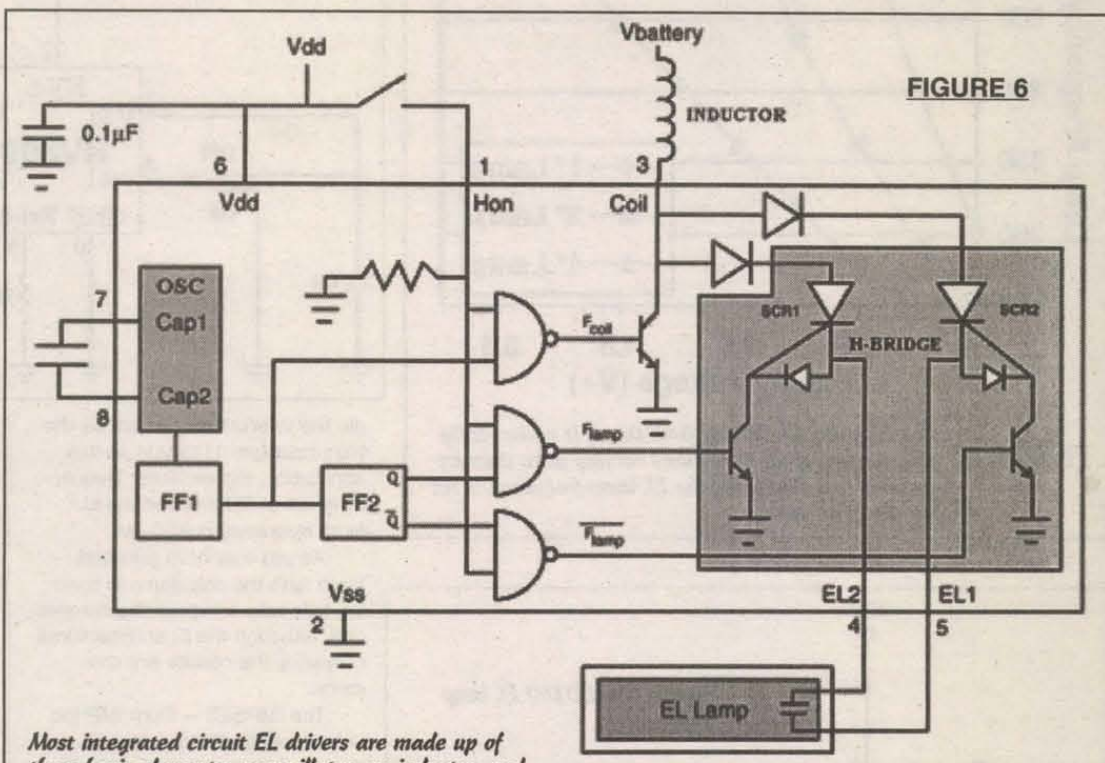
Like most EL inverters, the

SP4422A also has an input (pin 1) for placing the chip in a standby mode. In this mode, the battery current drops to an infinitesimal 50 nA or less. This step is critical for handheld battery operation,

where the inverter must be kept alive but not kill the battery (remember the Nokia commercial?). Typically, a logic high starts the oscillator and a logic low turns it off.

Practical EL Driver Applications

With that said, here's what a finished SP4422A design looks like (Figure 8). If you don't need to tog-



Most integrated circuit EL drivers are made up of three basic elements: an oscillator, an inductor, and a switched H-bridge. Here's a look inside the SP4422A from Sipex.

Generally, the switching frequency of the inductor is higher than that of the EL lamp. As a consequence, the waveform across the EL lamp looks more like a sloppy ramp wave than a square wave.

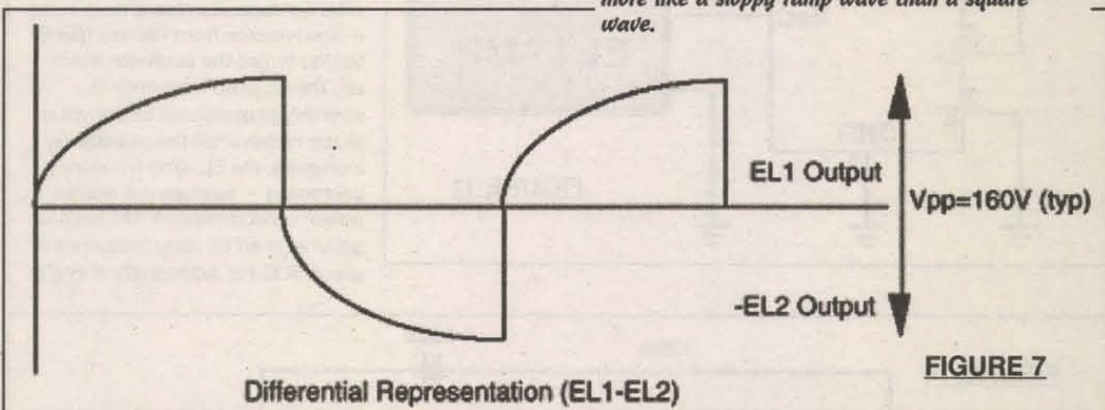


FIGURE 8

Typical Sipex SP4422 EL lamp application.

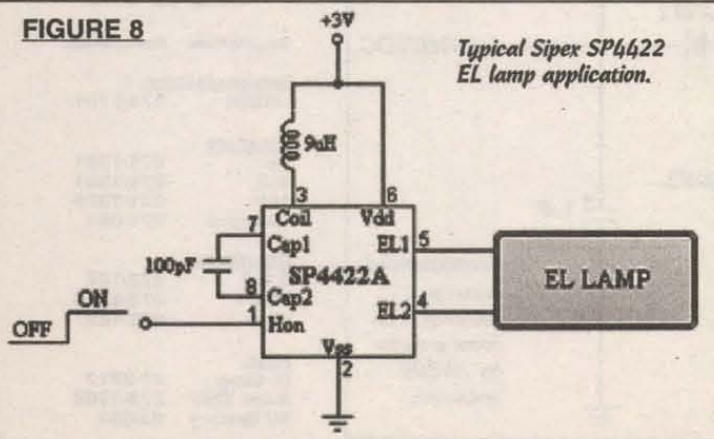
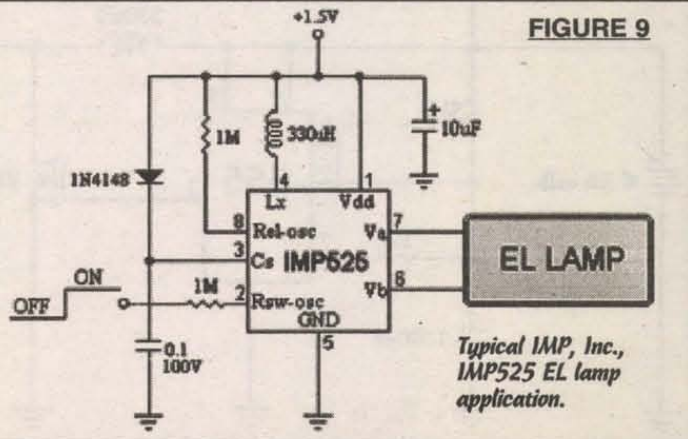


FIGURE 9

Typical IMP, Inc., IMP525 EL lamp application.



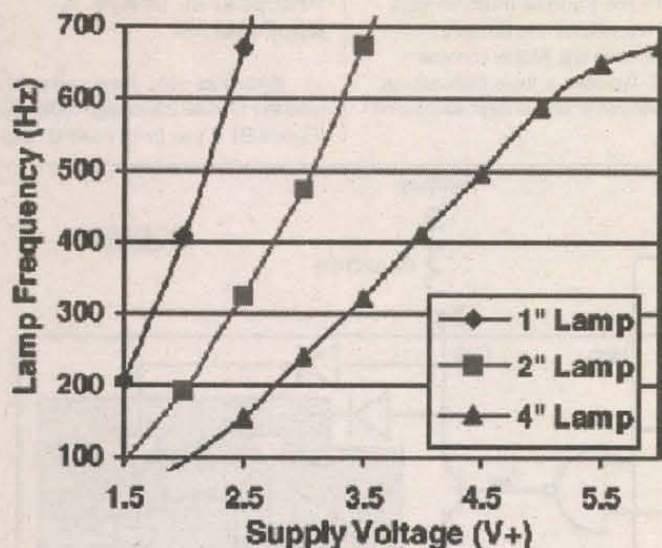
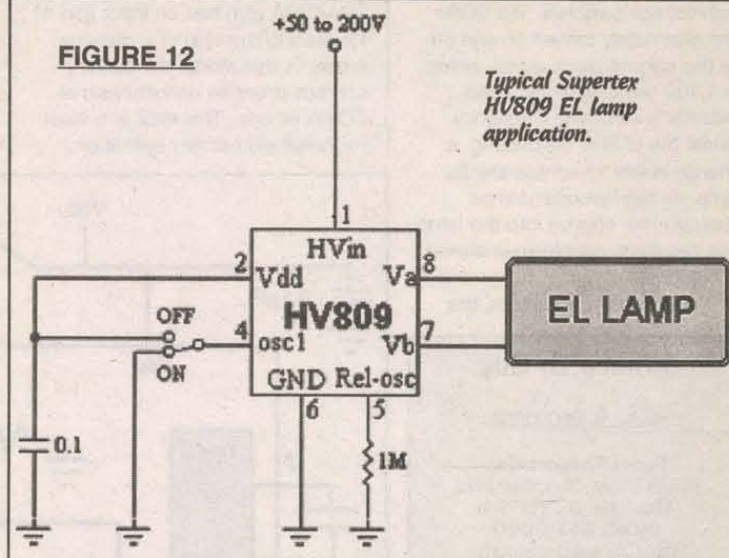


FIGURE 10 The D340DG EL drivers, from Durel, is undoubtedly the simplest of all. It requires nothing more than an external coil. Basically, the EL lamp frequency is set by the input voltage.



gle the inverter off and on, tie the Hon input (pin 1) to Vdd. In this application, the oscillator frequency is set at 90 kHz and the EL lamp frequency is 256 Hz.

As you may have guessed, Sipex isn't the only game in town. So, let's take a look at the competition. Although the IC architectures may vary, the results are the same.

The IMP525 — from IMP Inc. — is a popular EL inverter designed to operate off a single battery cell at voltages down to 0.9 volts. Figure 9 shows a typical IMP525 application.

This chip doesn't require an external capacitor, but it does need a bias resistor from Rel-osc (pin 8) to Vdd to get the oscillator started. The EL lamp frequency is inversely proportional to the value of the resistor; as the resistance increases, the EL lamp frequency decreases — as does the overall power consumption. A 1M resistor generates an EL lamp frequency of about 500 Hz. Additionally, there's

a logic ON/OFF input (pin 2) which puts the inverter into the standby mode (typically 1uA) when pulled low. This pin also sets the switching frequency for the inductor, when connected to Vdd, via a series resistor.

The switching frequency is inversely proportional to the value of the resistor; with 1M being the recommended value. Typical values for the inductor range from 330 uH (1.5V) to 680 uH (0.9V). See Table 1 for recommended coil manufacturers. Unlike the SP4422, the two switching frequencies aren't synchronized, but the resultant EL waveform is the same.

The D340DG and its family of switching mode EL drivers, from Durel, is undoubtedly the simplest of all. It requires nothing more than an external coil — no resistors, no capacitors. Of course, that gives you less control over the EL lamp frequency and inductor switching frequency, but if your EL panel size falls within its parameters, it doesn't matter.

Basically, the EL lamp frequency is set by the input voltage (Figure 10). The lamp voltage of

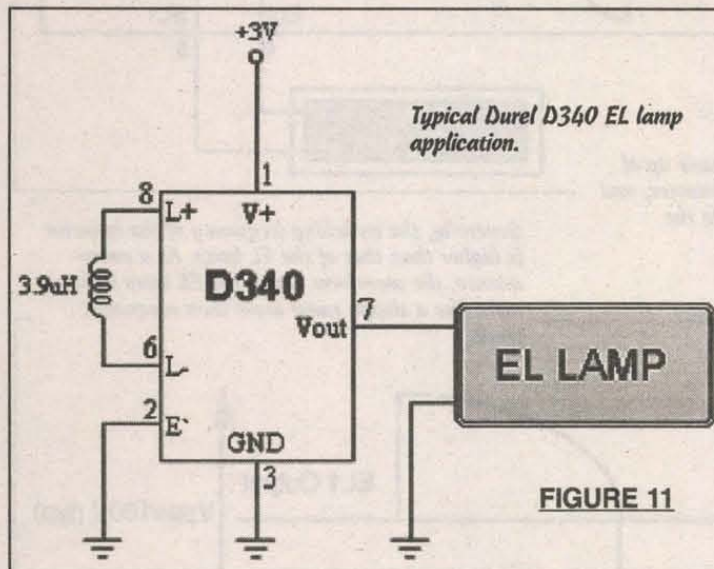
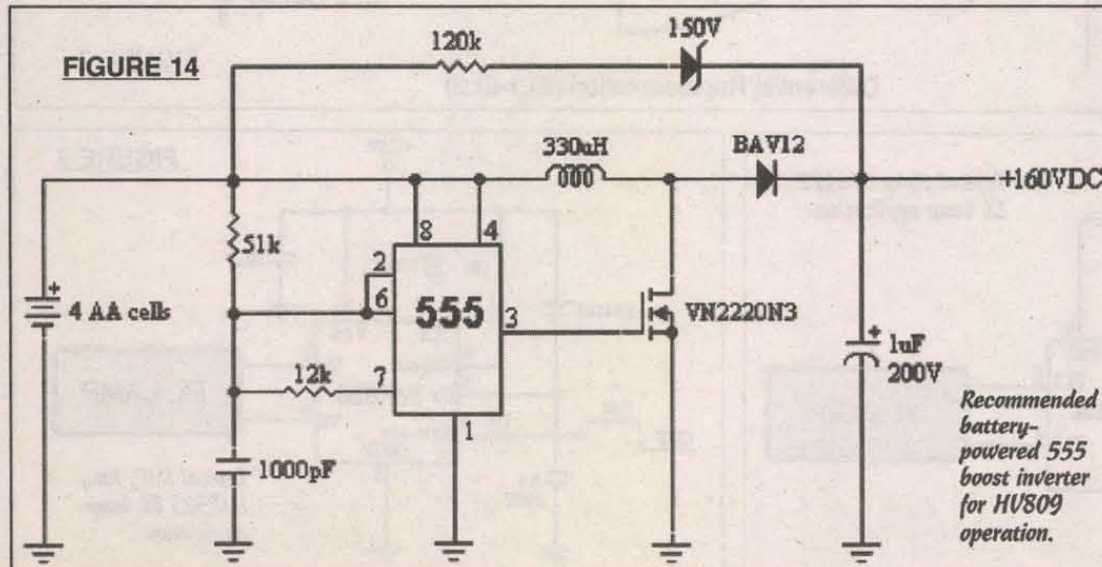


FIGURE 11



Recommended battery-powered 555 boost inverter for HV809 operation.

Parts List

Description RadioShack

Semiconductors

LM386 276-1731

Resistors

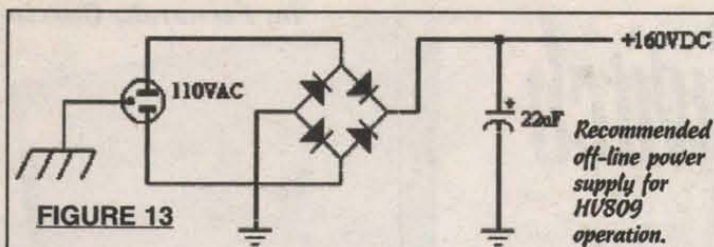
1k 271-1321
33k 271-1341
10k 271-1335
100k pot 271-092

Capacitors

0.1uF 272-135
10uF 272-1025
50uF 272-1027

Misc.

EL Lamp 61-2717
Audio Xfmr 273-1380
9V Battery 23-553



the D340B is nominally set at 140 volts peak-to-peak; in each case a 3.9uH Sumida inductor was used. A typical D340B circuit is shown in Figure 11.

The Supertex HV809 addresses a totally different area of EL illumination — literally. This chip is capable of powering EL lamps up to 100 square inches. That's the equivalent of a 14-inch (diagonal) panel. Unlike the previous examples, the HV809 requires a high-voltage input in the range of 50 to 200 volts DC, typically supplied by a boost inverter if you're working from batteries. Consequently, the HV809 itself needs no inductor. Essentially, an on-board oscillator drives an H-bridge which powers the EL lamp. Let's first look at an HV809 application (Figure 12) and then the recommended boost inverter (Figure 14).

The Rel-osc resistor sets the switching frequency of the EL lamp, which is inversely proportional to the value of the resistor — the higher the resistance, the lower the frequency. A 1M resistor generates 400 Hz. The output voltage is typically 340 volts RMS when the input voltage is 170 volts DC, which is easily obtained

by rectifying a 110-volt AC line via a full-wave bridge rectifier (RadioShack 276-1161) and a small 22uF filter capacitor (Figure 13).

Pulling OSC1 low (GND) starts the oscillator; forcing it high (Vdd) stops the oscillator. Like I said, the HV809 requires a high-voltage input. When working from batteries, this voltage has to be generated by a separate boost inverter. Supertex recommends using a 555 chip (Figure 14), but any boost regulator that generates 50 to 200 volts will work.

In the 555 version, the chip generates a pulse that charges the 330uH inductor which, in turn, kicks up the six-volt input (four AA batteries) to 160 volts. A 150V zener is placed from the output to the input to regulate the width of the pulse, thus keeping the output voltage more or less constant.

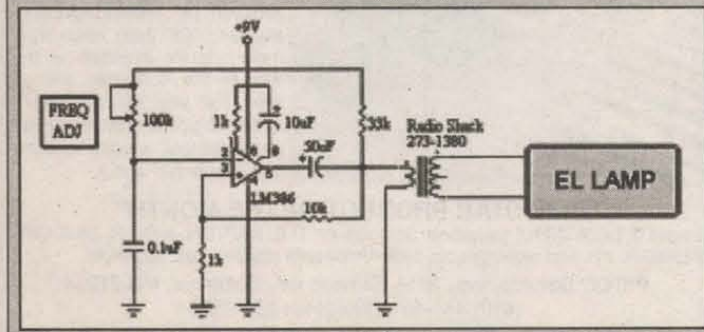
That's Light

Well that's EL light, and how versatile it can be. Now that you know how to make it work, take advantage of this low-power light source to illuminate your next genius project. **NV**

The AC voltage applied to the EL lamp has another component to it. In addition to increasing brightness as the voltage increases, higher AC frequencies produce a slight but noticeable shift in the color of the EL panel. Here's a simple experiment that lets you have fun with the effect. First, hook it over to your local RadioShack, buy the listed parts, and then wire them accordingly.

This is a simple audio amplifier that's configured as a squarewave oscillator. A portion of the amplifier's output is fed to its non-inverting input at pin 3. This voltage serves as a reference for the 0.1uF capacitor, which is connected to the inverting input at pin 2. The capacitor continually charges and discharges around the reference voltage as the IC's output voltage jumps up and down in response to the inputs. The output voltage is then fed to the secondary winding (8 ohms) of an audio output transformer with a 1000 ohms to 8 ohms impedance ratio (that's an 11:1 turns ratio). This produces about 100 volts across the primary winding, which is used to drive the EL lamp. The output frequency can be varied from 60 Hz to 20 kHz by rotating the FREQ ADJ potentiometer. As the frequency increases, the lamp will grow brighter and the color will change from eerie green to powder blue. Hey, don't take my word for it. Try it!

By the way, most 12-volt power transformers often work, too — just not as well, especially above 400 Hz. Just make sure you reverse the primary and secondary winding, as 12-volts in and 110-volts out.



ELECTRONIC TEST EQUIPMENT BOUGHT & SOLD

90 DAY WARRANTY PARTS & LABOR • 10 DAY RIGHT OF RETURN, OPEN ACCOUNTS

Altech 360011, Frequency Syn., 01-2GHz	\$800	HP 8697A, RF Plug-In, 26.5-40GHz	\$250
Altech Type 32, Precision Attenuator, 0-100dB	\$300	HP 8743A, Reflection Transmission Test Set	\$200
Argosystems AS210, Frequency Calibration System	\$2,000	HP 8743A018, Reflection Transmission Test Set, 18GHz	\$300
Austron 2100R, Loran-C Frequency Monitor	\$500	HP 8750A, Storage Normalizer, Includes Cable	\$250
Bird 4381, RF Power Analyzer, Opt. 832	\$450	HP 8753B, Network Analyzer, Opt. 002,006,010	\$10,000
Boonton 824D, Modulation Meter	\$250	HP 8753C, Network Analyzer	\$12,000
Boonton 928D, Digital RF Millivolt Meter	\$500	HP 8756A, Scalar Network Analyzer	\$1,500
Boonton 102B, Signal Generator, 45-520MHz	\$100	HP 8901A, Modulation Analyzer	\$1,000
Boonton 518-M, Q Standard	\$250	HP 8903B, Audio Analyzer, Opt. 001	\$2,500
Boonton 2500, DC Range Calibrator	\$300	HP 8920D, Dual-Mode Cellular Mobile Test System	\$10,000
Boonton 4G, Power Meter Sensor, 01-26.5GHz	\$200	Opt. 002,008,014	\$10,000
Boonton 4220/51013, Power Meter with Sensor	\$600	HP 8970A, Noise Figure Meter	\$4,000
Boonton 4300, Power Meter, 2 Channel	\$1,200	HP E3617A, DC Power Supply, 0-40V, 1A	\$250
Bruel & Kjaer 1612, Bandpass Filter	\$250	HP K486A, Power Sensor, 18-26.5GHz	\$250
Cal. Inst. 101T, AC Power Source	\$400	HP P486A, Power Sensor, 12-14.4GHz	\$100
Eaton 389K11, Frequency Synthesizer, 1-200MHz	\$250	HP X486A, Power Sensor, 8.2-12.4GHz	\$100
EIP 371, Source Locking Microwave Counter, 18GHz	\$1,000	Hughes 8010H, TWT Amplifier, 3-8GHz	\$1,000
EIP 578, Source Locking Microwave Counter, 26.5GHz	\$2,200	Hunttron HTR 1005B, Tracker Component Tester	\$200
EIP 931, Microwave Source, 01-18.6GHz, Opt. 9320	\$6,000	Keithley 192, Programmable DMM, 6.5 Digits, HP/IB	\$600
ESI 296, Auto LCR Meter	\$800	Keithley 195A, Digital Multimeter	\$300
Fluke 515A, Portable Calibrator, 1-200MHz	\$500	Keithley 614, Electrometer	\$700
Fluke 540B, Thermal Transfer Standard	\$500	Krohn-Hite 3202, Filter, LP, HP, BP, Unused	\$350
Fluke 5450A, Programmable Resistance Calibrator	\$1,000	Leeds & North 1091, Capacitor Decade, .001uF-1uF	\$150
Fluke 6010A, Frequency Synthesizer, 10Hz-11MHz	\$300	Microtronics NSI-52640W, Noise Source, 26.5-40GHz	\$350
Fluke 6080A/AN Frequency Syn., 5-1024MHz	\$4,000	Narda 5082, High Directivity Bridge, 2-18GHz	\$300
Fluke 8520A, Digital Multimeter	\$250	Narda 5292 Directional Coupler, 1-18GHz	\$200
Fluke 8522A, True RMS Voltmeter	\$250	Racal Dana 1515, Delay Pulse Generator	\$500
Fluke A55, Thermal Converter	\$250	Racal Dana 1992, Frequency Counter, High Stab.	\$500
FTS 1150/001, Frequency Standard	\$400	Racal Dana 9082P, Signal Gen. 1.5-520MHz	\$400
General Microwave 478A, Peak Power Meter	\$700	Simco A300, Aerostat Anti-static	\$100
General Radio 1557, Vibration Calibrator	\$400	Tek 134, Probe Amplifier for P6021 & P6022	\$100
Gigatronics 500B-12, Frequency Synthesizer	\$1,000	Tek 1470, NTSC Color Sync & Test Sig. Generator	\$500
Gigatronics 900-18, Frequency Synthesizer	\$1,500	Tek 1502, TDR, Opt. 4, Chart Recorder	\$1,000
Gigatronics 910, Frequency Synthesizer, 05-26GHz	\$8,000	Tek 1502C, TDR	\$3,500
Opt. 0306	\$8,000	Tek 1503/0105, TDR, Scale in Meters	\$1,000
Guideline 9154C, Transvol Standard Cell	\$300	Tek 176, Pulsed High Current Fixture for 576	\$500
Guideline 9577, Precision DMM, 7.5 Digits	\$300	Tek 178, Linear IC Test Fixture, For 577	\$150
Hiltech V212, Scope, 20MHz, Dual Trace	\$200	Tek 1790, Digital Waveform Monitor	\$500
HP 11590A, Bias Network	\$250	Tek 2246, Oscilloscope, 4-Channel, 100MHz, Custom	\$1,200
HP 11604A, Universal Extender	\$100	Tek 2432, Scope, Digital, 300MHz, 4 Channel, HP/IB	\$2,000
HP 11605A, Flexible Arm	\$100	Tek 2445A, Scope, 150MHz, 4 Channel	\$1,500
HP 11638A, Calibration Kit, Type N	\$600	Tek 2445B, Scope, 150MHz, 4 Traces, HP/IB	\$1,500
HP 11655B, Modulator	\$250	Tek 2465, Scope, 300MHz, 4 Channel	\$1,500
HP 11713A, Attenuator Calibrator	\$400	Tek 305DMM, Scope, 10MHz, Dual Trace, DMM, battery	\$500
HP 11869A, Adaptor for Plug-In 8350A/B	\$350	Tek 318, Logic Analyzer w/Scope	\$400
HP 11970A, Harmonic Mixer, 26.5-40GHz	\$800	Tek 464, Scope, 100MHz Dual Trace, Storage	\$400
HP 11970K, Harmonic Mixer, 18-26.5GHz	\$800	Tek 492, Spectrum Analyzer, Opt. 01A02	\$4,500
HP 11970Q, Harmonic Mixer, 33-50GHz	\$800	Tek 492/02, Spectrum Analyzer	\$4,500
HP 1600A, Logic Analyzer w/Scope	\$400	Tek 492B, Spectrum Analyzer	\$8,500
HP 1603D, Logic Analyzer w/Scope	\$500	Tek 492P, Spectrum Analyzer, Opt. 01, 02	\$5,000
HP 16530A/16531A, Digital Scope Card, 16500A System	\$500	Tek 604, XY Monitor	\$100
HP 214B, Pulse Generator	\$1,000	Tek 702D, Programmable Digitizer PI	\$800
HP 33102A, Microwave Switch, 100MHz-18GHz	\$100	Tek 7511, Sampling Unit w/54 Head, DC-14GHz	\$800
HP 3314A, Function Generator, Opt. 001	\$1,500	Tek AM503A/M502, Current Probe, Amp & Power Supply	\$800
HP 3325A, Function Generator	\$1,000	Tek DC503, Universal Counter/Timer TMS500	\$100
HP 3325A/01/02, Function Gen., Opt. 01/02	\$1,500	Tek DC504, Counter/Timer TMS500	\$100
HP 33322H, Programmable Attenuator, DC-18GHz	\$250	Tek DM502A, Autorange DMM	\$150
HP 3400A, RMS Voltmeter, 10Hz-10MHz	\$200	Tek FG501, Function Generator, 1MHz	\$100
HP 3403C, True RMS Voltmeter	\$200	Tek FG502, Function Generator, 1Hz-11MHz	\$250
HP 3455A, Digital Multimeter	\$500	Tek PB046, Differential Probe	\$300
HP 3458A, Multimeter, 5.5 Digits	\$400	Tek PB201, FET Probe Kit, 900MHz	\$400
HP 35689A, S-Parameter Test Set for 3589A	\$1,400	Tek PB202A, FET Probe, 500MHz unused	\$300
HP 3582A, Spectrum Analyzer, 0.2-25.5KHz	\$1,800	Tek PB602, Temperature Probe for DM5110, DM511	\$150
HP 4140B, Picometer, DC Source	\$2,000	Tek PG506, Scope Cal System w/FG501, SG503	\$1,500
HP 4274A, Multi-Frequency LCR Meter, Opt. 001,002,003	\$3,000	Tek PG508, Pulse Generator, 50MHz	\$150
HP/IB, Includes Test Fixture	\$350	Tek PS503A, Dual Power Supply	\$150
HP 435B, Power Meter	\$800	Tek SC502, Scope, 15MHz, Dual Trace	\$200
HP 436A/022, Power Meter, HP/IB	\$800	Tek SG502, Sig. Gen. 5Hz-50KHz	\$200
HP 5005B, Signature Multimeter	\$350	Tek TDS410A, Digitizing Scope, 200MHz, Opt. 13,1F	\$3,800
HP 5006A, Signature Analyzer	\$300	Tek TG501, Time Mark Generator	\$200
HP 5316A, Universal Counter, Opt. 004	\$200	Tek TM503, 3 Slot Power Module	\$100
HP 5334A/020, Universal Counter w/DVM	\$600	Tek WM490A, Waveguide Mixer, 26.5-40GHz	\$800
HP 5335A/010, Frequency Counter	\$500	Tek WM490K, Waveguide Mixer, 18-26.5GHz	\$800
HP 5335A/030, Frequency Counter, 1300MHz	\$800	Texcon SSG2000, Freq. Syn., 100KHz-2GHz	\$1,800
HP 5340A, Frequency Counter, 18GHz	\$800	AM, FM	\$250
HP 5340A, Frequency Counter w/Opt. 01/02/011	\$800	Ungar 4624, Solder, Desolder Station	\$250
HP 5345A, Microwave Counter	\$1,000	Valhalla 2000, Auto Digital Volt-Ammeter	\$200
HP 5345A, Frequency Counter, Opt. 012	\$1,000	Vu-Delta 5110, Semiconductor Tester, Invert Circuit	\$150
HP 5350A/010/002, Microwave Frequency Counter	\$2,000	Wavelet 178, 50MHz Programmable Waveform Syn.	\$1,000
HP 54100D, Digital Scope, 1GHz	\$2,000	Wavelet 180, Sweep/Function Generator	\$200
HP 54200A, Digital Storage Scope	\$600	Wavelet 185, Sweep Function Gen. 0.001-5MHz	\$400
HP 54601A, Digital Scope, 100MHz, 4 Channel	\$1,500	Wavelet 186, 5MHz Phase Lock Generator	\$200
HP 6112A, Power Supply, 0-40V, 0.5A	\$200	Wavelet 1084, Signal Gen. Sweeper, 3.5-4.5GHz	\$300
HP 8015A, Pulse Generator, 1Hz-50KHz, 30V	\$500	Wavelet 1910, XY Monitor, Dual Trace	\$400
HP 8165A, Programmable Signal Source	\$1,000	Wavelet 452, Filter, Dual Hi/Low, 1Hz-10KHz	\$450
HP 8165A, Programmable Signal Source, Opt. 02/03	\$1,200	Wavelet 7530A, FFT Spectrum Analyzer 0-100KHz	\$500
HP 8350B, Sweep Oscillator Mainframe	\$2,000	Wavelet 955, Micro Source, 7.5-12.4GHz, AM, FM	\$600
HP 8350B, RF Plug-In, 2-5GHz	\$200	Wiltron 560-7K50, RF Detector, 10MHz-40GHz	\$400
HP 8354SA, RF Plug-In, 5-12.4GHz	\$1,200	Wiltron 610D, Sweeper Mainframe	\$250
HP 83592C, RF Plug-In, 01-20GHz	\$8,000	Wiltron 6213D, RF Plug-In, 10MHz-4.2GHz	\$400
HP 84100/8412B, Network Analyzer	\$800	Wiltron 6219D, RF Plug-In, 2-8GHz	\$200
HP 8411A, Frequency Converters	\$250	Wiltron 6223D, RF Plug-In, 4-12.4GHz	\$250
HP 8414A, Polar Display	\$100	Wiltron 6229D, RF Plug-In, 7.9-18.5GHz	\$300
HP 8444A, Tracking Generator	\$500	Wiltron 62FF75, VSWR Bridge, 10-1000MHz	\$150
HP 8445B, Spectrum Anz., Automatic Pre-Selector	\$300	Wiltron 6NFS0, Autotester, 1-1500MHz, for 640	\$100
HP 8447E, Amplifier, 1-1300MHz, Gain 23dB	\$600	Wiltron 7B50, Detector, 1-1500MHz, for 640	\$100
HP 8481H, Power Sensor, 18GHz, 3 watts	\$400		
HP 8501A, Storage Normalizer, w/Scope	\$800		
HP 8505A, Network Anz., w/8501A & 8503A, Opt. 05	\$4,000		
HP 85021B, Directional Bridge, 10MHz-26.5GHz	\$1,200		
HP 8514B, S-Parameter Test Set, 45MHz-20GHz	\$10,000		
HP 8557A/180TR, Spectrum Analyzer, 01-350MHz	\$1,000		
HP 8558B, Spectrum Analyzer, 1-1500MHz	\$1,800		
HP 8559A/182T, Spectrum Analyzer, 01-21GHz	\$2,500		
HP 8559A/185SA, Spectrum Analyzer, Digital, 01-21GHz	\$3,500		
HP 8565A, Spectrum Analyzer, 01-22GHz, Opt. 100	\$4,000		
HP 8569A, Spectrum Analyzer, 10MHz-22GHz	\$5,000		
HP 86220A, RF Plug-In, 10-1300MHz	\$500		
HP 86241A, RF Plug-In, 3.2-6.5GHz	\$400		
HP 86260A, RF Plug-In, 12.4-18GHz	\$400		
HP 86290A, RF Plug-In, 2-18GHz	\$1,200		
HP 86290B, RF Plug-In, 2-18GHz	\$1,400		
HP 8643A, Synthesized Frequency Generator	\$8,000		
HP 8656B, Signal Generator, 1-990MHz, AM/FM	\$2,000		
HP 8660C, Freq Syn w/8660A & 8663A, 2.6GHz	\$2,500		
HP 86601A, RF Plug-In, 110MHz	\$300		
HP 86602A, RF Plug-In, 1300MHz	\$500		
HP 86603A, RF Plug-In, 2600MHz	\$1,000		

MONTHLY CLEARANCE SALE
HP 3325A PROGRAMMABLE FREQUENCY SYNTHESIZER, .001Hz-21MHz, 11 DIGIT DISPLAY, HP/IB PROGRAMMABLE, OUTPUT 1mV-10V INTO 50Ω. **\$795**

PHELPS INSTRUMENTS

2631 Hillside Ave., Norco, CA 91760
909-279-7347 • FAX 909-279-7323



Low Loss Electronic Switch

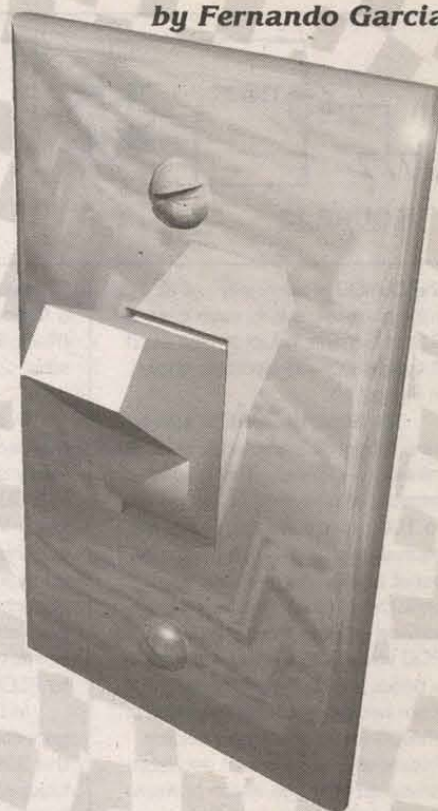
by Fernando Garcia

Apparently, there are quite a few hobbyists who are interested in battery-powered portable electronics. However, can portable also be stationary? Read on ...

The battery-powered SEPIC regulator article (April '99 issue of *Nuts and Volts*) generated a considerable amount of interest and lots of questions. Apparently, there are quite a few hobbyists who are interested in battery-powered portable electronics. But one of the most frequent queries centered upon the fact that portable electronics may also be stationary. This means that the device will be hooked, via a wall-wart transformer (a.k.a.

battery eliminator), to the AC line for extended usage or while the batteries are being recharged. It may also mean that the portable electronics may be connected to an automobile's electrical system from a cigarette lighter to operate the circuit while travelling.

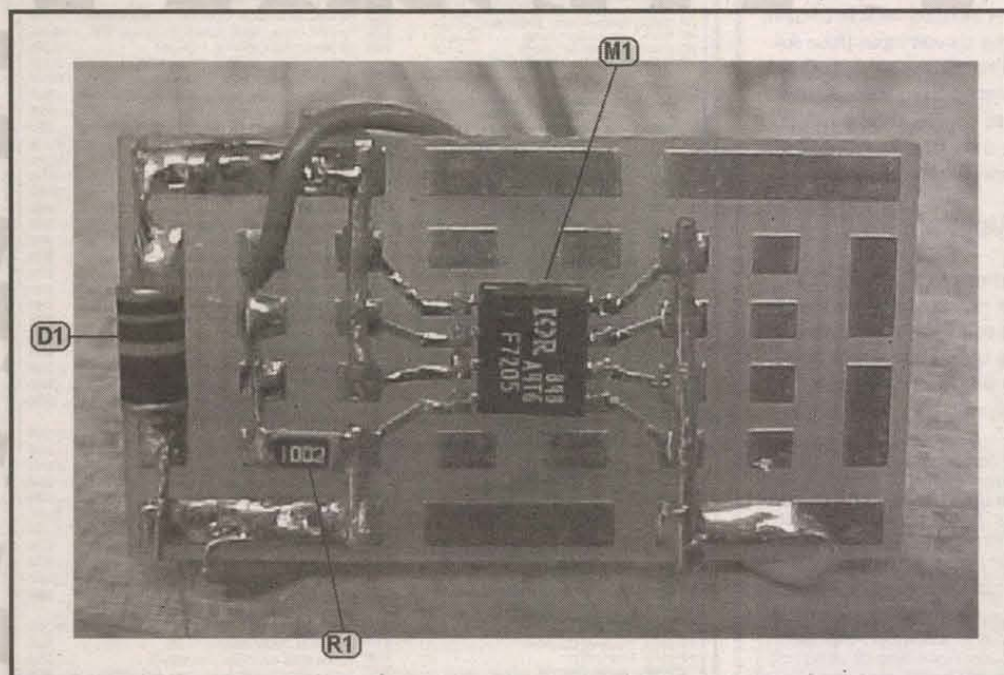
The question is: Will the regulator be able to handle the higher voltages provided by the transformer or vehicle? The short answer is yes, although simple modifica-



tions are required to accommodate the higher source voltages. The component substitutions are shown in Table 1. Please note that a nine-volt (nominal) battery eliminator may output as much as 10 volts, and a vehicle's alternator may output over 14 volts.

But other questions were involved with the fact that a seamless transfer from battery to AC power and back to the battery is sometimes required to avoid resetting our digital project. What happens if the portable device becomes accidentally unhooked from the wall or automobile? Also, many vehicles will only apply power to cigarette lighters if the ignition key is on, so what happens if the ignition key is turned off? How do you

Figure 3: The ultra simple project may be implemented on a Surfboard®.



LASERS & ACCESSORIES

HELIUM NEON LASERS

- ✓ Complete Systems
- ✓ Plasma Tubes
- ✓ Power Supplies

ACCESSORIES

- ✓ Optics
- ✓ Electro-Optics
- ✓ IR Viewers
- ✓ Books & More



MEREDITH
INSTRUMENTS

Phone: 602-934-9387 • Fax: 602-934-9482

DIODE LASERS

- ✓ Visible / IR
- ✓ Complete Modules
- ✓ Collimating Optics
- ✓ Drive Circuits

FREE CATALOG

WEB SITE:
www.mi-lasers.com

Model PTS-10
\$55



LIFETIME WIRE STRIPPER, a breakthrough in wire stripping technology. Extremely fast tool will strip PVC insulation #14 to #30 AWG from solid, stranded or shielded wires. High quality strip is achieved by patented stripping element (.008" thick) which thermally cuts the insulation all the way to the conductor without nicks. Five year test, with over 2 million stripped wires, using the same element, speaks for itself. The stripper has won a —

"FIVE STAR PRODUCT OF THE MONTH"

award in DESIGNFAX magazine. Strippers for TFE, KAPTON, KYNAR, SILICONE RUBBER, etc. and rechargeable, battery powered strippers also available.

PATCO Service, Inc., 2515 Glencoe Rd., Baltimore, MD 21234
(410) 444-4010 Fax (410) 254-9566

Parts List

D1: 1N4001 diode
R1: 10k, 5% SMT resistor
M1: IRF7205, logic level P-channel MOSFET.
D2: P6KE16A Transient suppressor diode (optional).

Misc.:
Model 9081 Surfboard®

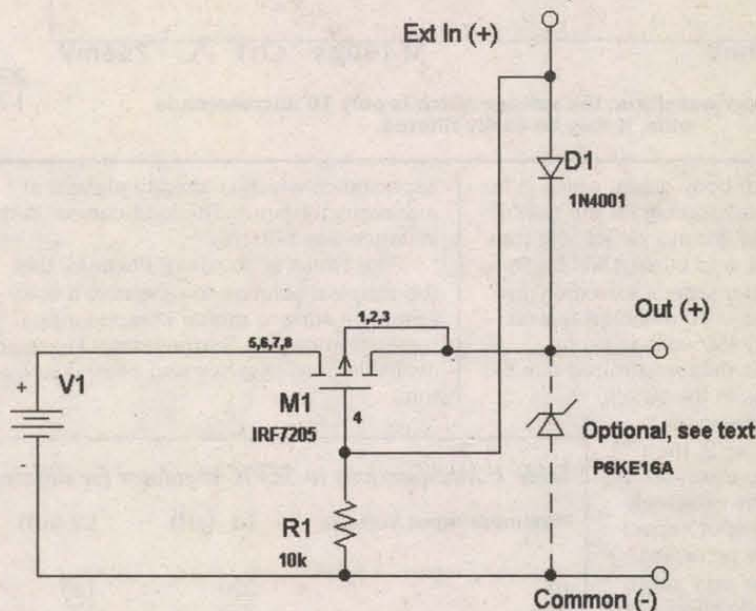
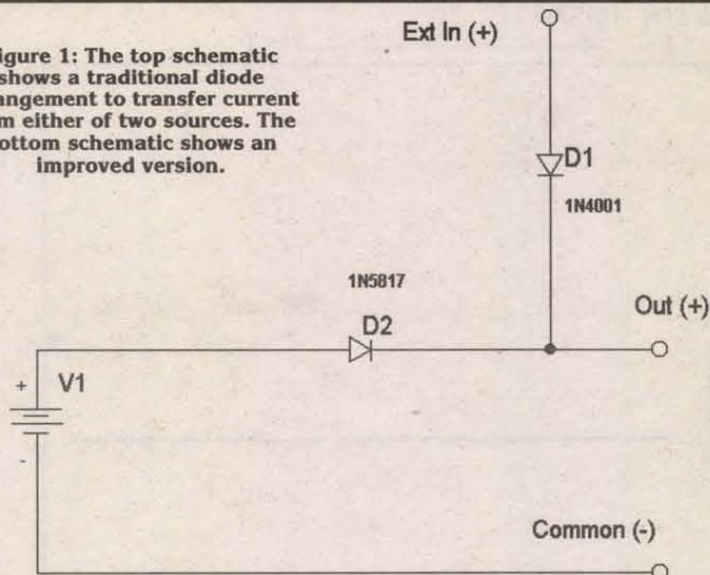
ensure continuous power to the load?

Again, a simple question apparently has a simple answer; that back-up current delivery will be required from the "AA" cells. In its simplest form, the transfer circuit only comprises two diodes, as shown in Figure 1 (top of figure). If the battery eliminator or vehicle's ignition are turned on, current is supplied to the load via D1, and D2 is reverse-biased. In the opposite case, D1 will be reverse-biased and load current will be supplied from the "AA" cells to the load via D2. Piece of cake, uh?

The only pitfall is that D2's forward voltage drop will subtract from the "AA" cell's voltage, and these precious tenths of a volt may well mean several minutes of usage time. Even with a Schottky diode, the voltage drop may be substantial when the device is operating close to its maximum ratings.

Fortunately, by spending just a little additional money, you can build a fully automatic transfer switch with (almost) negligible cell voltage loss. The improved circuit is shown in Figure 1 (bottom of figure). Diode D1 still carries the wall-wart's current when available, but diode D2 has been replaced by P-channel MOSFET M1. When the main external voltage is available, current will flow through D1, but most important, the MOSFET gate will be reverse-biased (remember, on a P-channel device, a positive gate voltage — with respect to source — will turn off the transistor). Since M1's gate voltage is taken

Figure 1: The top schematic shows a traditional diode arrangement to transfer current from either of two sources. The bottom schematic shows an improved version.



from D1's anode, it will be about 0.7 volts positive with respect to the source. Thus, the cells are, for all practical purposes, dis-

connected from the circuit.

If the main supply voltage is lost, current will flow initially through the

SOLUTIONS TO YOUR CABLING NEEDS

Cat.5 — Enhanced Cat.5 — USB — IEEE1284 / 488 / 1394
 Firewire — High-End Monitor — Manual & Auto Switches
 Apple — Custom Cables — Premise Wiring — more!
HUGE SELECTION OF SCSI CABLES & ADAPTERS

FIREWIRE Cables

All types are now in: 4-4, 6-4, and 6-6 pin, in 6, 10, & 15-foot lengths.

Cat.5 Special

\$69.00 / 1000ft.

Solid conductor, blue PVC jacket, 4pr UTP

Order Online 24 hrs./day. Reseller & Qty. Discounts Available!

No minimum order, same day shipping on most orders, A+ and CET technician available to answer your questions.



Northwest Cable & Connector Co.

www.nwcable.com



Phone: (360) 754-3606

Fax: (360) 754-0825



Write in 71 on Reader Service Card.

Your shrinking options are expanding!

MicroCore-11™

NEW!

- tiny 2" x 2" 68HC11 module
- RS232, 5V regulator, 8MHz crystal
- 32K SRAM plus 8K or 32K EEPROM
- plugs into your breadboard like a DIP
- 8K Starter Package #MC11SP8K...\$75*
- 32K Starter Package #MC11SP32K...\$89*

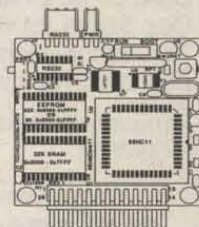
* plus shipping & handling
 Visa*MasterCard*Discover*Amex

Technological Arts

Phone: (416) 963-8996

Fax: (416) 963-9179

www.technologicalarts.com



Tek Stop: Single Seq 1MS/s

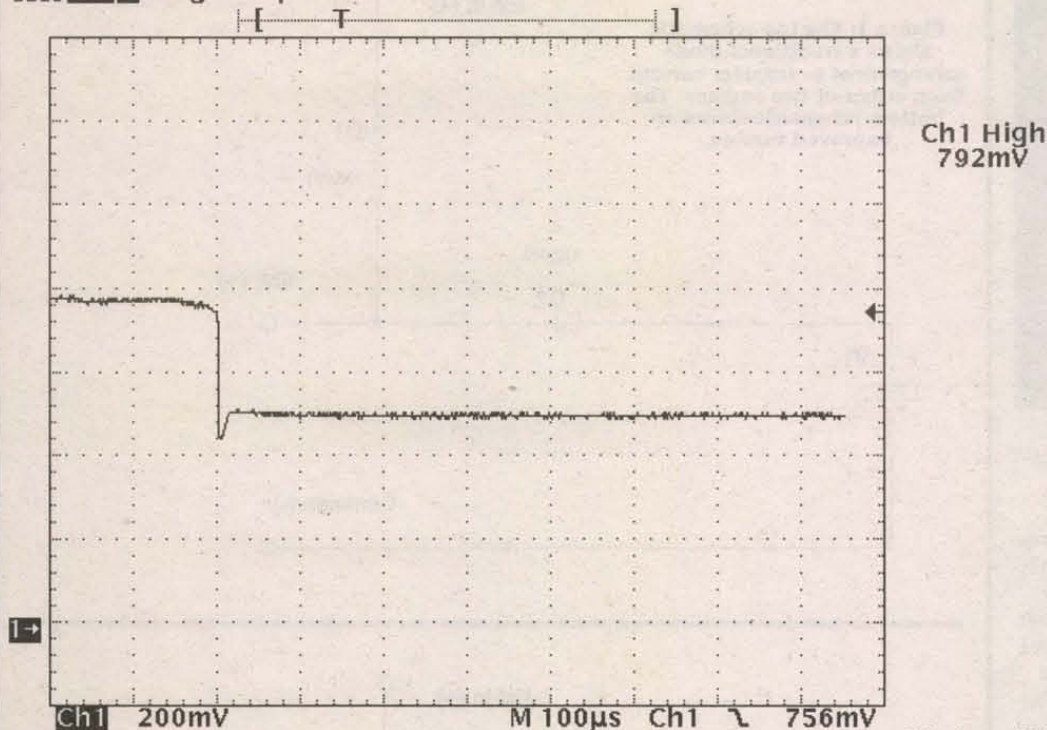


Figure 2: Transfer waveform; the voltage glitch is only 10 microseconds wide, it may be easily filtered.

22 Apr 1999
12:07:29

MOSFET's internal body diode, which is in parallel to drain and source. As the gate's voltage is pulled to ground via R1, the transistor is turned on, and current will begin to flow through the transistor's extremely low channel resistance — 70 milliohm typical — allowing extremely low voltage drops. Battery capacity is thus maximized due to the reduced losses in the switch.

As shown in the scope waveforms of Figure 2, the transfer is virtually instantaneous. To show the extremely fast transfer, no output capacitor was used while recording the waveform. The very short glitch may be easily filtered out with the mandatory input

capacitance which is already present at any regulator input. The load current in this instance was 600 mA.

The circuit is so straightforward, that the simplest solution to assemble it is to employ a surface mount breadboarding medium known as Surfboards®. These are available from Digi-Key and other distributors.

myself — a magnifying glass. I always like to rant that as I become older, devices are becoming smaller. And although you may have heard this warning a thousand times, here it goes again: **Always ensure ESD-safe handling for the MOSFETs.**

If operation from a vehicle is required, or if frequent connect/disconnect cycles are expected, it is strongly suggested that optional TRANZORB diode D3 is installed.

Surprisingly, large voltage transients in a vehicle's electrical system or during disconnects are generated, which could damage the switch and the regulator downstream. **NV**

Table 1: Modifications to SEPIC regulator for different input voltages.

Maximum Input Voltage	L1 (µH)	L2 (µH)	C4, C5, C6 (µF/ volt)
10	220	120	4.7/ 10
14.5	330	120	6.8/ 16

Check us out on the web: <http://www.nutsvolts.com>

Lowest Dealer Price Available

	5+	10+	20+
Refurb. Panasonic 145	\$45	\$40	\$35
Regal w/Remote	\$38	\$35	\$30
BC4535 86 Channel	\$30	\$28	\$25
Oak Sigma 99 Channel	\$45	\$40	\$35
75 Channel Converter	\$18	\$18	\$18
Zenith ST1600 w/Remote	\$75	\$70	\$65
Panasonic Converters Model-175 (550MHz)	\$65	\$55	\$45

Six month's warranty on this model only

Call us today to satisfy all your cable equipment needs!

SAM'S ELECTRONICS
1-405-631-1856

All Cable Equipment is unmodified.

FASTER THAN MOTOROLA

Two-way radio jamming equipment 800/900MHz. Stop illegal surveillance. **Pager jammers 900MHz.** Stop pagers from going off during school or church service. **Cellular phone jammers.** Stop cellulars from going off during school or church service. **PCS jamming, PCS phones. Lojack/teletrack/boomerang.** Stop illegal tracing/anti-surveillance. Cordless phone jammers 49MHz/900MHz • Radar jammers Xband • Nextel jammers • Car alarm jammer • CB radio jammer • Garage door jammer • RC radio jammers • AM/FM radio • HF/VHF/UHF radios • 1/8000MHz jamming equipment.

This equipment is designed for anti-surveillance customers: embassies, schools, churches, governments, law enforcement.

IF YOU DON'T SEE WHAT YOU WANT, WE WILL BUILD IT FOR YOU!!

We sell only to specific organizations or for export. Anyone implying illegal activity will be denied assistance and will be reported to law enforcement.

Jam RF • 954-561-8128 or www.jamrf.com

Get **Hot Deals** On Great Electronic Titles through the **Nuts & Volts** Bookstore

As a paid
subscriber to
Nuts & Volts, you'll
receive a 10%
discount off the
listed price shown
here!!



\$34.95

"Programming and Customizing the BASIC Stamp Computer" by S. Edwards

Build smart electronics projects with the inexpensive, simple-to-use, surprisingly powerful BASIC Stamp.



\$44.95

"Handbook of Radio and Wireless Technology" by S. Gibilisco

A comprehensive compendium on the entire field of radio and wireless technology.



\$39.95

"Encyclopedia of Electronic Circuits" by R. Graff

An extensive library of 1,000 circuits from the bestselling, six-volume "Encyclopedia of Electronic Circuits."



\$54.95

"Handbook of Microcontrollers" by M. Predko

This much-needed reference is the first to cover all the most common types of eight-bit microcontrollers.



\$34.95

"Electronic Troubleshooting" by D. Tormel and N. Widmer

Troubleshoot and repair any type of electronics with this comprehensive guide.



\$39.95

"Programming and Customizing the 8051 Microcontroller" by M. Predko

This tutorial/disk package details the features of the 8051 and demonstrates how to use these embedded chips to access and control many different devices.



\$39.95

"Circuit Troubleshooting Handbook" by J. Lenk

This handbook gives full descriptions of the operation of important circuits, and how each circuit's characteristics may figure in its failure or poor performance.



\$24.95

"How Electronic Things Work ... and What to Do When They Don't" by R. Goodman

Never again be flummoxed, flustered, or taken for a ride by a piece of electronic equipment with this fully illustrated, simple-to-use guide.

Other Available Titles ...

"Practical Antenna Handbook" by J. Carr **\$39.95**

"Secrets of RF Circuit Design" by J. Carr **\$29.95**

"The Illustrated Dictionary of Electronics" by S. Gibilisco **\$39.95**

"TAB Encyclopedia of Electronics for Technicians and Hobbyists" by S. Gibilisco **\$69.50 (Hard Cover)**

"The Robot Builder's Bonanza" by G. McComb **\$18.95**

"Programming and Customizing the PIC Microcontroller" by M. Predko **\$34.95**

"How Radio Signals Work" by J. Sinclair **\$24.95**

"Making Printed Circuit Boards" by J.L. Axelson **\$22.95**

"How to Read Electronic Circuit Diagrams" by R.M. & Lawrence Brown **\$19.95**

"Build Your Own Test Equipment" by H.L. Davidson **\$22.95**

"Radio Receiver Projects You Can Build" by H.L. Davidson **\$21.95**

"Troubleshooting and Repairing Consumer Electronics Without a Schematic" by H.L. Davidson **\$24.95**

"Amateur Radio Encyclopedia" by S. Gibilisco **\$29.95**

"Basic Electronics Theory" by D.T. Horn **\$26.95**

"Ready-to-Build Telephone Enhancements" by D.T. Horn **\$17.95**

"The Benchtop Electronics Handbook: 260 Most Common Popular Electronics" by V. Veley **\$65.00 (Cloth Cover)**

**Build your electronics library at a price you can afford!!
Order now!!**

BOOKS PUBLISHED BY MCGRAW HILL

Call 1-800-783-4624 today!

WE ACCEPT VISA AND MASTERCARD

Send check or money order to Nuts & Volts, 430 Princeland Court, Corona, CA 91719. Include a complete shipping address (no P.O. Boxes, please). Shipping & handling \$4.50. CA residents add 7.75% sales tax. Or, call our toll-free order-only line at 1-800-783-4624 and use your MasterCard or Visa. **ALL ORDERS MUST BE PREPAID.**

Voice Changer

An electronic circuit that can shift the pitch of your voice is called a voice changer.

Thanks to Holtek, there's an easy, inexpensive way to build a voice changing circuit: Use the HT8950A.

by Jack Dennon

Voice changing is an interesting application of electronics and could even have some important applications if you need, for example, to answer the phone without having your voice be recognized.

Voice changer circuits can be based on the frequency-shifting characteristics of the double balanced mixer (see sidebar) or, nowadays, you can take advantage of digital signal processing (DSP) techniques. Either approach involves a fair amount of design work. But thanks to Holtek, there is now an easier way to build a voice changing circuit: use the HT8950A.

This is actually a DSP-type approach, but you don't have to do any programming. Just add an LM386 audio output amp, a few passive components, and a nine-volt battery, and you have a system capable of shifting your voice up to sound like a lady, or down to sound like a gruff old man. There are six frequency shifts available, plus normal (no shift).

About the HT8950A

This Holtek HT8950A chip appears to simulate the operation of an audio tape recorder. But since it uses digital techniques, it can pull some tricks that would not be possible with physical tape. Mind you, I'm not certain that the way I will describe its operation is

endless loop of tape, or a magnetic drum, with a write head that moves at about 8000 samples per second, and a read head that moves a selectable fraction or multiple of that rate.

For shifting up, you can select 4/3, 8/5, or two times the write rate; for shifting down you have available 8/9, 4/5, or 2/3 the write rate.

The chip was designed to be used in a handheld device. It has four pins internally debounced for dedicated push-button inputs. One of these inputs punches the pitch up one step, one punches the pitch down one step, and the other two invoke special effects that are a robot-like voice, and vibrato.

The chip powers up in the robot voice mode. The stepping up and stepping down provided by the two push-button inputs are each actually performed in a cir-

About the Circuit

The HT8950A operates on 2.4 to 4.0 volts and draws less than 10 milliamps so, as shown in Figure 1, we use a simple zener regulator to drop the voltage from a nine-volt battery down to our operating level.

Zener diode D1 draws just the right current through resistor R1 to maintain V_{dd} at about 3.5 volts. Pin 11 of the HT8950A — the "lamp" pin — draws current through LED D2 proportional to the audio level, so they say, but if you install resistor R10, then mainly it just shows that the power is on.

Resistors R7 and R8 set the internal clock rate. Resistors R9 and R5 establish the gain of the audio input amplifier. Resistors R4 and R6, with the help of smoothing capacitor C3, provide the bias voltage that the electret micro-

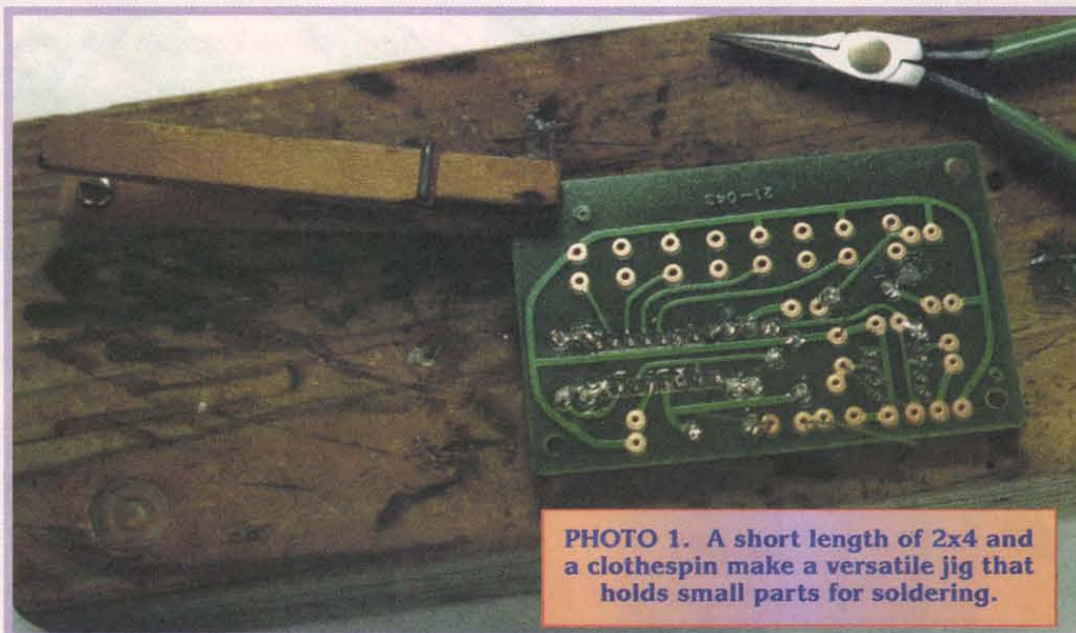


PHOTO 1. A short length of 2x4 and a clothespin make a versatile jig that holds small parts for soldering.

in fact what the chip actually does; Holtek's data sheet doesn't tell you exactly what is going on inside this chip.

We are told that there is an analog-to-digital converter at the input, a digital memory, and then a digital-to-analog converter for output. The actual algorithm may be quite sophisticated, but what it simulates is a tape recorder with variable speed readout.

So you can visualize it as an

cular fashion.

In other words, you can get to any frequency shift by just punching the up button or the down button because when you hit the end of the multiplier table, they just wrap around to the other end of the table and keep stepping; the only difference between the two buttons is the direction in which they step. One goes clockwise, the other goes counter-clockwise, so to speak.

phone requires.

Coupling capacitor C4 isolates the microphone's DC bias voltage from the IC's audio input amplifier while passing the audio voice signal.

The frequency-shifted audio available at pin 12 is low-pass filtered by R2 and C5 and then applied via pot R3 to the input of the audio output amplifier U2. The audio output amplifier is configured for a voltage gain of 20; out-

Voice Changer

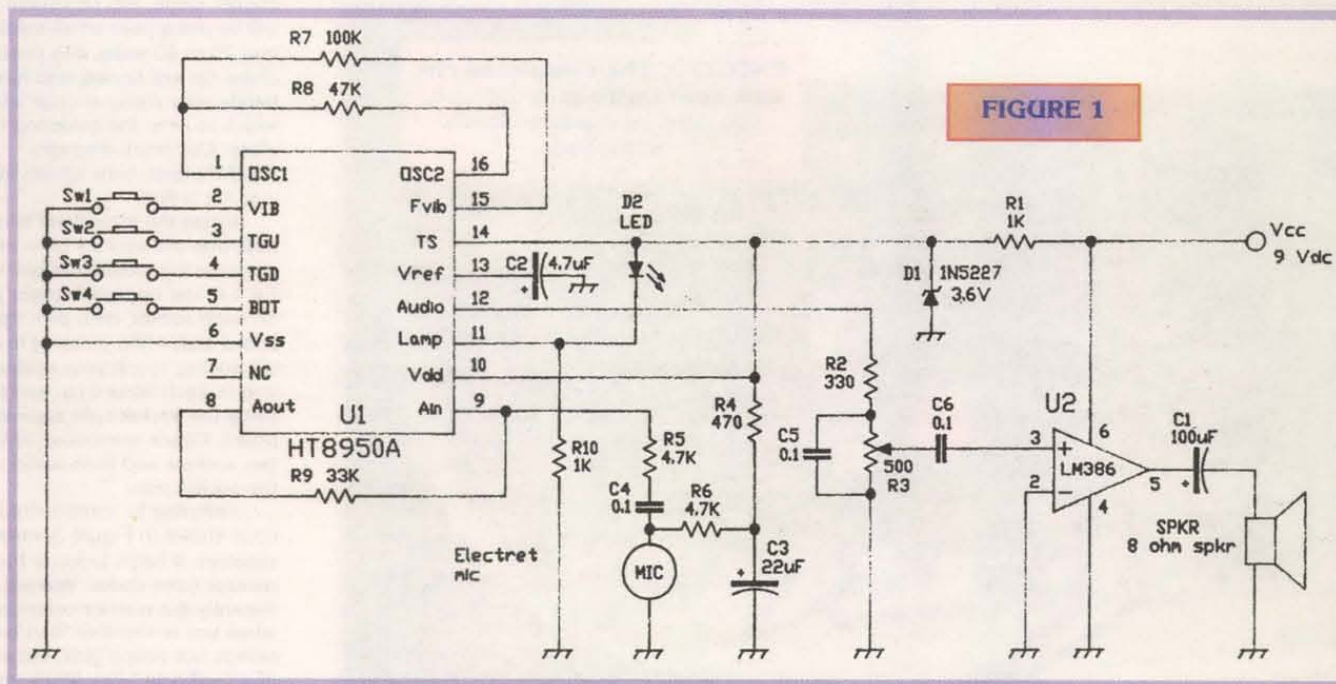


FIGURE 1

put volume is, of course, controlled by pot R3. The LM386 drives an eight-ohm speaker via coupling capacitor C1.

Vibrato

An output voice will be generated with a vibrato effect when the VIB pin is triggered, regardless of what state the system is in. The vibrato pin toggles the vibrato state. That is to say, when a voice output is playing with vibrato effect, this effect can be eliminated by retriggering the VIB input. The rate of vibrato effect can be changed by changing the value of resistor R7.

Voice Modulation

The HT8950A provides eight-bit analog-to-digital (A/D) and eight-bit digital-to-analog (D/A) converters with a sampling rate of 8 KHz, ensuring voice output of high quality with a high signal-to-noise (S/N) ratio. The large scale integrated (LSI) circuit includes seven steps to shift the frequency of the input signal. The frequency steps are illustrated in the following table:

0	Down3	2/3
1	Down2	4/5
2	Down1	8/9
3	Normal	1
4	Up1	4/3
5	Up2	8/5
6	Up3	2
7	Robot	

FIGURE 3

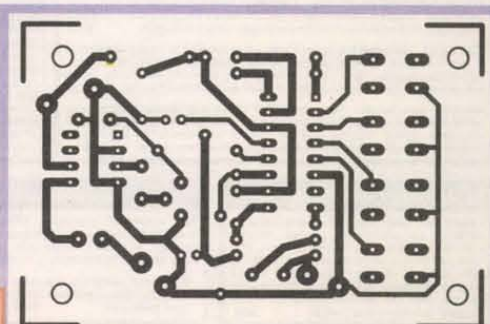
Power Up

The chip powers up in robot mode. The TGD (down) pin steps the frequency in the direction Down1, Down2, Down3. The TGU (up) pin steps the frequency in the direction Up1, Up2, Up3. So after power-up, if you assert the TGU (up) input by pressing the UP button, you step to Down3. Simple, huh? The numbers listed in the far right column of the preceding table give you the "speed ratio" that indicates, for example,

that Down3 provides an output frequency that is two-thirds of the input frequency.

Either input TGD or TGU can get you to any frequency setting. The only difference between "up" and "down" is the direc-

FIGURE 2



Voice Changer

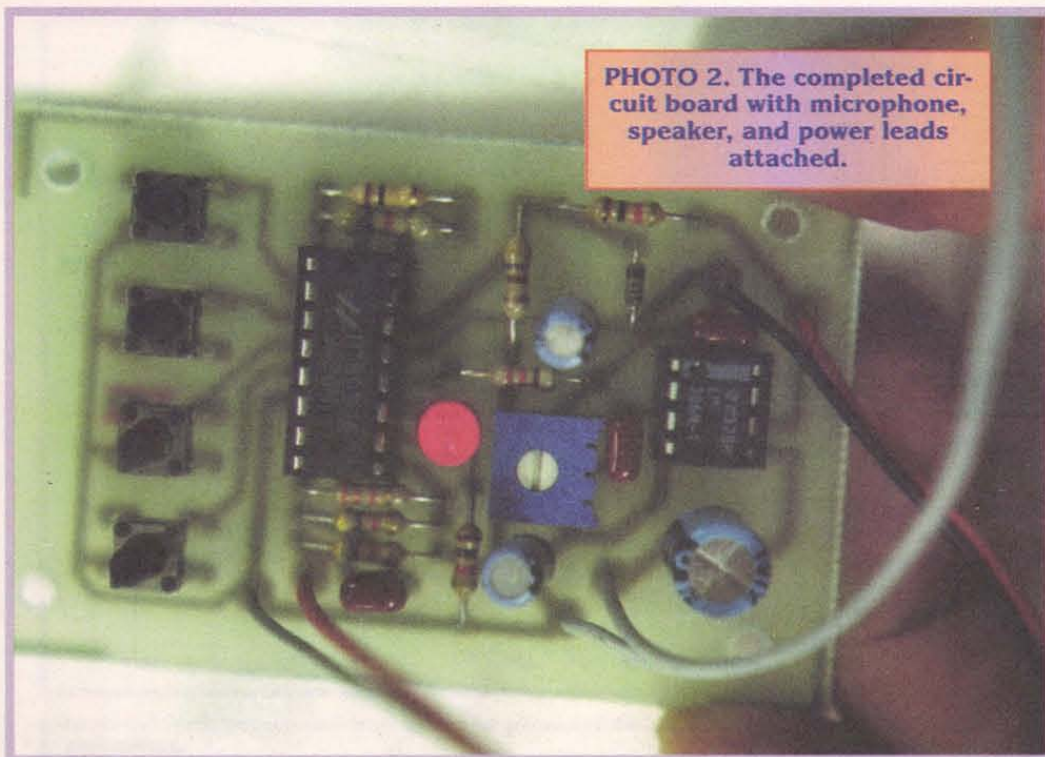


PHOTO 2. The completed circuit board with microphone, speaker, and power leads attached.

tion in which they step you through the frequency table.

Robot Mode

The system changes to Robot state after the ROBOT pin is triggered, regardless of what state the system is in. Or, you can simply power down and then up; the chip comes up on Robot state, or punch either the up button or the

down button until you get back to state 7, the Robot state.

Construction

The circuit is simple enough to be built on perf-board wired point-to-point, or even wire-wrapped, but I like a printed circuit board, so I made one for it. The foil side artwork is shown in Figure 2. You can make the board

yourself, or you can order the board from the address given with the bill of materials. All the parts required to build the voice changer, except for the Holtek chip, are available from Mouser. The Holtek chip is available from Digi-Key.

Begin by cleaning the copper side of the printed circuit board. Use fine steel wool to burnish the copper foil to make it bright and shiny and remove resist residue,

copper oxide, etc. Of course you will be using your small soldering iron 25 to 40 watts with pencil or chisel tip well tinned, and have handy your damp sponge with which to keep the soldering tip clean. Use small diameter (0.031") rosin core solder; 60/40 lead/tin is fine.

Install the IC sockets taking note that the sockets have an indicator for the location of pin 1. Tack-solder opposite corner pins on each socket, then pick up the board and, while pressing in on the socket, touch your soldering iron to each tacked pin and thus press the socket tight against the board. Check orientation of the two sockets and then solder all of the socket pins.

Referring to component locations shown in Figure 3, install the resistors. It helps to know the resistor color codes. You will recall instantly the resistor color codes when you remember "bad boys ravage our young girls, but violet gives willingly." Yes, black, brown, red, orange, yellow, green, blue, violet, gray, white, for 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. (They're not allowed to teach stuff like that anymore, so be thankful that there are still some of us old timers around to pass along important electronic lore of the past.) All resistors are mounted on 0.5" centers, so you can use your bending tool (Jameco part number 106884) to form the leads.

It is good practice to insert the resistors such that the color codes read consistently such as left-to-

Weeder Technologies

PO Box 2426, Ft. Walton Beach, FL 32549

ON-LINE CATALOG
www.weedtech.com

Pro-Kit

Voice/Fax 850-863-5723

Stackable RS-232 Kits

Digital I/O - 12 I/O pins individually configurable for input or output. DIP switch addressable; stack up to 16 modules on same port for 192 I/O points. Turn on/off relays. Sense switch transitions, button presses, 4x4 matrix decoding using auto-debounce and repeat. **\$32**

Analog Input - 8 input pins. 12-bit plus sign self-calibrating ADC. Returns results in 1mV steps from 0 to 4095. Software programmable alarm trip-points for each input. DIP switch addressable; stack up to 16 modules on same port for 128 single-ended or 64 differential inputs. **\$49**

Home Automation (X-10) - Connects between a TW523 and your serial port. Receive/transmit all X-10 commands with your home-brewed programs. Full collision detection with auto re-transmission. **\$39**

Caller ID - Decodes the caller ID data and sends it to your serial port in a pre-formatted ASCII character string. Example: *12/31 08:45 850-863-5723 Weeder, Terry <CR>. Keep a log of all incoming calls. Block out unwanted callers to your BBS or other modem applications. **\$35**

Touch-Tone Input - Decodes DTMF tones and sends them to your serial port. Keep a log of all outgoing calls. Use with the Caller ID kit for a complete in/out logging system. Send commands to the Home Automation and/or Digital I/O kits using a remote telephone. **\$34**

Phone Line Transponder

7 individual output pins are controlled with buttons 1-7 on your touch-tone phone. Automatically answers telephone and waits for commands. Monitor room noises with built in mic. "Dial-Out" pin instructs unit to pick up phone and dial user entered number(s). Password protected. **\$49**

DTMF Decoder/Logger

Keep track of all numbers dialed or entered from any phone on your line. Decodes all touch-tones and displays them on a 16 character LCD. Holds the last 240 digits in non-volatile memory. Connect directly to radio receiver's speaker terminals for off-air decoding of repeater codes, or numbers dialed on a radio program. **\$55**

IR Remote Control Receiver

Learns and responds to the data patterns emitted by standard infrared remote controls used by TVs, VCRs, Stereos, etc. Lets you control all your electronic projects with your TV remote. 7 individual output pins can be assigned to any button on your remote, and can be configured for either "toggle" or "momentary" action. **\$32**

Telephone Call Restrictors

Two modes of operation; either prevent receiving or placing calls, or prevent those calls (or call prefixes) which have "not" been entered into memory. Use touch-tone phone to program.

Block out selected outgoing calls. Bypass at any time using your password. **\$35**

Block out selected incoming calls. Calls identified using Caller ID data. **\$46**

ABC ELECTRONICS 315 7TH AVE N. MPLS. MN. 55401
(612)332-2378 FAX (612)332-8481 E-MAILSURP1@VISI.COM
WE BUY TEST EQUIPMENT AND COMPONENTS.
VISIT US ON THE WEB AT WWW.ABCTEST.COM

HP 54501A 100MHZ DIGITIZING SCOPE	\$1300.00	HP 4935A TRANS. IMPAIRMENT TEST SET	\$900.00
HP 54201D 300MHZ DIGITIZING SCOPE	\$1000.00	HP 5006A SIGNATURE ANALYZER	\$150.00
HP 54201A 300MHZ DIGITIZING SCOPE	\$1000.00	HP 86602B 1MHZ-1300MHZ RF PLUG	\$400.00
HP 54200A 50MHZ SCOPE/WAVEFORM ANALYZER	\$700.00	EIP 575 MICROWAVE COUNTER	\$1500.00
HP 3312A 13MHZ FUNCTION GENERATOR	\$250.00	FLUKE 95 50MHZ SCOPEMETER	\$450.00
HP 3370A 100MHZ U.T.I. COUNTER	\$400.00	LECROY 7200 400MHZ O-SCOPE	\$1000.00
HP 3586C LEVEL METER	\$750.00	TEK 475 200MHZ O-SCOPE	\$500.00
HP 436A POWER METER W/O SENSOR&CABLE	\$300.00	TEK 465 100MHZ O-SCOPE	\$400.00
HP 8350B SWEEP OSCILLATOR MAINFRAME	\$2000.00	TEK 496P 1KHZ-1.8GHZ SPEC. ANALYZER	\$3500.00
HP 3437A 3.5DIGIT SYSTEM VOLT METER	\$250.00	TEK 1240 LOGIC ANALYZER	\$750.00
HP 3455A DIGITAL MULTIMETER	\$250.00	TEK TDS300 100MHZ DIGITAL O-SCOPE	\$1400.00
HP 3466A DIGITAL MULTIMETER	\$400.00	TEK 1140A 500MHZ PROG. O-SCOPE FRAME	\$750.00
HP 3336C SYNTHESIZER/LEVEL GENERATOR	\$800.00	TEK 7854 400MHZ OSCILLOSCOPE FRAME	\$500.00
HP 3325A SYNTHESIZER/FUNCTION GENERATOR	\$1000.00	TEK 7904 400MHZ OSCILLOSCOPE FRAME	\$250.00
HP 5335A 200MHZ COUNTER	\$600.00	TEK 7A26 200MHZ VERTICAL PLUG	\$75.00
HP 8165A PROGRAMMABLE SIGNAL SOURCE	\$1100.00	TEK 7A24 400MHZ VERTICAL PLUG	\$150.00
HP 8558B/181 100K-1500MHZ SPECTRUM ANALYZER	\$1000.00	TEK 7B80 400MHZ TIME BASE	\$75.00
HP 8559B/183 10MHZ-21GHZ SPECTRUM ANALYZER	\$3000.00	TEK 7B92A 500MHZ DUAL TIME BASE	\$125.00
HP 1740A 100MHZ OSCILLOSCOPE	\$250.00	TEK 7S12 SAMPLING PLUG	\$250.00
HP 6034A 60VDC-10A POWER SUPPLY	\$750.00	TEK 7L14 10KHZ-1.8GHZ SPEC. ANALYZER	\$1000.00
HP 6269B 40VDC-50A POWER SUPPLY	\$800.00	TEK AM503 CURRENT PROBE AMPLIFIER	\$250.00
HP 6553A 40VDC-12.5A POWER SUPPLY OPT J01	\$1200.00	WAVETEK 145 20MHZ PULSE/FUNCTION GEN.	\$400.00
HP 6632A 20VDC-5A POWER SUPPLY	\$500.00	WAVETEK 182A 4MHZ FUNCTION GEN.	\$150.00
HP 6643A 45VDC-4.3A POWER SUPPLY OPT J03	\$750.00	WAVETEK 955 7.5-12.4GHZ MICROSOURCE	\$1100.00

Analog voice changers

Analog voice scramblers and voice changers are based on the same building blocks, mixers, and local oscillators. A voice scrambler and a voice changer are diagrammed side-by-side in Figure 4 to show how similar they are. Each system has a microphone, two mixers, two local oscillators, a transmission line, and a speaker.

In the voice scrambler, the local oscillators are at separate ends of the line; one in the transmitter and one in the receiver, and they oscillate at the same frequency. In the voice changer, both local oscillators are in the transmitter and they operate at different frequencies; the difference being the amount by which voices are to be shifted.

The device that audio engineers call their "mixer" is not the device we are dealing with here. The audio engineer's mixer is really an adder. The mixer we need here is the kind used by radio engineers; it is really a multiplier.

If you add signal $s_1 = \cos f_1$ to signal $s_2 = \cos f_2$, you just get $\cos f_1 + \cos f_2$. The signals remain intact and, in fact, you can isolate and extract either signal with a band-pass filter. But if you multiply $\cos f_1$ times $\cos f_2$, you create an entirely different signal. In your trigonometry textbook, you will find the following two identities (they are called identities because they hold for all values of A and B):

$$\cos(A+B) = \cos A \cos B - \sin A \sin B$$

$$\cos A \cos B + \sin A \sin B$$

If we add these two identities together, we get

$$\cos(A+B) + \cos(A-B) = 2 \cos A \cos B$$

or

$$\cos A \cos B = 0.5 \cos(A+B) + 0.5 \cos(A-B)$$

Applying this result to our case, we get:

$$\cos f_1 \cos f_2 = 0.5 \cos(f_1+f_2) + 0.5 \cos(f_1-f_2)$$

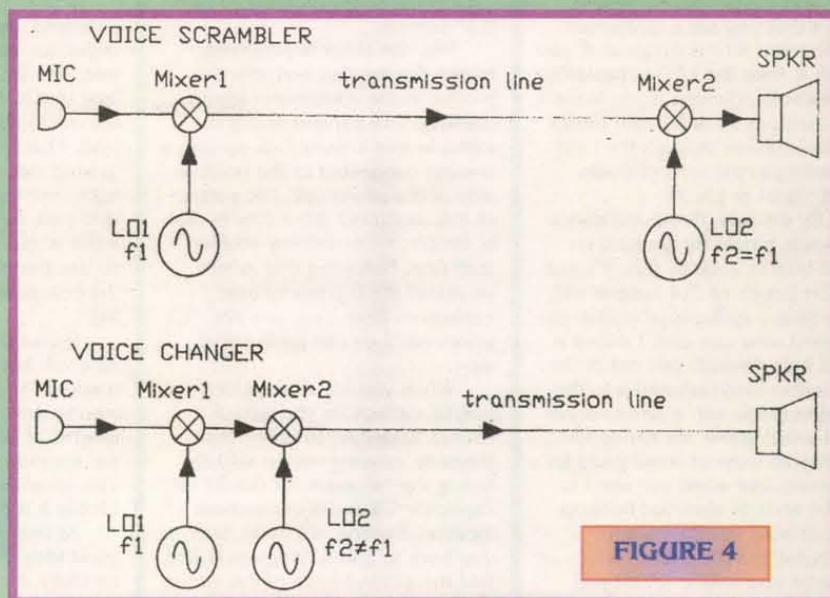


FIGURE 4

In other words, when you multiply signal s_1 by signal s_2 , what you get are two new signals: one oscillating at the sum of the original frequencies, and the other oscillating at the difference of the two original frequencies; with amplitude reduced to half its original value.

In this ideal mixer, the two original frequencies disappear entirely. In a real mixer, of course, things are not quite this tidy.

But this mixer is doing something else that does not at first meet the eye; it is inverting the spectrum of the input signal. If we use a low-pass filter to save only the lower sideband of what comes out of the mixer, we will find that what goes in low comes out high, and vice versa.

To understand this "sideband" lingo, it is advisable to draw a diagram of what is actually going on here. In Figure 5, we have plotted a band of audio input frequencies extending from 300 Hz up to 3000 Hz. The amplitudes are not important; we show a linear spread of frequencies just to help see which end of the spectrum is which. We set up our local oscillator to run at say, 3500 Hz. What comes out of the mixer is a lower sideband containing all of the difference frequencies (f_1-f_2), and an upper sideband containing all of the summation frequencies (f_1+f_2).

On the lower sideband, what goes in at 300 Hz comes out at 3200 Hz; what goes in at 3000 Hz comes out at 500 Hz. In other words, the spectrum has been inverted; what was low is now high, what was high is now low. The frequency inversion is what scrambles your voice. We put the output of the mixer through a low-pass filter to save only this lower sideband and, in this way, we have turned the spectrum end-for-end. Garbled indeed.

To recover the original voice at the receiver, we run the garbled signal through another mixer identical to the first one; with its local oscillator set to the same 3500 Hz frequency. Again we save only the lower sideband. What now goes in at 3200 Hz comes out at 300 Hz, and what goes in at 500 Hz comes out at 3000 Hz. In other words, we have inverted the inverted spectrum and everything is back to normal.

What will happen if you run the second local oscillator at a frequency different from the first local oscillator? What will happen is, you will have invented the voice changer. Suppose we run the second local oscillator at 3600 Hz, or 100 Hz above the frequency of the first local oscillator. What goes in now at 3200 Hz will come out at 400 Hz, and what goes in at 500 Hz will come out at 3100 Hz. But the 3200 Hz signal is really our original 300 Hz signal in disguise, so what we have done is shifted the original 300 Hz signal up to 400 Hz.

Similarly, the 500 Hz signal is our original 3000 Hz in disguise, so overall what we have is our original spectrum shifted up in frequency by 100 Hz; we have a voice changer.

The second mixer inverts the inverted spectrum output from the first mixer, so your voice is no longer garbled, it is just shifted up in frequency. The diagram in Figure 5 shows the amplitude dropping by one half at each mixer in accordance with our earlier mathematical analysis but, in an actual system, one or more amplifiers — probably integrated into the low-pass filters — would be used to maintain signal volume.

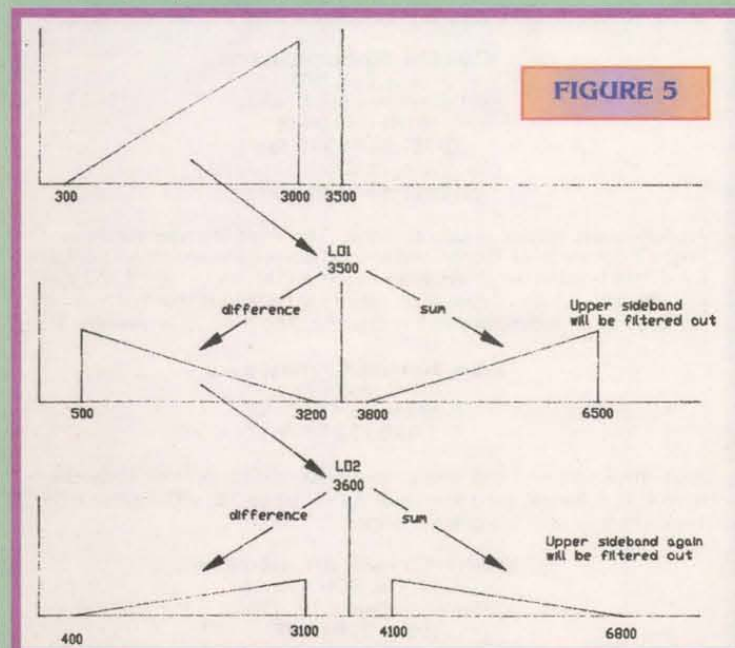


FIGURE 5

Voice Changer

right and top-to-bottom. Well, it shows that you are a craftsman.

Resistor R10 is optional. If you install it, then the LED is basically a power-on indicator. If you leave it out, then pin 11 of IC1 will modulate the current through the LED according to the level of audio input signal at pin 9.

By the way, Photo 1 shows a jig that is handy for working on small boards such as this. It's just a short length of 2x4 lumber with an ordinary spring-type clothespin fastened near one end. I drilled a small hole through one ear of the clothespin then fastened it to the wooden block with a small round-head wood screw. It's handy for holding all sorts of small parts for soldering, like when you need to tin the ends of stranded hookup wire, or hold this little board.

Install the trimmer potentiometer and solder. When you bend the leads of the zener diode, hold the lead with your needlenose pliers, grabbing the lead between the glass package and the bending place. That way you won't crack the glass. But you have to hold really close to the

case because the diode goes in on 0.3" centers.

Yes, the zener is polarized; match the banded end with the picture in the component layout drawing. The banded end is the cathode and it must look up into a resistor connected to the positive side of the power rail. The pattern of this assembly procedure is pretty simple: we install low profile stuff first. Following that advice, we install the 0.1 microFarad capacitors next. They are not polarized; they can go in either way.

When you install the electrolytic capacitors you will, of course, take care to orient them properly, cussing me for slightly hiding the "+" mark for the 22 uF capacitor C3 in the component location drawing. It's there, but you have to find it. When in doubt, find the ground trace of the circuit board and put the "-" lead there.

The push-button switches will fit down against the board if you push them in. If you don't want to push that hard, then you may want to open up the mounting holes slightly.

The electret microphone is polarized, like an electrolytic capacitor, but it isn't marked as well, so look it over carefully. The lead that is attached to the case of the microphone is the negative lead. That lead attaches to the ground side of your circuit. The light emitting diode also is a polarized part. Its cathode is marked by a flat portion of the plastic case, so use the orientation shown in the component placement drawing.

Solder the red lead of the nine-volt battery clip to the pad marked "+" and solder the black lead to the "-" pad. Use two lengths of hookup wire to connect the speaker to the "SPKR" pads. The speaker is not polarized; electrically it is just a coil of wire.

At this point, it would be a good idea to look your work over carefully. Measure the resistance across the nine-volt battery clip. No, it should not be zero. The assembled circuit in Photo 2 measured just a little over 6000 ohms across the battery clip.

If you have a small resistance, or no resistance, something is upsidown, like maybe the zener, or you've got a solder bridge somewhere.

If things look okay, install the two ICs following the orientation

indicated in the component placement drawing. Both are installed with pin 1 toward the top of the board. Well, now you're ready to connect a nine-volt battery and "tune for smoke," zero smoke being the preferred value.

Options

As we indicated earlier, you don't really need four push buttons to step through the available modulations. A single push-on push-off power switch and one momentary push button connected to the TGU pin, for example, would allow you to get to any modulation the HT8950A provides. To get to robot mode, power down and then up; the circuit powers up in robot mode. Punching the up-button can then step you in circular fashion through all the other modulations. So, depending on how you decide to package your voice changer, you may find it easier to provide just a power switch and one push button connected to either TGU or TGD.

In place of the eight-ohm speaker, you may want to install a phone jack so that you can connect the audio output to headphones. The 32-ohm headphones that I tried worked fine. **NV**

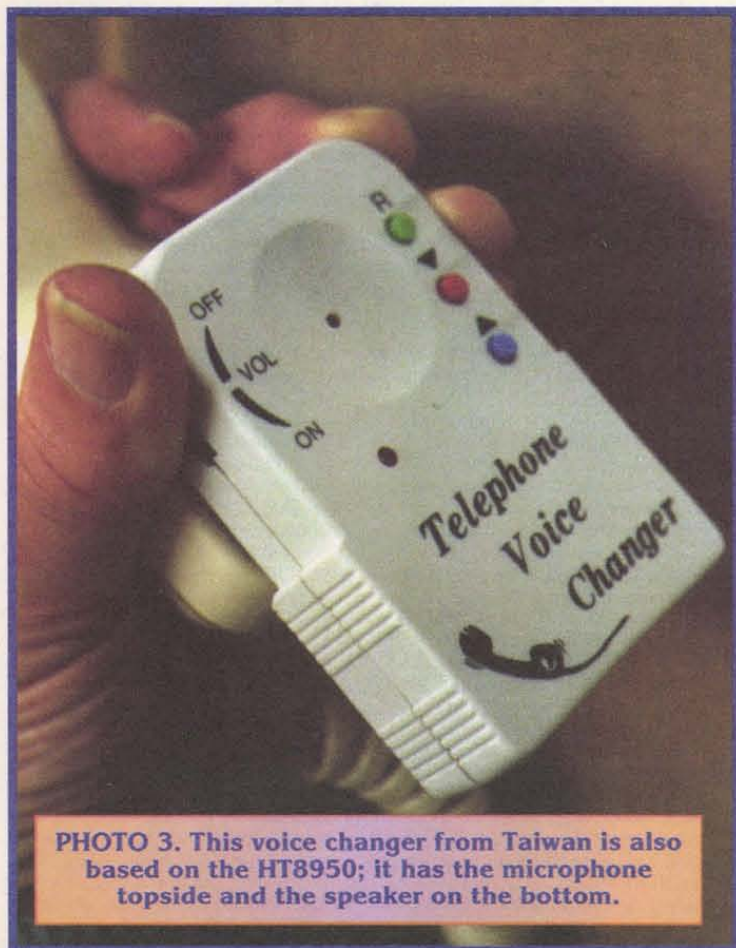


PHOTO 3. This voice changer from Taiwan is also based on the HT8950; it has the microphone topside and the speaker on the bottom.

You Have Alternatives ...

After designing my own board for this kit, I got on the Internet and discovered an almost identical kit imported from Taiwan; available from Carl's Electronics. Sharp-eyed readers may notice that the circuit board being worked on in Photo 1 is the PC board from the Taiwan kit.

Carl's Electronics

P.O. Box 722
Leominster, MA 01453
(978) 840-8834
(978) 840-6172 fax
<http://www.electronickits.com>
carlton@mail.ultranet.com

A ready-made version is also available. The voice changer shown in Photo 3 comes from Taiwan and is built around a bare HT8950 unpackaged chip bonded out directly onto pads on the circuit board and then covered with a blob of epoxy; an assembly technique that really carries surface mount technology to the extreme. The product is available from:

The Edge Company

P.O. Box 826
Brattleboro, VT 05302
1-800-732-9976

Alas, there's more. From China, an AK-700 style telephone (available from C & S Sales, Inc.; see their ad on page 75) with built-in HT8950 voice changer chip is available from:

Deer Creek Products

3038 N.W. 25th Avenue
Pompano Beach, FL 33069
(954) 978-0597

New Product News

DFA 5 DIFFERENTIAL AMPLIFIER

Allison Technology Corp. announces the release of its new DFA 5, a low-voltage differential amplifier for test and measurement applications.

The unit is small, lightweight, and low cost. It can run for days on its internal battery or be powered from an external power source.

DFA 5 provides gain settings from 1x to 1000x and may be used as either a differential mode or a single-ended mode amplifier. With common mode noise rejection that exceeds 100 dB, DFA 5 makes low-voltage measurements straightforward. The unit is suitable for use with oscilloscopes and other common test equipment.

DFA 5 is designed to amplify differential signals ranging from several volts down to microvolts. Gains of 1x, 10x, 100x, and 1000x are switch selected with a gain accuracy of 1%. Maximum frequency depends on the gain setting ranging from 20 KHz at a gain of 1000x to over 1 MHz at unity gain. The unit allows for both AC and DC coupling with the AC mode low-frequency cut-off being 10 Hz using non-attenuating probes.



probes.

DFA 5 is available for \$129.00. For more information, contact:

ALLISON TECHNOLOGY CORP.
2006 FINNEY VALLET, DEPT. NV
ROSENBERG, TX 77471
1-800-980-9806
281-239-8500 FAX: 281-239-8006
E-MAIL: atc@accesscomm.net
WEB: <http://www.atcweb.com>

REVISED RING-IT!

Digital Products Company announces the release of their newly revised Ring-It!, a popular micro-processor-controlled telephone-line simulator.

Ring-It! acts like a phone company central office and it is used to test and demonstrate telephones, answering machines, fax units, voice mail systems, or modems.

Its recently updated design now supports E-911 training and Caller-ID signalling. A convenient external audio jack has been added for call monitoring applications.

Telephone equipment connected to the simulator behaves as if it were connected to a real analog telephone line. For example, a connected telephone produces an authentic sounding dial tone. Dialing a 7- or 11-digit phone number with a touchtone phone rings the device plugged into the test line. Busy signals and reorder tones are also heard as with a standard phone line.

The Caller-ID feature provides number only or name/number messages. Five different test modes offer standard telephone-line emulation or special repetitive cycle testing, including automatic ring-up. An LED digital readout displays the DTMF digits that are dialed to verify operation of touchtone phones.

Ring-It! can be purchased factory assembled or as a kit. The kit comes with a high-quality printed circuit board, all electronic components, and a technical manual.

Factory assembled units (#RI-001F) are \$325.00. The deluxe kit (#RI-001D) is \$205.00 and it includes the Caller-ID option and custom enclosure. Non-Caller-ID kit versions (#RI-001) are available starting at \$149.00.

For more information, contact:

DIGITAL PRODUCTS COMPANY
134 WINDSTAR CIRCLE, DEPT. NV
FOLSOM, CA 95630
916-985-7219 FAX: 916-985-8460
<http://www.digitalproductsco.com>
info@digitalproductsco.com



Showcase your New Products here! Send all press releases or information/photos to:

Nuts & Volts Magazine
New Product News
430 Princland Court,
Corona, CA 91719
or E-Mail to
newproducts@nutsvolts.com

NEW HIGH-EFFICIENCY GaN LED

A new high-efficiency gallium nitride (GaN) green 530 nm LED (IF-E93) is the latest addition to Industrial Fiber Optics.

The green 530 nm light produced by this device is ideally positioned to take advantage of the low attenuation window of PMMA plastic optical fiber.

The many applications for this LED include: water turbidity sensors, plant sensors, long distance communications over plastic fiber, optical wavelength multiplexing, medical electronics, and displays.

Some key features of the line are: no optical design required; mates with standard, 1000 mm core, jacketed plastic fiber cable; internal micro-lens for efficient coupling; inexpensive plastic connector housing; excellent linearity; and visible light output.

The cost-per-unit ranges from \$5-\$9.

For more information, contact:

INDUSTRIAL FIBER OPTICS
627 S. 48TH ST., STE. 100, DEPT. NV
TEMPE, AZ 85281
480-804-1227 FAX: 480-804-1229

ADC-11



ADC-11 is a versatile matchbox-size unit that turns a PC's parallel port into an 11-channel, 10-bit datalogger for recording analog signals up to 5 kHz. A digital output is also provided, which can be used for control or preset alarm functions. This output can also be used to power sensors such as thermistors. An optional screw terminal board makes it easy to connect 0V to 2.5V signals to the 10 kHz sampling rate ADC-11.

Supplied PicoLog software is a powerful but flexible datalogging package for collecting, analyzing, and displaying data from the converter.

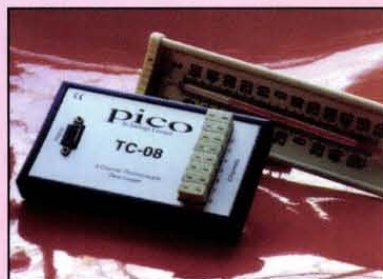
PicoLog software can collect data at rates from once per second to once per hour. Data can be displayed in both graphical or spreadsheet format, both during and after data collection.

The software is easy to set-up and use with on-line help, and features time data collection, analysis, and display on the large screen of a PC.

Data can be exported to spreadsheets and databases, and multiple loggers may be used on the same PC. Waveforms can be saved, printed, faxed, or E-Mailed from your PC.

ADC-11 comes complete with PicoScope and PicoLog software for only \$155.00.

TC-08 THERMOCOUPLE CONVERTER



TC-08 is an easy-to-use eight-channel thermocouple-to-PC interface which works with all popular thermocouple types to measure temperatures from -270°C to +1800°C.

Just plug TC-08 into the serial port of your computer, connect a thermocouple and you are ready to measure temperatures with 0.1°C or 0.025°C resolution depending on sensor type, at ±4% accuracy.

TC-08 software provides all of the calculations necessary for cold junction compensation. DOS drivers with program examples in C, Pascal, and Win 3.1/95/NT drivers with examples for C, Visual Basic, and LabView are also provided.

For 16 channels of temperature measurement, two TC-08s may be installed in a PC with a dual serial port card.

TC-08 comes complete with manual and PicoLog software for \$325.00.

For more information, contact:

SAELIG COMPANY
1193 MOSELEY RD., DEPT. NV
VICTOR, NY 14564
716-425-3753 FAX: 716-425-3835
E-MAIL: saelig@aol.com
WEB: www.saelig.com

Fantastic DMM Offer!

Don't let this price fool you. This meter is a digital multimeter designed for engineers and hobbyists. Equipped with 5 functions and 19 ranges. Each test position is quickly and easily selected with a simple turn of the FUNCTION/RANGE selector rotary switch. **Rubber Boot Included!**

Display: 3-1/2 Digit LCD, 21mm Figure Height with Automatic Polarity

Overrange Indication: 3 Least Significant Digits Blank

Temperature for Guaranteed Accuracy: 23°C

±5°C RH<75%

Temperature Ranges:

Operating: 0°C to 40°C (32°F to 104°F)

Storage: -10°C to 50°C (14°F to 122°F)

Power: 9V Alkaline or Carbon-Zinc Battery

(NEDA 1604)

Low Battery Indication: BAT on Left of LCD Display

Dimensions: 188mm(L) x 87mm(W) x 33mm thick

Net Weight: 400g **Get All the Specs From Our Web Site**



ONLY \$19

7 1/2" Pro Modular Crimping Tool Kit

Includes:

- Heavy Duty Ratchet Crimp Tool
- 5 Die Sets!

#HT-330K

ONLY \$64.95

Details on our Web Site

True RMS DMM

- Full Sized, 4 1/2 Digit
- Frequency Range to 20 KHz
- Capacitance Ranges from 2000 pF to 20 uF
- 100 Hz Audible Continuity, 20A max 1000VDC/20A max & 700VAC max
- Selectable Data Hold Function

ONLY \$69

CSI-980 DMM

Removable Hard Drive Rack

For IDE/Ultra DMA Hard Drives

We Sold Over 14,000 in 1998!

This product can be used with any 3-1/2 IDE hard drive up to 1" high. It includes an electronic keylock for safe removal and insertion. Made of ABS 707 fireproof plastic. Use this product to protect sensitive hard drive data, take your hard drive between work and home or even set up different users with their own hard drives that they physically insert every time they use a PC. Other models available from C.S.I. include RH10 series and RH20 series, which are interchangeable within the same interface design (IDE or SCSI).

Other Models are Available. See www.web-tronics.com under "hard drive and accessories" for more details and pictures.



ONLY \$14.95

RH-10C-IDE

Our Most Sophisticated DMM We Sold Over 700 Last Year!

with RS-232 Interface & Software, 3-3/4 Digit, 4000 Count, More Details on our Web Site

Auto-Ranging with Analog Bargraph

- True RMS Mode
- 10MHz Frequency Counter
- Time Mode with Alarm, Clock, and Stop Watch
- Dual Display
- 10 Location Memory
- Min. Max, Avg and Relative Mode
- Decibel Measurement
- Cap and Ind. Measurement
- Temperature Mode (°C/°F)
- K-Type Temperature Probe Included
- Pulse Signal for Logic &

SALE \$139 Reg. \$169

PROTEK 506

Audible Test

Continuity/Diode Test

Logic Test

Auto Power OFF/Keep ON Mode

Fused 20A Input with Warning Beeper

Back Light

Data Hold/Run Mode

Safety Design UL1244 & VDE-0411

Protective Holster

Silicon Test Leads

Auto-Temp Solder Station with Ceramic Element

With Ceramic Heating Element for More Accurate Temp Adjustment

3 Conductor Grounded Power Cord

250°C-480°C (470°F-900°F)

Fast Heating Feature

SR-976 Extra Tip Options Available. See Web!

ONLY \$39

CTRL - D to bookmark this site

Easy to Navigate

Includes a Search Engine

That Really Works

New Items Added Constantly

In Business Since 1971

Don't forget the dash

Circuit Specialists Inc.

www.web-tronics.com

For More Info See www.web-tronics.com

CCD B&W Board Cameras

ASIC CCD Area Image Sensor

Extremely Low Power Consumption

0.5 Lux Min Illumination

Built-In Electronic Auto Iris for Auto Light Compensation

Detailed Specs on the Web

VM1030PA

Pinhole lens with audio, 30mmx30mmx25mm, 12V, 430 horz & vert TV lines

\$59.00 \$49.00 5 or more

VM1030A

30mmx30mmx26mm Standard lens with audio, 12V, 430 horz & vert TV lines

\$59.00 \$49.00 5 or more

VM1036A

32mmx32mmx25mm Standard lens with audio, 12V, 430 horz & vert TV lines, reverse mirror image feature

\$69.00 \$63.00 5 or more

VM1035A

42mmx42mmx25mm Standard lens with audio, 12V, 430 horz & vert TV lines with back light compensation

\$77.00 \$68.00 5 or more

VMCB21

44mmx38.5mmx28mm with 6 infra-red LEDs, 12V, 380 horz TV lines

ON SALE \$59.00 any qty. Reg. \$69.00

Infra-Red

Detailed Specs on the Web

VM1030PA

Pinhole lens with audio, 30mmx30mmx25mm, 12V, 430 horz & vert TV lines

\$59.00 \$49.00 5 or more

VM1030A

30mmx30mmx26mm Standard lens with audio, 12V, 430 horz & vert TV lines

\$59.00 \$49.00 5 or more

VM1036A

32mmx32mmx25mm Standard lens with audio, 12V, 430 horz & vert TV lines, reverse mirror image feature

\$69.00 \$63.00 5 or more

VM1035A

42mmx42mmx25mm Standard lens with audio, 12V, 430 horz & vert TV lines with back light compensation

\$77.00 \$68.00 5 or more

VMCB21

44mmx38.5mmx28mm with 6 infra-red LEDs, 12V, 380 horz TV lines

ON SALE \$59.00 any qty. Reg. \$69.00

Infra-Red

Detailed Specs on the Web

VM1030PA

Pinhole lens with audio, 30mmx30mmx25mm, 12V, 430 horz & vert TV lines

\$59.00 \$49.00 5 or more

VM1030A

30mmx30mmx26mm Standard lens with audio, 12V, 430 horz & vert TV lines

\$59.00 \$49.00 5 or more

VM1036A

32mmx32mmx25mm Standard lens with audio, 12V, 430 horz & vert TV lines, reverse mirror image feature

\$69.00 \$63.00 5 or more

VM1035A

42mmx42mmx25mm Standard lens with audio, 12V, 430 horz & vert TV lines with back light compensation

\$77.00 \$68.00 5 or more

VMCB21

44mmx38.5mmx28mm with 6 infra-red LEDs, 12V, 380 horz TV lines

ON SALE \$59.00 any qty. Reg. \$69.00

Infra-Red

Detailed Specs on the Web

VM1030PA

Pinhole lens with audio, 30mmx30mmx25mm, 12V, 430 horz & vert TV lines

\$59.00 \$49.00 5 or more

VM1030A

30mmx30mmx26mm Standard lens with audio, 12V, 430 horz & vert TV lines

\$59.00 \$49.00 5 or more

VM1036A

32mmx32mmx25mm Standard lens with audio, 12V, 430 horz & vert TV lines, reverse mirror image feature

\$69.00 \$63.00 5 or more

VM1035A

42mmx42mmx25mm Standard lens with audio, 12V, 430 horz & vert TV lines with back light compensation

\$77.00 \$68.00 5 or more

VMCB21

44mmx38.5mmx28mm with 6 infra-red LEDs, 12V, 380 horz TV lines

ON SALE \$59.00 any qty. Reg. \$69.00

Infra-Red

Detailed Specs on the Web

VM1030PA

Pinhole lens with audio, 30mmx30mmx25mm, 12V, 430 horz & vert TV lines

\$59.00 \$49.00 5 or more

VM1030A

30mmx30mmx26mm Standard lens with audio, 12V, 430 horz & vert TV lines

\$59.00 \$49.00 5 or more

VM1036A

32mmx32mmx25mm Standard lens with audio, 12V, 430 horz & vert TV lines, reverse mirror image feature

\$69.00 \$63.00 5 or more

VM1035A

42mmx42mmx25mm Standard lens with audio, 12V, 430 horz & vert TV lines with back light compensation

\$77.00 \$68.00 5 or more

VMCB21

44mmx38.5mmx28mm with 6 infra-red LEDs, 12V, 380 horz TV lines

ON SALE \$59.00 any qty. Reg. \$69.00

Infra-Red

Detailed Specs on the Web

VM1030PA

Pinhole lens with audio, 30mmx30mmx25mm, 12V, 430 horz & vert TV lines

\$59.00 \$49.00 5 or more

VM1030A

30mmx30mmx26mm Standard lens with audio, 12V, 430 horz & vert TV lines

\$59.00 \$49.00 5 or more

VM1036A

32mmx32mmx25mm Standard lens with audio, 12V, 430 horz & vert TV lines, reverse mirror image feature

\$69.00 \$63.00 5 or more

VM1035A

42mmx42mmx25mm Standard lens with audio, 12V, 430 horz & vert TV lines with back light compensation

\$77.00 \$68.00 5 or more

VMCB21

44mmx38.5mmx28mm with 6 infra-red LEDs, 12V, 380 horz TV lines

ON SALE \$59.00 any qty. Reg. \$69.00

Infra-Red

Detailed Specs on the Web

VM1030PA

Pinhole lens with audio, 30mmx30mmx25mm, 12V, 430 horz & vert TV lines

\$59.00 \$49.00 5 or more

Bullet CCD Cameras B&W and Color

Smart Rugged Metal Housing

Extremely Low Power Consumption

12 Volt

CCD Area Image Sensor for Long Camera Life

Built-In Electronic Auto Iris for Auto Light Compensation

No Blooming, No Burning

0.1 Min Lux Illumination (B&W), 1 Lux Min Lux Illumination (color)

VM1030PA

Pinhole lens with audio, 30mmx30mmx25mm, 12V, 430 horz & vert TV lines

\$59.00 \$49.00 5 or more

VM1030A

30mmx30mmx26mm Standard lens with audio, 12V, 430 horz & vert TV lines

\$59.00 \$49.00 5 or more

VM1036A

32mmx32mmx25mm Standard lens with audio, 12V, 430 horz & vert TV lines, reverse mirror image feature

\$69.00 \$63.00 5 or more

VM1035A

42mmx42mmx25mm Standard lens with audio, 12V, 430 horz & vert TV lines with back light compensation

\$77.00 \$68.00 5 or more

VMCB21

44mmx38.5mmx28mm with 6 infra-red LEDs, 12V, 380 horz TV lines

ON SALE \$59.00 any qty. Reg. \$69.00

Infra-Red

Detailed Specs on the Web

VM1030PA

Pinhole lens with audio, 30mmx30mmx25mm, 12V, 430 horz & vert TV lines

\$59.00 \$49.00 5 or more

VM1030A

30mmx30mmx26mm Standard lens with audio, 12V, 430 horz & vert TV lines

\$59.00 \$49.00 5 or more

VM1036A

32mmx32mmx25mm Standard lens with audio, 12V, 430 horz & vert TV lines, reverse mirror image feature

\$69.00 \$63.00 5 or more

VM1035A

42mmx42mmx25mm Standard lens with audio, 12V, 430 horz & vert TV lines with back light compensation

\$77.00 \$68.00 5 or more

VMCB21

44mmx38.5mmx28mm with 6 infra-red LEDs, 12V, 380 horz TV lines

ON SALE \$59.00 any qty. Reg. \$69.00

Infra-Red

Detailed Specs on the Web

VM1030PA

Pinhole lens with audio, 30mmx30mmx25mm, 12V, 430 horz & vert TV lines

\$59.00 \$49.00 5 or more

VM1030A

30mmx30mmx26mm Standard lens with audio, 12V, 430 horz & vert TV lines

\$59.00 \$49.00 5 or more

VM1036A

32mmx32mmx25mm Standard lens with audio, 12V, 430 horz & vert TV lines, reverse mirror image feature

\$69.00 \$63.00 5 or more

VM1035A



CLONE, TEST OR REPAIR ANY HARD DRIVE

"THE MOST COMPLETE HARD DRIVE WORKSTATION WE'VE SEEN!" BOB ROSENBLOOM, DIGITAL VIDEO, INC.

DRIVE SERVICE STATION

Copy entire hard drives with ease. Drive duplicators are essential tools for dealers and system builders. Don't spend hours installing and formatting drives. Do it instantly with the Pro. Set up any SCSI or IDE drive with your original software. Connect blank drives to the Pro and press start. You'll copy entire drives faster and more accurately than is possible on any PC. With our combination IDE and SCSI model, you can even copy data between different interfaces. All models include both 2.5" and 3.5" interface adapters. The Pro also supports SCA and Wide SCSI drives.

Choose the Pro, and you'll also have an entire factory drive test and repair system for under \$1000. The Pro gives

BUY MANUFACTURER DIRECT: \$995

408 330-5525

you the ability to copy, reformat, repair, translate, and test any hard drive. Use the Pro to put any hard drive through its paces. A full factory final test and performance analysis is performed. Complete test and repair reports are sent to any standard printer.

The Pro will also reassign and eliminate drive defects. Here's how it works: First, a precise media analysis system scans the disk for errors. Defects are mapped out, and effectively "erased." The error correcting system then "trains" the drive to permanently avoid defective areas. Data is stored only on the safe

areas of the disk. Capacity is reduced by an insignificant amount, and the drive works flawlessly once again. Get the technology used by major repair shops and data recovery centers. The Pro repairs all disk defects caused by normal wear. Drives with mechanical damage may not be repairable.



CORPORATE SYSTEMS CENTER

3310 WOODWARD AVE., SANTA CLARA, CA 95054
WWW.DRIVEDUPLICATORS.COM

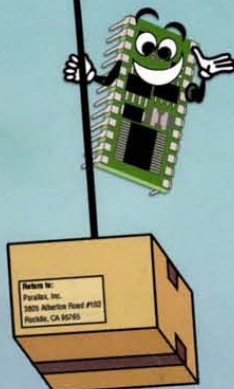
Call today for high volume multi-drive copiers and CD Duplicators
Sold and intended for backup purposes only. Copyright laws must be observed.



AIRBORNE BASIC Stamp®

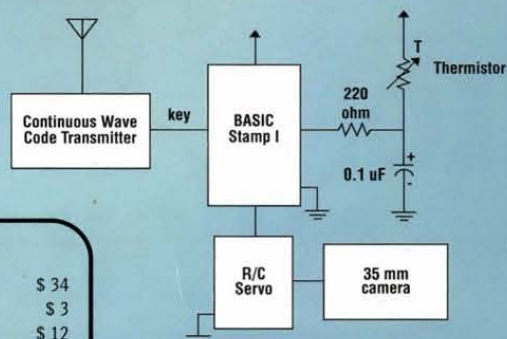


There's no such thing as a free launch, but you can build a platform to loft your scientific or communications payload to 100,000 feet for around \$100.



Here's an end of summer project you can build in your garage provided you've got an amateur radio operator's license. Using a surplus weather balloon from an Army/Navy store, you can build a BASIC Stamp-controlled data transmitter that flies up to 100,000 feet above sea level. The thermistor data could be used to calculate altitude, and the R/C servo presses a button on an inexpensive 35 mm camera. This application is used by JP Aerospace (<http://www.jpaaerospace.com>) and the Kansas Near Space Project (<http://www.ksu.edu/humec/knsp/>).

The BASIC Stamp sends the data back to earth through a continuous wave transmitter using Morse code.



The bill of materials:

BASIC Stamp I Module	\$ 34
Surplus Balloon	\$ 3
Helium	\$ 12
Continuous Wave Code Transmitter	\$ 15
R/C servo	\$ 15
35 mm (disposable) camera	\$ 15
Thermistor, wires and resistors	\$ 8
Duct tape, string, battery, etc.	\$ 4

total \$106

Picture taken at 67,000 feet by the "Winds Aloft" package flown by Davis, California based JP Aerospace. Camera shutter activation, telemetry and recovery controlled by BASIC Stamp I. More information at <http://www.jpaaerospace.com/comet.html>.

PARALLAX

To order call 916.624.8333

More information, visit www.parallaxinc.com

BASIC Stamp and the Parallax logo are registered trademarks of Parallax, Inc.

Write in 194 on Reader Service Card.

NUTS & VOLTS MAGAZINE
430 PRINCELAND COURT
CORONA, CA 91719

CHANGE SERVICE REQUESTED

P003/PT015 ***** 3-DIGIT 543
220378 9912
THOMAS T LORITZ
424 WILSON AVE
GREEN BAY WI 54303-4115

BULK RATE
U.S. POSTAGE
PAID
PERMIT No. 49
LONG BEACH CA

