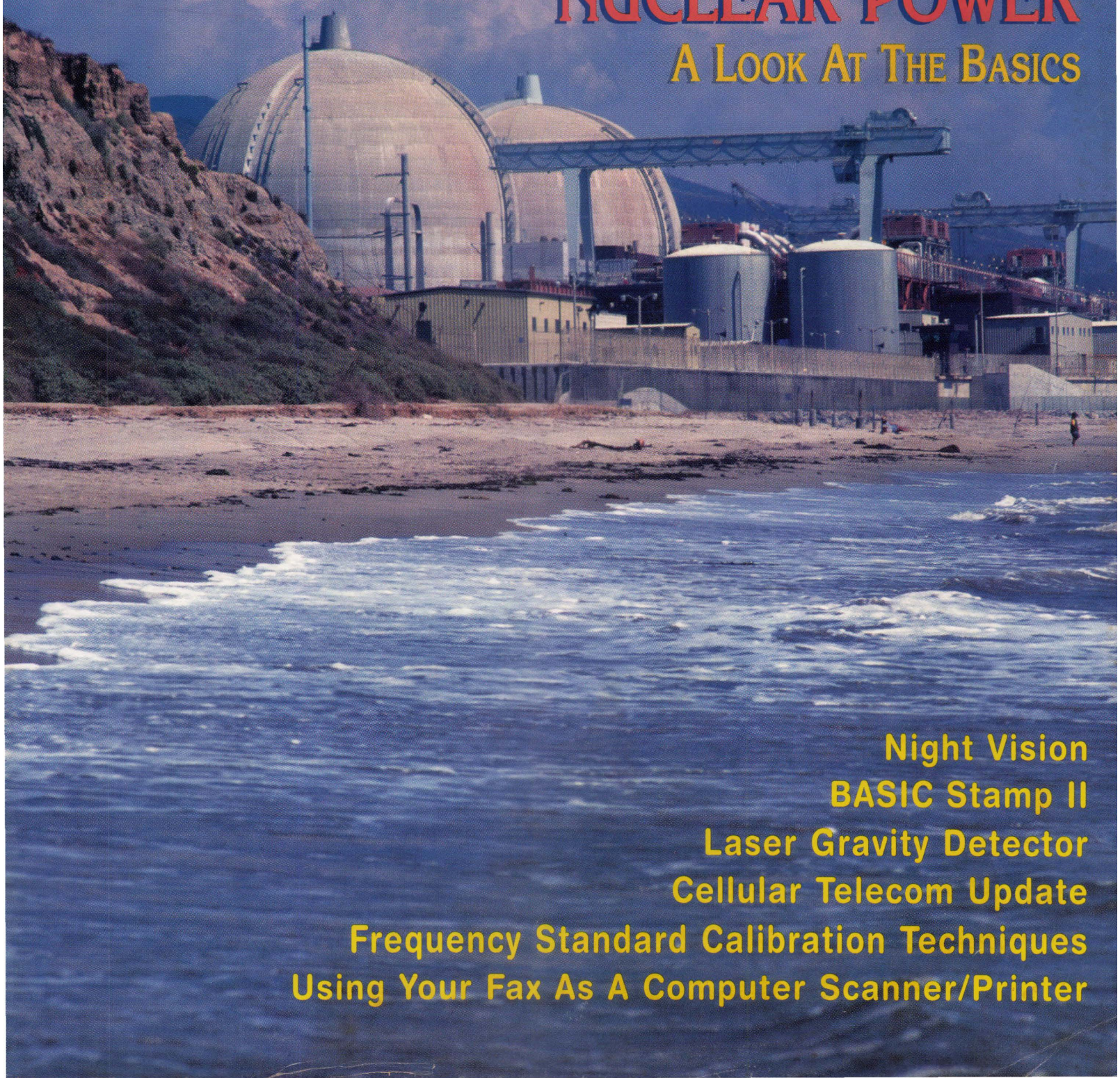
NUTS & VOLTS MAGAZINE

OUR 16th YEAR

$3.50
VOL. 16 NO. 9
SEPTEMBER 1995

Exploring Electronics And Technology For The Hobbyist And Professional



NUCLEAR POWER

A Look At The Basics

Night Vision
BASIC Stamp II
Laser Gravity Detector
Cellular Telecom Update
Frequency Standard Calibration Techniques
Using Your Fax As A Computer Scanner/Printer

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An Incredible Deal . . .A Complete System, A New CRT, and A New Low Price!

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We've reduced the price on these fully calibrated, solid-state Spectrum Analyzer Systems and we're including **BRAND NEW CRTs**...all for about what a new CRT alone would cost! It's not just a great price with a new CRT, it's a great system too. It offers Variable Persistence Storage capabilities while providing absolute calibration of frequency and amplitude, high resolution and sensitivity, plus a wide dynamic range. Your system will include a Brand New CRT installed in an HP 141T Display Unit along with an 8552B IF section and your choice of either an 8553B or 8555A RF section. Many other plug-ins are available so when your requirements change, your Spectrum Analyzer can too! Call today while supplies last.

With 8553B RF Section

$1995

- Frequency Range: 1 kHz to 110 MHz
- Scan Width: 18 calibrated scan widths from 20 Hz/div to 10 MHz/div in a 1,2, 5 sequence
- Bandwidth Range: selectable 3 dB bandwidths from 10 Hz to 300 kHz in a 1, 3, 10 sequence
- Measurement Range: -130 dBm to +10 dBm (Log ref. level); 0.1 µV/div to 100 mV/div (Linear sensitivity)

Brand New CRT!

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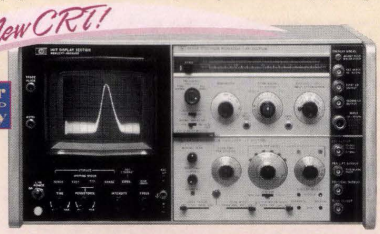

FULLY CALIBRATED TO NIST SPECS.

With 8555A RF Section

$2495

- Frequency Range: 0.01-18.0 GHz (w/internal mixer), 12.4-40.0 GHz (w/external mixer)
- Scan Width: 16 calibrated scan widths from 2 kHz/div to 200 MHz/div in a 2, 5, 10 sequence
- Bandwidth Range: selectable 3 dB bandwidths from 100 Hz to 300 kHz in a 1, 3, 10 sequence
- Measurement Range: -60 dBm to +10 dBm (Log ref. level); 0.1 µV/div to 100 mV/div (Linear sensitivity)

All Test Instruments Include Manuals and are Completely Operational Unless Otherwise Stated.

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WE TAKE TRADE-INS!

AMERICAN EXPRESS DISCOVER

NEW SHIPMENT JUST RECEIVED

Racal RA6790/GM HF Receiver . . . $1495

The RA6790/GM is a fully synthesized, microcomputer-based, tunable, solid-state receiver designed to provide reception capabilities for CW, AM, LSB/USB, and FM over the frequency range of 0.5 MHz to 30 MHz. Frequency tuning can be accomplished by either keyboard entry or single knob control for continuous tuning with selectable rates of 1000 Hz, 30 Hz, and 1 Hz increments and BFO continuous in 10 Hz increments. An 8 digit LCD displays frequency and 3 digit LCD displays sign readout of BFO data relative to IF center. Other front panel displays include an RF Meter, AF Meter, Bandwidth, AGC Mode, Remote and Fault indication. These are fully calibrated Receivers, hurry for the best selection of available filters.

OPTOELECTRONICS GoldStar EXTECH INSTRUMENTS BK PRECISION LEADER Protek WAVETEK HAMEG

RS-232C Optoelectronics 3000A

Plus HandiCounter

$349

Advanced hand held 10 Hz to 3 GHz counter with dual 50 Ω/1 MΩ input amplifiers. Measures Frequency, Period, Ratio, & Time Interval. Features high resolution/high speed counting, digital filter and digital auto capture for hands free recording, signal strength bargraph, RS-232C interface and 6+ hour battery operation. Antenna sold separately.

TCXO Time Base Option $100

FACTORY NEW

Optoelectronics 3300

HandiCounter

$139

This pocket sized LCD Frequency Counter covers the range from 1 MHz to 2.8 GHz while providing ten digit resolution! The design of the Model 3300 makes it easy to use and the display has excellent viewing characteristics in both direct sunlight and indoors. The 3300 is 256 times faster than the older models and offers longer battery life. Only 3.7"H x 2.75"W x 1.2"D. Antenna sold separately.

FACTORY NEW

Optoelectronics Scout 40

Frequency Scout

$439

The Scout 40 can record up to 250 hits on each channel and store into memory 400 unique frequencies (10 MHz to 1.4 GHz). Features Digital Filter/Auto Capture and the ability to automatically Reaction Tune or Memory Tune many receivers. 10 digit LCD, EL backlight, and 16 segment signal strength bargraph. Includes NiCad batteries, AC adapter/charger and PC utility disk.

FACTORY NEW

Optoelectronics R10

Communications Interceptor

$359

Excellent for two-way communications tests, security, counter-surveillance and recreational communications monitoring applications. Covers 30-2000 MHz. Measures deviation (wide and narrow band), relative signal strength, signaling tones (CTCSS, DCS, and DTMF) using the companion DC440 Decoder or TC200 Tone Counter. Features pocket sized, demodulated audio output, and built-in speaker.

FACTORY NEW

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Call: 800-527-4642

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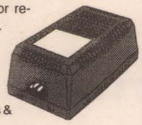
A) Linear supply rated at 12VDC @ 1200 mA. Input is strapped for 240 VAC input, use as is with 110VAC for lower voltage output, or re-strap it for 110VAC use at 12VDC. Measures 2.5 x 4 x 6.5", IEC cord not included. **HSC# 14980 $5.95**



B) Standard 6' IEC power cord for use with above supplies, misc. colors & styles, used. **HSC# 80119 $.99**

Multimedia Speakers

- Two styles to choose from, both new in box
- White plastic enclosures, grey grilles
- Econo-import model MSS-1000 has:
  - Volume control, Bass boost switch
  - Uses 3 C-cells per side, measures 3.5" x 3.5" x 5"
- CS-550 by Labtec (pictured below) has:
  - Volume control, Bass boost switch, Treble-boost switch, measures 4" x 4" x 6"
  - CS-550 has 40 - 16000 Hz freq. response, 3" speakers, and power light.
  - 4 watt amplifiers (uses 2 C-cells per side)
- Both feature magnetically shielded enclosures, "enhanced bass-response cabinet design",) and attractive beige styling.

MSS-1000 HSC# 15127
Pair/ $6.95

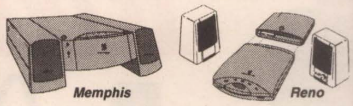
CS-550 HSC# 15517
Pair/ $9.95

Dealer Inquiries Invited...
Quantity Discounts Available!

Multimedia Kit Deals!

- Two styles to choose from, Hobby Grade or Plug 'n' Play
- Limited quantities available -- Don't delay!
- Hobby Grade Mediavision *Memphis* Kit:
  - Consists of used, tested good SCSI double -speed drive, custom enclosure with 10W/Channel amplifier and detachable Bose active speakers
  - Requires 12VDC 2.5A Adapter, not included. We tried a modified adaptor "A" at left, and unit appears to work. Inquire about other supplies when ordering.
  - We don't have the interface card, but you could make your own SCSI Cable to connect to your SCSI sound card or controller. Unit has a high-density 44-pin connector, or remove it and fabricate your own hookup.
  - Midi ports and audio jacks on back, NEC CDR210 CD/ROM Drive has tray, does not need caddies.
  - Awesome sound from Bose speakers!

Mediavision *Memphis* kit HSC# 15566 $139.00



- Plug 'n' Play Mediavision *Reno* Kit:
  - Complete Multimedia kit contains external Reno CD/ROM drive, speakers, sound card, microphone, headphones, all necessary cables and software, and a variety assortment of 15 CD/ROM's
  - Easy installation with included "how-to" video
  - Award-winning SRS "3-D" Sound
  - Double-speed 180mS drive is detachable from docking bay, and usable as a portable personal audio CD player.
  - CD titles include action games, kid's learning games, Compton's Encyclopedia, Family health, etc.
  - Brand new in factory sealed box, 90-day warranty

Mediavision *Reno* Kit HSC# 15533 $199.00

Mark Your Calendars...It's almost time once again for our

Giant End-of-Summer Sale!

Saturday, Sept. 16, 1995

It's the event you've been waiting for, our Summer's-End Sale with deals too good to miss! All three HSC Stores will be featuring hundreds of discounts, mark-downs and closeouts, and in addition, the Santa Clara location will be hosting its gigantic annual Parking-lot Sale!

Hundreds of Bargains! Free Refreshments! Huge Discounts! Saturday 9AM to 5PM

High Power AA NiCads!

- New Kenwood AA NiCad Batteries
- High quality, new, shrink-wrapped
- 1.2V at 800 mAh!
- Regular AA NiCads are only 300mAh
- Standard charge 15 hrs. @ 80mA
- Sorry, no quantity discounts

HSC# 15281 $2.99 / pr.

Easy File Transfers!

- SmartSync Software by Nomadic Systems
- Provides easy way to keep multiple computers in synch
- Fast and efficient, transfers only the changes
- Works with modems, cables or diskettes
- Automatically updates multiple files, single and multi-user
- Prevents accidental overwrites, can remotely copy

HSC# 15305 $19.95

CD/ROM Specials!

- Tested Good CD/ROM Drives removed from systems
- 90-Day Warranty ♦ 2x and 3x Speeds available
- NEC Drives are standard SCSI 50-pin interface
- Phillips drives are proprietary 16-pin interface

Phillips CM-206 2X-Drive HSC#15366 $49.95
NEC CDR-55JD 2X-Drive HSC# 15386 $99.00
NEC CDR-510 3X-Drive HSC# 15327 $139.95

Digital Bathroom Scale

- General Electric Model EDS1B3 Digital Bathroom Scale
- Weighs from 25 to 299 lbs.
- LED Readout, attractive beige case
- Requires 9V Battery (Not Included)
- Easily adjustable offset for calibration
- Transducer and readout unit should be useful for many electronic "Hacker" applications

HSC# 15336 $12.50

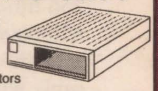
386 CPU Special!

- Special deal on 25MHz 386 Processor / Oscillator Combo!
- Intel 80386DX-25 Chip (New, prime)
- Four-pin 50MHz Dip Oscillator for clock rate
- Use with Motherboard at right for bargain workstation!

HSC# 15375 $9.95

SCSI Disk Drive Case

- Low-profile case for 5.25" drives
- Perfect for lower-power drives
- 9.5" x 2.5" x 10.5" overall size
- 50-pin SCSI daisy-chain connectors
- Internal audio cable, RCA jacks on back, SCSI ID switch
- Uses External 15-16VDC, 1-2A Supply (Not Included)
- Internal Regulator board can deliver +5, +12 @ 1.5A



HSC# 15245 Low-Profile 5.25" Drive Case $17.95

Serial Smartswitch

- Two computers can share one serial printer or plotter
- Automatically detects and switches to active line
- User-selectable Auto form-feed ensures each print job starts on new page
- Printer-ready light shows status at a glance
- X-on / X-off light show print job status
- External power supply, instructions included
- New in box, 90-day warranty

HSC# 15449 $19.95

Huge SCSI Hard Drive

- Fujitsu M2266S Full Height 5.25" Hard Drive
- 1.2 Gigabyte (1.08 GB Formatted)
- SCSI Interface (SCSI-II Capable)
- 14.5 mS avg. access time
- Great for File Server
- Looks like new, 90-day warranty

HSC# 15365 $299.00

Trackball for Mac!

- Mouse Systems A³ Trackball for ADB-type Mac's
- "Three-button Power Control Panel" Software
- High Resolution (680 dpr) for smooth, fingertip operation
- 100% A/UX, MacX, X Window and Mac OS compatible
- Multi-mode operation: Standard or 3-Button Power
- Reassignable buttons for left- or right-handed use
- New in box with software, 90-day warranty

HSC# 15432 $27.50

Remote Control for your Computer!

Dealer Inquiries Invited!

FORTE COMMUNICATIONS

- Infrared Remote operates your computer from 50 feet
- Perfect for sales presentations, training, demonstrations
- Serial Interface (IBM version) or ADB (Mac version)
- Handheld remote is 7" x 2.5" x .5"
- Included software provides screen pointer for emphasis
- Keystroke mapping table can be customized, saved
- Roam the room, make eye contact with your audience
- Like using a TV set remote control (easy to set-up, use)

HSC# 15240 IBM Remote Keyboard $29.95
HSC# 15241 Mac Remote Keyboard $39.95

Inmac Telco/Network Items

- Inmac 570-3 Patch-panel for RJ-45 Connectors
- 48 jacks on a 19" panel, fanned out from 8 50-pin conn.
- New in box, panel is 3.5" x 19" with 1" deep chassis

HSC#15510 $29.95

- Inmac 6683 Data Line Protector for modem/telco lines
- 2.25" x 2.75" x .75" box has adhesive strip
- New in box, 6' telco cable, 6' grounding cord

HSC#15544 $4.95

Serious Operating Systems!

- SCO XENIX 386 - Development tools for C, Graphics, Applications. 5.25" Floppies, Manual **HSC#15522 $99.00**
- SCO Open Server Ver. 3.0.0 - Tape or CD Format, TCP/IP/ Novell/NFS, UNIX V386 Ver. 4.0 **HSC#15512 $295.00**
- SCO Open Desktop R2.0/R3.0 - SCO UNIX R4.0/R4.2 Open-look style GUI, 9 Track Tape Cartridge Media, Requires min. 386, VGA, 8MB, 120MB **HSC#15513 $250.00**
- Interactive Looking Glass Professional Ver. 2.1.2 - Open-look style GUI, BSD UNIX 4.2 Compatible, Requires min. 386SX, VGA, 4MB, 100MB **HSC# 15514 $295.00**

Tiny Trackball for DOS!

- Mouse Systems NewPoint Trackball for DOS/Windows
- Portable Trackball for the Laptop on the go!
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- Mini-trackball with two buttons, ergonomic shape
- Clamps to keyboard, comes with padded carrying case
- New in box with software, 90-day warranty

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You Won't Miss a Thing With SCOUT™ Reaction Tune

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The SCOUT™ Has Taken Tuning Your Receiver To a New Dimension

Featuring Automatic Tuning of your AR8000 and AR2700 with the Optoelectronics Exclusive, Reaction Tune (Pat.Pend). Any frequency captured by the Scout will instantly tune the receiver. Imagine the possibilities! End the frustration of seeing two-way communications without being able to pick up the frequency on your portable scanner. Attach the Scout and AR8000/2700 to your belt and capture up to 400 frequencies and 255 hits per frequency. Or mount the Scout and AR8000/2700 in your car and cruise your way into the future of scanning. A simple interface cable will connect you to a whole new dimension of scanning.

The Scout's unique Memory Tune (Pat.Pend.) feature allows you to capture frequencies, log into memory and tune your AR8000/2700 at a later time. A distinctive double beep will inform you when the Scout has captured a new frequency, while a single beep indicates a frequency that has already been recorded. For discreet monitoring, a pager style vibrator will inform you of any hits the Scout captures.

The Scout will also Reaction Tune and Memory Tune Icom CI-V receivers: (R7000, R7100, and R9000) and (Pro 2005/6 equipped with OS456, Pro 2035 equipped with OS535). Download the Scout frequencies to a PC with the Scout Utility Disk and CX-12AR (optional), then compare them to the Spectum CD-ROM/PerCon FCC Database (optional).

Act Now!! Let the Scout Reaction Tune you into The World of Scanning

SCOUT™ $449

Features

- Automatically tunes these receivers with Reaction Tune (Pat.Pend.) CI-V receivers (ICOM's R7000, R7100, and R9000), (Pro 2005/2006 equipped with OS456, Pro 2035 equipped with OS535) or AOR models (AR2700 and AR8000).
- Records and saves 400 unique frequencies
- Records 255 hits on each frequency in memory
- Digital Filter and AutoCapture (Pat.Pend.)
- 10MHz-1.4GHz single frequency range
- View frequencies in RECALL mode
- 10 digit LCD with EL Backlight
- 16 Segment RF signal strength bargraph
- CX-12AR Computer Interface (optional)
- PC Utility Disk for downloading memory to PC
- Rapid charge NiCads with 10 hour discharge time
- Scout Spectrum CD-ROM/PerCon FCC database (optional)
- AC Adaptor/Charger
- DB 32 VHF/UHF mini-antenna shown with Scout (optional)
- Distinctive Beeper/Vibrator indicate frequency hits

At right: Scout shown with CLIPMATE™. A handy windshield mount for Scout, for quick access and visibility.

CLIPMATE™ $25.00

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Call or write for current advertising rates.

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Nuts & Volts Magazine encourages article submissions and queries. Send a SASE for a copy of our writer's guidelines.

All submissions should be on 5-1/4 or 3-1/2 inch diskettes and include hard copy as well. If return of materials is requested, include a SASE with your submission.

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

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11720A, Pulse Modulator 118 GHz ... $1250
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1630A, Logic Analyzer ... $700
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1725A, 275 MHz Oscilloscope ... $500
1741A, 100 MHz Storage Oscilloscope ... $450
182T/8755C, Swept Amplitude Analyzer ... $850
3310A, Function Generator ... $250
3310B, Function Generator, .0001Hz-5MHz ... $250
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332A, Distortion Analyzer ... $150
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reader FeedBack

Dear Nuts & Volts:

Concerning reader Robert Tiffany's July '95 letter (p. 135) and writer Shari Prange's response: Robert is correct and Shari is dead wrong.

Shari is reading her wire gauge chart without understanding what she's seeing. Here's the math. Typical resistance for 30 feet of single-strand copper wire in AWG 8, 10, and 12 is 0.023, 0.037, and 0.059 ohms, respectively (1987 National Electrical Code, Chapter 9, Table 8). 20 amps flowing through each of these 30' wires results in a voltage loss of approximately 0.46, 0.74, and 1.18 volts, respectively. (The approximate power loss per foot is thus 0.3, 0.5, and 0.8 watts, respectively.)

Shari apparently doesn't understand that there is a voltage drop from one end of the wire to the other, and that the wire (and insulation) will heat up due to the resulting power loss.

Her example of a 30-foot wire run means a total of 60 feet of wire (supply and return). For her 6 volts, 12 volt, and 115 volt circuits of AWG 8, 10, and 12 wire, respectively, the voltage loss in the wire will be approximately 0.9 (15%), 1.5 (13%), and 2.4 (2%) volts. The two big questions, both of which Shari missed, are 1) will the load receive enough power after the loss in the wire, and 2) is the circuit safe (i.e., will the insulation soften, melt, or burn)?

The wire's insulation should be spec'd (among other things) for voltage breakdown rating, maximum rated temperature, and toxicity when on fire. Cable bundles should be engineered for adequate cooling (for example, put the hottest wires on the outside of the bundle).

Peter Skye
Glendale, CA

Shari Prange's Response:

I am not sure why Mr. Skye disagrees with me. I said that it is not enough to spec wire according to current and length. System voltage must also be considered. This is true. Any automotive wire gauge chart will tell you to use heavier wire for 6 volt systems than for the same application in 12 volts.

To address his other points: If you are using a wire gauge chart for the proper system voltage and current draw, the safety of the insulation for the heat generated in the wire has already been calculated into the chart.

I chose the example of 30 feet and 20 amps simply because I wanted an apples-to-apples comparison across all three voltages, and that was the only perfect match. It sounds as though Mr. Skye's expertise is in electrical areas other than cars. In an automotive application, wire runs are not usually long enough for voltage drop to be an issue. The only exception I can think of is the old VW Bug, with the battery in the rear, ignition switch in the front, and starter in the rear. Sometimes after the wiring got old, there was not enough juice to kick over the starter when the car was hot. That is an unusual situation, however.

Shari Prange

Dear Nuts & Volts:

I was reading the article on the stepper motor. The stepper motor can only supply so much horsepower. I have an application for Halloween that a "ghostly sheet" travels along a one hundred foot guy-wire. Presently, I have two magnets on the power string. One to stop the motor going forward and the other to stop the motor when going back. A small program Logic Controller is the brains.

Now, since I cannot get a stepper motor to push/pull the string that pushes/pulls the ghost, therefore I need a way that the computer can know where the ghost is positioned without the use of limit switches. Instead of a 'stepper' motor I want a sensing device so that the computer knows, "this is the end!" Let the computer "count" how many feet the ghost has traveled down the guy-wire.

Using this technology, I can change the software to make the ghost stop over a section of the trail/sidewalk — shake back and forth — then continue to the end. It is a LOT simpler to change the software than try to change the hardware (more magnets).

Bob Anderson

John Iovine's Response:

Bob Anderson has already determined that a stepper motor isn't a suitable choice for his project. I agree. So a discussion on the horsepower of stepper motors isn't necessary. The question involves the control of a standard analog motor. Since Bob has most of the equipment necessary to accomplish this project, let's move ahead and give him an answer.

The ability to detect the magnet on the guy wire is key. What you must do now is mount a magnet on the shaft of the driving motor to detect motor revolutions. You may find it easier to secure the magnet on a disk connected to the motor's

Continued on page 8

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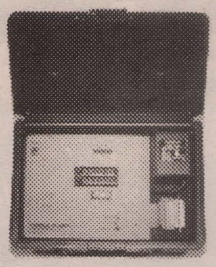

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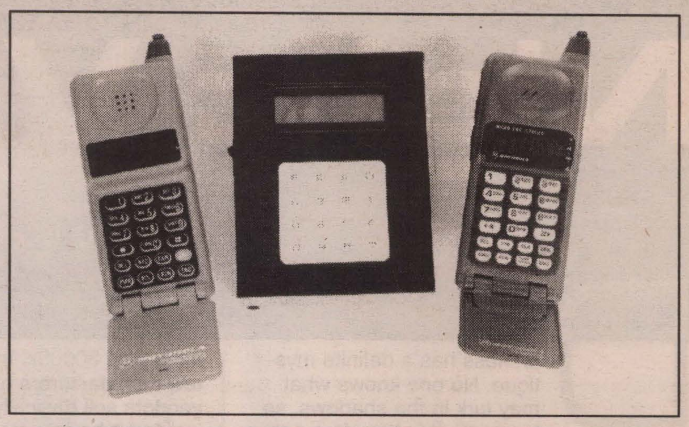

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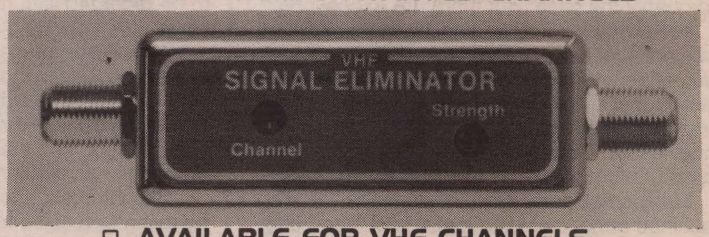

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Night Vision

by Jan Zaluda

There is almost a primeval desire to see in the dark . . .

Darkness has a definite mystique. No one knows what may lurk in the shadows, so to speak. It is therefore only natural that recent appearances of reasonably priced night vision scopes warrant some investigation.

Night vision units are becoming available, in retail stores and by mail order, at prices starting under $400.00. Do these units work? Where are they made? How are they made?

Anybody who has ever worked in astronomy, or with any kind of low-level fluorescence assay technique, knows, that a $50.00 photomultiplier tube with some support circuitry is capable of individual photon counting. It is only natural to expect similar performance from night vision equipment. After all, it is not hard to find multiple stage microchannel plate tubes in catalogs.

However, after examining the price list, a relatively simple two-stage tube is offered for $23,000.00, power supply for another $2,100.00, and this does not even include a lens, an eyepiece, a housing, or batteries.

Hmmm . . . , maybe next week they will have a sale. Right now, however, unless you have a Department of Defense budget to work with, this approach is simply not feasible.

Enter Russian night vision equipment. If you have never seen a Russian factory, a local government building may be a good approximation. This is not to say that there aren't any skilled people in Russia. However, individuals with skills have no resources or control over product development. Well, judging by the overall quality of construction of Russian night vision scopes, this is probably the case. But there are exceptions.

For example, Russian lenses have excellent quality optical parts. Image tubes also mostly work, although usable gain varies. High voltage power supplies use early 1960-type discrete components, and many are simply bad. Housings are very heavy, cut out of massive blocks of aluminum.

Many small parts are custom made machined parts, including metal knobs and captive screws. No two are exactly alike. Few O-ring moisture seals, or shock mounts are used, switches are huge and hard to operate, adjustment knobs are hard to turn, awkwardly shaped, and do not fit well.

A night vision scope can be functionally compared to a camcorder. Both have objective lenses, image sensors, and viewfinder or eyepiece displays. However, assembly techniques used in construction are generations apart.

But, it is possible to select Russian made scopes which work. If lugging many extra pounds of glass and metal around is not a major problem, then selection is easy, since the Russians have no competitors in the same price range.

Why are there such variations in advertised performance specifications? First-generation binoculars sold by a retail chain are claimed to have gain 30000x. In Russia, there are only a few manufacturers of tubes. Therefore, all of the vendors sell basically the same units. The housing and tube mounts may differ somewhat, but the tubes are probably identical. Few vendors do any kind of testing, and they simply make up whatever numbers look good.

Prices of comparable performance units also vary considerably. Some vendors actually turn on a scope before shipment. Others ship whatever they receive from Russia, and let users do their own testing. Still others advertise low prices, but do not actually have anything in stock.

What Can be Seen with a Night Vision Scope?

First impression will probably be a disappointment. Even the best scopes are not that much better than a fully dark adapted human eye with some optical aid. In particular, first-generation scopes do not even see as well as the naked eye alone, and therefore are not very useful for generic outdoor use.

In spite of that, there are still applications which benefit from the use of first-generation night vision devices. In a semi-urban environment, with many bright lights, and sporadic automotive traffic, it is difficult to attain full dark adaptation. Here a night scope is useful to see reasonably well, without dark adaptation.

Another use is photography. Consumer grade film needs considerable intensity of light. A night scope may not add any detail, but it amplifies the available light enough for images to be recorded with reasonable exposure times.

Astronomical use yields somewhat disappointing results, except with mid-size telescopes observing extended objects. Here, first-generation tubes work better, because there is enough light, and the resolution is not degraded by the microchannel plate.

It is interesting to test night vision scopes by trying to resolve moons of Jupiter, a feat easily performed by K-Mart-quality binoculars. At comparable magnification — about 7x — Russian night vision scopes fail this test.

Second-generation scopes have about 100x more gain than first-generation units, and are more suitable for general use. Even under an overcast sky, it is possible to see some detail. Resolution is, however, significantly lower compared to first-generation devices. It is important to remember that image tubes of any generation need at least some ambient light to amplify. It is not possible to see in total darkness without an illuminator.

Photography is again a good application for second-generation devices. For visual observation only, however, a good wide aperture-spotting scope, used with fully dark adapted eyes, can challenge even second-generation night vision scopes.

Anatomy of a Russian Night Vision Scope

To really evaluate quality of parts and workmanship, it is necessary to disassemble a typical unit. The illustrations show components used in various Russian-designed and Russian-made night vision scopes.

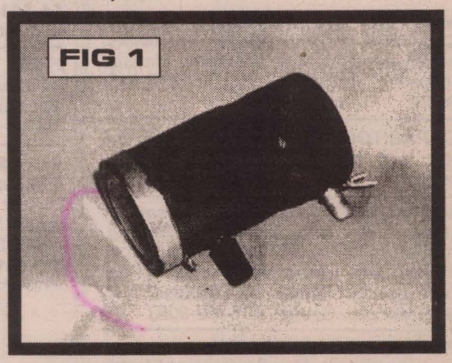

FIG 1

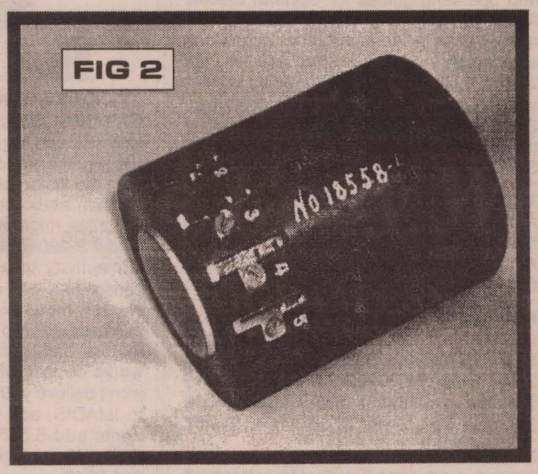

FIG 2

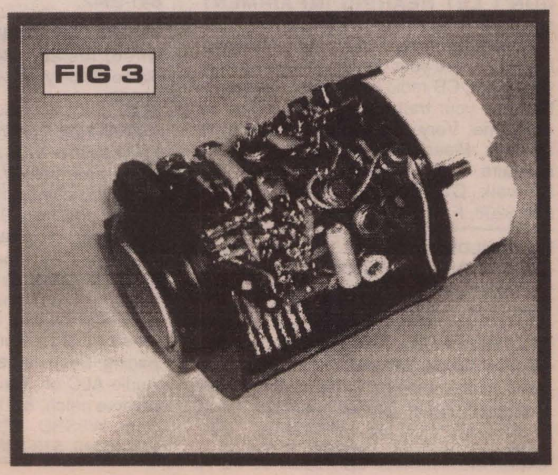

FIG 3

Figure 1 shows a first-generation image tube. Light enters from the left, the phosphor screen on the right. Electrostatic lens inside the tube focuses photoelectrons onto the phosphor screen anode. The body is a painted thick glass envelope. The shiny protrusion near the anode is a high-voltage connection. The other protrusion in the middle is the evacuation stem. Typical voltage applied to the anode is 5 to 10 KV. A photocathode is connected to the negative side of the supply.

Figure 2 shows a 25 mm microchannel plate second-generation tube. This tube is encapsulated in a black plastic shell filled with a whitish semi-hard substance of unknown composition. Included in the potting shell are high-voltage multipliers for the multiplier plate, and anode power supplies.

Otherwise, the tube construction is similar to, and, without encapsulation, would resemble the first tube. Light again enters from the left. The photocathode is obscured by a fiber optic plate, which has the characteristic concentric ring visual appearance.

Internal electrostatic lens again focuses photoelectrons, this time on a microchannel plate, placed close to the anode phosphor screen, on the right side. Electrons multiplied by the microchannel plate are proximity focused onto the phosphor screen. The electrical connections on the left side of the casing are inputs to the voltage multipliers. Typical voltages at the inputs are 100 VAC, at 12 KHz, in other words, audible.

Figure 3 shows another tube style. This one is a 15 mm microchannel plate second-generation tube with a complete internal power supply, constructed on a thin epoxy board, wrapped around the tube. One inverter with its multiplier supplies about 700 volts to the microchannel plate; the other inverter with another multiplier provides about 5K volts to the anode. The remaining parts were used in a marginally successful attempt at automatic brightness control. The circuit board is a prehistoric attempt at surface mount assembly technique. Reject rate of this type of electrical assembly? Don't even ask!

Figure 4 shows key parts used to construct a night vision scope. On the left is a rather large and heavy lens, in the middle is an image tube, above the tube is one type of housing, and on the right is an eyepiece used to observe the intensified image. The eyepiece is somewhat optional; it is possible to directly observe the image formed on the phosphor screen. Different lens, eyepiece combinations result in varying image magnification.

Figure 5 shows one style of inverter. The large encapsulated box contains a voltage multiplier and a flyback transformer. The internal parts are encapsulated in what appears to be good quality silicone. The small board is a flyback-style inverter driver. Note the quality and style of the power switch and the battery clip. This power supply has a huge capacitor at the output, which stores enough energy to damage a tube exposed to a sudden flash of bright light.

Figure 6 is another style of inverter. This type is used with second-generation tubes with built-in voltage multipliers. It is a simple resonant push-pull circuit without any controls. Current limiting is accomplished by placing a resistor in the power input to the inverter, and by general softness of the voltage multiplier circuits. The large silver part is a 1960-style electrolytic capacitor; the upright black part is a pot core transformer with several taps in the secondary winding. Highest output is about 120 VAC. The inverter operates at 12 KHz.

What are Generations?

The term, *generation* of night vision scope, refers to the type of the image intensifier tube used by the scope.

First-Generation — The earliest mass-produced tubes consist of a glass cylinder with two windows mounted at the ends. One window is coated with a photo-emissive material — the photocathode — which emits electrons when illuminated by light.

The other window is coated with a phosphor, which emits visible light when struck by electrons. Although these tubes are sometimes claimed to be infrared conversion devices, spectral response drops off rapidly above 800 nm.

Inside the glass tube, there is an electrostatic lens which accelerates and focuses electrons emitted from the photocathode onto the phosphor coated window.

The phosphor window is the anode, and is connected to positive high voltage, typically 2 to 10 KV. The cathode is connected to ground potential.

This power supply must be current limited, otherwise the tube would be rapidly destroyed by exposure to bright light, and the resulting high-current flow.

The internal lens also inverts the image, hence no prisms are needed to produce an upright image.

Light emitted by the phosphor is then observed through an eyepiece. Light amplification is due to the acceleration of photo emitted electrons, as they fall through the high-voltage potential drop, and produce many photons when stopped in the phosphor.

Tubes of this construction have a usable light gain of about 300x. Light gain can be defined as a ratio of the light intensity emitted by the phosphor, divided by intensity of light incident onto the photocathode.

A usable gain is a somewhat subjective parameter, and is defined as a gain at which the image still has good contrast, and is not overwhelmed by internal tube noise flicker. Resolution of first-generation tubes is excellent in the center, but rapidly degrades toward the edges.

First Plus Generation — To correct severe spherical aberration away from the center of first-generation tubes, a fiber optic faceplate can be added in front of a curved photocathode, to flatten the equivalent cathode surface. Only second-generation Russian-made tubes use a fiber optic faceplate.

Second-Generation Tubes — First-generation tubes have a limited light gain. To some extent gain can be increased by increasing the high voltage. However, thermal electrons, internal arcing, and significant X-ray generation become major obstacles in this approach. Enter the microchannel plate.

A microchannel plate is a thin glass wafer with many small holes, or microchannels, running through the plate, parallel to each other, somewhat inclined from the axis of the plate. Inside each microchannel it is coated with electron emissive coating. The plate works as an electron multiplier.

Electrons traveling parallel to the axis of the plate strike the inside wall of the microchannel, and produce a cascade of secondary electrons, which are swept from the channel by voltage applied to the plate faces.

Typically, several hundred volts potential is applied to the plate. When such a plate is placed inside of a first-generation tube, it multiplies the number of emitted photoelectrons, and therefore increases total light gain of the tube.

Single microchannel plate tubes have additional usable light gain up to 100x per microchannel plate, over a first-generation tube. Therefore, usable gain of a typical second-generation tube with a single microchannel plate is (300x) x (100x) = 30000x.

Microchannel plates are traditionally made from a bundle of glass tubes, which are heated, stretched, and then sliced into thin wafers. Existing manufacturers have little competition, and therefore little incentive to use cheaper lithographic and dry-etch technologies. If this ever happens, microchannel plates will become orders of magnitude cheaper.

The electrostatic lens can be omitted, using only proximity focus. Resolution is somewhat degraded, but wafer thin tubes can be produced. To produce an upright image, either an additional lens, or a fiber optic twister must be used. Russians do not presently manufacture wafer thin tubes.

To obtain more gain, it is possible to use multiple microchannel plates per tube. A two-plate tube has up to 100x more gain, than a single plate tube. Russians do not presently produce multiple microchannel plate tubes.

The Next Generation

In principle, it is possible to construct an image intensifier using a monolithic array of avalanche photodiodes, with built-in scanning and readout circuitry. Such a device would be very thin and lightweight, have sensitivity to 1500 nm if made out of silicon, and may approach microchannel plate tube gain. No such device is at present available commercially.

Indispensable Features of a Night Vision Scope

Night vision scopes need an operator-accessible tube brightness adjustment. Default brightness is usually set too high — the phosphor screen glows a brilliant green color, but the image shows no more detail than at a more reasonable setting. Moreover, it takes many minutes to recover eye dark adaptation after looking at such a bright image outdoors at night. Same reasoning applies to illuminator and reticle brightness controls, if installed.

Another useful feature is a standard lens mount. Pentax thread mount or TV camera lens threads allow easy selection of lenses from many sources, and simplify photography or telescope mounting. Lens should have a stowable cap, which does not dangle, when the scope is used.

FIG 4

FIG 6

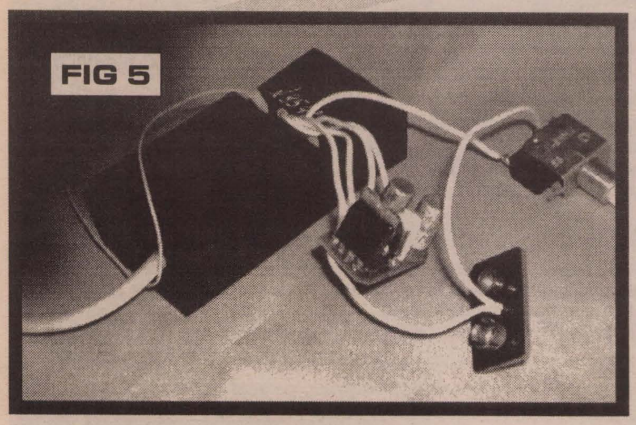

FIG 5

Easy-to-Perform Tube Tests

The microchannel plate in second-generation tubes also has diagnostic use. In normal operation, there is a dark spot on the screen, corresponding to the angle of the channels. If the voltage across the plate is decreased, the spot becomes less distinct. When multiplication gain becomes 1x, the spot disappears. If the voltage is reduced even more, the spot becomes bright. The plate now acts as an obstruction, blocking many of the original photoelectrons from reaching the anode, except the ones traveling parallel to the microchannels.

If there is enough interest, a future article will describe how to unencapsulate a reject second-generation Russian tube, remove the voltage multipliers, and connect new power supplies which match the tube. For optimal operation, all three voltages, cathode-to-microchannel plate, across plate, and plate-to-anode, should be individually adjustable.

Night Vision Accessories

Lenses

Average Russian tubes do not have very high usable gain, hence a wide aperture lens, f/2.8 or better, needs to be used. To see objects at a moderate distance, 3x magnification is a good choice. Using a 25 mm focal length eyepiece, the objective lens should then have a focal length of at least 75 mm. The electrostatic lens in first-generation tubes typically reduces image size by about 2x, so that at least 150 mm objective is needed for 3x total magnification with these tubes. A 150 mm f/1.8 is a rather large and very heavy lens.

Illuminators

Although the use of an illuminator to some extent defeats the principle of night vision, there are useful applications for such a device. Image intensifiers amplify available ambient light. Therefore, when there is not enough ambient light to amplify, additional light can be supplied by an illuminator. This is true in a cave, in a dark forest, or in a basement with the lights turned off. In the last case, the illuminator can be used to test operation of the night vision system under controlled conditions.

Simply put, an illuminator is a dim flashlight. The light source may be a common red LED, or a near infrared LED. Red LEDs do emit a visible reddish glow, IR. LEDs are nearly invisible, but operate near the cutoff wavelength of the tube photocathode, and therefore must be operated at a higher current to give enough illumination. Battery life then becomes an issue.

Other Uses of Night Vision

Night vision scopes are frequently mounted on rifles. But not every night vision scope can be used as a rifle scope. It must be ruggedized to survive this type of use. Russians do not use any kind of a shock mount for the tube. Instead, they seem to believe in the principle of mass compensation. That is, if the scope is made massive enough, the rifle and scope combination is so heavy, that there is little recoil when the rifle is fired. This may work with low power rifles, but unless the scope is constructed to survive real recoil shock, it is not suitable for general rifle mounting.

In other words, regardless of what some salesman may claim, it is necessary to disassemble the scope, and visually verify that the tube is shock mounted with elastomer fingers or metal spring shock mounts, power supply components securely mounted and encapsulated, or otherwise anchored, and that lenses do not rattle. A generic, not ruggedized, unit will fall apart after only a few shots.

A rifle scope also needs an illuminated adjustable aiming reticle. Adjustable means that the position of the reticle mark can actually be smoothly changed by turning elevation and azimuth adjusting screws. Russian designers have not quite grasped this concept. Also, the reticle needs to be visible at night, with tube brightness set to a reasonable level.

First-generation tubes do not have enough gain for use in a rifle scope. A second generation tube is needed in this application. Actually, a good large aperture, low power telescope with an illuminated reticle, mounted on a rifle, can challenge even the best night vision rifle scopes.

Why are Night Vision Components So Expensive?

Well, there is not really a good technical answer. There are only a few manufacturers of image tubes in the world today, and all are old style companies. They still make microchannel plates from stacked glass tubes, mostly by hand, and have little desire to innovate. After all, they have been doing it this way for years, so why change? Prices are set to whatever the existing market will bear, and new high volume markets are of no interest to these companies.

An image tube is simply a glass envelope with some wires, optical windows, one or more thin plates with many holes, electrostatic lens (which is actually optional), and a couple of sheet metal parts to hold it all together. A garage shop with a good vacuum system, semiconductor lithography, deposition, and plasma etch equipment can potentially become a manufacturer. If this ever happens, quality, commercially priced, high-performance night vision will become reality. **NV**

Simplified Optical Terms

Terminology used at optical wavelengths may seem needlessly complicated. Most of the complexity is the result of attempts to account for human eye spectral sensitivity. That is, the radiometric light intensity in watts/square meter is multiplied by some standard correction curve, to produce photometric values, which measure values similarly to what the human eye sees.

Magnification — Magnification refers to image size seen through the scope, divided by image size seen by the naked eye. Generic binoculars have magnification 7x, or 10x. Typical night vision scopes have magnification 1x to 5x.

Illumination — Illumination is the light power intensity incident upon an object.

Luminance — Luminance, or brightness of a passive object, depends on illumination and reflectivity. A black object, even when intensely illuminated, has low luminance. Conversely, a white object, poorly illuminated, can still have high luminance.

Light gain — Light gain of a night vision scope is the ratio of luminance of the tube phosphor image, divided by luminance of the observed object. Typical values are 300x for first-generation tubes, and 30,000x for single microchannel plate tubes.

Usable light gain — There are two major factors which determine usable light gain. In low illumination conditions, tube noise limits the maximal gain. If the gain is set too high, the phosphor image has so much random flicker that little detail can be seen. Under moderate illumination, if the gain is set very high, the phosphor can glow like a locomotive headlight, but again no more image detail can be resolved than with a more reasonable gain setting. Usable light gain is a somewhat subjective parameter.

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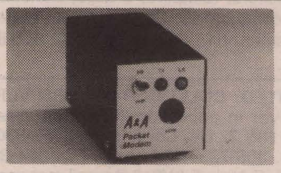

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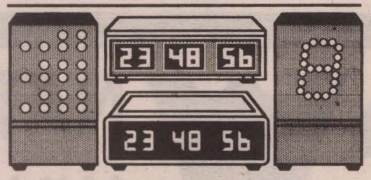

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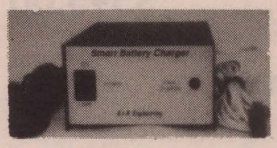

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Today's Electronics

by Anthony Charlton

Build A Multi-purpose Surface Mount Technology Oscillator

While researching this article, I had the chance to speak with several people about Surface Mount Technology (SMT). One of them said "I don't know why people are scared of SMT — they'd best learn to use it, because five years down the road, it will be the only technology available. Why, in some cases, there are more types (of specialty analog) ICs available in SMT than in DIP packages."

Well, I hate to think of being confined to *just* SMT, because even I still enjoy working with vacuum tubes occasionally. But it is a worthwhile investment of time to look into SMT. Once you get the "hang" of it, it's rather captivating. That is why we'll be constructing some simple SMT learn-by-doing projects in the next few installments. Once again, we will be interchanging the acronyms of SMT and SMC (Surface Mountable Component.)

There is an analogy here to the switchover from the antiquated vacuum-tube technology of the past to transistor technology. The next big switch-over augmented the electronic possibilities greatly, and that climb was from discrete transistor technology to IC technology.

The final leap involves the reduction of package sizes from conventional to SMT; another aspect of this large gradation is the proliferation of THOUSANDS of specialized ICs in SMT packages. Here's where we are now.

We can keep up with this progress just as we kept up with the previous advances in electronic technology.

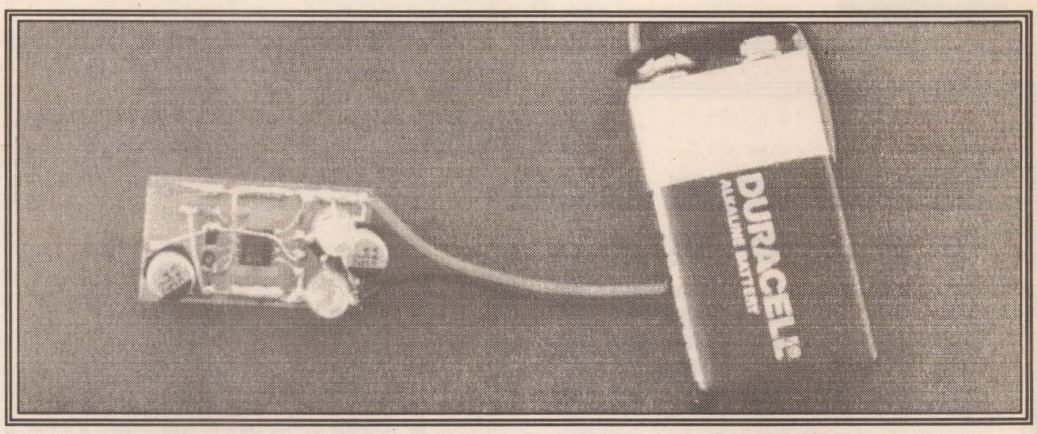
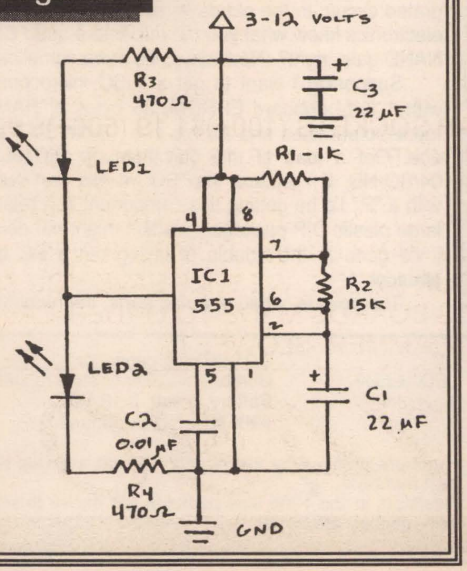


Figure 1



Stemming from nostalgia, I still keep some old issues of electronic magazines dating back to the early '60s that were, at that time, introducing transistor technology as a replacement for vacuum tube technology.

Although these were given to me at a later date by a good engineer-type friend (I was just learning how to ride a bicycle back when the magazines were published), it was fascinating to read them and also the wonderful *Amateur Radio Relay League (ARRL) Handbook For Radio Amateurs.* That was done in my teens, and one could grasp the fundamentals of vacuum-tube technology thanks to the clarity of the writers who described same. Then, one compared vacuum with transistor technology and emerging fundamental IC technology, and you could get a real grasp of the progress at hand.

Since those days when the first ICs became available, and maybe contained four or six logic gates, the semiconductor and related industries have advanced their progress to the point where technology has given us one million byte RAMs and the capability of storing a billion bytes of data in an area half the size of a shoebox. Amazing! We can't humanly expect to individually experiment with such complexity, but we will be looking at and working with different and interesting facets of "Today's Electronics."

We shall begin our hands-on journey by building this first simple, bench-top useful SMT project; the Multi purpose-Oscillator.

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SMT Project Numero Uno

One of the most useful electronic tools a person can have is an oscillator. They are used in many areas, including RF and audio signal generation, as markers on an RF band; ready audio for tone generation or for signal tracing a circuit.

Further ideas are: You can make an oscillator to drive an inverting power supply circuit for changing the voltage from a lower to a higher level, or vice versa, for whatever purpose is at hand. Or for that matter, a circuit that can furnish SEVERAL voltages simultaneously, such as are used in computer power supplies.

To build this project, you'll want a low-wattage, fine-tipped soldering iron, a razor knife, and fine diameter solder.

A cyanoacrylate (CA) glue is also helpful to secure components to the prototyping board during the soldering process. Krazy Glue™ is a fast-setting (2 to 10 second) CA that works fine, but get your alignment right the first time, or else you're stuck!

Static-sensitive ICs and other parts will require static-elimination methods such as a grounded soldering iron and a static-eliminating conductive wrist strap.

Solder the parts quickly, and if the joint isn't good, allow time for the part to cool between passes. Inspect the finished project for solder bridges, cold solder joints, and the possibility of a bridge UNDERNEATH a component. This latter problem is diagnosed by shining a bright light through the prototyping board. Not too unusual, because the pads connecting SMT components can be really close together.

The Ubiquitous 555 Timer

555 timers are everywhere, and make a logical entry into a hands-on approach to SMT. The circuit, pictured in Figure #1, can be configured to run as a squarewave oscillator that has a variable frequency anywhere from one-tenth of 1 Hz or less to 100,000 Hz with this particular chip. The frequency is dependent upon the three elements that control it: R1, R2,

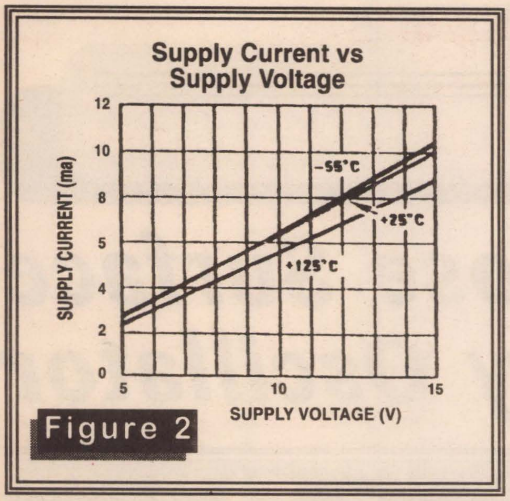


Figure 2

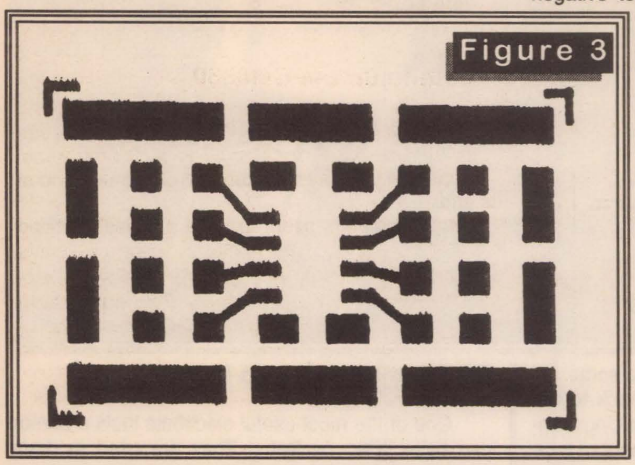


Figure 3

tion is quite reasonable. By using the CMOS version of the 555, part no. LMC555CM-ND, you can create a low-power consumption circuit that will run off of three button watch cells. Even sans the CMOS timer, the circuit drain isn't high; Figure 2 shows the quiescent current consumption vs. supply voltage.

Watch Polarity and IC Terminals!

The project is laid out on a product called a Surfboard™ which we'll explain about shortly. Figure 3 shows the unmounted pattern of the 9081 Surfboard, a PWB product (the acronym is for Printed Wired Board).

Figure 4 shows a sketch of the component layout on the 9081 Surfboard, Digi-Key #9081CA-ND. This is the FOIL side, and the components are also placed on this side. This necessitates several jumpers, each marked with a "J."

Note, electrolytic capacitors will always have their negative terminal marked, either by a dot, a black band, or minus (-) symbols.

Tantalum capacitors will be marked with a (+) symbol on their positive side.

Rectifiers, diodes, and Zener diodes will have their cathode band identified by a single colored band, or a series of bands.

ICs are a little tricky here. Plastic SOIC ICs that look like miniature replicas of their larger bretheren in DIP packages will have pin 1 identified by a dot at the UPPER LEFT HAND CORNER — remember, this is SMT, and not through-hole DIP technology, so the IC mounts to the foil of the board, and thusly, it's not lying on its back relative to the FOIL side of the PC board like with DIP technology. So, don't get discouraged if you accidently fry an IC by placing it backwards.

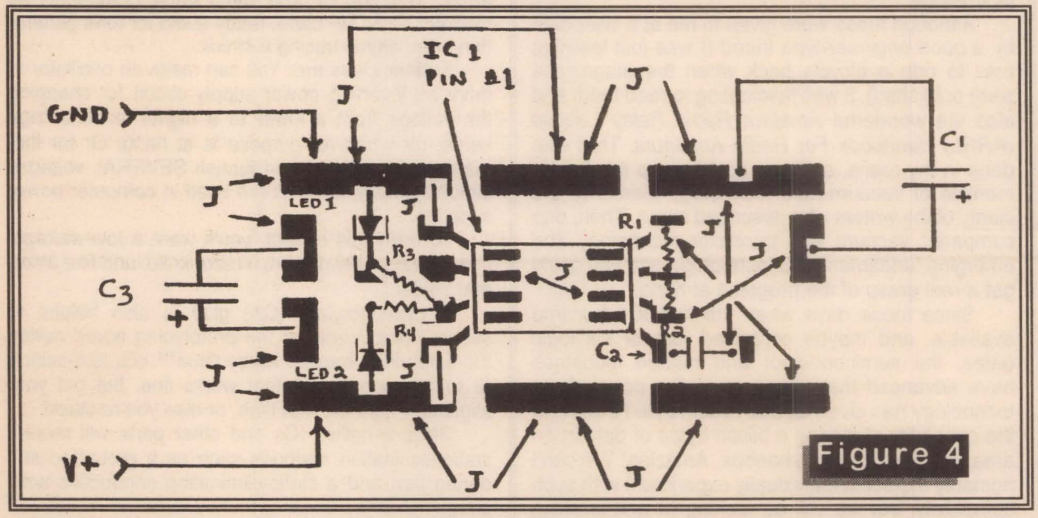


Figure 4

and C1. The formula for determining the frequency is:

F = 1.44/(R1 + 2* R2) *C where:
F is the frequency, R1 and R2 are in megohms, and C is in microFarads

With the values shown, the circuit produces about a 2 Hz blink that alternates between the two LEDs. I used ultrabright LEDs of conventional packaging, and will apply this circuit as wingtip marker lights for an R/C model airplane to add realism to that model.

Model railroaders might find this circuit useful for lighting various structures on their layouts; another idea is to use it as an attention-getting gadget for sales promotions, or you could even wear it on your person to get noticed at a party!

Since the circuit can be constructed in an area about the size of a postage stamp, this latter suggestion is quite reasonable. It just takes a little adjustment in thinking to properly place them. PLCC and LCCC packaged ICs will likely NOT have their pin 1 at the upper left corner. Instead, an identifying dot or other marker will appear at pin 1. These ICs have a square profile usually, and a chamfer is cut into one corner of the package. (For a more complete explanation of SMT acronyms and packages, reference the Glossary in the Aug. '95 issue.)

Construction — It Can Be Easy!

There is a terrific line of products that lend themselves to simple fabrication of SMC projects in prototype and small production quantities. As mentioned, they are called Surfboards and are specifically designed to accommodate SMCs of nearly all types. That is important, as the tiny size of the SMT packages makes putting a project together a skillful endeavor unless one has the proper equipment to work with. Even so, you won't want to omit a strong light and a magnifying glass from your tool kit when working with SMT. After getting the hang of it, SMT techniques are learned quite rapidly.

Let's briefly review Surfboards, courtesy of the material donated by Capital Advanced Technologies, Inc.; as this product will be an important player in our SMT projects now and in the future.

Surfboard Breadboarding Medium

We are all familiar with non-SMT breadboarding mediums. Since there are no projecting pins on SMCs, wirewrapping and solderless breadboard techniques won't work. But this system allows one to build prototypes, and if desired, plug them into conventional solderless breadboards for circuit evaluation. It depends upon what model Surfboard one chooses to use. Most of the models are equipped with SIP, or Single In-line Pins, so that they can be plugged into through-hole PCBs or breadboards.

Figure 5 shows one page of the literature Capital distributes that shows hints and techniques about how to use their products.

Capital's products lend themselves easily to custom modification by cutting their traces where desired with a razor knife, and lifting out the unneeded trace(s) as shown in the figure.

A couple of other hints are: Trimmed leads of 1/4 watt resistors make nice jumpers. There are also zero-ohm SMT resistors available for the same purpose. You can also mix SMT and leaded technology on a Surfboard; one wants to bend the attachment leads of the non-SMT component at a 90 degree angle, so they will mount nicely to the SMT board. And try not to use too large a diameter wire to join bulky external components, such as switches, transformers, etc., to a Surfboard or any other SMT board. The traces are too fine, and the extra heat required for soldering will lift them up, leading to frustration. Fine wire is perfect, in fact, the #30 wire-wrap wire makes a good interconnection medium to large parts unless you plan to use significant power in the SMT/external part circuit.

Part Number Alphabet Soup

Okay, so you want to purchase a CD4011 integrated circuit. In the old days, everybody familiar with electronics knew what you meant. Aha! a quad CMOS NAND gate, right? Nowadays, it's more complicated.

Supposing I want to get a RISC microcontroller with 1 K of onboard EPROM, 36 bytes of RAM, 12 Input/Output lines and all this in a 18-pin SMT package. Get a load of this part number: PIC16LC61-04/SO-ND. If I replace the "SO" in this part number with a "P," I'd be getting this component in a relatively large plastic DIP package — which might not do at all if I'd gone to the trouble of laying out a PC board already!

The point is, when ordering parts, the number has

Parts List

Multipurpose Oscillator:

IC1	#LM555CM-ND
R1	1,000-ohm, 1/8 watt chip resistor
R2	15,000-ohm, 1/8 watt chip resistor
R3,R4	470-ohm, 1/8 watt chip resistor
C1,C3	22 uF, 15 WVDC or higher aluminum electrolytic capacitor
C2	0.01 uF chip capacitor
LED1,LED2	Ultrabright LEDs or style to suit
1	Battery to suit, 3-12 VDC
1	#9081CA-ND Surfboard

Numbers prefixed by the pound (#) sign are Digi-Key part numbers.
Resistors in the 1206 size package are easier to work with, as they are larger.

to be exactly correct, or you'll likely end up with the wrong part. Although it may seem unduly complex, it's not unfairly so, simply because there are 100,000 or so different ICs out there, and the numbering protocol, while somewhat intimidating, CAN be mastered. All one has to do is determine the EXACT part number of what you want because it's all computerized by the vendor.

An analogy here is those who work on mechanical repairs for cars. The dealer will ask for the make, model, year, possibly the serial number and/or manufacture date, and for other information like cubic inch displacement of the engine. Then, he or she can supply you correctly with the replacement part you desire. Exercise patience with electronics as you would with a mechanical repair endeavor.

Parts Coding Hints

Resistors are coded according to their tolerance. If it's a 5% or 10% resistor, it will have three digits printed on it. If it's a 1% resistor, it will have four. The first two digits of a three digit coding scheme are the significant figures of its value. For example: "25." The next digit is a power of 10 multiplier. So, a resistor marked "253" would be 25* 1,000 (10 {3}) or 25,000 ohms (25K). A resistor marked "105" would be 1 megohm. If the resistor is 1%, the first three digits are the significant figures, and the last a decimal multiplier. A resistor marked "9152" would be 915* 100 or 91.5K, not 9.15K

Capacitor marking codes will vary, which clouds this picture. I have seen aluminum electrolytics with their working voltage and capacitance printed quite decodeably on them. Such as "4.7 uF 35 WVDC." That is easy enough to interpret. Many chip capacitors will have a code such as "4.7 35V" which is the same thing. Other chip capacitors will have a house marking such as "KY1," a marking that appeared on one purchase of 82 pF capacitors. What does THAT mean? Or take this example: a red dot that appeared on a 1500 pF size. These and other example of "odd" markings may be perfectly clear to the manufacturer, but it doesn't help the experimenter.

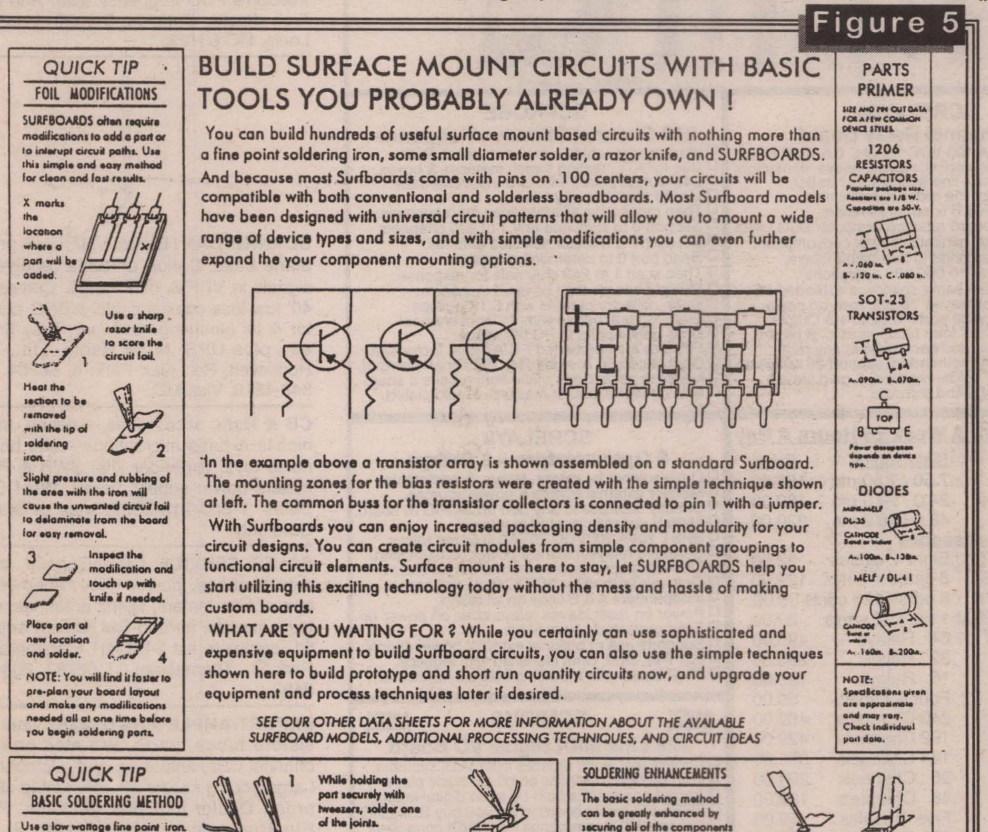
In cases like these, segregate your parts carefully, labelling the container they are kept in with the known specs. Inductors, potentiometers, and so forth have their unique codes, as well. You can be assured if you run across a small, tubular package the component is probably a diode, rectifier, or a Zener diode. The cathode is always marked with a colored band at its end.

Potentiometers seem to have a logical marking scheme. For instance, the numeral usually represents the Kohm value of the device, like 47 or 24 would represent 47K and 24K, respectively. Pots are easy to test with an ohmmeter as are unmarked resistors.

Some surplus parts have no markings at all, so it's up to you to test them with the appropriate equipment. I wish there was an ironclad, unilateral standard for code markings, but there isn't one at this time unfortunately that I am aware of, so hopefully this guideline will help. Brand new parts from major suppliers are the ones that will either carry instantly recognizable markings or proper documentation as to their specs.

ICs are generally easy to identify. While there may be more numbers in the manufacturer's marking than the part requires to be identified, that's usually because it has a manufacture date, lots number, perhaps a serial number, and other data are included in the marking. So if you ordered a 555 timer IC, and you get one marked "NE555 SS8723" (like we did for the prototype Project Numero Uno) it's still just a 555 timer.

Figure 5



Past Article Numbering Protocol

In order to keep from reprinting prior data in future installments, references to prior issues will be coded thusly so you can easily look up past articles: TEmmmYY. TE is for *Today's Electronics*, mmm for the month, and YY for the year. So, if a reference is given to TEaug95, that means the August issue in the year 1995, which was also our debut.

Conclusion

Next time around, we'll be doing a super-fun little project that involves mixing a hybrid circuit using both SMT and conventional technology. And, if you have any questions or comments, please drop us a note at the *Today's Electronics* P.O. box listed elsewhere in this article; we'd love to hear from you! **NV**

SUPPLIER LIST

Capital Advanced Technologies, Inc, 309-A Village Drive, Carol Stream, IL 60188. Ph: (708) 690-1696, FAX: (708) 690-2498. Manufacturer of the Surfboard™ breadboarding medium for SMT, sells mostly through distributors such as Digi-Key. OEMs can contact Capital directly for large quantity pricing.

Carolina Biological Supply Company, 2700 York Road, Burlington, NC 27215. Ph: (919) 584-0381, FAX: (503) 656-4208. Lab supplies including test tubes, plastic, and glass vials handy for use in categorizing SMCs. Contact for current price of their 30,000 item, full-color catalog.

Contact East, 335 Willow Street, North Andover, MA 01845-5995. Ph: (508) 682-2000, FAX: (508) 688-7829. SMT and electronic repair tools; chemicals. Free catalog.

Datak Corporation, 55 Freeport Blvd., Unit #23, Sparks, NV 89431. Ph: (702) 359-7474, FAX: (702) 359-7494. Dry transfers for PWB fabrication, chemicals, Circuit-Fix™ products. Free catalog.

Digi-Key Corporation, 701 Brooks Avenue South, P.O. Box 677, Thief River Falls, MN 56701-0677. Ph: (800) 344-4539, FAX: (218) 681-3380. Top-of-the-line supplier of SMT components; features a large selection. Free catalog.

DynaArt Designs, 3535 Stillmeadow Lane, Lancaster, CA 93536-6624. Ph: (805) 943-4746. Provider of and seller (through distributors as well) of the Toner Transfer System (TTS) method of PCB fabrication. Also sells a desk-top integrated package for small OEM and prototype PCB fabrication.

Electronic Goldmine, P.O. Box 5408, Scottsdale, AZ 85261. Ph: (602) 451-7454, FAX: (602) 451-9495. SMT surplus PWBs and SMT components. Some great values here. Free catalog.

ESP Solder Plus, 14 Blackstone Valley Place, Lincoln, RI 02865-1145. Ph: (401) 333-3800, FAX: (401) 333-4954. Small manufacturer, educational and industry SMT repair kits and solder cream.

Garrett/IEU, Inc., 3130 Skyway Drive #104, Santa Maria, CA 93455. Ph: (805) 922-0594, FAX: (805) 922-3643. Small and bulk quantities of surface mountable components.

Pace Inc., 9893 Brewers Court, Laurel, MD 20723-1990. Ph: (301) 490-9860, FAX: (301) 498-3252. Manufacturer of SMT soldering/desoldering equipment and workstations.

Techni-Tool, 5 Apollo Road, P.O. Box 368, Plymount Meeting, PA 19462. Ph: (215) 941-2400, FAX: (215) 828-5623. Soldering/desoldering equipment and electronic tools of all types.

All Electronics Corporation, P.O. Box 567, Van Nuys, CA 91408-0567. Ph: (800) 826-5432, FAX: (818) 781-2653. Some SMT parts and occasional surplus SMT boards useful for parts salvage and experimentation. Free catalog.

Be sure to mention Nuts & Volts when you contact the above suppliers so they can process your requests properly.

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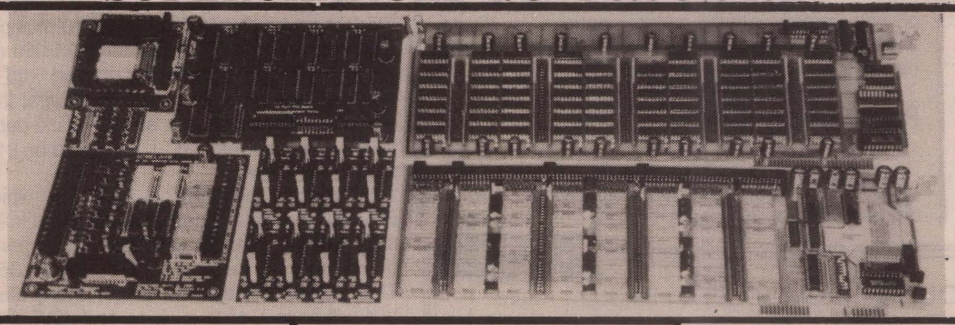

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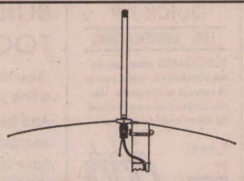

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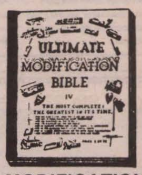

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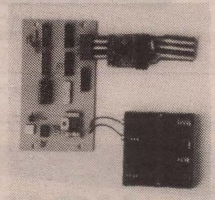

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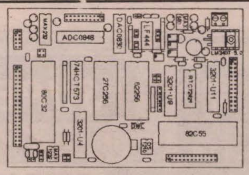

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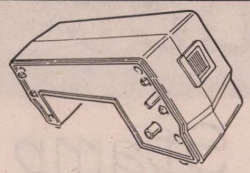

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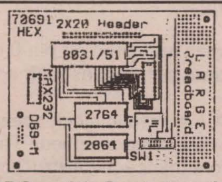

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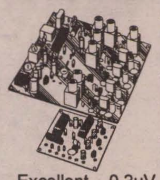

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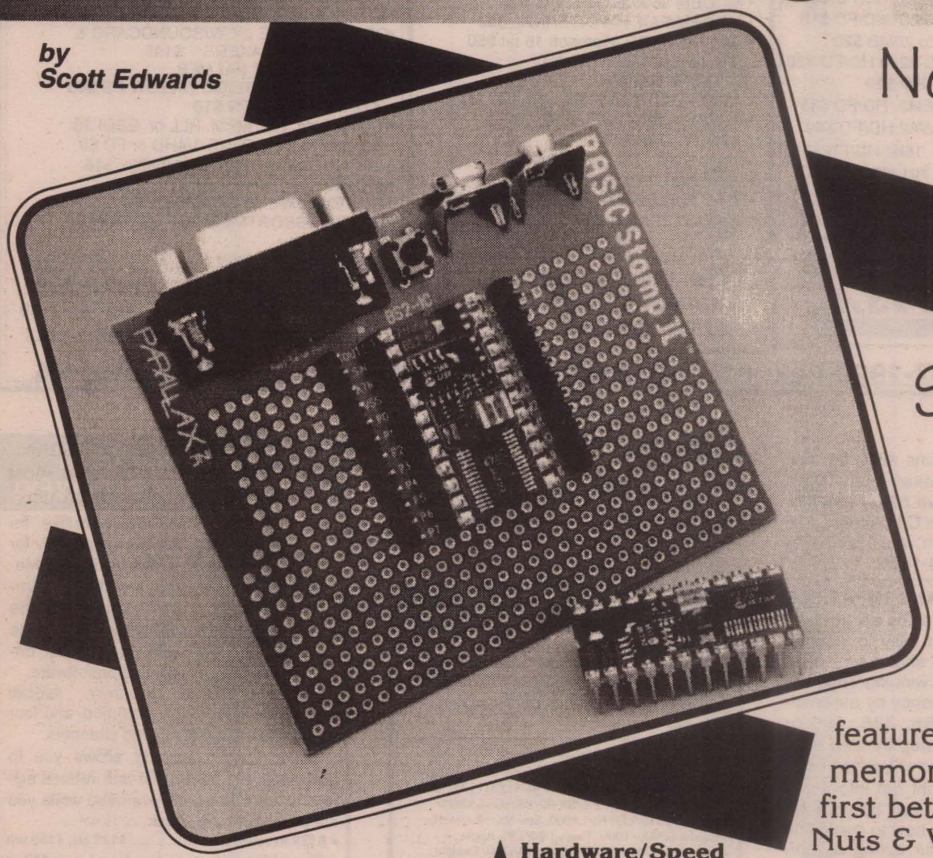


New BASIC Stamp II Microcontroller Offers Improved Speed, I/O, Memory

Long delayed and anxiously awaited, the BASIC Stamp II is here to take the concept of an easy-to-use microcontroller to the next level with increased speed, features, input/output (I/O) capabilities, and memory. I got my hands on one of the very first beta-test models a couple of days before Nuts & Volts' article deadline for this issue. What follows is a breathless first glimpse of the future of small microcontrollers.

What's a Stamp, anyway?

The original BASIC Stamp, so named because it is close in size to a commemorative postage stamp, is the smallest computer ever to run the BASIC programming language. It snaps directly to the terminals of a nine-volt battery, and is programmed via a temporary tether to a PC running special host software. The original Stamp, or BS1 as it is now called, has 14 bytes of RAM for variable data, 256 bytes of EEPROM for program instructions and constant data, and eight I/O pins. It runs at 4 MHz; about 2,000 BASIC instructions per second.

The dialect of BASIC (PBASIC) that began with the BS1 is cunningly simple. PBASIC cuts right to the heart of microcontroller applications, with integer math, pulse generation and measurement, serial communication, pseudo-analog I/O, sound output, and bit-oriented digital input and output.

Ease of use made the Stamp an instant hit with hobbyists and professionals alike. Hobbyists like the low cost and simplicity; pros like to amaze the boss or customer with instant results.

PBASIC's ease of use is its best and worst feature. Worst feature? Yes: Users like it so much that they want to use it for everything! They're lured into complex projects that are beyond the BS1's capabilities. With the introduction of the Stamp II, the ante has gone up considerably.

Table 1 is a feature-by-feature comparison. The comparison is the outline for the rest of this article; we'll look at each category in further detail.

Hardware/Speed

The BS2 uses a PIC 16C57HS controller running at 20 MHz to execute BASIC instructions stored as tokens in a 24LC16 serial EEPROM (electrically programmable, erasable, read-only memory). The 16C57 is quite similar to the 16C56 used in the BS1, but has twice the internal program memory (2048 machine-language instructions vs. 1024), more RAM (80 bytes vs. 32), and more I/O lines (20 vs. 12). These additional resources translate almost directly into improved capabilities for the BS2.

The 20-MHz operating speed does not, however, bring about a 5X increase in BASIC execution speed. The primary speed limitation for the Stamps has to do with how fast they can retrieve tokens (compressed symbols representing instructions and constants) from their serial EEPROMs. Here the BS1 has an advantage over its big brother; its 93LC56 EEPROM is faster, and its instructions are shorter.

To illustrate, I wrote and ran a benchmark program on both Stamps. On the BS1:

```
Symbol x = b1        ' Assign byte variable 'x'.
again:
  let x = x + 1      ' Increment x.
  toggle 0           ' Toggle pin 0.
goto again           ' Loop.
```

A 479-Hz squarewave appeared on pin 0 of the BS1, indicating that the three runtime instructions (let, toggle, goto) took a total of 1.044 ms (half the period). I repeated the benchmark with the BS2:

```
x var byte           ' Assign byte variable 'x'.
again:
  x = x + 1          ' Increment x.
  toggle 0           ' Toggle pin 0.
goto again           ' Loop.
```

A 689-Hz squarewave appeared on pin 0 of the BS2, so the three runtime instructions took a total of 0.726 ms.

What good is a 5X increase in clock speed if it only buys a 44% gain in execution speed? The BS2 uses that swift clock to enhance the instructions for serial communication, and to provide new instructions that require split-microsecond timing (X-10 control, pulse I/O, frequency counting) or digital signal processing (DSP) capabilities (DTMF/sinewave generation).

Program Memory

The BS2 stores programs in a 2048-byte serial EEPROM: the 24LC16. The manufacturer estimates that this will equate to BASIC programs approximately 600 instructions long. The BS1 has storage for fewer than 100 instructions.

Both Stamps permit a mixture of data and instructions to be stored in the EEPROM. Since EEPROM retains data with the power removed, this is a desirable feature for storing control settings, small databases, text strings (for user-interface prompts), or even data logs. The BS2 also has a new instruction — Data — to help manage the

increased EEPROM capacity. Data reserves space in the EEPROM to store data that may be written by your BASIC program, or it writes data into the EEPROM for later use by your program. It can allocate the storage space automatically, or obediently put the data where you tell it to. Error checking prevents you from writing data and program instructions to the same EEPROM addresses.

I/O Pins

The BS2 has 16 general-purpose I/O pins. Each pin can source (conduct to +5V) 20 mA or sink (conduct to ground) 25 mA with minimal voltage drop, thanks to all-CMOS construction. This feature, a characteristic of the PIC microcontroller, is an important one in small designs, as it eliminates the need for additional components to drive LEDs and other low-current devices. The I/O pins are compatible with standard TTL logic levels (decades-old 'transistor-transistor logic;' still the common denominator in digital electronics).

In addition to the standard I/Os, the BS2 now uses a serial port for programming, as opposed to the dedicated programming connector on the BS1. User programs can perform serial I/O through the 16 general-purpose I/Os or through this dedicated port with equal ease.

Variable Storage (RAM)

In desktop PCs, one measure of brute power is system RAM (random-access memory). The computer needs lots of it to hold programs, video images, data, the operating system, device drivers, etc. In microcontrollers like the Stamp series, RAM is not such a big deal. Here are some of the reasons:

- Programs reside in EEPROM, not in RAM.
- The 'operating system' (PBASIC) is stored in the PIC microcontroller's internal ROM.
- Any 'device drivers' are part of the program or built into PBASIC.
- And there's certainly no possibility of driving memory-hog devices like video monitors or sound cards!

Because control applications are not terribly RAM-oriented, users of the BS1 are generally content with their miserly 14 bytes. Most would agree that program memory and I/O pins run short sooner than RAM in most applications. So it's no surprise that the BS2 provides a relatively modest increase in RAM to 26 bytes. An amazing and welcome surprise is the new flexibility with which programs can use that RAM.

In the BS1, each byte of RAM has a name associated with it; B0, B1, B2, . . . B13. In addition, every second byte has a word name (W0, W1, W2, . . . W6) allowing the programmer to pair up bytes for use as 16-bit words. In addition, the bits of W0 may be addressed individually by names Bit0 through Bit15.

A limitation of this arrangement is that there's no way to access variables in terms of a memory address. Variable names are hard-coded into the instructions that work with them, and cannot be altered by a PBASIC program. This means no arrays, PEEKs, or POKEs of other BASICs; no pointers of Pascal or C; no indirect or indexed addressing of assembly language. Without these techniques, it's very difficult to write a subroutine that can work on different variables, and it's darn near impossible to store a series of values to a series of RAM locations.

With the improved PBASIC of the BS2, those limitations are gone. The BS2 allows you to define and use variables and arrays consisting of bits, nibbles, bytes, and 16-bit words using the new Var instruction. (Var is short for "variable.") When you run a program, PBASIC automatically arranges all of a program's variables of different sizes for the best possible fit in available RAM. For example:

```
Just_a_bit      var     bit
                ' One bit — range 0-1.
A_tiny_nibble var       nib
                ' A nibble, 4 bits — range 0-15.
A_full_byte     var     byte
                ' A byte, 8 bits — range 0-255.
A_mighty_word           var     word
                ' A word, 16 bits — range 0-65535.
```

To create an array, you just follow the variable size with how many of them you wish to include in the array:

```
DTMF_digits var nib (28)
    ' Create a 28-nibble array
    'of DTMF digits.
```

Note the advantage of the new nibble variable type. Most languages don't support nibble-size variables, so to store DTMF digits or other four-bit values, you would have two choices, both bad:

1. Use the next larger variable type — the byte — and waste half of the array's storage capacity. (The example above wouldn't even fit into BS2 RAM in that case.)
2. Write your own routines to pack and unpack the data into and out of byte variables.

The new PBASIC also lets you create variables that are windows into other variables. For example, suppose you'd like to examine or change bit 11 of the word variable named 'bit_flags':

```
bit_flags       var     word
    ' Word variable.
the_bit         var
bit_flags.bit11
    ' Bit variable: bit 11 of
    ' above word.
```

In addition to individual bits, the BS2 supports every conceivable type of window variable using modifier words made up of the prefixes "high" and "low" and the words "bit," "nib," and "byte." In addition, these modifiers can be chained together. All of the following are legal:

```
bit_flags       var     word
                ' Word variable.
a_nib           var
bit_flags.highnib
                ' High nibble
a_bit           var
bit_flags.lowbyte.bit3
                ' A bit.
nuther_bit      var
bit_flags.highbyte.lownib.bit2
                ' Another bit.
```

Table 1. Comparison of Features and Capabilities of the Stamp and Stamp II

	BASIC Stamp	BASIC Stamp II
Hardware/Speed	PIC 16C56XT controller 4-MHz clock 93LC56 EEPROM available in IC (14-pin SIP) or PCB form Price: $34.00 for BS1-IC $10.00 for carrier PCB	PIC 16C57HS controller 20-MHz clock 24LC16B EEPROM available in IC form (24-pin DIP) Price: $49.00 for BS2-IC $20.00 for carrier PCB
Program Memory	256 bytes (80 instructions)	2,048 bytes (600 instructions)
I/O Pins	8	16 + serial port
Variable Storage (RAM)	14 bytes with direct addressing only (bytes can be combined into 16-bit words; lowest word usable as 16 separate bits)	26 bytes addressable separately or as arrays of bits, nibbles, bytes, or words; any part of any variable may be accessed
Math/Logic	Unsigned 16-bit arithmetic, combinational logic	Unsigned 16-bit arithmetic; square roots, sine/co-sine, digit extraction; combinational logic, bit shifts and swaps
Serial Data Reception	2,400 baud max; 8 bits, no parity or flow control; stop until data received; translate decimal numeric text to value	9,600+ baud; parity; flow-control; wait for symbol, byte sequence, or time; translate binary, decimal, or hex text formats to value; store incoming data in RAM array; handle parity errors
Serial Data Transmission	2,400 baud max; 8 bits, no parity or flow control; translate value to decimal numeric text; open-drain or -source output	9,600+ baud; parity; flow control; translate value to binary decimal or hex text formats; open-drain or -source output
Special Digital I/O and Peripheral Support	Pulse I/O	Pulse I/O, synchronous-serial I/O, 125-KHz frequency input, X-10 home control output
Special Analog I/O and Peripheral Support	Read resistance, generate PWM for voltage out	Read R/C time constant, generate PWM for voltage out, DTMF out, two-tone sine out
Data-Table Functions	Match item to index; match index to item	Match item to index; match index to item meeting specified comparison (=, <, >, etc.)

Table 2. Listing of BS2 Math and Logic Operators

BS2 Math Operators (N = new for BS2; I = improved from original BS1 version)

^		Bitwise XOR
~	N	One's complement of 16-bit value (bitwise not)
&		Bitwise AND
*		Multiply
**		Multiply and return high 16-bits of result
*/	N	Multiply and return middle 16-bits of result (use to simultaneously multiply by a whole and a part; i.e., 'value */ $0180' multiplies by 1 and a half)
+		Addition
-		Subtraction
-	N	Two's complement of 16-bit value (negation)
/		Divide
//		Divide and return remainder
<<	N	Shift left
>>	N	Shift right
ABS	N	Absolute value of signed 16-bit value
COS	N	Co-sine of 8-bit value. Result is in the range of ±127, unit circle is 0-255 radial units.
DCD	N	2^n decoder of 4-bit value (0...15 -> 1,2,4,8,16,...32768)
DIG	N	Return decimal digit; '12345 dig 3' returns 2
MAX		Limit value to maximum
MIN		Limit value to minimum
NCD	N	Priority encoder of 16-bit value (=>32768,=>16384,=>8192,...=1 -> 15,14,13,...1 ; 0 > $FFFF)
REV	N	Reverse order of bits, lsb-justified; '%100110 rev 6' yields %011001
SIN	N	Sine of 8-bit value. Result is in the range of ±127, unit circle is 0-255 radial units.
SQR	N	Square root of unsigned 16-bit value
|		Bitwise OR

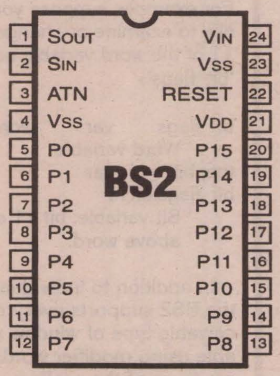
Of course, the whole idea of defining variables this way is to make the program easier to read, so the last example is thrown in more to illustrate flexibility than to recommend specifying bits that way.

Math/Logic

The BS2 builds on the solid core of integer math operations established with the BS1. There's still no support for floating-point numbers, which would bog down the arithmetically challenged PIC. The BS2 can do some fancy figuring though: sines, co-sines, one's and two's complements (binary representations of negative numbers), absolute values, priority encoding and decoding (determining the closest power of 2 that's less than or equal to a number, or raising 2 to the nth power), and square roots.

Another significant new math operator is Dig, which computes the nth decimal digit of a given number. The digit number is specified as 0 through 4 for a 16-bit value, since the largest number that can be represented this way is 65535. For example, "65535 dig 1" would equal "3" since digit 1, the second digit from the right, is 3. Why is Dig so great? In applications that drive a display, it's very handy to be able to extract individual digits for output to the display device. This lets you format the data for numbers that line up correctly, or insert a fixed decimal point to scale a number by a multiple of

The BS2 math package also features new support for parentheses to establish the order of computation. The BS1 does math from left to right. So 2+3*4 equals 20 in BS1 math. It's the same with the BS2, but you can now use "bowlegs" to ensure that the multiplication happens first: 2+(3*4) will yield 14. The parentheses also work to alter the order of comparisons in If/Then instructions.



Pin	Name	Description
1	SOUT	Serial output
2	SIN	Serial input
3	ATN	Serial attention
4	VSS	Ground
5–20	P0–P15	General-purpose I/O pins
21	VDD	Regulated +5 volts
22	RESET	Reset I/O
23	VSS	Ground
24	VIN	Unregulated + supply input

Pinout of the BS2's IC-style printed-circuit board.

Serial Data Reception

One of the neatest aspects of the original Stamp is its ability to send or receive serial data through any I/O pin. One of the biggest headaches for users is that the Stamp cannot do anything else while waiting for serial data to arrive. If data never arrives, the Stamp is locked up. The BS1 is limited to a maximum data rate of 2,400 baud with a fixed data format of no parity, eight data bits, one stop bit.

The BS2's updated Serin (serial-input) command addresses the limitations of the original on several fronts. It can receive data through any of the 16 I/O pins, or a dedicated serial input that's normally used for programming. It can optionally assign a flow-control pin that signals the sender when it's okay to talk. It can also set a timer to abort the serial input if data doesn't arrive within a specified number of milliseconds (up to 65,535; over a minute). You may specify an error-handling subroutine for the program to go to in the event of such a timeout.

The new Serin can fill RAM arrays with received data, wait for a specific terminating character (like a carriage return), and translate incoming numeric text in various binary, hex, and decimal formats into their equivalent values.

Finally, BS2's Serin can optionally check a parity bit and go to a routine if a parity error occurs. Since parity has been largely abandoned as a way of checking for data errors, clever programmers have begun using it as an extra data bit for network applications, like distinguishing between addresses and data, or master and slave transmissions.

Serin's stated maximum speed is 9,600 baud, but in my most recent conversation with Chip Gracey, the BS2's designer and programmer, I got the impression that it could go faster, depending on which of the instruction's options were enabled. In the preliminary documentation for the BS2, the programmer specifies not the baud rate, but the bit time in microseconds, less 20 µS for processor overhead. From this, it appears that Serin may be pushed to 19,200 or even 38,400 baud, provided that it doesn't have to perform time-intensive processing between received bytes. Details like this will undoubtedly be clarified by the time most users get their hands on the BS2.

Serial Data Transmission

The Serout (serial output) instruction has received basically the same upgrades as described above for Serin. You may transmit through any I/O pin or through the dedicated serial-output pin. You may optionally specify a flow-control pin to connect to another device's clear-to-send handshake line. If flow-control is enabled, you may also specify how long in milliseconds to wait for sending clearance before timing out, and a routine to go to in the event of a timeout.

The new Serout can format numeric data in a variety of binary, hex, and decimal formats. And as with the BS1, it can be set up to drive the serial line high and low, drive high/float low, or drive low/float high. This allows multiple Stamps to share a serial party line for networking.

Special Digital I/O and Peripheral Support

Some of the most popular microcontroller peripherals around use synchronous-serial communication to reduce the total number of I/O lines. You can find analog-to-digital converters (ADCs), display drivers, memory devices, real-time clocks, I/O expanders, digital-to-analog converters (DACs), frequency synthesizers, and a world of other handy accessories with a synchronous-serial three-wire interface.

Synchronous serial differs from asynchronous serial (like the Serin and Serout instructions discussed above) in that it uses a separate "clock" line to allow the transmitter and receiver to agree on the exact instant when the data is valid. This extra wire allows synchronous serial communications to run much faster than asynchronous.

Despite the fact that there are synchronous serial protocols like National Semiconductor's Microwire and Motorola's Serial Peripheral Interface (SPI),

Sources

For more information on the BASIC Stamp series of single-board computers, contact:
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there's little agreement from one device to another about the mechanics of data transfer. Here are some of the factors that must be considered:

- How many bits are to be transferred?
- In what order should the bits be transferred? Least-significant bit (lsb) first? Most-significant (msb) first?
- How do the devices know who talks and who listens?
- When are the bits valid relative to the clock? Rising edge? Falling edge?
- If the devices take turns talking and listening, how is the changeover accomplished?

With the BS1, the only choice was to write a custom routine to drive each type of synchronous-serial device. The BS2 now includes native instructions Shiftout and Shiftin to simplify this process. Oh, you'll still have to find the answers to the questions above, but once you do, you can build your code around the Shift instructions, which let you specify most of the critical items. And as soon as the dust settles on the BS2 rollout, commercial supporters (like me) and individual users will undoubtedly begin to compile data on using popular serial peripherals with the BS2.

More than ease of programming, the new Shift instructions will permit synchronous-serial data transfers to run much closer to their maximum speed potential, which can exceed a million bits per second. Routines crafted in PBASIC have little hope of exceeding a few hundred bits per second. (Remember the speed benchmarks at the beginning of the article.)

Another new instruction is Count, which counts pulses on an input pin for a specified number of milliseconds. Maximum squarewave frequency that Count can handle is 125 KHz. What's Count good for? Obviously a frequency counter or tachometer. But think of all the analog qualities that can be measured with a frequency counter: light intensity with a TI TSL230 light-to-frequency chip; temperature with a thermistor-controlled oscillator; humidity with a capacitive sensor and 555 timer; voltage with a voltage-controlled oscillator.

The final new digital instruction will undoubtedly take the BS2 where few single-board computers have gone before: home. The BS2 now features X-10 wireless home-control output. X-10 is a remote-control scheme that sends signals through the AC electrical system of your house. Plug an X-10 receiver module into an outlet and an appliance into the module, and voila! instant remote control from anywhere in the house.

Using X-10 requires a safe and standardized interface with the house wiring called a TW-523 or TW-513 box — about $35.00 from a home-control supplier. It is not advisable to try to hack this interface yourself for safety reasons.

The BS2 retains the original BS1 instructions Pulsin (pulse input) and Pulsout (pulse output), but offers improved resolution. Pulsin now measures the edge-to-edge time of an input pulse to the nearest 2 µS, and Pulsout allows you to specify an output pulse width in 2-µS units. In the BS1, both of these instructions operate in units of 10 µS.

Special Analog I/O and Peripheral Support

One of the BS1's most popular features is the Pot instruction, which can read the relative resistance of a potentiometer (or other resistance) by measuring the time required to discharge a capacitor through it. The BS2 retains this feature in a more general form through its RCtime instruction. Where Pot is limited to a scaled eight-bit output based on capacitor discharge, RCtime produces an unscaled 16-bit output based on charge or discharge time.

The change is not earthshaking, but it does permit measurement of resistances outside the usual pot/capacitor scenario. For example, suppose you wanted to use Pot with PC-type joysticks. Pot is limited to a max resistance of 50K with a suggested capacitance of 0.1µF. Joystick pots are greater than 100K. Pot always charges, then discharges the capacitor to make its time measurement. This runs afoul of joysticks with built-in electronics (like auto-fire circuits) which expect the opposite polarity. Intelligent application of the new RCtime instruction should overcome these limitations.

The PWM (pulse-width modulation) instruction has been carried over from the BS1 to BS2 with a single change: it now automatically changes the specified pin from output to input when it's done. Since PWM is normally used to charge a capacitor to a specified voltage, this immediate switchover to input prevents a steady output state from altering the charged voltage when PWM is done. BS1 users must do this in software.

Two exciting new analog-output commands are DTMFout and Freqout. DTMFout generates the standard telephone "touch" tones. Its output is in the form of pulse-width modulated signals that can be easily filtered with a resistor and capacitor to make clean waveforms.

Freqout is the more general version. It allows you to specify one or two frequencies up to 32768 Hz (in 1-Hz units) for pulse-width modulated sinewave output. As with DTMF, a resistor/capacitor filter smoothes out the digital PWM bumps to make clean sinewaves.

Data-Table Functions

The BS2 retains the same data-table functions originally offered by the BS1: Lookup and Lookdown. Lookup lets you define a table of values, then retrieve those values by using an index. For instance, if your table contained (5,13,3,99), an index of 0 retrieves 5; 1 gets 13, etc. If the index exceeds the last entry in the table, no value is retrieved.

Lookdown has gotten an exciting enhancement in the BS2. The original Lookdown was simply the converse of Lookup; given a table of values and value to search for, it returned the index of the first value exactly matching the search value. For example, if the table contained (5,13,3,99) and the search value was 3, Lookdown would return 2, the index of the match.

The BS2 lets you specify what kind of comparison is used to match search values to items in the table: equal (=, the default); not equal (<>); greater than (>); less than (<); less than or equal (<=); or greater than or equal (>=). Clever use of such comparisons will allow you to create calibration tables, or group values into ranges.

Summing up

The BS2's enhancements read like a Stamp user's wish list. More memory, more speed, peripheral support, improved serial comms, and powerful math just scratch the surface. Combine these with the original Stamp's virtues of ease of use and minimal dependence on external hardware, and Parallax has another winner on their hands. **NV**

Table 3. Listing of BS2 BASIC Instructions

BS2 Instructions (N = new for BS2; I = improved from original BS1 version)

BRANCH		Branch according to an index, like ON X GOTO of other BASICs.
BUTTON		Debounce button, auto-repeat, and branch if button is in target state.
COUNT	N	Count cycles on a pin for specified number of milliseconds.
DEBUG	I	Show variables and messages for debugging purposes.
DTMFOUT	N	Output DTMF telephone "touch" tones.
END		End program and put BS2 to sleep.
FOR...NEXT		Repeat instructions between For and Next for some number of times.
FREQOUT	N	Output one or two sinewave(s) (1 to 32,768-Hz) for specified number of milliseconds.
GOSUB		Go to a subroutine.
GOTO		Go to a specified program step.
HIGH		Make specified pin an output and write a 1 to it.
IF/THEN	I	Evaluate a condition and go to specified program step if true.
INPUT		Make specified pin an input.
LOOKDOWN	N	Search for a match to a value and return an index.
LOOKUP		Look up a value in a table according to an index.
LOW		Make specified pin an output and write a 0 to it.
NAP		Shut down to reduce power consumption for 0.018 to 2.3 seconds.
OUTPUT		Make specified pin an output.
PAUSE		Pause for x milliseconds (x=0 to 65535).
PULSIN		Measure the length of an input pulse in 2µS units.
PULSOUT	I	Output a timed pulse (specified in 2µS units).
PWM	I	Output pulse-width modulation for specified milliseconds.
RANDOM		Create a pseudo-random number.
RCTIME	N	Measure resistor/capacitor charge/discharge time.
READ		Read a byte from the EEPROM.
RETURN		Return from a subroutine to the program step following most recent GOSUB.
REVERSE		If pin is an input, make it an output; if pin is an output, make it an input.
SERIN	I	Input data serially (RS-232-style asynchronous serial).
SEROUT	I	Output data serially (RS-232-style asynchronous serial).
SHIFTIN	N	Shift bits in synchronously.
SHIFTOUT	N	Shift bits out synchronously.
SLEEP		Shut down to reduce power consumption for x seconds (x=0 to 65535).
STOP	N	Stop execution, but do not put BS2 to sleep.
TOGGLE		Make specified pin an output and invert its state (0 to 1 or 1 to 0).
WRITE		Write a byte into the EEPROM.
XOUT	N	Output X-10 codes to a TW523 or TW513 module (by X-10 Powerhouse).

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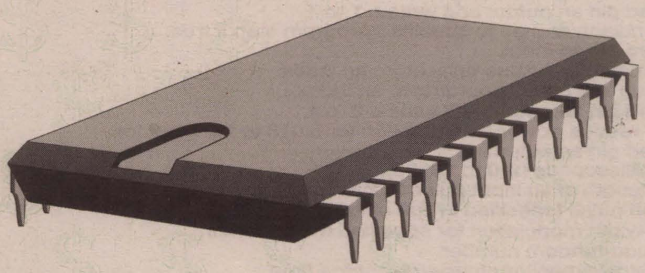

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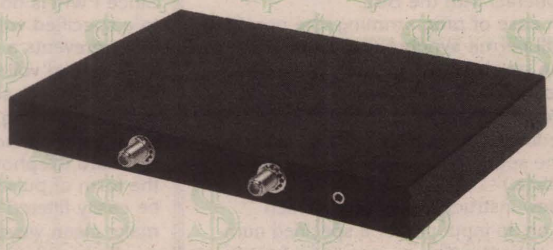

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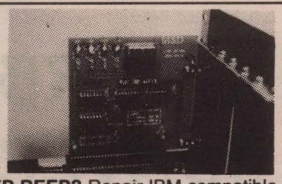

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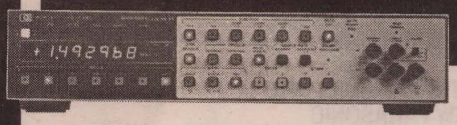

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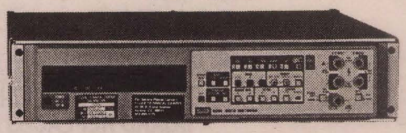

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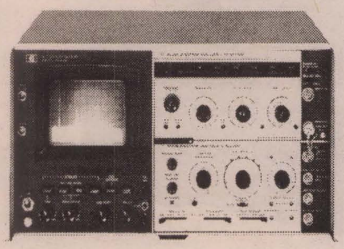

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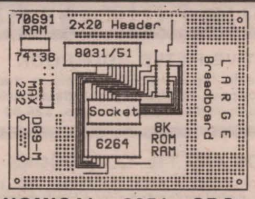

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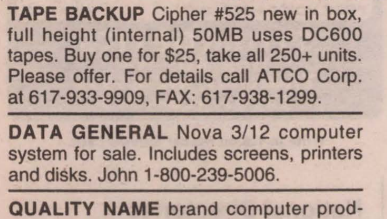

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			160x128	Optrex	$15.00

LASER PRODUCTS

HeNe Laser Head (10Mw max. output) TEM00, 15.5" long MFG:NEC **$99.00**
Laser Power Supply (for HeNe tube) **$100.00**

LASER SCANNER ASSEMBLY $29.00
Assembly intended for a laser printer. Includes laser diode, polygon motor (6 sided) and misc. optics and lenses.

LASER DIODE (5mW) **with collimator $20.00**

***LASER DIODE:* Sharp part#: LT022MC**
5mW at 780 nm, single transverse mode $10.00

NETWORK

IRMA BOARD 8 bit $99.00
Links 3270 mainframe systems to IBM PC

Proteon ProNet-4 Model p1347 Token Ring Board $79.00
16 bit • 4 Mbps • IEEE 802.2 and 802.5 compatible • twisted pair • interoperable with IBM Token Ring network

POS & BAR CODE

MAGNETIC CARD READER $25.00
Includes: • 20 character dot matrix display with full alpha-numeric capability • keypanel with full alpha-numeric entry • separate 7.5 VDC/0.5 Amp power supply • standard telephone interface extension cord • lithium battery and flat-cone speaker.

HP bar code wand (HBCS 2300).....$35.00

POWER SUPPLYS

73 WATT SWITCHING $15.00 or 2 @ $25.00, (2) 4 pin power connectors attached • 115/230 Volt, Dim: 8.5" L x 4.5" W x 2" H • Output: +5V @ 2-9.75 A, +12V @ 0-1.5 A, -5V @ 0-0.4 A, -12V @ 0-0.5 A

68 WATT SWITCHING $12.00 or 2 for $20.00, 115/230 Volt, Dim: 5.5" L x 3.2" W x 1.7" H • Output: 5V @ 4 A, 12V @ 4A

MISCELLANEOUS

ADAPTEC 4070A (RLL) OR 4000A (MFM) SCSI Controller, your choice $40.00

IBM 370 option XT and AT emulation boards $50.00

MONITORS

Non-Enclosed TTL

Comes with pinout. 12V at 1.4 Amp input • Horizontal frequency 15Khz. • Ability to do 40 and 80 column.

5 inch Amber	$35.00
7 inch Amber	$39.00
9 inch Amber or Green	$29.95

5" COLOR MONITOR $49.00

2 for $89.00

• Flat Faceplate • 320 x 200 Dot Resolution • CGA & Hercules Compatible
• 12 VDC Operation • 15.75 KHz Horiz. Freq. • 60 Hz Vert. Sync. Freq.
• Open Frame Construction • Standard Interface Connector
• Degaussing Coil Included • *Mfg.: Samtron*

CHARGE COUPLED DEVICES

MATRIX TYPE

"The Spy In The Sky" $29.00

Sony CCD Imager - designed for black and white composite video cameras. Picture elements: 384 (H) x 491 (V)
Chip size 10.7 (H) x 9.3 (V) mm² • Unit cell size 23.0 (H) x 13.4 (V) um² • Ceramic 24 pin DIP package. • Mfr: Sony, Part# 016AL

LINEAR TYPE

4096 element CCD $29.00
2048 element CCD $15.00 • 1728 element CCD $15.00

HACKER CORNER

CELL SITE TRANSCEIVER $99.00

These transceivers were designed for operation in an AMPS (Advanced Mobile Phone Service) cell site. The 20 MHz bandwidth of the transceiver allows it to operate on all 666 channels allocated. The transmit channels are 870.030–889.980 MHz with the receive channels 45 MHz below those frequencies. A digital synthesizer is utilized to generate the selected frequency. Each unit contains two independent receivers to demodulate voice and data with a Receive Signal Strength Indicator (RSSI) circuit to select the one with the best signal strength. The transmitter provides a 1.5 watt modulated signal to drive an external power amplifier. Channel selection is accomplished with a 10 bit binary input via a connector on the back panel. Other interface requirements for operation are 26 VDC (unregulated) and an 18.990 MHz reference frequency for the digital synthesizer. The units contain independent boards for receivers, exciter, synthesizer, tunable front end, and interface assembly (which includes power supplies and voltage-controlled oscillator). Service manual, schematics and circuit descriptions are available.

Encased Black & White Composite CCD Camera with Adapter

IR viewing to 1000 nm1.7 W x 2.6 H x 4.5 L
Comes complete with CCD camera, mounting nut on bottom of casing, 12VDC power supply. Excellent low light capability, standard RCA NTSC video out. **$89.00**
Great for: entryway security/remote monitoring, video conferencing/desktop video conferencing **2 for $159.00**
This miniature camera is perfect for multimedia computer applications as well as security and surveillance. NTSC output allows use with all popular video digitizing boards for Apple Macintosh and Microsoft video for Windows. Connects directly to any composite monitor or VCR with "video" input. Its razor-sharp wide-angle lens focuses from two inches to infinity and its state-of-the-art CCD technology accurately captures 16 level grayscale images for Quick Time movies and still pictures. Records at 30 frames per second and 260 lines resolution with excellent low light capability. Uses 12 VDC (adapter supplied) and standard RCA cable.

Portable Micro Terminal

Flip up LCD display (9-16 VDC) • Can communicate with any computer having RS 232 port • Can communicate with another Microterminal • Use by itself as electronic notebook • Onboard microprocessor, data RAM (32K) and Video RAM (64K) • Complex built in diagnostics and set up capabilities. • Original intention for POS applications. • display size 40x16 (256 x 128 pixels.) Dimensions: 6.3" W, 11"L, 2"H. (With LCD up height is 7.1") **$99.00 or 2 for $149.00**

BAREBONES 286-12 COMPUTER $49.00 (2 FOR $79.00)

Slim line desk top case, 100 watt supply, math co-processor support. On board IDE, + Floppy controllers, 2 COM ports and 1 parallel port with software setup. Supports up to 8 Megs using standard 30 PIN SIMMs. Internal room for (1) 3 1/2 inch IDE hard drive and (2) 3 1/2 inch floppies. Four 16 BIT ISA slots, accepts full length AT size cards. Keyboard can be set to no test at boot. Case size is 15.5" W x 16" D x 4" H.
(Motherboard can be purchased separately: $29.00 or 2 for $49.00)

23605 TELO Ave, Torrance, CA 90505
Order desk only: USA: (800) 872-8878 CA: (800) 223-9977
L.A. & Technical Info: (310) 784-5488 Fax: (310) 784-7590
OEM INQUIRIES WELCOME

Minimum Order: $20.00. Minimum shipping and handling charge $5.00. We accept cashiers checks, MC or VISA. No personal checks or COD's. CA residents add 8.25% sales tax. We are not responsible for typographical errors. All merchandise subject to prior sale. Phone orders welcome. Foreign orders require special handling. Prices subject to change without notice. 20% restocking fee for returned orders..

Write in 40 on Reader Service Card.

Don Lancaster's

RESOURCE BIN

number forty-four

Disabled and handicapped resources.

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

A portion of my PSRT RoundTable on *GEnie* has also been set aside for you *Nuts & Volts* readers. This is the place you go for instant tech answers. Among the many files in our library, you will find complete reprints for all the *Resource Bin* columns.

I did manage to wrangle one super special sign-up deal for you *Resource Bin* readers. Ten free hours.

GEnie now offers far lower daytime rates, a direct Internet access, plus a Windows graphics interface, so it's an even better deal than ever.

See the trailer blurb for details.

Handicapped Resources

This month, I thought we'd take a look into resources for the disabled. High tech and otherwise. But before we begin, here are several politically incorrect guidelines which I do feel definitely need to be said . . .

First off, just about any third-party disability situation appears bound to involve psychic energy sinks, guilt, or bad vibes. Pathos 101. The foremost rule is to *separate the baggage from the problem.* So, the *only* reason to involve yourself is *because you want to.*

It is not your problem, unless you *personally* choose to make it so.

Second, I do not see there is any point whatsoever in developing *any* handicapped product or service *unless you have specific, long term, and first hand knowledge of the problem.*

Otherwise, you are *certain* to end up with what those french veterinarians call a *four paw.*

Third, recognize that institutions that supposedly "help" the disabled may have hidden goals and agendas. Such as a school lumping the truly gifted right on down with the epsilon minuses. And then treating both of them as "special" problems.

Fourth, many laws and regulations involving disability issues range from woefully cost-ineffective on down to outright ripoffs. Outright ripoffs that benefit nobody but bureaucrats. It is insane to add $50.00 to the cost of a TV set when a $.17 connector (and an optional card for a tiny minority of the sets) can do a better job.

A strong case can be made that the sole purpose of ADA is to cripple and handicap small business.

Finally, and most important, most disability subjects have long ago been thoroughly discussed. All you have to do is look. Some ferinstances . . .

NEXT MONTH:
Don looks at mightily manic multimedia magazine madness.

Disability Bookshelf

In the past, we looked at a number of those special interest direct mail bookshops which literally defined the resource center for a topic. That *SAE Library* for cars, the *Mix Bookshelf* for music and audio, *Lindsay Publications* for "lost" technical lore, *Navtech* for GPS navigation, and so on. A lot more on these in my *GEnie* PSRT.

One definitive resource here is the *Disability Bookshelf.* They stock over 400 titles, along with videos, cassettes, and talking books.

Any information quest should start off with their $5.00 catalog.

T.A.S.K.

Otherwise the *Team of Advocates for Special Kids* is the parent organization serving all ages and disabilities. They do a newsletter and run a dozen title bookstores. They also distribute a free *Parent Information Packet.*

Trace Center

This one is run by the University of Wisconsin. Start with their free *Trace Center Publications and Media Catalog.* They also maintain a co-op electronic library on disability.

Their most important product is the *Co-Net* CD-ROM. 20,000 listings for co-op directories, publications, media, and materials. Plus a text library. A single CD is $27.00.

This appears to be *the* single most important disability resource.

Apple Computer

Just about all of the major personal computer manufacturers have strong support for the disabled in one form or another. But *Apple Computer* seems to be head and shoulders above the rest. They pride themselves in having created the industry's first disability group back in 1985.

Start off with their free *Worldwide Disability Solutions.* Their info packet has reprints and a MDR 4.0 disk.

This disk is mainly two files. The first is a Hypercard tour of dozens of third-party keyboards, displays, and alternate input devices.

The second file whips on by as you exit. And holds a dozen of the most important field resources.

At one time, Apple did publish a more extensive resource directory. A dated copy of this is in HACK10.PDF on PSRT. Some of the info here may no longer be current, though.

N.I.C.H.C.Y.

The *National Information Center for Children and Youth with Disabilities.* They offer dozens of free booklets to parents, educators, and caregivers.

You can contact them for a free list.

Some Magazines

Closing the Gap is a bimonthly mag on the use of microcomputer-related technology by the disabled. They also put on international conferences that include hands-on workshops. Their next show is October 19-21, 1995 at the Minneapolis Radisson South Hotel.

The *Disability Rag* is one well done in-your-face alternate tabloid. It tells it like it is. Bimonthly. It includes an outspoken *Advocado Press* book and pamphlet service. I particularly like their "This jerk violates accessible parking spaces" stickers.

Educom Review is a slick bimonthly mag about learning, communications, and information technology. *Educom* is a nonprofit consortium of colleges, universities, and corporations.

The *Exceptional Parent* is a thick and slick monthly magazine for families and professionals, on parenting the disabled child or young adult.

Careers & the Disabled touts itself as the career magazine for people with disabilities. Has a Braille centerfold. Mostly "feel good" stories by Fortune 500 firms congratulating each other.

new from
DON LANCASTER

ACTIVE FILTER COOKBOOK
The sixteenth (!) printing of Don's bible on analog op-amp lowpass, bandpass, and highpass active filters. De-mystified instant designs. **$28.50**

CMOS AND TTL COOKBOOKS
Millions of copies in print worldwide. **THE** two books for digital integrated circuit fundamentals. About as hands-on as you can get. **$28.50** each.

INCREDIBLE SECRET MONEY MACHINE II
Updated 2nd edition of Don's classic on setting up your own technical or craft venture. **$18.50**

LANCASTER CLASSICS LIBRARY
Don's best early stuff at a bargain price. Includes the CMOS Cookbook, The TTL Cookbook, Active Filter Cookbook, PostScript video, Case Against Patents, Incredible Secret Money Machine II, and Hardware Hacker II reprints. **$119.50**

LOTS OF OTHER GOODIES

Ask the Guru I or II or III	$24.50
Hardware Hacker II, III or IV	$24.50
Micro Cookbook I	$19.50
PostScript Beginner Stuff	$29.50
PostScript Show and Tell	$29.50
Intro to PostScript Video	$29.50
PostScript Reference II	$32.50
PostScript Tutorial/Cookbook	$19.50
PostScript by Example	$31.50
Understanding PS Programming	$29.50
PostScript: A Visual Approach	$22.50
PostScript Program Design	$24.50
Thinking in PostScript	$22.50
LaserWriter Reference	$19.50
Type 1 Font Format	$16.50
Acrobat Reference	$24.50
Whole works (all PostScript)	$380.00
PostScript Insider Secrets	FREE
Hacking Insider Secrets	FREE

POSTSCRIPT SECRETS
A Book/Disk combination crammed full of free fonts, insider resources, utilities, publications, workarounds, fontgrabbing, more. For most any PostScript printer. Mac or PC format. **$29.50**

BOOK-ON-DEMAND PUB KIT
Ongoing details on Book-on-demand publishing, a new method of producing books only when and as ordered. Reprints, sources, samples. **$39.50**

THE CASE AGAINST PATENTS
For most individuals, patents are virtually certain to result in a net loss of sanity, energy, time, and money. This two volume set shows you tested and proven real-world alternatives. **28.50**

BLATANT OPPORTUNIST I
The reprints from all Don's Midnight Engineering columns. Includes a broad range of real world, proven coverage on small scale technical startup ventures. Stuff you can use right now. **$24.50**

RESOURCE BIN I
A complete collection of all Don's Nuts & Volts columns to date, including a new index and his master names and numbers list. **$24.50**

FREE SAMPLES
Well, nearly free anyway. Almost. Do join us on GEnie PSRT to sample all of the Guru's goodies. The downloading cost on a typical Guru file is **21 cents**. Modem access: Dial (800) 638-8369. On prompt, JOINGENIE, then DMD524 on key.

FREE VOICE HELPLINE VISA/MC

SYNERGETICS
Box 809-NV
Thatcher, AZ 85552
(520) 428-4073

Write in 198 on Reader Service Card.

National Directories

Grey House Publishing has a pair of humongous references available. The first is the *National Housing Directory For People With Disabilities.* The second is the *Directory of Nursing Facilities for Younger Adults with*

RESOURCE BIN

DISABILITY AND HANDICAPPED RESOURCES

Accommodating Disabilities 4025 West Peterson Ave. Chicago IL 60646 (800) TELL CCH	**APH** PO Box 6085 Louisville KY 40206 (800) 223-1839	**Centerlines** PO Box 31345 Raleigh NC 27622 (919) 828-1218	**Disability Policy Journal** 346 North West Avenue Fayetteville AR 72701 (501) 575-3656	**GEnie** 401 North Washington Rockville MD 20850 (800) 638-9636	**NICHCY** PO Box 1492 Washington DC 20013 (800) 695-0285
Accreditation Council 100 West Road #406 Towson MD 21204 (410) 583-0060	**ASHA** 10801 Rockville Pike Rockville MD 20852 (301) 897-5700	**Closing the Gap** PO Box 68 Henderson MN 56044 (612) 248-3294	**Disability Rag** PO Box 145 Louisville KY 40201 (502) 459-5343	**Grey House Publishing** Pocket Knife Square Lakeville CT 06039 (800) 526-2139	**PALAESTRA** PO Box 508 Macomb IL 61455 (309) 833-1092
ACM/SIGCAPH 1515 Broadway New York NY 10036 (212)626-0500	**Arizona Talking Books** 1030 North 32nd Street Phoneix AZ 85008 (800) 255-5578	**Dialog Information Svcs** 3460 Hillview Avenue Palo Alto CA 94304 (415) 858-2700	**Educom Review** 1112 16th Street NW #600 Washington DC 20036 (280) 872-4200	**Issues in Law & Medicine** PO Box 1586 Terre Haute IN 47808 (812) 232-0103	**Spinal Network** 23815 Stuart Ranch Road Malibu CA 90265 (800) 543-4116
AFB 15 West 16th Street New York NY 10011 (212) 620-2000	**Careers & the disABLED** 150 Motor Parkway #420 Hauppauge NY 11788 (516) 273-0066	**Disability Bookshop** PO Box 129 Vancouver WA 98666 (800) 637-2256	**Encyclopedia Associations** 835 Penobscot Building Detroit MI 48226 (313) 961-2242	**Mobility International USA** PO Box 10767 Eugene OR 97440 (503) 343-1284	**T.A.S.K.** 100 West Cerritos Avenue Anaheim CA 92805 (714) 533-TASK
Apple Computer One Infinite Loop Cupertino CA 95014 (800) 776-2333	**CdLS Foundation** 60 Dyer Avenue Collinsville CT 06022 (800) 223-8355	**Disabilities Digest** 522 Cinti-Batavia Park Cincinnati OH 45244 (513) 528-0404	**Exceptional Parent** 209 Harvard Street #303 Brookline MA 02146 (617) 730-5800	**Natl. Recreation/Park Assn.** 2775 S Quincy St. Ste 300 Arlington VA 22206 (703) 820-4940	**Trace Center Publications** S-151 Waisman Cen UWI Madison WI 53705 (608) 263-5408
AOTA PO Box 31220 Bethesda MD 20824 (301) 652-2682	**CEC** 1920 Association Drive Reston VA 22091 (800) 845-6232	**Disability Issues Newsletter** 300 Longwood Avenue Boston MA 02115 (800) 848-8867	**Gale Research** 835 Penobscot Blvd Detroit MI 48226 (313) 961-2242	**New Mobility** PO Box 8987 Malibu CA 90265 (800) 543-4116	**Ulrichs Dictionary** 121 Chanlon Road New Providence NJ 07974 (908) 771-7714

Chronic Physical Disabilities. Fairly pricey.

These are mostly for the library or medical reference shelves.

Online Help

As with any field today, the latest, fastest, and finest info comes down online. This should be your first and foremost place to search for help on just about anything.

All of the major online services do offer a disability forum.

GEnie has a fine *ABLE RoundTable*. Including a 1600+ download library.

To reach them, you enter ABLE on any prompt. If you want to talk to a real sysop person, E-Mail ABLE.DAVE or ABLE.DEBI instead.

There is one sure fire way to find out everything about anything. If it ever appeared in print, chances are it's offered through the *Dialog Information Service*. Available direct, through your local libary, or conveniently online at *GEnie*. Of the hundreds of *Dialog* data bases available, you might start with their MEDLINE service.

Yeah, *Dialog* is a premium service. Until you include that good old "Uh, compared to what?" factor.

Your real biggie, of course, is that Internet. There's lots of online and CD search services available these days. It gets hard to keep current on even the searchers, let alone the sites.

But, for readers not quite Internet literate, there's a printed alternative. I just got a copy of the brand new *Gale Guide to Internet Data Bases*. With only 8,000 files at 2,000 sites described, this one is barely off to a good start. But I have found it extremely useful . . .

handicap.afd.olivetti.com does provide more than 800 files on handicapped life. It is run by Rice University.

trace16.waisman.wisc.edu holds their *Co-Net* text library. This is a co-op network of information providers in the areas of assistive technology. Also files on info system and computer accessibility.

sjuvm.stjohns.edu is that EASI database, short for *Equal Access to Software and Information*. Publications, workshops, laws, and grant sources.

val-dor.cc.buffalo.edu is the location for the *HEATH Resource Center* on higher ed for individuals with disabilities.

ericir.syr.edu is a librarian data base. It includes disability coverage.

www.law.cornell.edu is a repository of US Law. Has documents and comments. One source for the ADA regs.

The *GEnie* ABLE library file #1604 lists additional Internet resources.

Also Rans

There are great heaping bunches of support groups, mags, and products available. Besides an online search, two great ways to pick these up are with *Ulrich's Periodicals Dictionary* or the *Encyclopedia of Associations*. Found on the reference shelf at your local library. Or via *Dialog* on *GEnie*.

Here is my random selection in no particular order . . .

New Mobility is the slick bimonthly magazine that covers wheelchairs and accessories. $18.00 per year. These folks also have a mail bookstore.

Recreation Access in the 90's gets published by the *National Recreation and Park Association*.

Palaestra is a quarterly magazine. It serves as a forum for sport, physical education, and recreation.

The *MATP Center* is part of Boston's children's hospital. They are basically a clearing house and info center who publish a *Disability Issues* newsletter. Their BBS is (800) 950-6287. They have free brochures. Also available in large print, Braille, tape, disk, or Spanish.

Funny, I never thought of Spanish as a disability. Oh well.

The *Disabilities Digest* is a smaller, half-size bimonthly pub. Sorta in the same tone as *Prevention*.

The ACM, otherwise known as that *Association for Computer Machinery*, has special interest groups on pretty near everything. Their SIGGRAPH graphics stuff is probably the one you are most familiar with. They also publish the SIGCAPH newsletter. On computers and the physically handicapped. They also put on conferences.

An *Accreditation Council on Services for People with Disabilities* appears to be a group of, by, and for institutional bureaucrats. Their newsletter is called *Update on Quality*.

Mobility International is mostly on disabled travel tips. Their newsletter is called *Over the Rainbow*. They've got videos on leadership and homestay.

The *American Federation for the Blind* publishes a quarterly tabloid known as, of all things, the *AFB News*.

Physical Disabilities is the newsletter by the *American Occupational Therapy Association*. Quite technical. Mostly by and for medical types.

Asha is the bimonthly mag from the *American Speech-Language-Hearing Asn*. It is mostly for speech therapists.

The *Council for Exceptional Children* appears to cater to special ed teachers and administrators. Covered interests here do include special ed, behavioral disorders, research, early childhood, education, comm disorders, learning disabilities, and teacher ed.

I'd guess that just about every state has some blind assistance program. In Arizona, one resource is the *Arizona State Braille and Talking BookLibrary*. I'm certain there's 49 more where this one came from.

Issues in Law & Medicine is a unique scholarly quarterly. Published by the *National Legal Center for the Medically Dependent & Disabled*.

Another heavy pub is the *Journal of Disability Policy Studies*. Published by the University of Arkansas.

Centerlines is the publication of the *Cued Speech* center. This stuff used to be called *sign language*.

American Printing House for the Blind is apparently the leading publisher of Braille and large print books.

The *Spinal Network* offers their *Total Wheelchair Book* for $38.00 This is mainly support for paralysis victims.

Accommodating Disabilities Decisions is a book by and for lawyers from *CCH*. On prosecuting disability cases. They also publish a monthly *Accommodating Disabilities Management Guide*.

Last, and possibly least, the *Cornelia de Lange Syndrome Foundation* appears to be the ninth alternate runner up in the *Reader's Digest* obscure disease of the month sweeps. Their newsletter is called *Reaching Out*.

This Month's Contest

Our resource topic this month is a little off the beaten track for me. But it was obviously needed for a "complete set" of whatever it is we're up to here.

Let me know if you find out.

So, for this month's contest, please tell me about anything major that I might have missed along the way of handicapped or disabled resources.

There will be a largish pile of my new *Incredible Secret Money Machine II* books going to the dozen or so better entries, plus an all-expense-paid (FOB Thatcher, AZ) *tinaja quest* for two that will go to the very best of all.

Let's hear from you. **NV**

Microcomputer pioneer and guru Don Lancaster is the author of 32 books and countless tech articles. Don maintains his no-charge tech helpline found at (520) 428-4073, besides offering all of his own books, reprints, and all of his consulting services. He also has a free catalog full of his resource secrets waiting for you. Your best calling times are 8-5 on weekdays, Mountain Standard Time.

Don is now the sysop of GEnie PSRT, where a special Resource Bin topic has been reserved for Nuts & Volts readers. For modem access: (800) 638-8369. When prompted, enter JOINGENIE. When asked for an offer code, enter DMD524.

You can also reach Don at Synergetics, Box 809, Thatcher, AZ 85552. Or send any messages to his Internet address of SYNERGETICS@GENIE.GEIS.COM

NOVAPLEX

The One-Stop Source for Cable Parts, Tools & Accessories

Announcing the Centurion — great performance at an incredible price!

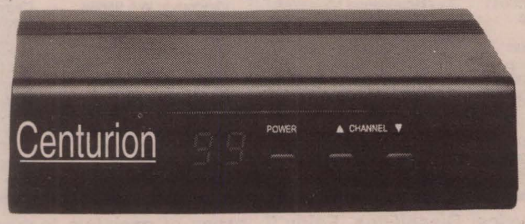
Centurion

The New Centurion converter offers a number of powerful features:

- parental control
- switched AC outlet
- sleep timer
- remote control included
- auto/manual fine-tune
- favorite channel memory
- batteries included
- jumper cable included
- illustrated user manual
- LED display

Introductory Offer! For a limited time only, 10-lot price is only: **$65**

please place your orders soon — demand for the Centurion is high!



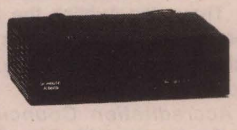
Panasonic & SA Converters

Panasonic TZPC 145 Converter
SA 8511-300 Converter

Units sold with wireless remote control & batteries
Features include: parental control (Panasonic only), last channel recall, favorite channel memory, sleep timer, channel 2 or 3 available.
In quantities of 10 or more, **$65**

Panasonic TZPC 145 $ 65
channel 2 or 3; 10-lot prices

SA 8511 channel 3 $ 65



Also: Panasonic TZ - PC 175 Series Converter w/volume. Topcases for Panasonic, SA and Jerrold (all models) also available. Call for pricing and availability.

Quality capacitors (1,000-lot price)

Capacitor	Cost	Capacitor	Cost
1uF - 50V	.06	3.3uF - 50	.06
100uF - 50V	.10	33uf - 35V	.06
100uF - 63V	.11	33uF 50V	.07
1000uF - 16V	.15	330uF - 50V	.14
1000uF - 50V	.30	330uF - 63V	.14
.22uF - 50V	.06	4.7uF - 50V	.07
22uF - 50 V	.06	47uF - 50V	.08
2200uF - 16V	.22	47uF - 63V	.08
600uF - 50V	.24	470uF - 50V	.19

Security Bits (10-lot)

Pioneer 6300 Oval Bit $15.50

Jerrold-compatible bits

1/4" Female Bit	$9.50
1/4" or 5/16" Bits	8.50
AVSAFE #4 round D series	14.50

TORX Bits

Tocom	T - 7	$3.95
Zenith	T - 10, T - 15	3.95
Pioneer	T - 20	3.95
SA	T -20	3.95
Magnetic bit driver		4.75

Novaplex Converters (10-lot)

Novavision full-featured converter
Watch one channel and record another using inVIEW technology **$180**

Millennium multi-option converter
Configure the various optional packages to suit your specific needs **$62**

Remotes (10-lot)

Novaplex R1000 Universal Remote 6-in-1 for TV, Cable, Satellite, VCR, Audio & More	$11.50
Jerrold-compatible 400/450/550	5.75
CFT 2000	7.50
Scientific Atlanta-compatible	
075 / 175	5.75
475 with volume control	6.25
8600 with on-screen display	6.25
Zenith-compatible (all Z-TACs)	6.00
Panasonic-compatibles	
120 /140	7.75
170 with volume control	8.75
Pioneer-compatible for 81 / 82	7.00
Tocom-compatible (all models)	7.00

lower prices — New item! — lower prices — lower prices — lower prices

Dozens of other items in stock!

Panasonic-compatible topcases with lenses (lower price)	from	$7.25
SA-compatible cases	from	5.55
Toggle switches	from	.75
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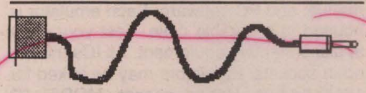

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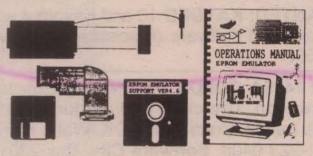

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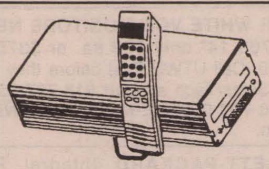

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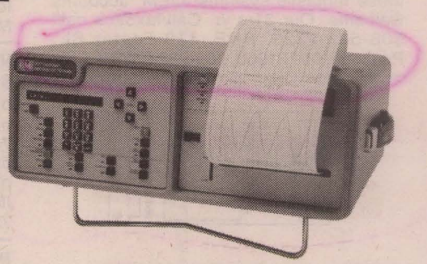

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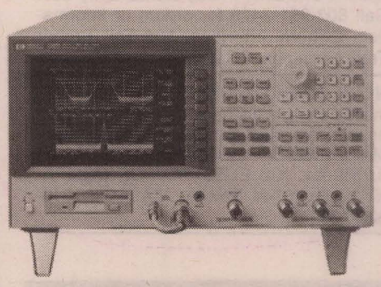

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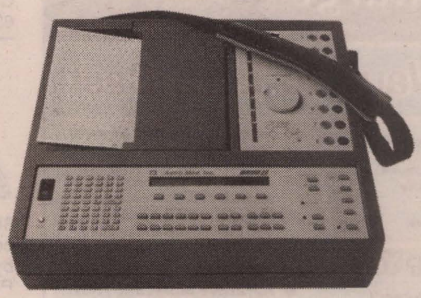

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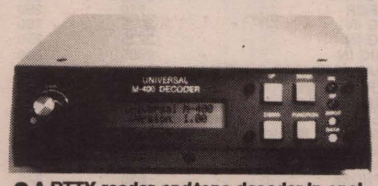

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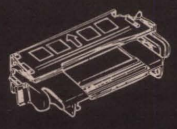

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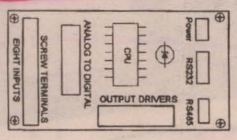

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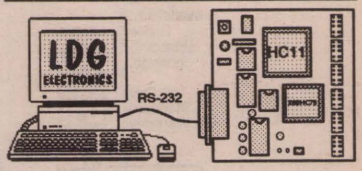

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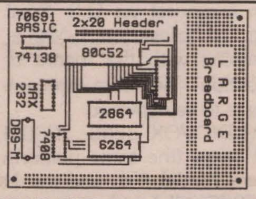

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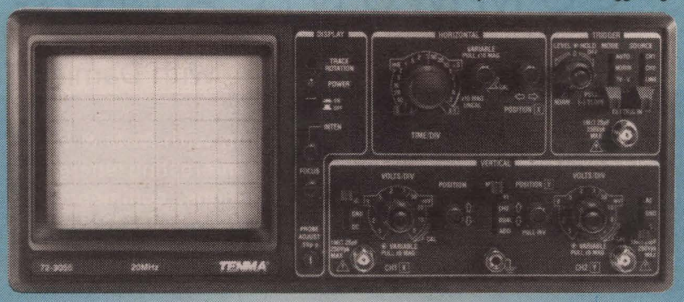

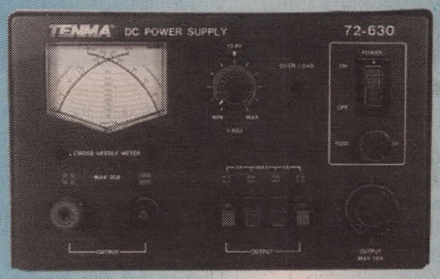

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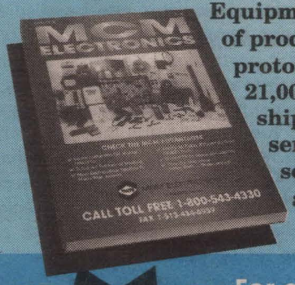

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FULL DUPLEX

COMMUNICATION

with Damien Thorn

"Full Duplex" is an interactive column with *Nuts & Volts* writer Damien Thorn We'll be reprinting the more interesting letters from readers along with Damien's responses. Questions, comments about his articles, or ideas for future issues are all welcome. Correspondence should be sent directly to Damien Thorn, c/o Phoenix Rising Communications, 3422 W. Hammer Lane, Suite C-110, Stockton, CA 95219. He can also be reached electronically as Damien@prcomm.com via the Internet. Names will not be published if anonymity is requested.

MAILBAG

Dear Damien:

First off, let me again say that your articles and wisdom shared in *Nuts & Volts* are greatly appreciated. I contacted you a while back with some questions regarding "cloning" and "tumbling" cellular phones. Your response was quite helpful in clearing up the confusion I was experiencing as far as cellular goes. What I am still unclear of, though, is how some people have cellular telephones that remain on infinitely — hence the term "lifetime" phones. I've run into a couple of people who have purchased them on the black market for anywhere from $1,000.00 to $2,500.00 each.

I'm not interested in purchasing one of these at all. What I want to know is HOW in the heck are these guys doing this? I've only seen these phones as Panasonic handhelds, umm . . . I believe it's model EB40, the one with the keypad on top. Anyway, I know the firmware is extracted and rewritten, but being that I am NOT one with lots of programming experience, I was wondering if you could explain what is needed to probe into the firmware of a phone and how it's modified to hold multiple ESNs. I don't understand if the phone is holding the same ESN/MINs all the time or if it's being programmed into the phone each time the phone is used. I don't know if it is using different ESN/MIN combinations each time, and if so — how does it know which pairs are valid???

The people I met who own these phones are definitely not the dumpster-diver type nor are they technically inclined enough to be re-programming phones, let alone their VCRs. I've seen the ads for the Oki-900 that holds five ESNs, but again, rather than buying one I am more interested in knowing how one is produced. Any help with this topic is genuinely appreciated.

Also, I was curious about Phoenix Rising's Online service. Is it still around? If so, how do I access it? I know you are in Stockton, that's only about 1-1/2 hours from me, here in the Bay Area. Maybe one day I can actually meet you in person, I would surely be honored to be able to ask you questions in person over a slice of pizza. My job as a field technician brings me into your area frequently.

Name withheld@aol.com

Thanks for the kind words. I've missed many a deadline with Nuts & Volts in recent months due to some rather time-consuming projects. The largest — a book on cellular fraud for Index Publishing Group of San Diego — is finally completed, although over a year behind schedule. If all goes well, you can look forward to a regular column here each month, and articles pertaining to communications, computers, and the Internet.

Many people have been confused by the types of cellular fraud known as ***"tumbling"*** *and* ***"cloning."*** *Tumbling fraud refers to a phone with modified firmware that randomly makes up a MIN or ESN/MIN pair for every call. This type of fraud was popular some years ago because the cellular network was unable to validate a particular ESN/MIN combination until after the first call had been placed, particularly while a phone was roaming. Tumbling fraud has been rendered obsolete for the most part as carriers implemented pre-call validation. Every call is checked against a database prior to the call being set up (placed).*

Cloning fraud is the current method employed by cellular bandits and involves programming a phone with a valid ESN/MIN pair belonging to a legitimate subscriber. This is the wireless equivalent to hooking up a telephone to a neighbor's phone line and making calls that ultimately end up on their bill.

So-called "lifetime" phones are pretty much what you think they are, and the name is somewhat misleading. We were loaned one of the Panasonic units you mentioned while taping a video on cellular hacking. It is simply a hand held phone with modified operating instructions stored in the firmware. The modification allows the user to key in any desired ESN from the keypad, much like the multiple-ESN modification you mentioned that is available for the Oki-900.

These phones are no different than any other illegally cloned phone in that they depend on being programmed with a legitimate subscriber's ESN and MIN. Rather than requiring computer software or a chip programmer to change the ESN, the phone accepts the data via the keypad. Since the ESN/MIN pair will no doubt be blacklisted as soon as the subscriber receives the bill demonstrating the fraudulent usage, the device's "lifetime" operation will depend upon a new ESN/MIN pair being programmed into the unit every so often.

While some phones may be offered with a number of "pairs" pre-programmed inside, eventually the users of these devices will need new numbers to continue billing calls to someone else. We've heard rumors of black market services that will fax a couple of new pairs to each "lifetime" phone purchaser each month, along with step-by-step instructions on programming.

How are these modifications created? Obviously by people with extensive software tools and the requisite knowledge to write low-level code for the particular microprocessor used in a given phone. According to the San Francisco Chronicle, the programmer who wrote the Panasonic modification was arrested at his home in San Jose last year. The article says he was "charged with altering more than 1,000 cellular phones so that millions of dollars in calls were billed to unsuspecting owners of legitimate phones."

The technology used in these phones isn't all that slick once you understand it. The real breakthrough for fraud artists will come (or perhaps has) with so-called "vampire" phones that actually intercept the ESN/MIN pair from nearby cellular phones when calls are placed. The phone will store these numbers and automatically cycle through them with each call. This type of fraud will be very insidious as it spreads a small number of fraudulent calls over a large number of subscribers' bills.

Phoenix Rising Communications is operating as it always has. In addition to the online service, we've produced a video tape aimed at technicians and investigators interested in understanding cellular hacking. We have also released our online educational cellular, hacking, and technology file archive on CD-ROM to save customers the toll charges involved in downloading files. To learn more about our offerings and receive a free copy of our newsletter, send a SASE to Phoenix Rising Communications, 3422 W. Hammer Lane, Suite C-110, Stockton, CA 95219.

Dear Nuts & Volts:

As always I enjoy reading *Nuts & Volts* from cover to cover. Damien Thorn's articles are always the high point for me. His article on accessing the test mode in cellular phones was quite interesting *(Nuts and Volts* June '94). The only down side to the article was that my two phones were not covered. Hence the old saying you can't please every one! At the end of the article, Mr. Thorn suggests sending in a request via U.S. Snail mail. I've got to believe that E-Mail is more in keeping with the theme of your publication. So here are my two requests to see covered:

AUDIOVOX 3200, 3200M, and 4200 series (the same platform with different model #'s), and the NOVATEL 8325 cellular phone.

Thank you very much and I look forward to the next Issue!

—*Kevin J. Rowell*—
k.rowell@genie.geis.com

Mr. Rowell;

Thank you for the note. While I encourage communication via E-Mail since it enables me to generally respond faster and with less effort, it has shortcomings when I need to save and tabulate information rather than simply respond. To save E-Mail, I need to buffer the message, save it to hard disk and finally spool it to my printer. This involves far more work for me than if readers simply write down the phone's model number of interest on the magazine's bound-in comment cards. In this fashion, I can easily save, file, and track the phones of common interest to readers. It is impossible for me to individually provide programming or test mode information to everyone.

The Audiovox phone series you are interested in is rather complex and I'm unable to find much information on it. The first possibility for discovering the test mode on these units would be a variation on the sequence used to enter programming mode. Normally one would power up the phone and punch in the three-digit unlock code followed by FNC, #, 1. While simply a blind guess, you might try this procedure, but substituting different digits for the final digit.

On the other hand, accessing the diagnostic mode (assuming there is one), may require some hardware or jumpers. It has been reported that accessing the programming mode without knowing the unlock code can be achieved by shorting pins 14, 30, 31, and 32 on the data cable and using 0,0,0 as the unlock code. Additional undocumented trickery of this type may be necessary, but proceed with caution.

Test mode on the Novatel 8325 is accessed in a manner similar to accessing the programming menu. According to information published in

*the electronic magazine "Phrack" issue #45, locking the phone (FCN, 1, SND) and keying in 5, 4, 6, * will invoke the debug mode. Whether navigating through the menu with the arrow keys or directly keying commands, #16 toggles received audio on and off, #15 allows adjustment of the audio gain, and #13 allows the technician to load the synthesizer with different frequencies (numerical channel numbers). Pressing the H/F and RCL keys will increment or decrement the channel number. As always, use caution when experimenting with diagnostic commands as it is easy to erase programmed data or key up the transmitter and interfere with the cellular network.*

Dear Damien:

I've been an ardent reader of your *Nuts & Volts* articles for some time now, and am really appreciative of how you can take certain aspects of current and emerging technologies, and put it in terms that even a lay person such as myself can understand. It is with this in mind, that I am suggesting that you consider authoring an article on cable; specifically on how one can curb his/her cable bill (no implication of theft here, mind you). I want to know how are boxes "chipped;" what ICs are involved; the use, availability, and pricing of software; term definitions (what the hell are "pans"); also suggested reading; etc. I am sure you are more than capable of writing such a piece, and will look forward to it. Thanks in advance for the consideration, and keep up the good work.

neotenic@dorsai.dorsai.org

Since your letter arrived early this year, I've been casually picking up bits and pieces of information about cable television systems, scrambling methods, decoder box testing aids, and the cable industry in general. You can expect an introductory article before the year ends. As for resources, this and many other magazines are full of ads for assorted hardware. The Arizona-based Telecode seems to be the pioneer and major supplier of documentation on cable systems, tuners, descramblers, etc. We'll contact them and see if we can obtain review copies of their current cable- related offerings and I'll provide a synopsis and review of each.

There is no problem with anyone wanting to curb their cable bill, yet remain on the right side of the law. There is a night and day difference between criminal theft of service from a cable system and the legions of people who would rather own their own set-top box outright rather than make monthly lease payments for the hardware. Most vendors even have a policy of not selling equipment to anyone who expresses an interest in defrauding a cable operator. Like any technology, descrambling devices can be misused by those with a criminal intent. **NV**

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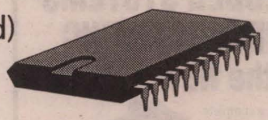

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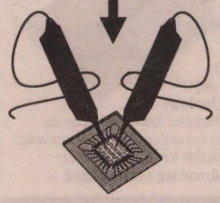

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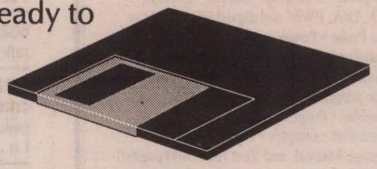

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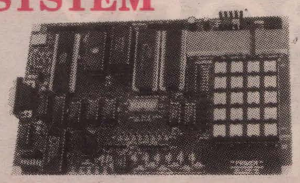

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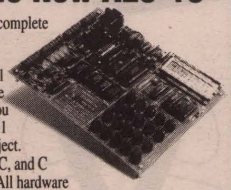

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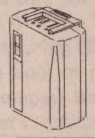

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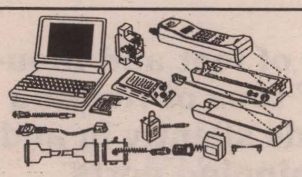

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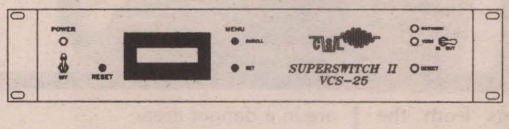

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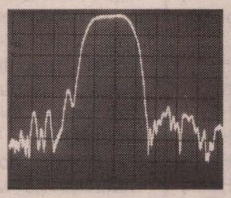

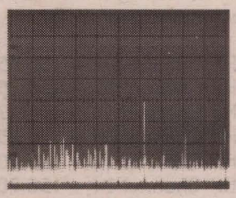

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TRACKING VESSELS WITH RADAR

by Gordon West

Hundreds of feet and thousands of tons of floating steel glide silently in and out of shipping ports every day under the supervision of the Vessel Traffic System (VTS). But, unlike Air Traffic Control (ATC), the VTS only gives advisories, not directions.

Color computer-aided radar at Vessel Traffic Control Room.

"Southbound tanker Mulholland be advised to watch for unknown small targets crossing your sea lanes 3.5 miles ahead," advises a VTS radio controller over marine VHF Channel 05. "We may also soon have outbound traffic at the gate," adds the radio controller — the "gate" referring to the breakwater entrance to the main channel.

The Vessel Traffic System can be found at most commercial shipping ports throughout the United States and in Alaska. VHF radio communications for positive two-way voice contacts are conducted on the VHF marine radio band on the following ITU (International elecommunications Union) channels:

VHF Channel 01 — 156.050 MHz
VHF Channel 03 — 156.150 MHz
VHF Channel 63 — 156.175 MHz
VHF Channel 05 — 156.250 MHz
VHF Channel 12 — 156.600 MHz
VHF Channel 14 — 156.700 MHz
VHF Channel 73 — 156.675 MHz
VHF Channel 74 — 156.725 MHz

Busy ports and major rivers carrying commercial ship traffic are also active on VHF marine Channel 13, 156.650 MHz. This is the international navigation ship-to-ship channel monitored by all incoming and outgoing commercial vessels for pilot house-to-pilot house communications.

This channel is specifically allocated for navigational "bridge-to-bridge" radio calls — a "bridge" meaning the pilot house of the big commercial boat (not to be confused with other VHF channels allocated to shore-based draw bridges).

Power output on VHF marine Channel 13 is limited to 1 watt maximum except in an emergency where 25 watts is permitted. All commercial vessels and passenger-carrying ships are required to guard Channel 13 with a separate receiver to insure direct communications from the bridge of one boat to another.

VHF Channel 16, 156.800 MHz, is the international and distress calling channel. This channel is used by commercial boats to immediately contact the United States Coast Guard in case of an emergency, or to place a general call to any vessel in the vicinity in an emergency.

During non-emergency communications with the U.S. Coast Guard, all vessels may switch to Coast Guard liaison Channel 22A, 157.100 MHz. The "A" means that Channel 22 is used in the simplex mode, not duplex. Duplex channels are only used for marine telephone calls.

The Vessel Traffic System separation zones are overlayed on all marine paper charts and on most marine electronic cartography. The overprinted traffic separation zones are normally One or two miles wide within the vessel traffic information service area. Unlike aviation charts, the separation zone is simply two-dimensional because everything is at sea level. This allows mariners with only the basic skills of navigation to quickly glance at the chart and see whether or not they are in a danger area.

The overprinted traffic separation zones are shipping lanes where incoming and outgoing traffic stay to starboard (to the right) within the zone. And much like roadway conditions, there are "posted" speed limits that all vessels under jurisdiction of the Vessel Traffic System must observe when approaching or leaving the crowded waters near a harbor entrance.

The Vessel Traffic System zones are also electronically displayed over the high-power, shore-side Vessel Traffic System radar monitoring screens — in full color. This allows the radar operator to see exactly where the targets are and where they should be in relationship to their shipping lane. Most shore-side vessel traffic control "towers" employ state-of-the-art ARPA radar consoles with back-ups, which not only display radar targets on the screen, but also display magnetic or true heading, direction, velocity, and operator-input identification.

Unlike aviation radar transponder response, marine radar transponders aboard commercial and non-commercial vessels do not have capabilities to "squawk" their ID. The opera-

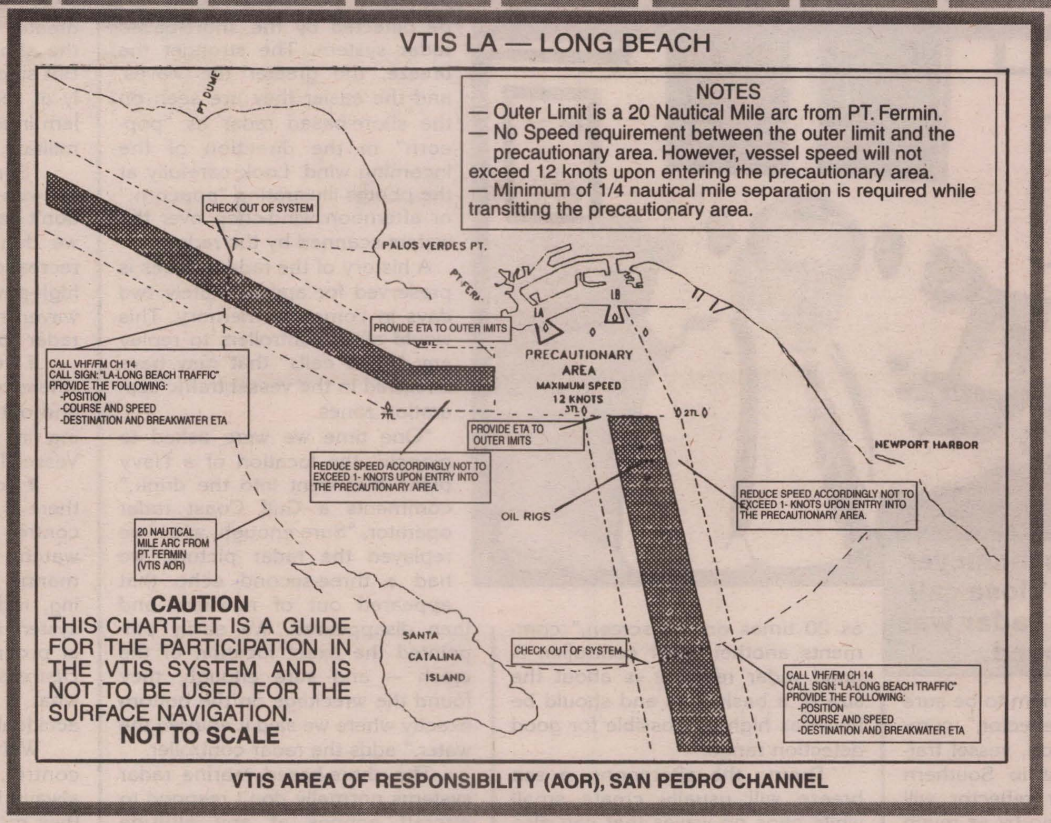
Radar view of the ship traffic covered by the Vessel Traffic System.

tor at the Vessel Traffic System must enter the vessel ID when incoming traffic calls in with the announcement they are entering the Vessel Traffic System. Digital selective calling, coupled with onboard global positioning systems with differential corrections, aid in a positive ID of all traffic within the Vessel Traffic System.

Every hour the shoreside Vessel Traffic System receives information on commercial traffic expected to enter their radar watch system soon. Vessel name, type, call sign, and other pertinent data is listed on the "expected to check in" manifest. This aids the radio communications officer in identifying who is on the channel with an E.T.A.

"This list really helps us in identifying who's who out there on the radio waves," comments one Vessel Traffic System radio communicator. "Although English is the international language, it sometimes really gets rough trying to copy what some of these foreign vessels are saying as their vessel name and identification," smiles the shore-based radioman. A quick look-up on the list makes for easy translation on who's who!

In the aviation service, airport traffic controllers routinely tell the pilots exactly how to pass through their jurisdiction, or exactly how to take off or land. In the marine world, the vessel traffic system might actually be dubbed "vessel traffic advisory service." "We give advice and information to all arriving and departing ships, pointing out ship traffic in the area, or anticipated traffic to come, and thereby alerting the ship masters of the situation around their particular vessel," comments Captain Manfred Aschemeyer, Executive Director of Marine Exchange, the vessel traffic information service serving Los Angeles and Long Beach, CA harbors.



VTIS AREA OF RESPONSIBILITY (AOR), SAN PEDRO CHANNEL

The black "hash" on the left is ocean wave reflections from the shore radar system.

"We almost never take control away from the master of the vessel by giving them direct orders to change course or speed up or slow down," adds Captain Aschemeyer. "We continually remind the captains to make passing arrangements with other ships in their vicinity, and we routinely broadcast incoming and outgoing ship position advisories on our marine VHF VTS channel," adds Aschemeyer.

When the Exxon Valdez disaster occurred in Alaska's Prince William Sound, everyone in the maritime industry got a rude wake-up call to the importance of active vessel position monitoring. It would no longer be "business as usual" in the commercial shipping business. Moreover, State and Federal governments took strong positions to make certain our environment would be protected for the future, and ship navigation was made more safe and prudent in the process.

Each Vessel Traffic System throughout the country has its own unique source of funding. It's an expensive operation to run the control center and all of the electronics 24 hours a day, every day of the year. Much of the operating expenses are paid by the commercial vessels coming into and going out of that particular port.

As an example, the port of Los Angeles and Long Beach has a lean vessel traffic information service budget of less than $1.5 million, and this budget is supported entirely by user fees. The fee is structured on a length-overall formula, with the larger ships paying $380.00 per arrival, and the smaller ships paying $200.00 per call. Fees may also be charged to commercial rescue/assist vessels, ferries, tugs, and barges. The fee varies from port to port under the Vessel Traffic System.

Monitoring the movement of small pleasure boats can sometimes be a major task during the warm summer months on Saturdays and Sundays. Pleasure boats pay nothing for this service and can get the most from a vessel traffic information service by simply monitoring on their marine VHF set for traffic advisories.

Vessel traffic controllers suggest all mariners throughout the country be familiar with the Vessel Traffic System's zones overprinted on their marine charts. Whenever they are transiting a zone area of responsibility, which is generally within 20 miles of the port entrance, they should monitor the vessel traffic system designated channel for their area. Mariners unfamiliar with which marine VHF channel is assigned for VTIS may contact the VTIS on Channel 16, and respond on the frequency indicated by the VTIS controller.

Recreational boats should refrain from ever transmitting superfluous traffic on VTIS VHF channels. "Listen, listen, listen, and avoid transmitting except in an emergency," comments an East Coast VTIS radio operator. "And if you must transmit a message to us, give us your name, vessel identification number, your GPS-derived position, and the nature of your call," adds the controller. Voluntary vessels could then legitimately call a controller and ask whether or not there is any incoming or outgoing traffic before transiting a two-mile-wide shipping lane. This is permissible.

The shore-based marine radar system operates on the 14.0-14.05 GHz region which is 5,000 MHz above the common X-band shipboard pleasure boat radar systems at 9.7 GHz. This higher frequency marine radar shore-based system puts out more than enough power to cover a 20-mile arc and to see tiny targets as small as a windsurfer. "But for recreational vessels to be easily seen within our ship-

Captain Aschemeyer explains a close call before VTS radar was approved.

ping lanes, we ask them to be sure to fly their radar reflector," comments Derek Johnson, vessel traffic control specialist in Southern California. "A radar reflector will enhance a target echo by as much as 20 times on the screen," comments another radar controller. A good radar reflector is about the size of a basketball and should be flown as high as possible for good detection range.

During the afternoons, a sea breeze will usually create small white caps on waves that can also be detected by the shore-based radar system. The stronger the breeze, the greater the waves, and the easier they are seen on the shore-based radar as "popcorn" in the direction of the incoming wind. Look carefully at the photos illustrating "popcorn," or afternoon wind-chop over the waters scanned by the radar.

A history of the radar echoes is preserved for approximately two days in computer memory. This would allow controllers to replay any "close calls" that may have occurred in the vessel traffic separation zones.

"One time we were asked to pinpoint the location of a Navy plane that went into the drink," comments a Gulf Coast radar operator. "Sure enough, when we replayed the radar picture, we had a three-second echo that appeared out of nowhere and then disappeared. We easily pinpointed the exact location of the crash — and sure enough, they found the wreckage on the bottom exactly where we said it entered the water," adds the radar controller.

The shore-based marine radar systems normally don't respond to aircraft echoes at any altitude greater than 1,000 feet in close to the shore-based radar installation. But since this aircraft was ultimately at sea level, there was no problem in identifying its echo after the military request.

"Sometimes we see near misses with small targets; and if we don't get a report from the skipper, we don't know whether it was a recreational small boat miss or a high-powered personal watercraft waverunner," comments another radar specialist out of New York.

If you live near a major port where commercial shipping goes in and out of the breakwater, try tuning in marine VHF channels for Vessel Traffic System reports.

If you're into flying, know that there is a counterpart of air traffic control for the oceans, too. And watch closely the merging of marine VHF, digital selective calling, radar, and global positioning system into the canopy international program called *Global Marine Distress Safety System,* and see what it does to prevent another accident like the Exxon Valdez.

With marine radar "approach control," commercial ships will always have an electronic eye on their movements. **NV**

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Gleanings from the surplus mines. My July 30 "Parade" Sunday newspaper supplement cover shows Ret. Maj. Gen Chuck Sweeny sitting in the cockpit of a B29, perhaps the Enola Gay. He is a pilot who flew on both the Hiroshima and Nagasaki missions, .

Something caught my eye in the bottom right corner of the photo. There it was, the ubiquitous **Norden** bombsight. My association with the Norden goes back to the beginnings of my interest in surplus. In the late Forties, Canal Street NYC was lined with shops that sold war surplus. The stuff was so cheap they just put it out on the sidewalk.I was hooked. I trembled with excitement on Saturdays when, clutching the few dollars I could dig up I took the BMT to Canal. One of the greatest items was an optical contraption, with curved mirrors, beamsplitters and various mechanisms. It cost $1, came wrapped in tissue paper. Later on, I bought complete Nordens, using the gyros for the infamous "briefcase that wont go around corners" trick.

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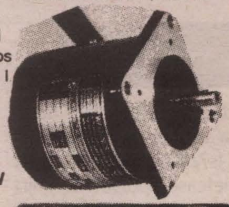

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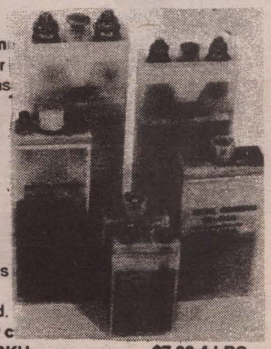

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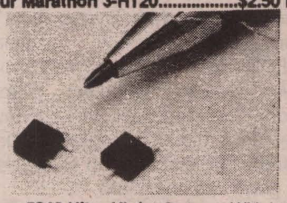

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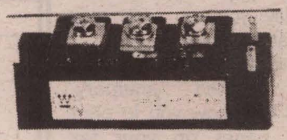


Nickel Cadmium Sealed Cell Power Pack 6AH 28 volt. This contains 20 cells, each the diameter of a "D" cell, but twice the length. Used, but fully guaranteed. Originally aircraft auxilliary lighting. Would make a nice electric bicycle.....**$45.00 14 lbs**

Write in 55 on Reader Service Card.

Using Your Fax as a Computer Scanner/Printer

by Fred Blechman

Facsimile ("fax") machines are everywhere. Businesses have come to depend on them for instant transmission of graphics and text through telephone connections worldwide. Fax machines have become so popular that many homes — especially those operating a home business — have also installed them.

Fax machines are normally used just for sending and receiving faxes, and until recently it seems no one has taken advantage of their powerful scanning and printing capabilities for computer use. Now, using a hardware/software package from SVA Software called "faxSCANNER for Windows," and a computer with a fax/modem, you can turn your existing fax machine into a full-page sheet-fed 16-gray-scale scanner, as well as a graphics or text near-laser-quality printer!

"faxSCANNER for Windows — Standard Version" ($49.95) is a powerful tool for today's desktop publishers, and for those interested in scanning text or black and white graphics (up to 16 shades of gray) into their IBM PC-compatible computer.

If you don't have a laser printer, faxSCANNER lets you use your existing fax machine as a substitute — and with the new plain paper fax machines available today, you can print near laser quality at a bargain price.

If you already have a laser printer with limited memory, faxSCANNER will allow you to print full graphic pages on your fax machine without adding printer memory! Also, in many cases, printing out an image to your fax machine takes a lot less time than laser printing.

Portable Use

There is another big advantage to using faxSCANNER if you travel and use a portable or laptop PC. A special module, a telephone line cord, and some software make up the full faxSCANNER for Windows package. Therefore, you can take your faxSCANNER on the road everywhere you go, since any standard G3 fax machine can become your scanner and printer.

The patented faxSCANNER hardware module (a telephone line simulator) is so small (1-7/8" x 2-1/4" x 7/8") it fits in your briefcase, purse, or shirt pocket! By simply using the telephone line cord to connect this module between a fax machine and a computer's fax/modem, you can scan one or more pages of printed material into your computer's memory and save the image as a file to be used with your favorite desktop publishing program. Or, you can print any file from someone else's computer.

Optical Character Recognition

To save you the time and effort of typing text into your computer, a page with text can be scanned and then converted from an image to computer-readable text by an OCR (optical character recognition) package. "faxSCANNER for Windows — International Edition" ($69.95) integrates Caere's award-winning "AnyFax" OCR technology that recognizes fonts from 6 to 72 points in 11 languages! It produces a text file in ASCII or any of 62 formatted text files for use with your favorite word processing application, including WordPerfect and MS Word. If your OCR needs are more critical, SVA Software offers "TypeReader" from ExperVision at great savings.

A Happy Marriage

faxSCANNER for Windows is actually a combination of a small hardware module from SVA Software and a special configuration of a leading fax/modem program called "BitFax Easy," from Bit Software. This lets you send, receive, and manage faxes with the click of a mouse.

So that you can take full advantage of your fax/modem, "BitCom," a full-featured communication program, is also included in this package. BitCom lets you log onto on-line services, computer bulletin boards, and Internet providers, and supports the most popular file transfer protocols, such as ASCII, Xmodem, Ymodem, Zmodem, and Kermit.

System Requirements

To use BitFax Easy for Windows you need:

- An IBM PC or compatible computer (386, 486, or Pentium).
- Windows 3.0 or 3.1 running in 386 Enhanced Mode.
- Hard drive with at least 5 MB of free disk space.
- 2 MB of RAM (4 MB to run AnyFax OCR).
- A fax/modem that can send and receive faxes. (A fax board with the EIA TR-29 Class 2, or EIA 578 Class 1, or Intel CAS, or Sierra Send Fax Standard.)
- A mouse or equivalent input device (optional).

Documentation

The perfect-bound 6.75" x 9" 288-page *BitFax Easy User's Manual* is clearly printed with many screen illustrations. It is divided into two sections, each with its own index and appendices: "BitFax Easy for Windows," and "BitCom for Windows." The size of the manual is an indication of the many, many features of these programs, and the great detail of explanation. I suggest you scan through it, then keep it handy for reference when doing various activities.

A 6" x 7.5" 14-page staple-bound booklet is specifically aimed at using faxSCANNER for direct fax-to-computer scanning and printing. While it was adequate, I found myself confused in several places.

I'll save you this confusion further on in this article by describing the simple step-by-step procedures I used to scan and print.

faxSCANNER Module Installation

The only hardware you'll need, besides a fax machine and a computer

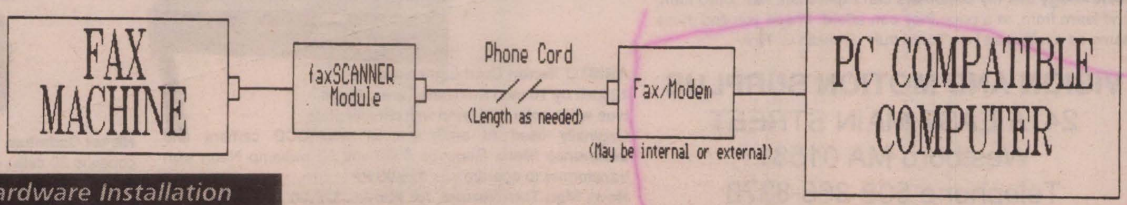
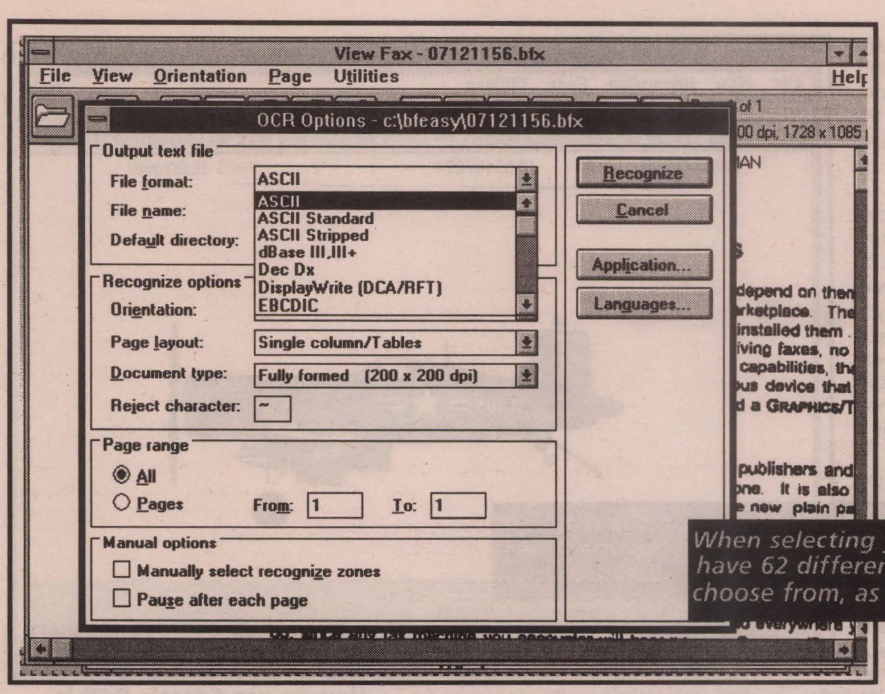
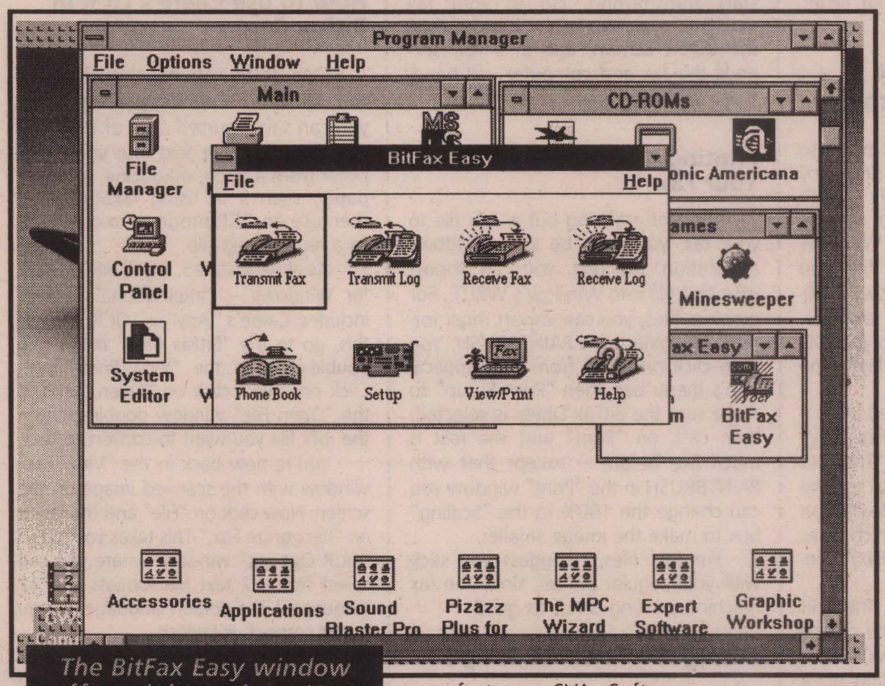


FIGURE 1 — Hardware Installation



When selecting your OCR format, you have 62 different possible formats to choose from, as well as 11 languages.



The BitFax Easy window offers eight options. Here "Transmit Fax" is selected.

fax/modem, are the special small black "module" and the telephone line cord that are included with faxSCANNER. Before you can use the module, you must install the included nine-volt battery into the faxSCANNER module. Slide open the panel and place the battery inside the faxSCANNER module, first snapping the connector to the battery terminals. Replace the slide panel.

After properly installing the battery, do a simple self-test: Connect the phone plug of your faxSCANNER module into its own phone jack to check battery power and internal functions. If the red LED (light emitting diode) turns on, your faxSCANNER hardware module has passed the test.

If the light does not turn on, try another battery. If the light still does not turn on, you'll need to call the manufacturer, SVA Software (address and phone number at the end of this article), for more assistance.

Hardware Installation

Figure 1 shows how the module is connected between your fax machine and the computer's fax/modem. No telephones are used. Use the telephone cord provided in the faxSCANNER package to connect the fax/modem "Line" jack to the faxSCANNER module. The black cable from the faxSCANNER module plugs into the "Line" jack input of the fax machine. After making the necessary connections, if your fax/modem is external, be sure to turn it on.

The six-foot phone cord that comes with faxSCANNER has a common four-wire modular phone plug on each end. If your fax machine and computer fax/modem are further than about six feet apart, either use a longer phone cord, or connect additional lengths using female modular couplers to join them. My computer and fax are about 18 feet apart, but I found no problem using three six-foot phone cords and two couplers.

Checking Your System

Before installing BitFax Easy for Windows, make sure your fax/modem is installed and configured according to the manufacturer's instructions. Determine which COM port your modem is using. An easy way to do this is to go into the Windows "Terminal" program (usually in the Accessories Group), click on "Settings" in the menu bar, then click on "Communications." In the "Connector" box, the highlighted COM number is the COM port to which your modem is connected. During installation, you may need to tell BitFax Easy which COM port number your modem is using.

You can test your modem with the Windows "Terminal" program. Make sure your telephone line is connected to the modem for this test, and make sure the modem is turned on if it is an external modem. On the "Terminal" program menu bar, click on "Phone," then click on "Dial." Type YOUR OWN PHONE NUMBER and click on "OK." The modem should dial your number and show BUSY on the screen as the modem hangs up.

BitFax Easy and BitCom

The regular use for BitCom is for communications between modems using the telephone lines. This is explained in detail in the *BitFax Easy User's Manual*. Similarly, the regular use for BitFax Easy is to send, receive, and print faxes using fax/modems and the phone lines, also explained in the manual.

The faxSCANNER version of BitFax Easy, however, has the special capabilities of scanning and printing using a fax machine and fax/modem – no telephone lines are used.

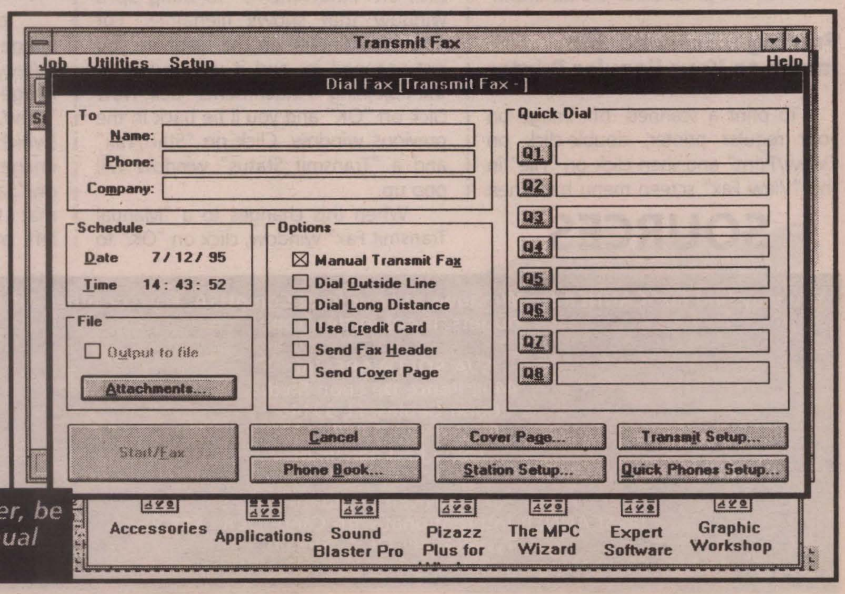
The remainder of this article will only cover these special applications of BitFax Easy, since the booklet provided does not include sufficient detail. At least, it took me considerable effort to get things working properly – so, if you decide to get this package, be sure to refer to this article!

Installing BitFax Easy

BitFax Easy includes an easy-to-follow installation program, which is run from your Windows desktop. The installation includes both BitFax Easy for Windows and BitCom for Windows. It will also install and activate the special BitFax Easy printer driver, as well as create a Windows program group, and place the BitFax Easy and BitCom icons into it. The whole installation takes less than five minutes.

How to Scan with BitFax Easy

Connect the fax machine and fax/modem as shown in Figure 1. If your fax/modem is external, be sure it is turned on. Also, make sure your fax machine is turned on. (Note: Some fax machines are always ON if they are



To use your fax as a printer, be sure you're in the "Manual Transmit Fax" mode.

plugged into a wall socket.) IMPORTANT! Set your fax machine to the "Fine" or "Hi-Resolution" mode. For high-definition images and gray scale, set it to "Half-Tone" if your machine has such a setting. Place the sheet to be scanned in the fax document feeder.

To start BitFax Easy, open the BitFax Easy program group (if it is not already open), and double-click on the "BitFax Easy" icon. The BitFax Easy window will appear. Double-click on the "Receive Fax" icon, then click on "Receive." The computer screen will show the modem going through some testing for about eight seconds.

When the "Operation" box says "Wait for fax call," click on "Job," then click on "Manual Receive." This activates the scanning process. When the "Response" box says "OK" and you can hear the modem sending, go to your fax machine, lift its handset (or press the HOOK button) and then hit the START button. After a short period of "handshaking," the document will feed through your fax machine as a filename appears — the six-digit date and time with a .bfx extension. When the sending is complete, the fax/modem disconnects.

Viewing the Received Fax

Once the scan is completed, you can view the received fax. Click on "Cancel" in the "Receive Fax" box. After a brief disconnect function, you're back in the "BitFax Easy" box. Double-click on the "View/Print" icon and you'll find yourself in the "View Fax" screen. Click on "File," then click on "New" (or just click on the file folder icon below File on the menu bar) and you'll see the "Open File" box. Click on the filename you just scanned, easily identified by the clever date/time name. Click on "Open" and your scanned image appears after a short delay.

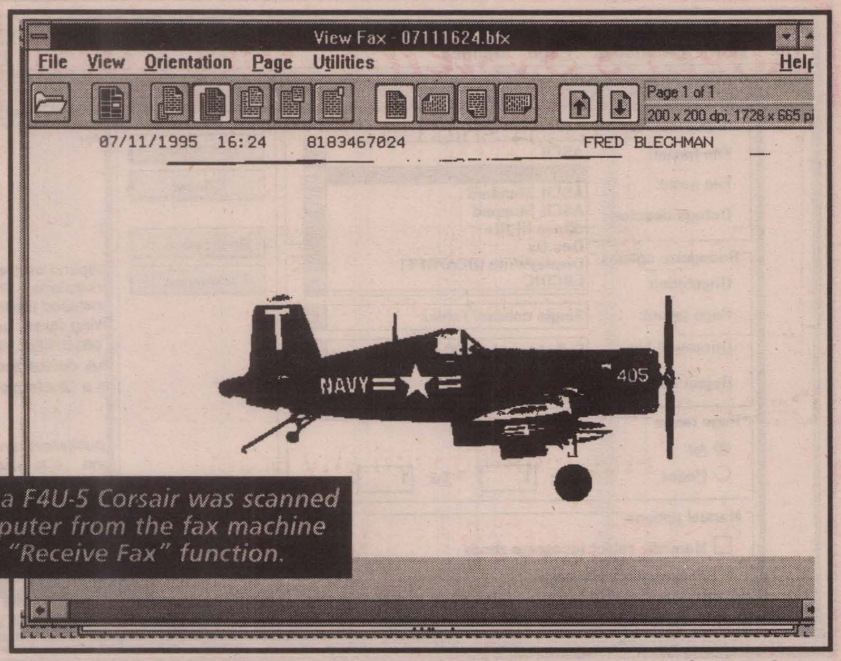
Bear in mind that your screen resolution is not as good as the 200 x 200 dot resolution of the scan, so the view may not look anywhere as good as the actual file. To prove this, you can print this file on one of your regular printers (a laser is best), or print it on the fax. However, the procedures are different.

Printing a Scanned .bfx Image to Your Regular Printer

To print a scanned .bfx image on your regular printer, double-click on "View/Print" and then click on "File" in the "View Fax" screen menu bar. Then click on "Printer Setup" and select the printer you'll be using. You may want to set some printer parameters by clicking on the "Setup" button. When you have selected the printer, click on "OK."

From the "File" menu, click on "Print." Make sure your printer is turned on and then click on "OK." After several minutes, your printer will deliver the file you had scanned in. You'll probably be surprised at how good it looks compared to the screen, especially if you used a laser printer for the printing — although it is slow.

In addition to an Okidata OL-400 laser printer, I tried an Epson LX-800 nine-pin dot-matrix printer for the output, and I was pleasantly surprised. Although it was not as sharp as the laser, it was a lot faster, and perfectly readable!



This photo of a F4U-5 Corsair was scanned into the computer from the fax machine using the "Receive Fax" function.

Printing a Scanned .bfx Image to your Fax Machine

When printing a scanned image to your fax machine, you can print any .bfx file rather directly with faxSCANNER. Other files can also be printed, but only from their Windows application. To print a DOS file, you must first bring it into a Windows application. Except for pure ASCII text files, you'll probably find printing to your fax machine takes considerably less time than to a regular printer.

To print a file you scanned in as a .bfx file, you'll use the "BitFax Easy" window. Double-click on the "Transmit Fax" icon, which takes you to the "Transmit Fax" window. Double-click on "Job," then click on "New," which takes you to the "Dial Fax (Transmit Fax)" window.

Make sure the "Manual Transmit Fax" box is checked (but none of the other boxes below it, for now). Next, click on "Attachments" to bring up a window that shows filenames. For now, double-click on the filename you just scanned in, and it will appear in the adjoining "Attachments" box. Now click on "OK" and you'll be back in the previous window. Click on "Start/Fax" and a "Transmit Status" window will pop up.

When this changes to a "Manual Transmit Fax" window, click on "OK" to start transmitting. Go to your fax machine, press the HOOK button, then the START button, and in a few seconds the fax and computer will handshake and the fax will print.

Printing Non-.bfx Files to Your Fax

To print anything but a .bfx file to your fax, you must be in a Windows application. For text, you can import your text file into Window's WRITE. For graphics files, you can import most formats into Window's PAINTBRUSH. You then click on "File" from that application's menu bar, then "Print Setup" to make sure the BitFax Driver is selected, then click on "Print" and the rest is much like before — except that with PAINTBRUSH in the "Print" window you can change the 100% in the "Scaling" box to make the image smaller.

For text files, I suggest you stick with your regular printer, since the fax machine printing is not as good.

Saving the Scanned Image

To save the received scanned image as a graphic file, while in the "View/Print" window, first view the image by clicking on "File," click on "New," then select the filename (which must be a .bfx file)! When the image is on screen, click on "File," click on "Save As," and select a desired format (.PCX, .BMP, or .DCX) at the lower left of the screen. Now go to the upper left of the "Save As" window and type in the name you want for this image, with the chosen format extension. Click on "Save" and the viewed image will be saved in that format. (Note: Even if you change the size on the screen with the "View" menu, the image will be saved full size.)

How to use Caere's OCR in BitFax Easy

One of the very big advantages of this whole fax scanning process is that you can save yourself a lot of typing. If you want to enter text into your computer from a book, magazine, or newspaper, scan it in using faxSCANNER, then use an OCR program to convert it to a regular text file.

As already stated, the "faxSCANNER for Windows — International Edition" includes Caere's "AnyFax" OCR. To use this, go to the "BitFax Easy" menu and double-click on the "View/Print" icon. Click on "File," click on "Open," and in the "Open File" window double-click on the .bfx file you want to convert to text.

You're now back in the "View Fax" window with the scanned image on the screen. Now click on "File" and then click on "Recognize Fax." This takes you to the "OCR Options" window, where you can select from 62 text file formats and 11 languages! The default language, as you might suspect, is English.

Click on "Recognize" and watch as the program puts a reduced size of the image on the screen and scans it three times — first in light gray, then dark gray, then black — then saves the file. This function of BitFax Easy requires a minimum of four megabytes of RAM, so if you have problems running it, close any other Windows you may have open.

To view the converted file, go to the application where you saved the file, open the file, and edit it there. I was expecting lots of errors here, but was pleasantly surprised. So long as the document was scanned using the "Fine" fax mode, the recognition was about 98%!

I was, frankly, VERY pleased. Although some cleanup was required in my word processor, it was a lot less effort than typing in the text.

If you would like to improve the accuracy of the OCR, contact SVA Software to purchase "TypeReader" from ExperVision at a special low price. **NV**

SOURCES

You may find faxSCANNER for Windows at your local CompUSA, Frys, or other software outlets. If not, order from:

SVA SOFTWARE, Inc.
4401 Ponce De Leon Blvd.
Coral Gables, FL 33146
Phone: (800) 457-4433
Fax: (305) 446-9928

Prices: faxSCANNER Standard - $49.95.
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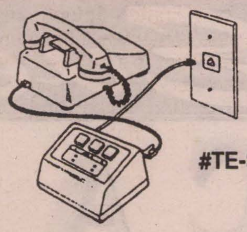

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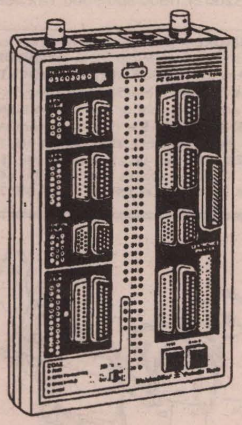

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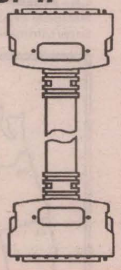

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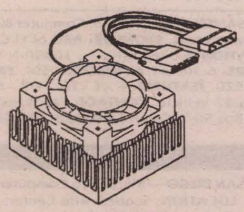

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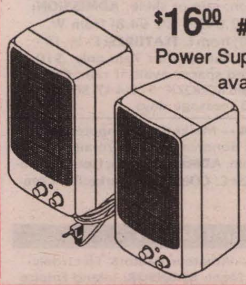

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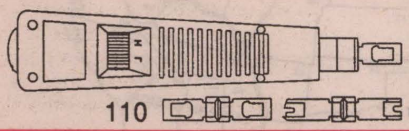

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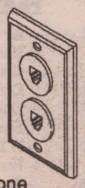

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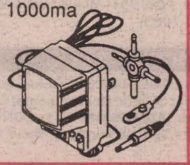

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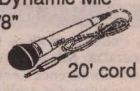

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Complimentary issues are available upon request for distribution to your attendees. A street address for UPS is required.

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Events Calendar
430 Princeland Court
Corona, CA 91719
Phone 909-371-8497
Fax 909-371-3052
CompuServe 74262,3664
Internet
74262,3664@compuserve.com

WESTERN REGION

SEPTEMBER 1-2-3

CA - LONG BEACH — Hamcom '95, ARRL Southwestern Division Convention. **SPONSOR:** Hamcom, Inc. **LOCATION:** Queen Mary. **HOURS:** Fri: 5pm-8pm; Sat: 9am-5pm; Sun: 9am-Noon. **ADMISSION:** Adv $12, Door $15. **TALK-IN:** 145.52 Simplex. **FEATURES:** B - CB - DP - EX - F - FM - F/R - H - RV-S - S. **CONTACT:** Nate Brightman, 310-427-5123 or Hamcom, Inc, POB 2111, Winnetka CA 91396.

SEPTEMBER 2

CA - ANTIOCH — MarketPro Computer Show & Sale. **LOCATION:** Contra Costa Fairgrounds. **HOURS:** 10am-5pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

CA - SANTEE — Ham Radio, Computer & Electronics Swap Meet. **SPONSOR:** ARC of El Cajon. **LOCATION:** Santee Drive-In, 10990 N Woodside. **HOURS:** 6:30am-? **ADMISSION:** 50¢. **TALK-IN:** 146.520. **FEATURES:** C - E - FM - F/R - H. **DEALER INFO:** $7 vehicle. **CONTACT:** Pat WA6MHZ, ARCEC, Box 50, El Cajon CA 92020. 619-561-0052.

SEPTEMBER 3

CA - LIVERMORE — East Bay Area Amateur Radio/Electronics/Computer Swap Meet. **SPONSOR:** Livermore Amateur Radio Klub (LARK). **LOCATION:** Las Positas College, N of I-580 at Airway Blvd exit. **HOURS:** 7am-Noon, rain or shine. **ADMISSION:** Free. **TALK-IN:** 147.045+ (PL 94.8) from W, 145.350 - (PL 100) from E. **FEATURES:** E - H - FP - F/R. **DEALER INFO:** Set-up after 7am only. $10 space fee. Covered spaces avail. if rain. **CONTACT:** Noel Anklam KC6QZK, 510-447-3857 eves or 510-783-2803 message days.

CA - SANTA ROSA — MarketPro Computer Show & Sale. **LOCATION:** Sonoma Co. Fairgrounds. **HOURS:** 10am-5pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

SEPTEMBER 9

CA - FONTANA — Amateur Radio & Electronic Equipment Swap Meet. **SPONSOR:** Inland Empire ARC & A.B. Miller High School ARC. **LOCATION:** A.B. Miller High School, 6821 Oleander Ave. **HOURS:** 7am-? **ADMISSION:** Free. **FEATURES:** E - FP - F/R - H. **DEALER INFO:** Tailgate space $6. Set-up 6am. **CONTACT:** Bill Gruber 909-822-4138 eves. VE exams are now on the first Sat. of each month at 8am; contact Ken Canfield, 685-7694.

CA - FRESNO — MarketPro Computer Show & Sale. **LOCATION:** Holiday Inn. **HOURS:** 10am-5pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

CA - RESEDA — Computer Marketplace. **SPONSOR:** National Productions. **LOCATION:** Sherman Square Entertainment Center, 18430 Sherman Way. From 101 Freeway take Reseda offramp, turn left to Sherman Way, turn right. Go 1 blk to Canby St. **HOURS:** 10am-5pm. **ADMISSION:** $5. **CONTACT:** National Productions, 408-778-5200 or 1-800-800-5600. FAX 408-779-1374.

SEPTEMBER 9-10

CA - VENTURA — MarketPro Computer Show & Sale. **LOCATION:** Ventura Fairgrounds. **HOURS:** 10am-5pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

SEPTEMBER 10

CA - BUENA PARK — Computer Marketplace. **SPONSOR:** National Productions. **LOCATION:** Sequoia Conference Center. Take Beach Blvd exit off 91 Freeway. Go 1 blk N to 7530 Orangethorpe. **HOURS:** 10am-5pm. **ADMISSION:** $5. **CONTACT:** National Productions, 408-778-5200 or 1-800-800-5600. FAX 408-779-1374.

CA - SACRAMENTO — MarketPro Computer Show & Sale. **LOCATION:** Scottish Rite Center. **HOURS:** 10am-5pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

SEPTEMBER 16

AZ - NORTH SCOTTSDALE — Family Amateur Radio Event. **SPONSOR:** 16 Local Amateur Clubs. **LOCATION:** Rawhide Rodeo Pavilion, 23000 N Scottsdale Rd. **HOURS:** 9am-2pm. **ADMISSION:** Adv $1, door $2, under 18 free. **TALK-IN:** 146.76-. **FEATURES:** C - CB - DP - FM - F/R - S - T. **DEALER INFO:** Tailgating $5. **CONTACT:** Len Winkler KB7LPW, 602-861-0303.

CA - PALM SPRINGS — MarketPro Computer Show & Sale. **LOCATION:** Riverside County Fair. **HOURS:** 10am-5pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

CA - SANTA BARBARA — Computer Marketplace. **SPONSOR:** National Productions. **LOCATION:** Earl Warren Showgrounds. Take Highway 101 to Las Positas Exit. Follow signs to fairgrounds. **HOURS:** 10am-5pm. **ADMISSION:** $5. **CONTACT:** National Productions, 408-778-5200 or 1-800-800-5600. FAX 408-779-1374.

CA - SANTEE — Ham Radio, Computer & Electronics Swap Meet. **SPONSOR:** ARC of El Cajon. **LOCATION:** Santee Drive-In, 10990 N Woodside. **HOURS:** 6:30am-? **ADMISSION:** 50¢. **TALK-IN:** 146.520. **FEATURES:** C - E - FM - F/R - H. **DEALER INFO:** $7 vehicle. **CONTACT:** Pat WA6MHZ, ARCEC, Box 50, El Cajon CA 92020. 619-561-0052.

SEPTEMBER 16-17

CA - SAN DIEGO — MarketPro Computer Show & Sale. **LOCATION:** Scottish Rite Center. **HOURS:** 10am-5pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

OR - PORTLAND — Ham Fair. **SPONSOR:** Hoodview ARC. **LOCATION:** Portland Meadows Race Track, Pari-mutual area, 1001 NE Schmeer Rd. **HOURS:** Sat: 9am-5pm, Sun: 9am-2pm. **ADMISSION:** Adv $5, door $6. **TALK-IN:** 147.28/.88. **FEATURES:** CB - DP - F - FM - FP - F/R - H - RV-S - S. **DEALER INFO:** Tables $12 + admission, set-up Fri: 2pm-6pm, Sat: 7:30am. Darrell AA7BD, 503-760-0572. **CONTACT:** Portland Ham Fair, POB 20876, Portland OR 97220.

SEPTEMBER 17

AZ - PHOENIX — Computer & Electronic Swap Meet. **SPONSOR:** Electronic Materials & Computers. **LOCATION:** Electronic Materials & Computers parking lot, 3102 W Thomas Rd #902. **HOURS:** 8am-3pm. **ADMISSION:** Free. **FEATURES:** FP. **DEALER INFO:** Vendor spaces $15. **CONTACT:** 3102 W Thomas Rd #902, Phoenix AZ 85017. 602-272-3200.

CA - STOCKTON — MarketPro Computer Show & Sale. **LOCATION:** Civic Auditorium. **HOURS:** 10am-5pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

NV - CARSON CITY — Swap Meet. **SPONSOR:** W7IND Nevada. **LOCATION:** Custom Computer Concepts parking lot, Hwy. 50 E, N of high school. **HOURS:** 8am-noon. **ADMISSION:** Free. **DEALER INFO:** Sellers, $3 space. Set-up 7:30am. **CONTACT:** 702-883-8900.

SEPTEMBER 22-23-24

OR - MILTON-FREEWATER — ARRL Hamfest. **SPONSOR:** Walla Walla Valley ARC. **CONTACT:** Jack Babbitt WA5ZAY, POB 951, Walla Walla WA 99362. 509-525-7003.

SEPTEMBER 23

OR - BEND — Northwest VHF/UHF Conference. **LOCATION:** Central Oregon Environmental Center. **HOURS:** 9am-3pm. **ADMISSION:** $15. **CONTACT:** Don Krug K7HSJ, 1126 NE Burnside, Bend OR 97701.

SEPTEMBER 23-24

CA - VALLEJO — MarketPro Computer Show & Sale. **LOCATION:** Solano Co. Fairgrounds. **HOURS:** 10am-5pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

SEPTEMBER 24

CA - OXNARD — MarketPro Computer Show & Sale. **LOCATION:** Community Center. **HOURS:** 10am-5pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

CA - SANTA ANA — ACP Computer Swap Meet. **SPONSOR:** Advanced Computer Products. **LOCATION:** 1310 E. Edinger. **HOURS:** 8am-2pm, rain or shine. **ADMISSION:** Free. **FEATURES:** C - E - FP. **CONTACT:** 714-558-8813.

SEPTEMBER 26-27-28-29

CA - SAN FRANCISCO — Seybold Expo '95. **LOCATION:** Moscone Convention Center. **FEATURES:** C - F - S. **CONTACT:** Seybold Seminars, POB 45295, San Francisco CA 94145-0295. 800-488-2883.

SEPTEMBER 30

CA - RESEDA — Computer Marketplace. **SPONSOR:** National Productions. **LOCATION:** Sherman Square Entertainment Center. **HOURS:** 10am-5pm. **ADMISSION:** $5. **CONTACT:** National Productions, 408-778-5200 or 1-800-800-5600. FAX 408-779-1374.

SEPTEMBER 30-OCTOBER 1

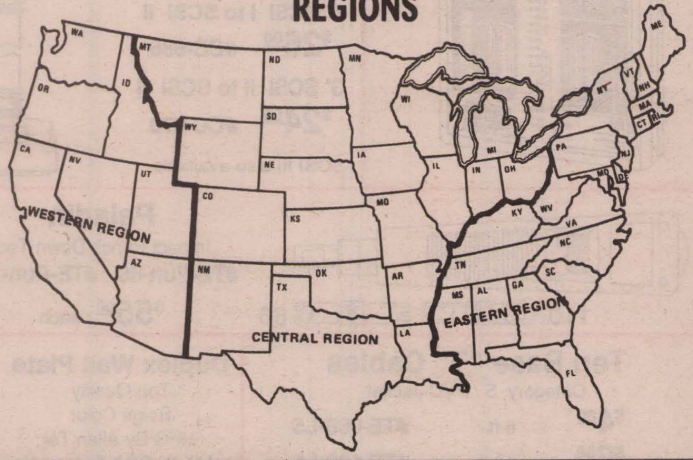
CA - SAN DIEGO — MarketPro Computer Show & Sale. **LOCATION:** Scottish Rite Center. **HOURS:** 10am-5pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

OCTOBER 1

CA - BUENA PARK — Computer Marketplace. **SPONSOR:** National Productions. **LOCATION:** Sequoia Conference Center. **HOURS:** 10am-5pm. **ADMISSION:** $5. **CONTACT:** National Productions, 408-778-5200 or 1-800-800-5600. FAX 408-779-1374.

CA - LIVERMORE — East Bay Area Amateur Radio/Electronics/Computer Swap Meet. **SPONSOR:** Livermore Amateur Radio Klub (LARK). **LOCATION:** Las Positas College, N of I-580 at Airway Blvd exit. **HOURS:** 7am-Noon, rain or shine. **ADMISSION:** Free. **TALK-IN:** 147.045+ (PL 94.8) from W, 145.350 - (PL 100) from E. **FEATURES:** E - H - FP - F/R. **DEALER INFO:** Set-up after 7am only. $10 space fee. Covered spaces avail. if rain. **CONTACT:** Noel Anklam KC6QZK, 510-447-3857 eves

REGIONS



FEATURES KEY

AC	— Air Conditioned
B	— Banquet
C	— Computers
CB	— Commercial Booths
DP	— Door Prizes
E	— Electronics
EX	— FCC Exams
F	— Forums
FM	— Flea Market
FP	— Free Parking
F/R	— Food & Refreshments
H	— Amateur Radio
RV/H	— RV Parking w/hookups
RV/S	— RV Parking Self Contained
S	— Seminars
T	— Tailgating

COMPUTER SHOW PROMOTER INFO

AGI Computer Fair — 317-299-8827
KGP Computer Shows — 908-297-2526
MarketPro Computer Shows
West (CA) — 415-388-8893
East (MD, OH, PA, VA) — 301-365-9696
N.E. (CT, MA, NJ, NY, RI) — 201-265-1075
NARISAAM Computer Shows — 800-436-6707
Northern Computer Shows — 508-744-8440

or 510-783-2803 message days.

OCTOBER 7

AZ - BULLHEAD CITY — Fallfest. **SPONSOR:** Tri-City ARC. **LOCATION:** Chamber of Commerce Bldg, 1251 Arizona, Hwy 95. **DEALER INFO:** Inside tailgating: $15, outside: $5. **CONTACT:** Dave Sumner KG7XZ: 520-763-2589.

CA - SANTEE — Ham Radio, Computer & Electronics Swap Meet. **SPONSOR:** ARC of El Cajon. **LOCATION:** Santee Drive-In, 10990 N. Woodside. **HOURS:** 6:30am-? **ADMISSION:** 50¢. **TALK-IN:** 146.520. **FEATURES:** C - E - FM - F/R - H. **DEALER INFO:** $7 vehicle. **CONTACT:** Pat WA6MHZ, ARCEC, Box 50, El Cajon CA 92020. 619-561-0052.

ID - NAMPA — Hamfest & Computer Show. **LOCATION:** Nampa Civic Center, 311 3rd St S. **HOURS:** 8am-4pm. **ADMISSION:** $2. **TALK-IN:** 147.240, 443.600. **FEATURES:** C - CB - DP - EX - FM - F/R - H - S. **DEALER INFO:** Dealers: adv only $60, nondealers: adv $6.50, Door $8.50. **CONTACT:** Jan Dyer, WA7VEF, 208-467-3245. Elvin Hightower, KA7BER, 208-466-2011.

OCTOBER 7-8

CA - POMONA — Los Angeles Computer Fair. **SPONSOR:** National Productions. **LOCATION:** Fairplex Expo Center. **HOURS:** 10am-5pm. **ADMISSION:** $5. **CONTACT:** National Productions, 408-778-5200 or 1-800-800-5600. FAX 408-779-1374.

CA - SACRAMENTO — MarketPro Computer Show & Sale. **LOCATION:** Cal Expo. **HOURS:** 10am-5pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

OCTOBER 8

CA - FRESNO — MarketPro Computer Show & Sale. **LOCATION:** Holiday Inn. **HOURS:** 10am-5pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

OCTOBER 14

CA - SANTA BARBARA — Computer Marketplace. **SPONSOR:** National Productions. **LOCATION:** Earl Warren Showgrounds. **HOURS:** 10am-5pm. **ADMISSION:** $5. **CONTACT:** National Productions, 408-778-5200 or 1-800-800-5600. FAX 408-779-1374.

OCTOBER 14-15

CA - OXNARD — MarketPro Computer Show & Sale. **LOCATION:** Community Center. **HOURS:** 10am-5pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

CA - VALLEJO — MarketPro Computer Show & Sale. **LOCATION:** Solano Co. Fairgrounds. **HOURS:** 10am-5pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

OCTOBER 20-21-22

CA - CONCORD — Pacific Division Convention. **CONTACT:** Lauren Styles, WA6CIE, 1910 Sunshine Dr, Concord CA 94520. 510-676-2186.

OCTOBER 21

CA - SANTEE — Ham Radio, Computer & Electronics Swap Meet. **SPONSOR:** ARC of El Cajon. **LOCATION:** Santee Drive-In, 10990 N. Woodside. **HOURS:** 6:30am-? **ADMISSION:** 50¢. **TALK-IN:** 146.520. **FEATURES:** C - E - FM - F/R - H. **DEALER INFO:** $7 vehicle. **CONTACT:** Pat WA6MHZ, ARCEC, Box 50, El Cajon CA 92020. 619-561-0052.

OR - MEDFORD — Swapmeet. **SPONSOR:** Rogue Valley ARC. **LOCATION:** Medford Armory, 1701 S Pacific Hwy. **HOURS:** 9am-4pm. **ADMISSION:** Adv: $5, Door $6. **TALK-IN:** South/147.160 repeater, North/ 146.940 repeater. **FEATURES:** C - CB - DP - EX - FP - F/R - H RV-S. **DEALER INFO:** Non-commer tables $10. **CONTACT:** RVARC, 1707 E Main St, Medford OR 97504 or W5HVK: 503-770-5631. VE Exams: Paul Miller, KE7VO, 503-878-3433.

OR - RICKREAL — Swap-toberfest & ARES/RACES Convention. **SPONSOR:** Mid-Valley ARES. **LOCATION:** Polk County Fairgrounds. **HOURS:** 9am-4pm. **ADMISSION:** Adv. $6, Door $7, under 12 free. **TALK-IN:** 146.86 repeater. **FEATURES:** CB - EX - F - FM - RV-S. **DEALER INFO:** Swap tables: $13, w/power: $15 Garry Zinn, KC7BSX: 503-378-3702. **CONTACT:** Evan Burroughs, N7IFJ: 503-585-5924.

OCTOBER 21-22

CA - DEL MAR — MarketPro Computer Show & Sale. **LOCATION:** Del Mar Fairgrounds. **HOURS:** 10am-5pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

OCTOBER 22

CA - STOCKTON — MarketPro Computer Show & Sale. **LOCATION:** Civic Auditorium. **HOURS:** 10am-5pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

OCTOBER 28-29

CA - POMONA — Computer Marketplace. **SPONSOR:** National Productions. **LOCATION:** Fairplex Expo Center. **HOURS:** 10am-5pm. **ADMISSION:** $7 **CONTACT:** National Productions, 408-778-5200 or 1-800-800-5600. FAX 408-779-1374.

NOVEMBER 4

CA - RESEDA — Computer Marketplace. **SPONSOR:** National Productions. **LOCATION:** Sherman Square Entertainment Center. **HOURS:** 10am-5pm. **ADMISSION:** $5. **CONTACT:** National Productions, 408-778-5200 or 1-800-800-5600. FAX 408-779-1374.

CA - SANTEE — Ham Radio, Computer & Electronics Swap Meet. **SPONSOR:** ARC of El Cajon. **LOCATION:** Santee Drive-In, 10990 N. Woodside. **HOURS:** 6:30am-? **ADMISSION:** 50¢. **TALK-IN:** 146.520. **FEATURES:** C - E - FM - F/R - H. **DEALER INFO:** $7 vehicle. **CONTACT:** Pat WA6MHZ, ARCEC, Box 50, El Cajon CA 92020. 619-561-0052.

NOVEMBER 5

CA - BUENA PARK — Computer Marketplace. **SPONSOR:** National Productions. **LOCATION:** Sequoia Conference Center. **HOURS:** 10am-5pm. **ADMISSION:** $5. **CONTACT:** National Productions, 408-778-5200 or 1-800-800-5600. FAX 408-779-1374.

CA - LIVERMORE — East Bay Area Amateur Radio/ Electronics/Computer Swap Meet **SPONSOR:** Livermore Amateur Radio Klub (LARK). **LOCATION:** Las Positas College, N of I-580 at Airway Blvd exit. **HOURS:** 7am-12noon, rain or shine. **ADMISSION:** Free. **TALK-IN:** 147.045+ (PL 94.8) from W, 145.350- (PL 100) from E. **FEATURES:** E - H - FP - F/R. **DEALER INFO:** Set-up after 7am only. $10 space fee. Covered spaces avail. if rain. **CONTACT:** Noel Anklam KC6QZK, 510-447-3857 eves or 510-783-2803 message days.

NOVEMBER 11

CA - FONTANA — Amateur Radio & Electronic Equipment Swap Meet. **SPONSOR:** Inland Empire ARC & A.B. Miller High School ARC. **LOCATION:** A.B. Miller High School, 6821 Oleander Ave. **HOURS:** 7am-? **ADMISSION:** Free. **FEATURES:** E - FP - F/R - H. **DEALER INFO:** Tailgate space $6. Set-up 6am. **CONTACT:** Bill Gruber 909-822-4138 eves. VE exams are now on the first Sat. of each month at 8am; contact Ken Canfield, 685-7694.

NOVEMBER 18

CA - SANTEE — Ham Radio, Computer & Electronics Swap Meet. **SPONSOR:** ARC of El Cajon. **LOCATION:** Sahtee Drive-In, 10990 N. Woodside. **HOURS:** 6:30am-? **ADMISSION:** 50¢. **TALK-IN:** 146.520. **FEATURES:** C - E - FM - F/R - H. **DEALER INFO:** $7 vehicle. **CONTACT:** Pat WA6MHZ, ARCEC, Box 50, El Cajon CA 92020. 619-561-0052.

NOVEMBER 18-19

CA - POMONA — Computer Marketplace. **SPONSOR:** National Productions. **LOCATION:** Fairplex Expo Center. **HOURS:** 10am-5pm. **ADMISSION:** $7. **CONTACT:** National Productions, 408-778-5200 or 1-800-800-5600. FAX 408-779-1374.

NOVEMBER 19

AZ - PHOENIX — Computer & Electronic Swap Meet. **SPONSOR:** Electronic Materials & Computers. **LOCATION:** Electronic Materials & Computers parking lot, 3102 W. Thomas Rd. #902. **HOURS:** 8am-3pm. **ADMISSION:** Free. **FEATURES:** FP. **DEALER INFO:** Vendor spaces $15. **CONTACT:** 3102 W Thomas Rd. #902, Phoenix AZ 85017. 602-272-3200.

NOVEMBER 26

CA - SANTA ANA — ACP Computer Swap Meet. **SPONSOR:** Advanced Computer Products. **LOCATION:** 1310 E. Edinger. **HOURS:** 8am-2pm, rain or shine. **ADMISSION:** Free. **FEATURES:** C - E - FP. **DEALER INFO:** All spaces $75 in advance. Call for multiple pricing. **CONTACT:** Mary Russo - 714-558-8813.

CENTRAL REGION

SEPTEMBER 2

IN - INDIANAPOLIS — Hoosier Hamfest & Computer Show. **SPONSOR:** Electronic Applications Radio Service. **LOCATION:** National Guard Armory, Holt Rd, & Minnesota off I-70. **HOURS:** 8am-? **ADMISSION:** $6. **TALK-IN:** 145.250. **FEATURES:** C - CB - E - F - FM - FP - H. **DEALER INFO:** $15 per space - tables limited, set-up 6am-8am. **CONTACT:** Marty Hensley KA9PCT, 317-253-7985 eves.

OH - TOLEDO — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** SeaGate Convention Center. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

SEPTEMBER 3

IN - FT. WAYNE — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Allen County Fairgrounds. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

SEPTEMBER 8-9-10

TX - ARLINGTON — 1995 ARRL Digital & Communications Conference. **SPONSOR:** Tucson Amateur Packet Radio & Texas Packet Radio Society. **LOCATION:** La Quinta Inn and Conference Center, 825 N. Watson Rd. **FEATURES:** F - H. **CONTACT:** Tucson Amateur Packet Radio, 8987-309 E Tanque Verde Rd, #337, Tuscon AZ 85749-9399. 817-383-0000, FAX 817-566-2544.

SEPTEMBER 9

IL - ROLLING MEADOWS — W9DXCC Convention. **CONTACT:** William McConnel N9US, 2511 Arlingdale Dr, Palatine IL 60067. 708-397-9593.

IL - WHEATON — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Dupage County Fairgrounds. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

IN - FT. WAYNE — Summit City Computer Show & Hamfest. **SPONSOR:** Fort Wayne ARC. **LOCATION:** Allen County 4-H Fairgrounds, 4 mi North of I-69 on State Road 3. **HOURS:** 8am-2pm. **ADMISSION:** $4 adv, $5 door. **TALK-IN:** 146.16/146.76. **FEATURES:** C - F/R - H - RV-S T. **DEALER INFO:** $12 inside 8' table (2 bldgs), $9 pavilion 8' table, $5 tailgate. **CONTACT:** Clifford Shreve N9MKB, 219-483-7570, 3412 Parnell Ave, Ft. Wayne IN 46805.

IN - INDIANAPOLIS — Indianapolis Computer Fair. **LOCATION:** Indianapolis Events Center, 3655 E Raymond, corner Sherman, about 5 mi E of downtown. **HOURS:** 10am-3pm. **ADMISSION:** $4, under 12 free. **FEATURES:** C - DP. **CONTACT:** Ben Yanto, AGI Computer Fairs.*

IN - LAPORTE — Hamfest. **SPONSOR:** Laporte ARC. **LOCATION:** Laporte County Fairgrounds. **HOURS:** 8am-2pm. **TALK-IN:** 146.61- (131.8 PL) 146.52 Simplex. **FEATURES:** C - E - FM - H. **CONTACT:** LARC, POB 30, Laporte IN 46352.

MI - TAYLOR — Computer Trade Show. **LOCATION:** Democratic Club of Taylor, 23400 Wick Rd, 4 blocks E of Telegraph. **HOURS:** 10am-3pm. **ADMISSION:** Adults $4; Seniors & students w/ID $3; under 12 free w/adult. **FEATURES:** C - DP. **CONTACT:** Computers & You, 313-283-1754.

SEPTEMBER 10

IA - DUBUQUE — Hamfest/Radiofest/Computer Expo. **SPONSOR:** Great River ARC. Iowa Antique RC & Historical Society. **LOCATION:** Tri-State Blind Society, 3333 Asbury Rd **HOURS:** 8am-3pm. **ADMISSION:** Adv $3, Door $4. **TALK-IN:** 147.84/24. **FEATURES:** C - CB - DP - E - EX - FM - FP - F/R - H - T. **DEALER INFO:** 8' Tables $8. Outside tailgating free with paid admission. **CONTACT:** Loren Heber N0YHZ, 319-556-5755, 9479 Laudeville Rd, Dubuque IA 52003, Jerry Ehlers, N0NLU, 319-583-1016, 3115 Brunswick St, Dubuque IA 52001.

IL - HARRISBURG — Hamfest. **SPONSOR:** Shawnee ARA. **LOCATION:** Southeastern Illinois College Rte 13, 5 mi E of Harrisburg. **HOURS:** 8am-2:30pm. **ADMISSION:** $4. **TALK-IN:** 146.880MHz, 3926.5KHz. **FEATURES:** EX - F/R - H. **DEALER INFO:** Tables $5, set-up 7am. **CONTACT:** Bob Bybee KF9YV, 2416 W North St, Harrisburg IL 62946, 618-252-7139. Ray Milhorn W9MXM, 512 S 27th St, Herrin IL 62948, 618-642-3375.

IL - JOLIET — Hamfest '95. **SPONSOR:** Bolingbrook ARS. **LOCATION:** Inwood Recreation Center, 3000 W Jefferson St, (Rte 52). **HOURS:** 8am-? **ADMISSION:** $4 adv, $5 door. **TALK-IN:** 147.33 +600KHz; 224.54 -1.6MHz 146.82 - 600KHz. **FEATURES:** AC - C - CB - DP - E - EX - FM - H - RV-S. **DEALER INFO:** Dealer perimeter tables (electricity available) $12. Main floor flea market tables (no electricity) $8. Indoor Set-up: Sat 3-6pm, Sun 6am. Table reservations, write to: BARS Hamfest Chairman, Ed Weinstein WD9AYR, 7511 Walnut Ave, Woodridge IL 60517, or call 708-759-7005. **CONTACT:** General Information: Call the BARS Hotline at 708-759-7005 between 6am-9pm. Bolingbrook Amateur Radio Society, POB 1009, Bolingbrook IL 60440.

IL - PALATINE — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Harper College. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

MI - FLINT — Computer Trade Show. **LOCATION:** Holiday Inn, 5353 Gateway Centre, Exit at Hill Rd from US-23 or I-475. **HOURS:** 10am-4pm. **ADMISSION:** Adults $4; Seniors & students w/ID $3; under 12 free w/adult. **FEATURES:** C - DP. **CONTACT:** Computers & You, 313-283-1754.

MI - WATERFORD — Computer Show. **LOCATION:** NOCCCAI Building, 5640 Williams Lake Rd., Btwn Airport Rd & RR tracks; I-75 to Exit 89, W on Walton Blvd. for 3.5 mi, Rt on Williams Lake Rd approx 1 mi. **HOURS:** 10am-4pm. **ADMISSION:** Adults $4, students & seniors w/ID $3, under 12 free. **FEATURES:** C - DP - . **CONTACT:** International Computer Trade Shows, 810-858-2416.

MO - MONETT — Hamfest & Picnic. **SPONSOR:** Ozarks ARS. **LOCATION:** Monett City Park, Hwys 60 & 37. **HOURS:** 8am-? **ADMISSION:** Free. **TALK-IN:** 146.97. **FEATURES:** DP - H - T. **DEALER INFO:** Tailgating: Free. **CONTACT:** Harold Schelin, 417-235-7801.

SEPTEMBER 15-16-17

IL - PEORIA — Superfest '95/Illinois State Convention. **SPONSOR:** Peoria Area Arc. **LOCATION:** Exposition Gardens Fairgrounds, Northmoor and University. **HOURS:** 8am-? **ADMISSION:** $5, good both days, under 12 free. **TALK-IN:** 146.160/ 146.760. **FEATURES:** CB - EX - F - FM - RV-H. **DEALER INFO:** Inside tables $10, flea market $10, set-up Fri 2pm-9pm, Sat 6:30am, Sun 7:30am. **CONTACT:** Superfest, POB 3508, Peoria IL 61612-3508. 309-694-5009.

SEPTEMBER 16

MI - HUDSONVILLE — Super Swap '95. **SPONSOR:** Grand Rapids ARA. **LOCATION:** Unity Christian High School, 3487 Oak St. **HOURS:** 8am-? **ADMISSION:** Adv $3, Door $4. **DEALER INFO:** Tables, $5. Set-up 6am. **CONTACT:** Jeff Belknap N8RWS, 454 Harp St SE, Kentwood MI 49548. 616-531-7899.

MI - TAYLOR — Computer Show. **LOCATION:** Democratic Club of Taylor, 23400 Wick Rd., E off Telegraph, 1 mi S of I-94. **HOURS:** 10am-3pm. **ADMISSION:** Adults $4, students & seniors w/ID $3, under 12 free. **FEATURES:** C - DP - . **CONTACT:** International Computer Trade Shows, 810-858-2416.

NM - SANTA FE — Hamfest. **SPONSOR:** Northern New Mexico ARC. **LOCATION:** Glorieta Conference Center, Patio Bldg, 16 mi SE of Santa Fe on I-25, Exit 299. **HOURS:** 8:30am-3pm. **ADMISSION:** $5. **TALK-IN:** 146.52 Simplex. **FEATURES:** DP - EX - F - FP - RV-H T. **DEALER INFO:** Indoor tables $10, Set-up 7am. **CONTACT:** Helenrose Burke W5IXS, Box 73 HCR, Ojo Sarco NM 87521. 505-689-2367.

OH - CLEVELAND — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Cuyahoga County Fairgrounds. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

SEPTEMBER 17

IL - GLEN ELLYN — Computer Central. **LOCATION:** College of DuPage, Park Blvd & College Rd. **HOURS:** 9:30am-3pm. **ADMISSION:** Adults $6, 8-12 $2, under 8 free. $1 off reg. adult admission w/this ad. **FEATURES:** AC - C - FP. **CONTACT:** Computer Central, Jay B. Robinson, 708-940-7547.

IN - SOUTH BEND — Camera & Computer Swap Meet. **LOCATION:** Century Center. **HOURS:** 10am-3pm. **ADMISSION:** $5, under 12 free. **DEALER INFO:** 8' tables - $50 ea. **CONTACT:** Roger L. Smith, 8863 E. Black Point Rd., Syracuse, IN 46567. 219-856-3863 VM/FAX.

MI - FLINT — Five Star Computer Shows. **SPONSOR:** Five Star Productions. **LOCATION:** Flint Holiday Inn, Gateway Centre, US-23 at Hill Rd Exit 2 miles S of I-69. **HOURS:** 10am-4pm. **ADMISSION:** $4. **FEATURES:** C - DP - FP. **CONTACT:** Five Star Productions. 810-239-3640.

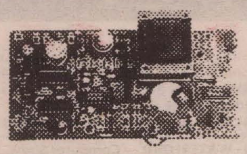
MI - MADISON HEIGHTS — Computer Trade Show. **LOCATION:** UF&CW Hall, 876 Horace Brown Dr, 1 block E of I-75, 1 block S of 13 Mile Road. **HOURS:** 10am-4pm. **ADMISSION:** Adults $4; Seniors & students w/ID $3; under 12 free w/adult. **FEATURES:** C - DP. **CONTACT:** Computers & You, 313-283-1754.

MI - MT. CLEMENS — 23rd Annual Swap N Shop. **SPONSOR:** L'Anse Creuse ARC. **LOCATION:** L'Anse Creuse High School. **HOURS:** 8am-2pm. **ADMISSION:** $5. **TALK-IN:** 147.08+, 146.52 simplex. **FEATURES:** EX - F/R - T. **DEALER INFO:** Tables: $12, trunk sale area $5, set-up 6am. **CONTACT:** Mark Castiglione N8REZ, 26279 Fairwood, Chesterfield, MI 48051-3031, 810-949-2508. VE Exams: Don Olszewski WA8IZV, 810-294-1567.

OH - AKRON — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Summit County Fairgrounds. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

OH - CINCINNATI — Hamfest. **SPONSOR:** Greater Cincinnati ARA. **LOCATION:** Shrine Oasis in Love-

Continued on page 142



SOUND-ACTIVATED ALARM BOARD

Removed from unused alarm system. When activated, this board listens for sounds made by an intruder and responds with a loud siren when tripped. Runs on 9V DC. Microphone is included. Speaker (95Z014) and battery holders are sold separately. Includes pinout diagram.

95Z015 $4.95 each

MINI AUDIO PLUGS

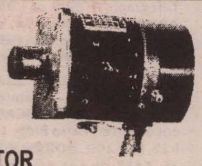
3.5mm monaural in plastic housing. Two per pack.

95J007 49¢/pack

AUTOMATIC DC/AC POWER CONVERTER

12VDC to 110 VAC at 100W. Use in your car or truck to run tools and small appliances. Has overload protection, audible alarm for low-battery indication and automatic low-voltage shutdown. Heavy duty metal case. Saiko #DAC-100.

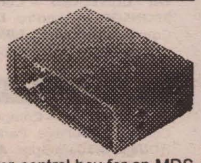
95E014 $29.95 each



STEPPER MOTOR

1.7 Volts, 3.4 Amps, 1.8°/step, with optical encoder assembly attached to rear shaft. Japan Servo Co. #KP6M2-020 or equivalent.

95M004 $14.95 each



PROJECT BOX

Used to be the power control box for an MDS receiver. It has an on/off switch on front, three "F" connectors and coaxial power jack on rear. Attractive "clamshell" box measures approx. 4½" x 3½" x 1½".

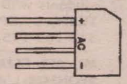
95U009 Three for $4.95

SPEAKER & GRILL COMBO

The speakers are 4 Ohm, 5 Watt units measuring 4" square at the mounting flanges. The speaker grills are an attractive flat black color and measure 5" in diameter.

95Z014 $4.95 per Set

BRIDGE RECTIFIER



KBL02. 200 Volt @ 4 Amps.

95S002 $1.49 each

MAGIC LIGHT

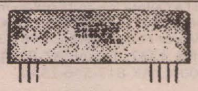
This pocket-sized ultraviolet light may be used for detecting invisible inks, minerals in rocks, etc. It's the same approximate size as a pocket pager and even has a belt clip to keep it handy. Runs on two "AA" batteries (not included). 3¼"W x 1¾"H x 1"D.

95L007 $7.95 each

680µF 250 VDC ELECTROLYTIC CAP

Radial snap-in type.

94P022 $3.49 each



BANDPASS AUDIO FILTER

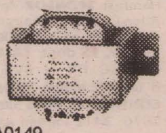
Pass 20Hz to 20 KHz. Murata #AFL811WF-2000083.

93P017 $4.95 each

TRANSISTOR SALE!

2N4033

60¢ Each - 50 for $25.00
100 for $40.00 - 1000 for $300.00



24VAC 3A POWER TRANSFORMER

110 VAC input. P/N TRA0149.

92N015 $4.95 each

6 METER FSK BOARD

Crystal controlled on 50.675 receive frequency. Super het 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

100' LONGWIRE ANTENNA KIT

For shortwave reception and transmission. End insulators included.

95A002 $4.95 each

PENTIUM HEATSINK AND COOLING FAN

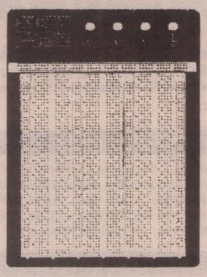
Very low profile. Fan is embedded into heatsink for a compact package. Has adhesive thermal transfer pad attached.

95C011 $8.95 each

BRAND NEW SOLAR PANELS

12 Volt, 1 Watt, 4" x 12" (92E005)	**$14.95**
12 Volt, 2 Watt, 6" x 12" (92E006)	**$24.95**
12 Volt, 4 Watt, 12" x 12" (92E007)	**$39.95**

Other sizes and voltages available.
Call of fax for stock check.
OEM pricing and custom panels available.



PROTOBOARD SB3220

9.5" x 8.3" x 1.2". Seven distribution strips; 700 distribution points. Four terminal strips; 2,520 terminal points. Four binding posts.

SB3220 $31.00 each

LED HOLDERS

92L018
200 for $9.95

MICRO SWITCH

With 1" plastic lever, N.O. and N.C. closed contacts.

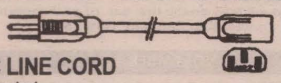
95B010 $1.25 each

Vernier Caliper

VERNIER CALIPER

Five-inch-long carbon steel, calibrated in inches and centimeters - very handy for instant conversions (who cares if it's a caliper, too?). Measures inside, outside, upside and downside. The pointy thing on the small end is used to measure depth. Thumb gizmo on top is for drag/lock and the one on the bottom is for trolling the jaws. Not NASA approved, but it doesn't cost a hundred bucks, either.

783VCI $6.25 each



IEC LINE CORD

Recycled.

95W011 Special $1.00 each

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New, in crates, with 1994 date codes.
12 Volt, 12 Amp/Hour. 5.875"L x 3.375"W x 3.625"H.

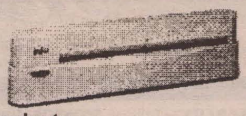
Crate of 18 Batteries - $325.00

95E024 $19.95 each

"AA" NICADS

Used, mixed manufacturers.

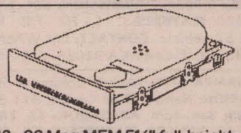
94E017 99¢ each
6 for $5.00
10 for $8.95



Info Products FULL PAGE SCANNER

400 DPI, 256 greyscale, TWAIN-compliant. Scans a full page in six seconds. Includes Windows-compatible image editing and OCR software. Very small footprint - 3.5" x 12.2".

SF2HGS $225.00 each



USED HARD DRIVE

Quantum Q540 - 36 Meg MFM 5¼" full-height.

94C025 $24.95 each

16-BIT SCSI CONTROLLER CARD

DTC 3280AS. ASPI drivers included. Corel-supported.

95C003 $79.95 each

16-BIT ESDI CONTROLLER CARD

Adaptec ACB-2322. Hard and floppy: Tested, with docs.

95C018 $19.95 each

VIDEO SWITCHING CENTER

Five inputs (VCR, Game, CATV, Aux, Ant), two outputs (TV, VCR). Measures 6.25"W x 5.5"D x 1.5"H. These units are new in box and come with instructions.

94V004 $9.95 each

SHAPE-MEMORY LINEAR ACTUATOR

This one inch-pound actuator is made of brass and plastic, and incorporates a helical spring made of the nickel-titanium alloy called Tinel®. This metal enables the actuator to perform a unique set of electromechanical functions. The device provides linear actuation in minimal space, without gears or converters, with nominal one-pound force continuously throughout its stroke. Shape-memory actuation starts and stops gently, minimizing vibraton. There are no magnetic materials, and the unit is resistant to corrosion, jams and overloads. Applications include robotics, doors, valves, toys, shutters, security devices, manipulators and many others. The unit may be operated by temperature or electricity. Spec sheets included.

Nominal Specificatons:

Operating voltage:	1V, 5A
Electrical resistance:	0.2 Ohms
Pull in cycle:	2 sec.
Relax cycle:	8 sec.
Max. cycle rate:	6 cpm
De-energized length:	100mm
Energized length:	75mm
Diameter:	9mm
Stroke:	20mm
Self-activating temperature:	165°F

95T001 $7.95 each

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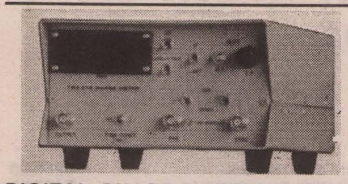

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HP 6260A power supply 0-10 volt, 0-100 amp $325. Dexis, 612-944-7670.

WANTED: SERVICE monitors-IFR, Motorola, Marconi, HP, Hewlett Packard signal generators, etc. 716-661-9964 or FAX 716-763-0371.

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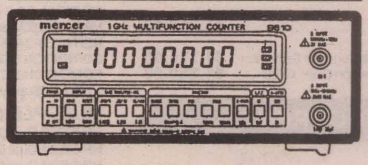
GIGATRONICS 1026-01 50MHz-26GHz LEVELED SYTHESIZED SWEEPER with HSR, frequency selective counter, digital power meter, cable compensation; **$12,900. GIGATRONICS 840 26-40 GHz LEVELED FREQUENCY DOUBLER/ AMPLIFIER,** calibrated variable output to over +10dBm. List $22,000; SPECIAL **$1,500**. 90-DAY WARRANTY. 619-439-1345, 800-TO-BUY-TE.



1GHZ FREQUENCY counter. Mercer (Div. of Simpson) Model 9810. 1 PPM time base stability, Low pass filter, 8 digit LED display. New in box, $209 plus UPS. MDM Radio, Ltd., 7112 Roosevelt Rd., Oak Park, IL 60304. 708-848-4210. Visa/MC.

TEKTRONIX 7000 SERIES VERTICAL AMPLIFIERS: 7A13 105MHz differential comparator (LED) $350. **7A18** 75MHz dual-trace $50; **7A18A** (newer version) $85; **7A18/6** (with variable offset) $110. **7A22** 1MHz high-sensitivity, differential $375. **7A24** 400MHz dual-trace $250. **7A26** 200MHz dual-trace $135. **7A29** 1000MHz single-trace $750. **7A42** 350MHz 4-channel $595. Excellent condition! Other plug-ins, mainframes, package discounts available. All with warranty. Pepper Systems, 214-353-0257.

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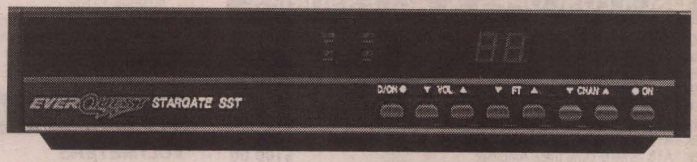

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FNB-33(S) 4.8v @ 1500 mAh
FNB-35SS 7.2v @ 1500 mAh
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OSCILLOSCOPES & ACCESSORIES

TO MHz

TEK 5440 50 MHz 4-Trace Oscilloscope System, w/(2)5A48, 5B42 .... $650.00
TEK 5A13N Differential Comparator $300.00
TEK 5A18N 2 MHz Dual Trace Amplifier $125.00
TEK 5A19N 2 MHz Differential Amplifier $175.00
TEK 5B10N 2 MHz Time Base / Amplifier $100.00
TEK 7A13 100 MHz Differential Comparator Amp., LED display $400.00
TEK 7A18 75 MHz Dual Trace Amplifier $100.00
TEK 7A22 1 MHz High CMRR Differential Amplifier $400.00
TEK 7B53A 100 MHz Dual Time Base $200.00
TEK SC502 15 MHz Dual Trace Oscilloscope, TM500 series $375.00

ABOVE 100 MHz

TEK 475 200 MHz Dual Trace Oscilloscope $850.00
TEK 485 350 MHz Dual Channel Oscilloscope $1,100.00
TEK 7904 500 MHz 4-slot frame $500.00
TEK 7904 500 MHz System, with 7A24, 7A26, 7B92A $1,100.00
TEK 7904 500 MHz System, with 7A24, 7A26, 7B80, 7B85 .... $1,100.00
TEK 7A16A 225 MHz Single Trace Amplifier $150.00
TEK 7A19 600 MHz Single Channel Amplifier $250.00
TEK 7A24 400 MHz Dual Trace Amplifier $450.00
TEK 7A26 200 MHz Dual Trace Amplifier $250.00
TEK 7A29 1 GHz Single Channel Amplifier $850.00
TEK 7B10 1 GHz Time Base $500.00
TEK 7B15 1 GHz Delaying Time Base $600.00
TEK 7B80 400 MHz Delayed Time Base $200.00
TEK 7B85 400 MHz Delta Delaying Time Base $250.00
TEK 7B92A 500 MHz Dual Time Base $450.00

STORAGE

TEK 5441 50 MHz 4-Trace Storage System, w/(2)5A48, 5B42 .... $850.00
TEK SC503 10 MHz Dual Trace Storage Oscilloscope, TM500 series $700.00

SAMPLING

TEK 7854 400 MHz Waveform Processing frame, GPIB $1,500.00
TEK 7S11 Sampling Unit $450.00
TEK 7S14 1 GHz Dual Channel Sampling Unit $700.00
TEK 7T11 Sampling Sweep Unit $950.00

PROBES

TEK 1101 Accessory Power Supply, for FET probes $250.00
TEK P6201 900 MHz 1X/10X/100X FET Probe $500.00
TEK P6205 750 MHz 10X FET Probe, for TDS/DSA/CSA/11000 series $275.00

CALIBRATION

TEK CG551AP/TM506A Oscilloscope Calibrator, with pulse head & power module $3,500.00

WAVEFORM GENERATORS

FUNCTION

HP 3310A 5 MHz Function Generator $325.00
HP 3310B 5 MHz Function Generator, monocycle & var.phase trigger $425.00
HP 3312A 13 MHz Function Generator, sweep, AM, FM $850.00
HP 8015A 50 MHz Dual Output Pulse Generator $650.00
HP 8015A-002 50 MHz Dual Output Pulse n $750.00 Generator, burst mode optio
TEK DD501 Digital Delay & Burst Gen., for function & pulse gen's $375.00
TEK FG502 11 MHz Function Generator, TM500 series $325.00
TEK FG504 40 MHz Function Generator, TM500 series $875.00
TEK RG501 Ramp Generator, TM500 series $225.00
WAVETEK 142 10 MHz Function Generator $275.00
WAVETEK 148 20 MHz Function Generator, AM/FM/PM modulation $700.00
WAVETEK 166 50 MHz Pulse/Function Generator $1,250.00
WAVETEK 188 4 MHz Sweep/Function Generator, 20Vp-p $275.00

PULSE

HP 214B 10 MHz Pulse Generator, 50V/50 Ohms, auto duty cycle $2,250.00
HP 8005B 20 MHz Dual Output Pulse Generator $450.00
HP 8007B 100 MHz Pulse Generator $650.00
HP 8013B 50 MHz Dual Output Pulse Generator, 3.5 nS fixed Tr $700.00
HP 8080A/81A/82A/83A 300 MHz Word Generator $900.00
HP 8080A/91A/92A/2x93A 1 GHz Dual Channel Pulse Generator $1,650.00
HP 8080A/91A/92A 1 GHz Single Channel Pulse Generator $1,400.00
HP 8080A/91A/93A 1 GHz Clock Generator $900.00
HP 8082A 250 MHz Dual Output Pulse Generator $1,400.00
PHILIPS PM5785B 125 MHz Dual Output Pulse Gen., burst mode, 1 nS Tr $1,100.00
PICOSECOND PULSE LAB 4600A 10V Step/ 3V Impulse Gen., 70 pS Tr, 0-100 kHz rep.rate $650.00
TEK PG501 50 MHz Pulse Generator, TM500 series $300.00
TEK PG502 250 MHz Pulse Generator, Tr<1nS, TM500 series $700.00
TEK PG505 100 kHz Pulse Generator, 80V, TM500 series $275.00
WAVETEK 801 50 MHz Pulse Generator $550.00

PROGRAMMABLE

HP 3325A Synthesizer / Function Generator, 1 uHz-21 MHz $2,500.00
HP 8165A Programmable Signal Source, 1 mHz-50 MHz $2,600.00
TEK AWG5102 Arb.Waveform Gen., 20 MS/s, 12 bits,50ppm synthesis <1MHz $1,800.00
TEK AWG5105 Arbitrary Waveform Generator, 50 MS/s, 12 bits $2,200.00
TEK AWG5105-opt.02 Arbitrary Waveform Generator, dual channel option $3,000.00
TEK PFG5505 Programmable 12 MHz Pulse/Function Generator $1,275.00
WAVETEK 275-opt.02 12 MHz Arbitrary Function Gen., GPIB $1,250.00

VOLTAGE & CURRENT

VOLTMETERS

HP 3456A 6-1/2 digit Voltmeter $850.00
SOLARTRON 7150 5-1/2 / 6-1/2 digit Multimeter, GPIB $550.00

CALIBRATION

FLUKE 332B/AF DC Voltage Calibrator, 0-1111V, 0-50 mA, 7 decades $675.00
FLUKE 343A DC Voltage Calibrator, 0-1100V, 7 decades, 20 ppm acc. $1,375.00
FLUKE 515A Portable Calibrator, DC/AC/Ohms, line & battery power $1,700.00

VOLTAGE SOURCES

HP 6114A Precision Dual Range Power Supply, 20V 2 A / 40V 1 A $875.00
HP 6115A Precision Dual Range Power Supply, 50V 0.8A / 100V 0.4A $875.00

CURRENT METERS & SOURCES

DRANETZ 656A / (3)TR2019A Current Demand Analyzer, w/(3) current probes 300A max. $5,000.00
HP 6177C DC Current Source, to 50V, 500mA $600.00
HP 6181C DC Current Source, to 100V, 250 mA $675.00
HP 6186C DC Current Source, to 300V, 100mA $750.00
KEITHLEY 225 Current Source, 1 nA-99.9 mA, 10-100 V compliance $450.00
KEITHLEY 414A Picoammeter, 0.1 nA-10 mA $325.00
KEITHLEY 480 Picoammeter, 1 nA-1 mA f.s., 3 digit $450.00
KEITHLEY 642 Electrometer $3,900.00
LEEDS & NORTHRUP 4360 Precision Current Shunts, 15-500 Amp $650.00
TEK CT-5 High Current Transformer for P6021/A6302, to 1000A $650.00

IMPEDANCE & COMPONENT TEST

L.C.R.

BOONTON 62AD 1 MHz Inductance Meter, 2-2000 uH $700.00
BOONTON 72BD 1 MHz Digital Capacitance Meter, 2-2000 pF $700.00
E.S.I. 296V 4-1/2 Digit LCR Bridge, 120 Hz & 1 kHz $850.00
HP 4261A 3-1/2 digit LCR Meter, 120 Hz/1 kHz $1,100.00
HP 4262A-101 3-1/2 digit LCR Meter, 120 Hz/1 kHz/10 kHz, HPIB $2,100.00
HP 4275A Multi-Frequency LCR Meter, 10 kHz-10 MHz $6,250.00
MEGURO MQ-171 VHF Q Meter, 20-230 MHz, Q=10-500, freq. readout 100 Hz $1,100.00

STANDARDS

E.S.I. RS-925 9-Decade Resistor, 0.01 ohm-1.2 Megohm $2,000.00
E.S.I. SR1010 Resistance Transfer Standards, 1 ohm-100 K/step $700.00
E.S.I. SR104 10 kilohm Standard Resistor, 0.5 ppm/year $2,500.00
FLUKE 5450A Programmable Resistance Standard, 2 & 4 wire $2,750.00
GR 1409-SERIES Standard Mica Capacitors, 0.05% accuracy $150.00
GR 1413 5-Decade Precision Capacitor, 0-1.1110 uF, 1 pF res. $1,675.00
GR 1422-N Precision Cap., 100-1150 pF, 0.2 pF res., 1% to 10 MHz $650.00
GR 1432-N 5-Decade Resistor, to 11,111 ohms, 0.1 ohm res. $275.00
GR 1432-U 4-Decade Resistor, 0-111.10 ohms, 0.01 ohm resolution $175.00
GR 1433-X 6-Decade Resistor, to 111,111.0 ohms, 0.1 ohm res. $550.00
GR 1434-G 7-Decade Resistor, 0-1,111,111.0 ohms, 0.1 ohm res. $500.00

HI & LO RESISTANCE

GR 1666 DC Resistance Bridge, 1 micro-ohm - 100 kilohms $1,000.00
HP 4328A-001 Milliohmeter, 0.001-100 ohms f.s., battery option $1,350.00
HP 4329A High Resistance Meter, 500K ohm- 2x10E16 ohm, 10-1000V $1,350.00
VALHALLA 4150-ATC 4-1/2 digit Ohmmeter, 20 milliohms-2 kilohms, 4-wire $1,000.00

CURVE TRACERS

HP 4145A Semiconductor Parameter Analyzer $12,000.00
TEK 577D1/177 Storage Curve Tracer, with standard test fixture $2,250.00
TEK 577D2/177 Curve Tracer, with standard test fixture $1,950.00
TEK 7CT1N Curve Tracer, to 0.5W, 7000 series $500.00

T.D.R.

TEK 1502-opt.04 Time Domain Reflectometer, 0-2,000 feet, chart recorder $2,250.00
TEK 1503-opt.04 Time Domain Reflectometer, 0-50,000 feet,chart recorder $2,000.00

POWER SUPPLIES

SINGLE OUTPUT

GLASSMAN PS/EG-05R06 5kV CV/CL Power Supply, to 6mA $500.00
HP 6023A Autoranging Power Supply, to 20V / 30 A / 240 Watts $1,000.00
HP 6207B 160 V at 200 mA CV/CC Power Supply $300.00
HP 6260B-027 10V at 100A CV/CC Power Supply $675.00
HP 6261B-027 20V at 50 A CV/CC Power Supply $675.00
HP 6263B 20V at 10 A CV/CC Power Supply $400.00
HP 6266B 40V at 5 A CV/CC Power Supply $400.00
HP 6267B 40V at 10 A CV/CC Power Supply $550.00
HP 6268B 40V at 30 A CV/CC Power Supply $850.00
HP 6299A 100 V at 750 mA CV/CC Power Supply $250.00
HP 6384A 4.0-5.5V at 8 A CV/CL Power Supply $175.00
HP 6438B 60V at 5A CV/CC Power Supply $375.00
KEITHLEY 240A HV Power Supply, 0-1200V, 0-10 mA, CV/CL $250.00
SORENSON DCR 110-45T 110V at 45 A CV/CC Power Supply $2,200.00
SORENSON DCR 300-8A 300V at 8 A CV/CC Power Supply; 208/230VAC line $950.00

MULTIPLE OUTPUT

HP 6227B Dual 25 V at 2 A CV/CC Power Supply $650.00
HP 6253A Dual Output 20V 3 A CV/CC Power Supply $500.00
HP 6255A Dual Output 40V 1.5 A CV/CC Power Supply $500.00

MISCELLANEOUS

ACME PS2L-1000 Programmable Load, 0-75V / 0-150 A / 1000 Watts max. $450.00
HP 59501A HPIB Isolated DAC/Power Supply Programmer $175.00
HP 6824A Bipolar Power Supply/Amplifier, to 50V, 1 A $400.00
HP 6827A Bipolar Power Supply/Amplifier, to 100V, 500 mA $800.00
KEPCO BOP-100-4M 100V, 4 A Four Quadrant Bipolar Supply / Amplifier $1,000.00
KEPCO BOP-36-5M Bipolar Op Amp/Power Supply, to 36V, 5 A $550.00

TIME & FREQUENCY

UNIVERSAL COUNTERS

HP 5314A 100 MHz/100 nS Universal Counter $225.00
HP 5315A 100 MHz/100 nS Reciprocal Counter, high res. audio $550.00
HP 5315A-001 100 MHz/100 nS Universal Counter, TCXO reference $650.00
HP 5316A-003 100 MHz/100 nS Universal Counter, HPIB, 1.0 GHz C-chan. $1,000.00
HP 5335A 200 MHz Universal / Statistical Counter $1,500.00
HP 5335A-010,20,30,40 200 MHz Counter, OCXO, DVM, 1.3 GHz C-ch.,expanded HPIB $2,350.00
HP 5370B-001 100 MHz Univ. Time Int. Counter, 20 pS single shot,OCXO $2,250.00
HP E1420A-010,030 VXI card 200 MHz/ 2 nS Univ. Counter, TCXO& 2.5 GHz C-ch $1,500.00
PHILIPS PM6654/056 120 MHz/ 2 nS Programmable High Res. Counter, OCXO,GPIB $950.00
TEK 7D15 225 MHz Universal Counter/Timer, 7000 series $275.00
TEK DC5004 Programmable 100 MHz/100nS Counter/Timer, TM5000 series $475.00
TEK DC5009-opt.01 Programmable 135 MHz Univ. Counter/Timer, TCXO, TM5000 .... $750.00
TEK DC5010 350 MHz/3.125 nS Univ. Counter, TM5000 series $1,200.00
TEK DC503A 125 MHz Universal Counter/Timer, TM500 series $500.00
TEK DC509 135 MHz High Resolution Universal Counter/Timer, TM500 .... $700.00
TEK DC510 350 MHz/3.125 nS Universal Counter, TM500 series $900.00

FREQUENCY COUNTERS

EIP 545-opt.05,08 18 GHz Frequency Counter, OCXO and GPIB $1,875.00
FLUKE 7220A-opt.111 1.3 GHz Communications Counter, TCXO option $650.00
HP 5305B/5300B-001 1.3 GHz Counter Package w/TCXO ref., high res. audio $450.00
HP 5340A-001,011 18 GHz Frequency Counter, OCXO reference, HPIB $1,900.00
HP 5342A-001,011 18 GHz Frequency Counter, OCXO, HPIB $2,750.00
HP 5342A-01,04,05,11 24 GHz Frequency Counter, OCXO, DAC, and HPIB $3,900.00
HP 5345/5355/5356A-006 Pulsed/CW Frequency Counter, 0.4-18.0 GHz, 75 nS pulse $3,500.00
HP 5361A-006 20 GHz Pulsed/CW Frequency Counter, 10 Watt protection $6,750.00
SYSTRON-DONNER 6054B 24 GHz Frequency Counter $1,875.00
SYSTRON-DONNER 6054B-opt.05,26 26.5 GHz Frequency Counter, GPIB $2,400.00
SYSTRON-DONNER 6245A-opt.12 18 GHz Frequency Counter, OCXO option $1,500.00
TEK 7D14 525 MHz Frequency Counter, 7000 series $175.00
TEK DC504 80 MHz Frequency Counter $125.00

STANDARDS

HP 5087A-031 Distribution Amp., 0.1/1.0/5.0 MHz x 4 channels each $1,800.00
HP 5359A Time Synthesizer, pulse width 5 nS-160 mS, jitter<200pS $2,000.00

AUDIO & BASEBANDS

SPECTRUM ANALYZERS

HP 3580A-002 Spectrum Analyzer, 5 Hz-50 kHz, 1 Hz res., bal. input $1,850.00
HP 3581A Wave Analyzer, 15 Hz-50 kHz $1,000.00
HP 3582A FFT Spectrum An., 25.6 kHz max., dual channels, HPIB $2,500.00
HP 3586C Selective Level Meter, 50 Hz-32.5 MHz, 50 & 75 ohms $1,750.00
HP 8556A LF Section, 20 Hz-300 kHz $500.00

DISTORTION ANALYZERS

HP 334A Distortion Analyzer, 5 Hz-600 kHz, -60 dB, auto nulling $550.00
HP 339A Distortion Analyzer, built-in low distortion osc. $2,400.00
HP 8903A Audio Analyzer, 20 Hz-100 kHz; THD, SINAD, S/N $2,750.00
TEK DA4084 Programmable Distortion Analyzer, 0.0025% THD, w/frame $1,500.00

RMS VOLTMETERS

FLUKE 8920A True RMS Voltmeter, 180 uV-700V, 10 Hz-20 MHz $700.00
HP 3400A RMS Voltmeter, 10 Hz-10 MHz $250.00

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HP 400FL AC Voltmeter, 100 uV-300 V f.s., 20 Hz-4 MHz $200.00

OSCILLATORS

FLUKE 6011A Synthesized Signal Gen., 10 Hz-11 MHz, 10 Hz res. $1,200.00
HP 204D Oscillator, 5 Hz-1.2 MHz, 5VRMS, 80 dB step attenuator $200.00
HP 209A Sine/Square Wave Generator, 4 Hz-2 MHz, 5 VRMS max. $225.00
HP 652A Test Oscillator, 10 Hz-10 MHz $300.00
ROCKLAND 5100 Synthesizer, 1 mHz-1.999999999 MHz $400.00

FILTERS, MISCELLANEOUS

HP 3575A-002 Phase-Gain Meter, 1 Hz-13 MHz, dual display $900.00
KROHN-HITE 3202 Dual High-Pass/Low-Pass Filter, 20 Hz-2 MHz, 24 dB/oct $600.00
KROHN-HITE 3342 Dual HP/LP Filter, 0.001 Hz-99.9 kHz, 48 dB/octave $1,100.00
KROHN-HITE 3343 Dual HP/LP Filter, 0.01 Hz-99.9 kHz, 48 dB/octave $950.00
TEK AM502 Differential Amplifier, 0.1 Hz-1 MHz, TM500 series $575.00

RF & MICROWAVE

SPECTRUM ANALYZERS

HP 11970A WR28 Harmonic Mixer, 26.5-40 GHz $1,100.00
HP 11970Q WR22 Harmonic Mixer, 33-50 GHz $1,400.00
HP 11970U WR19 Harmonic Mixer, 40-60 GHz $1,400.00
HP 11971A WR28 Harmonic Mixer, 26.5-40.0 GHz, for 8569B $1,100.00
HP 11971K WR42 Harmonic Mixer, 18.0-26.5 GHz, for 8569B $1,100.00
HP 5371A Modulation Domain Analyzer, 125 mHz-500 MHz $5,900.00
HP 8406A Comb Generator, 1/10/100 MHz increments, to 5 GHz $450.00
HP 8443A Tracking Generator, 0.1-110 MHz, LED display $700.00
HP 8444A Tracking Generator, 0.1-1300 MHz, for 8554B $800.00
HP 8444A-059 Tracking Generator, 0.5-1500 MHz, for 8554,8568,etc. $1,500.00
HP 8445B Preselector, 1.8-18.0 GHz, for HP 8555A $800.00
HP 8552B IF Section $750.00
HP 8553B RF Section, 1 kHz-110 MHz $500.00
HP 8554B RF Section, 0.1-1250 MHz $800.00
HP 8554B/8552B/141T Spectrum Analyzer, 100 kHz-1250 MHz, 100 Hz resolution $2,000.00
HP 8555A RF Section, 0.01-18 GHz $950.00
HP 8555A/8552B/141T Spectrum Analyzer System, 10 MHz-18 GHz, 100 Hz res. $2,375.00
HP 8555A/8552B/8445/141 As above, w/1.8-18 GHz Preselector, opt.003 freq.display $3,000.00
HP 8558B/181TR Spectrum Analyzer, 0.1-1500 MHz, 1 kHz res., w/display $2,250.00
HP 8559A/181TR Spectrum Analyzer, 0.01-21 GHz, 1 kHz res., w/display $4,500.00
HP 85711A CATV Measurements Personality, for 8590 series $375.00
TEK 496P Spectrum Analyzer, 10 kHz-1.8 GHz, 30 Hz res., GPIB $5,500.00
TEK 7L18/7603 Spectrum Analyzer, 1.5-18.0 GHz, 30 Hz res., w/display $3,400.00
TEK TR503 Tracking Generator, 0.1-1800 MHz, for 492/4/5/6 ..... $1,750.00

NETWORK ANALYZERS

HP 11590A Bias Network, 1.0-12.4 GHz, N(f/f) $375.00
HP 11590A-001 Bias Network, 1.0-18.0 GHz, APC7 ..... $450.00
HP 11665B Modulator, 0.15-18.0 GHz, for use with 8755/6/7 ..... $375.00
HP 8407A/8412A/8601A Network Analyzer, 100 kHz-110 MHz, with sweep generator $1,250.00
HP 85020A Directional Bridge, 0.01-4.3 GHz, N(f), for 8755/6/7 ..... $750.00
HP 85021A Directional Bridge, 0.01-18.0 GHz, APC7, for 8755/6/7 ..... $1,200.00
HP 85027E Directional Bridge, 10 MHz-26.5 GHz, for 8757 series $2,000.00
HP 85050D APC7 Calibration Kit, for 8510 series $1,100.00
HP 8505A-005/8503A Network An., 0.5-1300 MHz, w/S-Parameter & phase lock $6,000.00
HP 8755C/11666A-02/181T Scalar Network An. w/dir. bridge, 10 MHz-18 GHz & frame $1,750.00
NARDA 7000A/7202/7206 Microwave Multimeter System: scalar analysis 0.1-18 GHz $1,950.00
WILTRON 560/ 3x-7S50 Scalar Network Analyzer, w/3 detectors, 0.01-18.5 GHz $2,000.00
WILTRON 560/ 560-98K50 Scalar Network Analyzer, w/VSWR Autotester 0.01-40 GHz $2,950.00
WILTRON 640/G50/E(2)/7B50(2) Network An., w/1-1500 MHz source, (2) log amp, (2) det. $1,675.00

SIGNAL GENERATORS

BOONTON 1020 Synthesized Signal Gen., 0.15-540 MHz, GPIB $1,850.00
BOONTON 102C Signal Generator, 0.45-520 MHz, AM, FM $850.00
FLUKE 6060A-488 Synth. Signal Gen., 100 kHz-1040 MHz, 100 Hz res., GPIB $3,500.00
FLUKE 6060A/AN Synthesized Signal Gen., 10 kHz-520 MHz, 10 Hz res,GPIB $2,000.00
GIGATRONICS 605/0.01-8.0, opt.3 Synthesized Source, 10 MHz-8 GHz, 1 kHz res. $3,000.00
GIGATRONICS 605/10-18, opt.3 Synthesized Source, 10-18 GHz, 1 kHz res. $3,000.00
GIGATRONICS 605/6-12, opt.3 Synthesized Source, 6-12 GHz, 1 kHz res. $3,000.00
GIGATRONICS 875/50 Levelled Multiplier, x4, 50.0-75.0 GHz output, -3 dBm $3,500.00
GIGATRONICS 875/86 Levelled Multiplier, 26.5-40.0 & 50.0-75.0 GHz outputs $7,000.00
HP 85100V Frequency Mult., 10-15 GHz in / 50-75 GHz out >0 dBm $4,250.00
HP 8654A Signal Generator, 10-520 MHz, calibrated AM & uncal. FM $625.00
HP 8654B Signal Generator, 10-520 MHz, calibrated AM & FM $750.00
HP 8660B/86601A/86633B Synthesized Signal Generator, 0.1-110 MHz, AM, FM $1,500.00
HP 8660B/86602A/86632A Synthesized Signal Generator, 1-1300 MHz, AM, FM $2,500.00
HP 8660C/86602B/86633B Synthesized Signal Generator, 1-1300 MHz, AM, FM $2,750.00
HP 8660C/86603A/86633B Synth. Sig. Gen., 1-2600 MHz, AM, FM, digital sweep $4,500.00
HP 8683B Signal Generator, 2.3-6.5 GHz, AM, WBFM, Pulse $5,000.00
HP 8684B Signal Generator, 5.4-12.5 GHz, AM, WBFM, Pulse $5,000.00
WILTRON 6742A Synthesizer/Sweep Generator, 18.0-26.5 & 26.5-40.0 GHz $9,000.00

SWEEP GENERATORS

EIP 928-opt.9201 Sweep Gen., 1.0-18.6 GHz, step atten.,power sweep, GPIB $4,000.00
GIGATRONICS 900/0.05-12, opt.3 Synthesized Sweep/Sig. Gen., 50 MHz-12 GHz, 1 kHz res. $4,500.00
HP 8350A/86290B-H08 Programmable Sweep System, 2:0-22.0 GHz, +4 dBm lvl'd $5,500.00
HP 8601A Generator/Sweeper, 0.1-110 MHz, +20 dBm levelled $500.00
HP 8620C Sweep Oscillator Frame $550.00
HP 8620C-011 Sweep Oscillator Frame, HPIB programmable $675.00
HP 86222A-002 RF Plug-in, 10-2400 MHz, 70 dB step attenuator $1,750.00
HP 86222B-002 RF Plug-In, 10-2400 MHz, crystal markers, 0-70 dB atten $1,950.00
HP 86230B RF Plug-in, 1.8-4.2 GHz, +10 dBm unlevelled $675.00
HP 86240B RF Plug-in, 2.0-8.4 GHz, +13 dBm levelled $1,000.00
HP 86241A-001 RF Plug-in, 3.2-6.5 GHz, +8 dBm levelled $500.00
HP 86242D-004,008 RF Plug-In, 5.9-9.0 GHz, +10 dBm levelled $500.00
HP 86245A RF Plug-in, 5.9-12.4 GHz, +16 dBm levelled $1,100.00
HP 86250D-001 RF Plug-in, 8.0-12.4 GHz, +10 dBm levelled $700.00
HP 86260A RF Plug-in, 12.0-18.0 GHz, +10 dBm unlevelled $1,000.00
HP 86260A-H04 RF Plug-in, 10.0-15.0 GHz, +10 dBm unlevelled $1,100.00
HP 86290A RF Plug-in, 2.0-18.0 GHz, +7 dBm levelled $1,750.00
HP 86290B RF Plug-In, 2.0-18.6 GHz, +10 dBm levelled $2,000.00
HP 86290C RF Plug-in, 2.0-18.6 GHz, +13 dBm levelled $2,500.00
WAVETEK 1001A Sweep Generator, 0.5-300 MHz $350.00
WAVETEK 1067 Sweep Generator, 1-400 MHz, +10 dBm, 75 ohms $500.00
WAVETEK 954 Signal/Sweep Generator, 3.7-7.6 GHz, +7 dBm unlevelled $1,750.00
WAVETEK 962 Sweep Generator, 1.0-4.0 GHz, markers, +12 dBm unlvld. $2,000.00

POWER METERS

BOONTON 4200-01B/-4G Power Meter w/sensor, 1 MHz-26.5 GHz,-60 to +10 dBm,GPIB $1,500.00
BOONTON 42B/41-4E Analog Power Meter, with 1 MHz-18 GHz sensor $650.00
BOONTON 42B/42A-S3 Analog Power Meter, with 1 MHz-8.4 GHz N(f) sensor $375.00
GENERAL MICROWAVE 476/4240A Power Meter & Sensor, 0.01-18 GHz, -35 to +10 dBm $375.00
HP 11683A Range Calibrator, for HP 435/6/7/8 ..... $750.00
HP 432A/478A Power Meter, 0.01-10 GHz, -20 dBm to +10 dBm f.s. $375.00
HP 432A/8478B Power Meter, 0.01-18 GHz, -20 to +10 dBm f.s. $500.00
HP 432C Autoranging Digital Power Meter, 10 uW-10 mW f.s. $425.00
HP 435A/8481A Power Meter, 10 MHz-18 GHz, -30 to +20 dBm $1,000.00
HP 435A/8482A Power Meter, 0.1-4200 MHz, -30 to +20 dBm $1,000.00
HP 435A/8482H Power Meter, 0.1-4200 MHz, -15 to +34 dBm $1,150.00
HP 435A/8484A Power Meter, 10 MHz-18 GHz, -70 to -20 dBm $1,000.00
HP K486A WR42 Thermistor Mount, 18.0-26.5 GHz, for 432 series $400.00
HP Q8486A Power Sensor, 33.0-50.0 GHz, WR22 waveguide $1,500.00
HP R486A WR28 Thermistor Mount, 26.5-40.0 GHz, for 432 series $400.00

RF MILLIVOLTMETERS

MILLIVAC MV-723BBRS RF Millivoltmeter, 10 kHz-1.2 GHz, 1 mV-30V $375.00
RACAL 9303 TRMS Level Meter, 10 kHz-2 GHz, -77 to +23 dBm, GPIB $875.00

AMPLIFIERS, MISCELLANEOUS

AILTECH 7616 Noise Source, 1.0-12.4 GHz, N(m), 15 dB ENR $375.00
AILTECH 7618E Noise Source, 10 MHz-18 GHz, SMA(m), 15 dB ENR $500.00
AMPLIFIER RESEARCH 1W1000 Amplifier, 30 dB gain, 1-1000 MHz, 1 Watt output $650.00
BOONTON 82AD FM/AM Modulation Meter, 10-1300 MHz $1,000.00
ENI 403LA Amplifier, 37 dB gain, 150 kHz-300 MHz, 3 Watts $700.00
ENI 600L Amplifier, 24 dB, 0.8-1020 MHz, 150 mW $450.00
ENI A150 Amplifier, 55 dB, 0.3-35.0 MHz, 150 Watts $2,000.00
ENI A300 Amplifier, 55 dB, 0.3-35.0 MHz, 300 Watts $3,500.00
HP 8901B Modulation Analyzer, 150 kHz-1300 MHz $10,000.00
HUGHES 1177H01F000 TWT Amplifier, 30 dB, 2-4 GHz, 10 Watts $1,750.00
HUGHES 1177H02R000 TWT Amplifier, 30 dB, 4-8 GHz, 10 Watts $1,750.00
M.P.D. LAB2-1020-2A Amplifier, 34 dB, 1.0-2.0 GHz, 2 Watts $1,000.00
M.P.D. LAB2-110-1E Amplifier, 30 dB, 100-1000 MHz, 1 Watt $700.00
M.P.D. LAB2-714-3A Amplifier, 34 dB, 0.7-1.4 GHz, 3 Watts $1,000.00
MARCONI TF2304 AM/FM Modulation Meter, 18-1000 MHz, FM dev.1.5-150 kHz $500.00
MICROWAVE SEMI.CORP. MC5112 Noise Source, 25.5 dB ENR, 1.0-12.4 GHz, N(m), +28 VDC $325.00
VARIAN VZC6961D4N TWT Amp., 5.9-6.4 GHz, 20 Watts (from 4 to 8 GHz >10 W) $1,500.00

COAXIAL & WAVEGUIDE

AEROWAVE 15-3000/10WR15 Directional Coupler, 10 dB, 50-75 GHz $400.00
AEROWAVE 22-3000/10WR22 Directional Coupler, 10 dB, 33-50 GHz $400.00
ANZAC MDC-171 Mixer, RF/LO=4-18 GHz, LO +7 dBm, IF=DC-4 GHz, SMA $135.00
AVANTEK YO83-4037 YIG Tuned Osc.,5.4-10 GHz, +15/-5 V, TUNE & FM coils,NEW $100.00
GR 874-LTL Constant Impedance Trombone Line, 0-44 cm, DC-2 GHz $450.00
GR 900-LB Precision Slotted Line, 0.3-8.5 GHz, 50 Ohms 0.1% tol. $450.00
GR 900-Q GR900 14mm Interseries Adapters $125.00
HP 11691D Directional Coupler, 22 dB, 2-18 GHz $500.00
HP 11692D Dual Directional Coupler, 22 dB, 2-18 GHz $900.00
HP 33330D Detector, 0.01-33.0 GHz, APC3.5(m)/SMC(f) $275.00
HP 778D Dual Directional Coupler, 20 dB, 100-2000 MHz $550.00
HP 779D Directional Coupler, 20 dB, 1.7-12.4 GHz $375.00
HP 8472A Crystal Detector, 10 MHz-18 GHz, neg. pol., SMA(m) $150.00
HP K532A WR42 Frequency Meter, 18.0-26.5 GHz $500.00
HP K914B WR42 Sliding Load, 18.0-26.5 GHz $425.00
HP Q752D WR22 Directional Coupler, 20 dB, 33-50 GHz $650.00
HP R532A WR28 Frequency Meter, 26.5-40.0 GHz $500.00
HUGHES 45342H-1110 WR22 Dual Directional Coupler, 10 dB, 33-50 GHz $875.00
KRYTAR 202020016 Directional Det., 2-20 GHz, SMA(f/m)/SMC(f), 10 uV/uW $200.00
M/A-COM 3-19-300/10WR19 Directional Coupler, 10 dB, 40-60 GHz $450.00
MAURY MW. J320-series WR22 Calibrated Mismatch, VSWR values 1.1-2.0 ..... $375.00
MICROWAVE FILTER CO. 4043A 'Terrestrial Tracer' Dual Indep. Notch Filter, 3.7-4.2G $300.00
MILLIWAVE S90-1059 Amplifier, 3.5 dB, 18.0-26.5 GHz, +19 dBm Po, SMA(f) $150.00
MILLIWAVE S91-1779B Amplifier, 8 dB, 18.0-26.5 GHz, +16 dBm Po, SMA(f) $325.00
MITEQ AMP-1269 Amplifier, 30 dB gain, 700-1200 MHz, 1 Watt, 24V 500mA $175.00
NARDA 26298 20 dB Attenuator, 150 Watts, DC-1 GHz, N(f/f) $200.00
NARDA 3000-SERIES Directional Couplers $150.00
NARDA 3090-SERIES Precision High Directivity Couplers $225.00
NARDA 4000-SERIES SMA Miniature Directional Couplers $75.00
NARDA 4203-6 Directional Coupler, 6 dB, 2-18 GHz, SMA(f/f/f) $225.00
NARDA 5070-SERIES Precision Reflectometer Couplers $300.00
NARDA 792FF Variable Attenuator, 0-20 dB, 2.0-12.4 GHz $375.00
OMNI-SPECTRA 2082-5810-02 Adj.Phase Trimmer, 8-18 GHz, 10 deg./GHz range,SMA(m/f) $50.00
PRD N233A/232 Slotted Line, 3-12 GHz, N(m/f), w/carriage & detector $175.00
RLC AV-70124-R Level Set Attenuator, 0-20 dB, 7.0-12.4 GHz, SMA(f/f) $75.00
SPACEK LABS DQ-1 WR22 Flat Broadband Detector, 33-50 GHz $550.00
TRG V510 WR15 Precision Rotary Vane Atten., 0-50 dB, 50-75 GHz $1,000.00
TRG V551 WR15 Frequency Meter, 50.0-75.0 GHz $600.00
TRG/ALPHA V559-10 WR15 Directional Coupler, 10 dB, 50-75 GHz $400.00
WEINSCHEL 1515 Power Divider, DC-18 GHz, SMA(f/f/f) $125.00
WEINSCHEL 1579 Power Divider, DC-26.5 GHz, APC3.5(f/f/f) *NEW* $275.00
WEINSCHEL 3200-1 Programmable Step Atten., 0-127 dB, DC-2 GHz, SMA *NEW* $200.00
WILTRON 60A50-opt.1 SWR Bridge, 5-2000 MHz, APC7 test port, 46 dB directive $550.00
WILTRON 87A50 VSWR Bridge, 2-18 GHz, 35 dB dir., APC7 test port $950.00

LOGIC

HP 5005A Signature Multimeter $350.00
HP 8170A-002 Logic Pattern Generator, 2 MB/s, address driver option $1,400.00
TEK 1240 Logic Analyzer, w/(36) 50 MHz channels $1,500.00

COMMUNICATIONS

HP 4935A Transmission Test Set, 20 Hz-110 kHz $1,675.00
HP 59401A HPIB Bus Analyzer $700.00
TEK 1410R-opt.04 NTSC Test Signal Gen. w/ SPG2,TSG1,TSP1,TSG3,TSG5,TSG6 ..... $2,750.00
TEK 1411R-opt.04 PAL Test Gen. w/ SPG12,TSG11,TSP11,TSG13,TSG15,TSG16 ..... $2,750.00
TEK 144 NTSC Test Signal Generator $675.00
TEK 147A NTSC Test Signal Generator, with noise test signal $950.00
TEK 1485R Dual Standard Waveform Monitor, NTSC & PAL $1,850.00
TEK 520A NTSC Vectorscope $1,250.00

MISCELLANEOUS

HP 59307A HPIB VHF Switch $200.00
P.A.R. 5205-94,95,96,98 Lock-In Amp, 20 Hz-20 kHz, int. osc., lin/log, GPIB $2,750.00
P.A.R. 5206 Two-Phase Lock-In Amplifier, 2 Hz-200 kHz $3,000.00
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TEK TM5006 5000-series 6-slot Programmable Power Module $600.00
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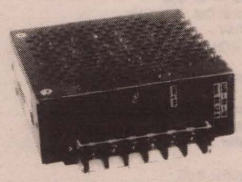

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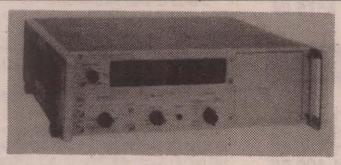
#80 TEST EQUIPMENT *cont.*

HEWLETT PACKARD 1740A oscilloscope 100MHz, dual trace delayed sweep, calibrated $400. 818-989-3848.

TEKTRONIX ACCESSORIES 7A12, 7A18 $50 ea., 7D12 $50, 7A13 $150, 7A26, $75; 7B50 & 7B50A, $115; 7B53A, $95; 7B71 $125; 7B85 400MHz, delaying time base $155. 7CT1N curve tracer $150; **S-2** $85. **S-3A** $100, **S-4**. Working scope at affordable price. 575 curve tracer excellent condition, $200. **TEK 7603** bright CRT with 7A16A, 7A18 & 7B53A, $365. **7904**, 7A26, 7B53, 7B80, 7B85, $675 with warranty. 1360P programmable switch, as new, $200. DC-501A opt. 1 $150; DC-505A $195; DD-501 $45 PG-501 $150. **TM**-System, TM 503, DM502A, DC503, PS501-1 $685 offers. Psitech Plus, 707-745-4804, FAX 707-747-5277.



HEWLETT PACKARD 5245L counters are all gone, but **PRETESTED REPAIR PARTS ARE STILL AVAILABLE:** Readout with Nixie, $14.95. A17 card, $14.95. Other cards, $9.95. Nixies, $7.50. Xtal oven assy, $39. Add $5 shipping. Send stamped addressed envelope for quote on any other part. Check/MO plus part number/description to: **TURCOTRONIX**, 1000 E. 14th, Suite 429A, Plano, TX 75074.

HEWLETT PACKARD 180A oscilloscope. 50MHz, dual trace, delayed sweep. Commercial version $300. Military version $250. 818-989-3848.

LOGIC ANALYZERS: HP 1630D logic analyzer (100MHz timing, 25MHz state) $995. **Pods** for HP 1600A $25 each. **Tek 7D01/DF1** logic analyzer plug-in (to 100MHz) $225. **Tek DAS 9129** color systems, up to 660MHz, lower prices. Analyzers sold with pods, warranty. Pepper Systems, 214-353-0257.

ISO 9002 calibration lab has lab standards for sale. FLU/5100 B/03/05 $6,900. FLU/5200A offer, FLU/335D offer, FLU/5205A offer. Call Brian, 708-238-8100 of Tru Cal for our complete inventory listing or FAX 708-238-8101.

ACME P5 2L-1000 electronic load $675/offer. Dexis 612-944-7670.

HP 4815A Z-METERs: Sandford Associates is your source for repair of the Probe and Main Frame. Former HP 4815A tech/supv., with factory expertise, specs, parts, special tooling, restores & warrantees probes to HP/QA specs. many other HP 4815A factory parts available. Tel/write: Sandford Associates, 110 Highview Terr., Hackettstown, NJ 07840. 908-852-7989, CIS: 72540,1345.

TEST EQUIPMENT for sale. 1 ea. Tektronix 492 Spectrum Analyzer w/opt2 excellent cond., just calibrated, $4,500. 5 ea. Tektronix 491 spectrum analyzers $2,700 all ($900 ea). 11 ea. Tektronix 7B53A Dual Time base plug-ins $600 all. 1 ea Boonton 4200 RF Microwave watt meter w/opt 01b-03 $325, 1 ea HP 3456A Digital Voltmeter w/HPIB $450, 1 ea HP 5335A Universal Counter w/opt 12 $850, 1 ea HP 5340A w/opt11 $925. Call Scott, 805-542-9574. Leave mess.

HEWLETT PACKARD 3400A RMS voltmeter. $275. Fluke 887AB AC-DC differential voltmeter. $300. 818-989-3848.

TEKTRONIX P601S HV probe with 10ft. cable, comp box & manual. $500. 417-546-4318 or leave message.

TEST EQUIPMENT Sale: Halycon 803B Datalink ana, $300; Guildline 9936 voltage calibration system, $1,000; Weksler 0811PU 7-day vacuum circular chart recorder, 0-30" $150; Wayne Kerr B221, Q221 Z bridge, $150; video research AN/TNH-21 reel-to-reel tape recorder, $200, digital VR160 color monitor, $150 (for digital equipment). A-Comm Electronics, 7198 S. Quince St., Englewood, CO 80112. 303-290-8012, 303-290-8133 FAX.

CLAROSTAT 240C 0-999,999 ohm decade box. $125. 818-989-3848.

THIS LOW circuit loading SCOPE PROBE produces a 60dB **SPECTRUM ANALYZER** display on **your** inexpensive scope. Excellent EMI/compliance tool. Request Technical Tips for line conduction, field strength, and current probe. 255 Spectrum Probe 30KHz to 2.5MHz $279. 107 Probe 1 to 100 MHz $249 ($279 extra shielding). Accessory Current Adapters: IA5 $19, IA7 $29. **SMITH DESIGN**, 215-661-9107, 207 E. Prospect Ave., N. Wales, PA 19454.

LOW-COST AUTOMATIC wire & tubing measure/cut machine, the Model PMC-110 by Red Line Mfg., Co. 314-831-3014. FAX 314-831-3927.

HEWLETT PACKARD 3551A Transmission Set, rack mount. $400. HP 3581 Wave Analyzer. $400. 818-989-3848.

TEK 7104 1GHz mainframe warranty $4,995. Dexis 612-944-7670.

WE SELL/RENT/BUY all types of test equipment: HP, Tek, Wav, Flu, Biddle, B&K, CSI, Lecroy, PHI, etc. **Specials:** HP 1662A $7,000, HP 4291A $11,500, Tek PFG5505 $1,200, PHI PM3585/90 $6,000, Flu 8842A/059 $895. FAX 415-573-1843. DC Tech, 1025A Terminal Way, San Carlos, CA 94070. (1-800-DCTECH3)

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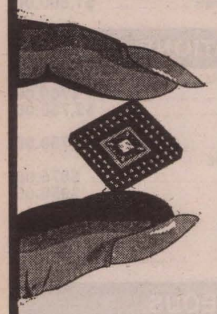

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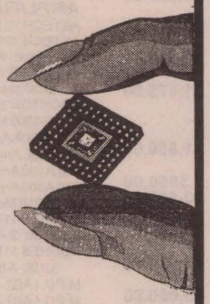

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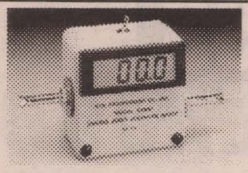

FS73 "SIGNAL Cube RF field strength meter. Calibrated 1-100 MHz. Relative readings to GHz range. Dipole antenna for consistent readings. NYE Engineering, Inc. 4020 Galt Ocean Dr., Suite 606, Fort Lauderdale, FL 33308. Tel. 305-566-3997, FAX 305-537-3534, $169. Visa/Master Card.

TEKTRONIX 492 SPECTRUM ANALYZERS 50KHz-21GHZ, 220GHz capability. INCLUDES **DIGITAL STORAGE/MAX-HOLD/COMPARISON** OPTION, 300 HOURS USAGE **$5,700;** 492 with above and internal **PRESELECTION** and **FREQUENCY STABILIZATION/100Hz RESOLUTION** option $6,750. Our 492s are newer production. Calibrated units with front cover, manuals and diplexer. **HP 8553B 110MHz SPECTRUM ANALYZER RF SECTIONS; 10Hz resolution, $275.** 10-day inspection, 90-day warranty. Hamilton Instruments, 619-439-1345, 1-800-TO-BUY-TE.

K&L TUNABLE BAND PASS FILTERS model 5 BT-250/5005N. Frequency range is 250-500 MHz. These lab quality filters are 5 section and have N(F) connectors. Quantities available. $130 includes CONUS shipping. Brian Kent (Kentronix), PO Box 2444, Farmingdale, NJ 07727. 908-681-3229, FAX 908-681-3312.

WANTED! TEST equipment. We pay top dollar for used, scopes, generators, analyzers from HP, Tektronix and others. Call Charles at **Metric** for immediate quotation. 1-800-432-3424.

HEWLETT PACKARD 5245L Frequency counter with 5262A time interval unit. $225. 818-989-3848.

BARTON 6001 Delta-P transmitter with 250" H20 capsule $195. Keithley 191 5-1/2 digit DMM $75. Fluke 883A differential voltmeter $30. General radio 544B MEGOHM Bridge $30. All plus shipping. Dave Betz, 449 Chandlee Rd., Rising Sun, MD 21911. 410-658-6130.

WAVETEK MODULE M32A urgently needed or will consider replacement Wavetek model 3001 or 3002 signal generator. Bob Yereb, W8MIG, 501 Southern Ave., Columbiana, OH 44408. 216-422-4008.

HEWLETT PACKARD 6515A 0-1600 volt 0-5mA power supply. $150. HP 6271B 0-60V 0-3A power supply. $150. HP 6268B 0-40V 0-30A. $650. 818-989-3848.

WANTED: HP equipment. HP-01 watch in good condition, HP 19800A software for HP 1980 oscilloscope, front panel cover for HP 5005A Signature Multimeter, and HP 08750-60034 cable to connect an HP 8750A Storage-Normalizer and HP 180T scope. Stan Perkins, 619-490-9074 or stan@netcom.com.

NEW PACE SX-20 desoldering irons. Boxed kit includes 115VAC grounded tip desoldering iron, insulating grip, cleaning brushes, extra tips, filters, vacuum hose, manual. Use w/Pace stations or w/your vacuum source for high quality desoldering system. $79.95 postpaid USA. Mike, 303-443-0515.

HEWLETT PACKARD 8011A Pulse generator. $225. 8011A with burst generator $265. Pulse generator. EH133A. 1Hz to 5MHz. $225. 818-989-3848.

HEWLETT PACKARD 3581A wave analyzer. 15Hz to 50KHz, 5 digit frequency readout. Very good condition. $650. **Tektronix 2901** time mark generator, pushbutton select 5 sec. to 2 nsec., up to 25V output. $225. **HP 465A** AC amplifier. 5Hz to 1MHz, >5V output into 50Ω, $65. **Gelman HV power supply**, 0-500 VDC, 125mA, dual meters. $100. **Power Designs 2K20** power supply, 0-2000 VDC, 20mA, VG condition. $225. **HP 6516A** power supply, 0-3000 VDC, 0-6 mA, $200. **Wavetek 143** function generator. 20MHz, 5 function, rack mount. $350. **HP 8015A** 50MHz pulse generator. Option 02 adds counted burst, option 07 adds level tracking. $695. **Marconi TF2300B** FM/AM modulation meter, 4MHz to 1.2GHz, excellent condition. $350. **30-day guarantee.** Visa/MC. **Lehman Scientific.** 717-244-7540, Fax 717-252-4266.

WANTED: LATE MODEL TEST EQUIPMENT (Tektronix, HP, Fluke). Especially: Tek SG 505/2 oscillator plug-in, Tek S-52 pulse generator, Tek 2465A/B portable scopes. Also, we buy test equipment service manuals and catalogs. **Pepper Systems, 214-353-0257; 214-902-9511 FAX.**

TEXSCAN BLOODHOUND Receiver FDM-2 and Transmitter FDM-1. Both pieces $400. 818-989-3848.

WANTED: CESIUM and rubidium standards, any condition. I also have a few nice ones available for sale, inquire. Repairs on all makes with free estimates. Also want manuals (no copies) for HP 5061A or B, and FTS 4050. Corby Dawson, 805-736-0288.

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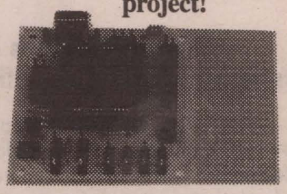

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by Donald Wilcher

Strain Gauges and Instrumentation Amplifiers: Part 2

Well, I hope you had an opportunity to experiment with the circuits that were discussed in the first installment of this two-part series dealing with mechanical strain and strain gauges.

This month, will finish up our discussion on describing the operation of an instrumentation amplifier and how to wire a strain gauge to it.

But before we begin our talk on instrumentation amplifiers, I would like to reiterate that this column is devoted to the hands-on hobbyist who is interested in learning about electronics, but doesn't want to spend a lot of money on expensive equipment and parts.

What I do in this column is present technology that is accessible off-the-shelf and doesn't require a major equipment investment. The ads that sell test equipment and parts in *Nuts & Volts* are a very good purchasing source for building a small electronics lab in the home.

The hobby of building and experimenting with electronic circuits is becoming an obsolete activity. The dedicated few that remain are looking for simple projects that they can build and be entertained by. That is the main focus of this column.

Although the information presented may be slanted toward one type of product or piece of equipment, other test gear or components can be easily used to obtain the same functional results.

So, don't worry that you may not have a particular computer system or microprocessor development unit being discussed in the article. The project can still be completed by reading data books and making the appropriate modifications to your electronics development system.

Where most of the fun lies is in design and experimentation. I also have an E-Mail address where you can send your questions directly, in case of a construction obstacle you might encounter.

So read, modify, and experiment with the circuits and systems discussed in this column. Don't be surprised at the amount of fun you might have in your new-found discovery.

Now that the pep talk is done, let's take a look at the operation and construction of an instrumentation amplifier.

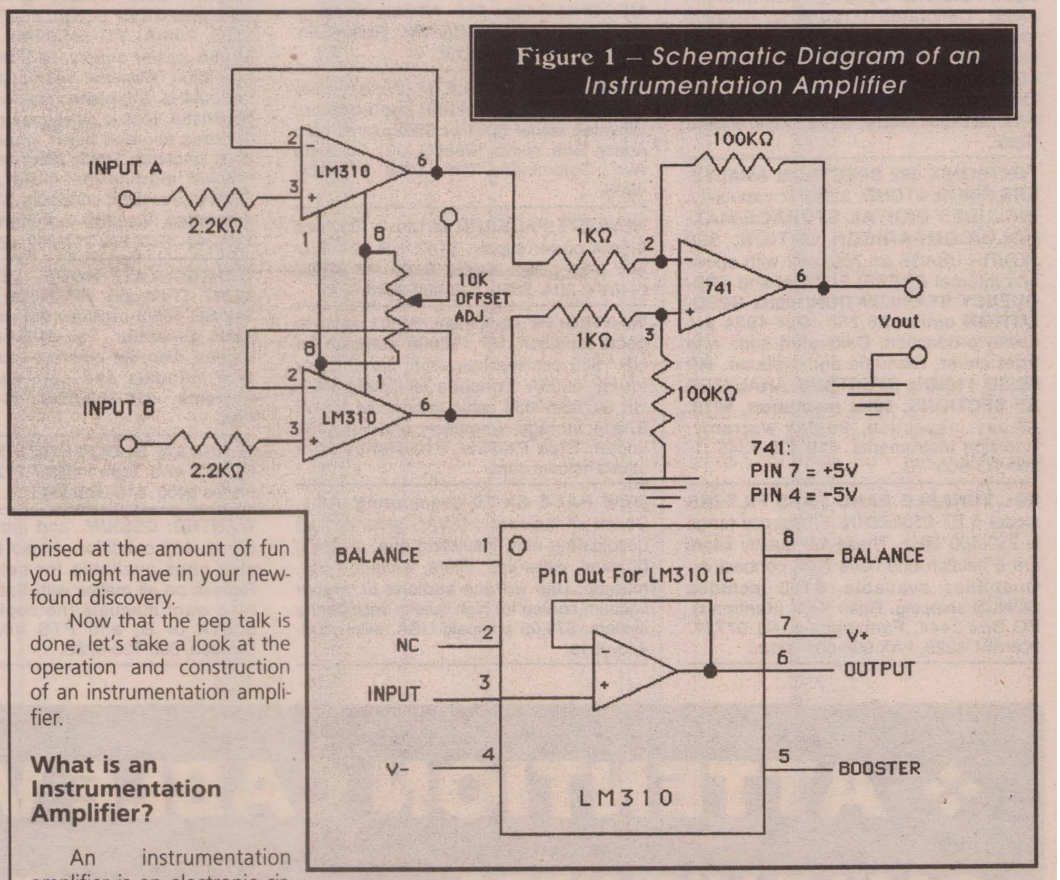

Figure 1 – *Schematic Diagram of an Instrumentation Amplifier*

What is an Instrumentation Amplifier?

An instrumentation amplifier is an electronic circuit capable of amplifying the difference between two input signals. The signals can be any audio, DC, or transient (noise) voltage that the IA (short for instrumentation amplifier) inputs receive.

Figure 1 shows the schematic circuit for an IA. This circuit consists of two voltage followers wired to a difference amplifier. The voltage followers provide an input buffer to the difference amplifier's inputs. If the output voltage is the same as the injected signal, with no loss of the original source, then the circuit's inputs are buffered. The total gain for the two circuits provides a high input resistance for the IA, which is important for reducing input signal loss.

That's why the voltage follower circuits are hardwired into the inputs of the difference amplifier as shown in Figure 1. The overall gain for the IA is accomplished by the feedback resistor "RF." High values of "RF" establish high amplification for the instrumentation amplifier, which leads us to describing the *Common Mode Rejection Ratio* (CMRR).

Common mode rejection ratio relates to rejecting voltage signals referenced to ground that are present or common to a difference amplifier's inputs. An example of CMRR in action is the elimination of 60 Hz hum in AC lines. Audio amplifiers that are powered by an AC source can couple 60 Hz noise onto its input terminals by capacitors and transformers.

The noise is very annoying because it can be heard through the loudspeakers of the audio system. That's where CMRR comes to the rescue by rejecting the "coupled" noise to ground. By adding a trimmer pot for adjusting the CMRR value, the noise is attenuated.

Figure 2 shows a schematic circuit for adjusting the CMRR. The higher the CMRR value, the better the amplifier is capable of handling noise. The noise rejection feature is what makes the instrumentation amplifier an outstanding device to use with sensory detection applications.

But how can we use this circuit with a strain gauge for measuring mechanical strain?

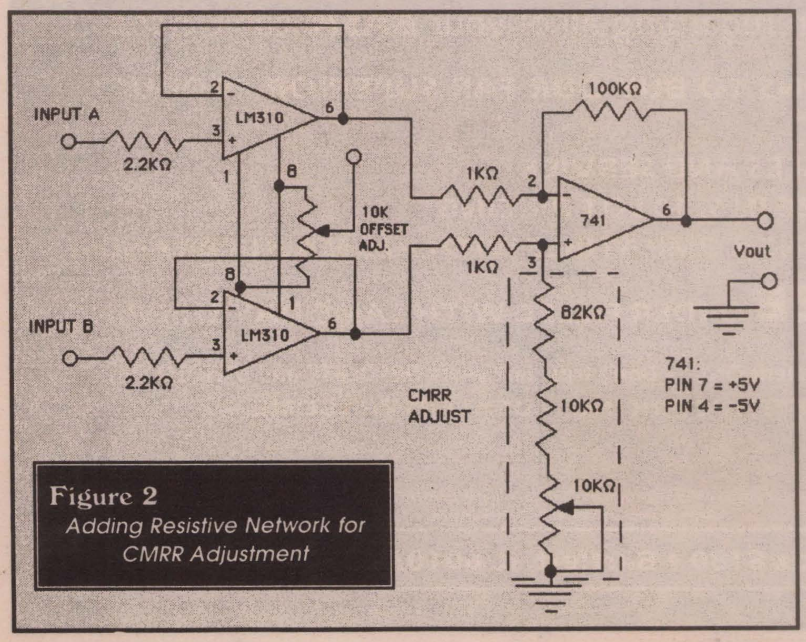

Figure 2
Adding Resistive Network for CMRR Adjustment

The IA/Strain Gauge Connection

Instrumentation amplifiers are perfect for strain gauge applications. IA's sole purpose in life is to ampli-

fy differences between two input signals.

The Wheatstone Bridge circuit that was discussed in last month's column is capable of producing a range of voltages depending on its "unbalanced" state. If the four resistors in the bridge circuit are not equal in value, the output voltage will be a value greater than zero. That's where the unbalanced condition exists for the Wheatstone Bridge which is then wired to the input terminals of the instrumentation amplifier for further signal processing.

The block diagram in Figure 3 shows the IA to strain gauge connection. When developing sensory or data acquisition systems, the unbalanced state of the detector is very important to the instrumentation amplifier's function. The variance in voltages produced by the sensor represents data pertaining to temperature, sound, vibration, or light that the acquisition device is "acquiring."

Oh, by the way, in the instrumentation field, IAs are called conditioning amplifiers because they prepare the input signal to an output level that is compatible for displaying data via driving an XY plotter or scope. The conditioning amplifier could also be used to drive relays for controls applications. This feature gives the data acquisition system an output alarm for warning the user that a critical level has been reached in data measurement.

The strain gauge circuit that was discussed in last month's installment could be used with this amplifier quite easily. The two output points from the gauge circuit would tie into the voltage follower input circuits of the IA. The output of the circuit could be monitored by using a digital voltmeter. The reading from the meter would indicate the amount of strain applied to the metal beam.

So, how can you obtain some practical experience with instrumentation amplifiers and strain gauges?

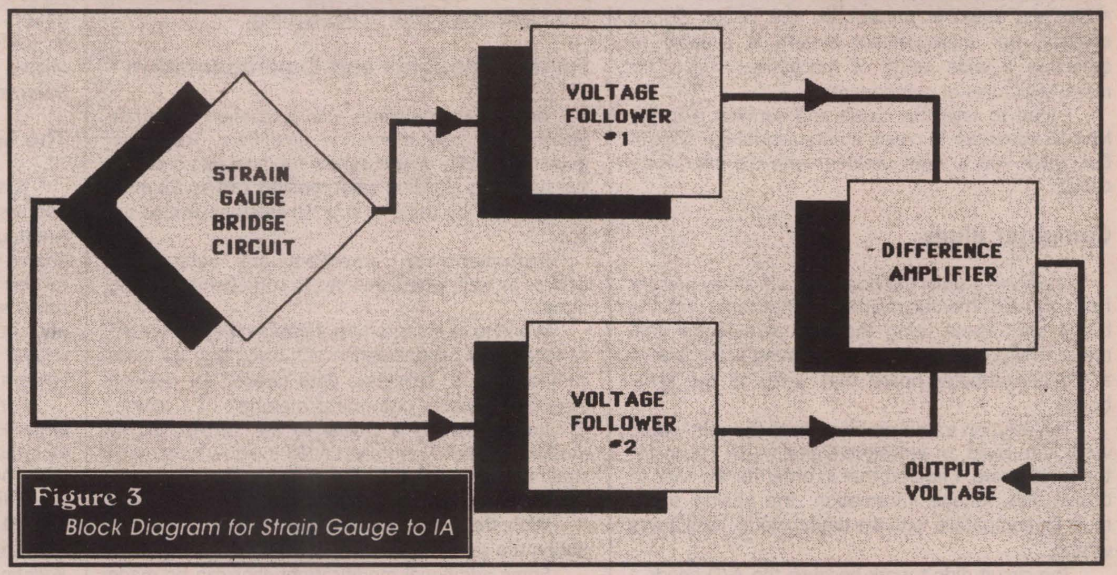

Figure 3
Block Diagram for Strain Gauge to IA

An Experimental Strain Gauge Measurement System

Now we've reach the point in our discussion were the sleeves can be rolled up and the nuts and bolts no pun intended can be carried out with some good old electronics experimentation.

The circuit in Figure 4 is our vehicle for obtaining some experience with a strain gauge measurement system. The measurement system consists of a bridge circuit for detecting strain on the metal beam, and the instrumentation amplifier for output monitoring of the circuit.

The bridge circuit will act as an unbalanced system providing data on the amount of strain being applied to the beam. This data will be in the form of DC voltage. This signal will then be tied to the input of the instrumentation amplifier's voltage followers.

The voltage follower circuits will provide buffering for the difference amplifier, eliminating any signal degradation that might threaten the IA's overall amplification performance.

The difference amplifier will amplify the difference in input voltages producing an appropriate output signal. This explains the basic operation of the measurement system.

In order to obtain a correct output reading from the bridge circuit, the system must be calibrated. The 10K pot shown on the circuit diagram is used to adjust the offset voltage that might exist from the op-amp (741). Generally speaking, the output voltage of an op-amp should be zero, with no input signal present. The offset voltage is at a level that is below or above ground. That's where this trimmer pot adjustment comes into play.

By taking both inputs of the voltage follower circuits and tying them to ground, the 10K pot should be adjusted until the offset voltage at pin 6 of the 741 op-amp reads zero. This adjustment completes the calibration procedure for the measurement system.

Now that the strain gauge bridge circuit is wired to the instrumentation amplifier, and the system has been calibrated, the system is ready for strain measurements.

Depending on the type of metal that the strain gauge is mounted on, the output voltage might change from a 10th of a volt to a few millivolts. The change in voltage is dependent on the amount of force applied to the metal beam. Although the system is measuring volts instead of strain, you can get a good indication of the force that is being detected.

Higher voltages represent a significant amount of strain being applied to the beam. Small voltage values

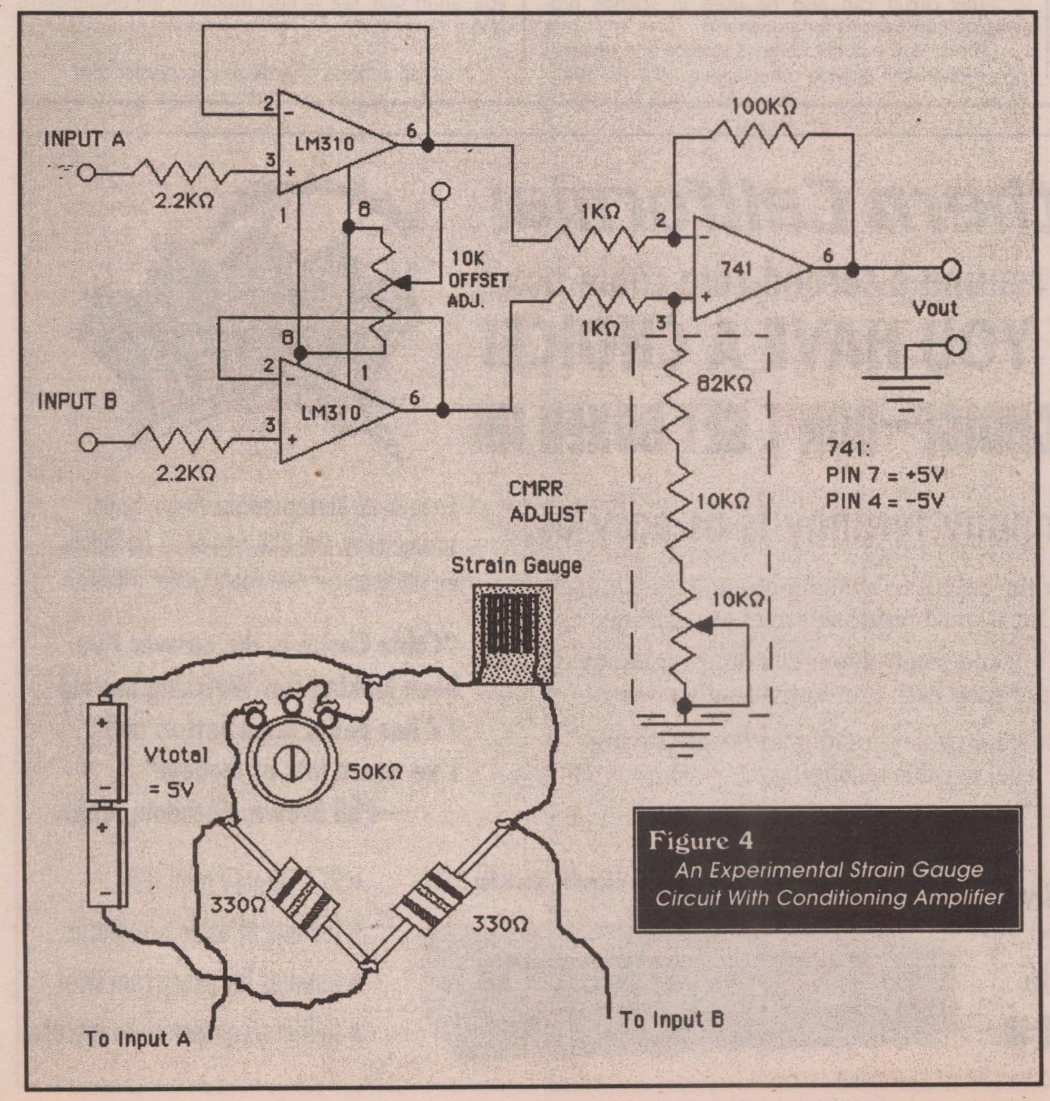

Figure 4
An Experimental Strain Gauge Circuit With Conditioning Amplifier

mean less strain is present on the beam. So, in essence, our measurement system is capable of detecting a wide range of mechanical strains for metal structures or components.

I tried to take this circuit and connect it to my Mac SE computer to create a data acquisition system. But, there was a slight problem with the interfacing circuit.

Computer Blues

I received a serial I/O board for a birthday present from my wife. The documentation that came with the board talks about using the Mac as a digital voltmeter. The problem with this document is the lack of a digital voltmeter board that wires to the serial board.

The solution to this problem that I thought would work is to build an analog-to-digital (A/D) circuit for the serial board. I figured that in order for the Mac to display this voltage information, the analog signal must be compatible with the digital world. Well, I was wrong.

The circuit didn't work because the A/D needs a "Start" and "EOC" (End Of Conversion) inputs to drive them. Unfortunately, the serial board does not have these two inputs for the A/D circuit.

Instead, I used the transmit and receive inputs as substitutions for the "Start" and "EOC." The software that comes with the serial I/O board could not recognize what the heck was going on in terms of wiring configuration or input signal monitoring. So, as an alternative solution to this problem, I plan to use my old, but trusty, color computer and repeat the whole design/development process again. I'll keep you posted on my progress of this data acquisition substitute in a future installment of this column.

Further Thoughts and Experimentation

Well, that completes our discussion on strain gauges and instrumentation amplifiers. The strain gauge is a pretty unique sensor for detecting mechanical strain. It's amazing what resistors can do for measuring strain by using it in a Wheatstone Bridge circuit.

Instrumentation amplifiers are outstanding devices as well, when it comes to conditioning analog signals.

Working in an automotive design field allows me to obtain first hand experience in using both of these components for collecting data needed for packing electronic modules onto metal members of a vehicle.

Impact testing is crucial to the success of my module designs. Therefore, I need to know how much strain can be applied to the metal surface I'm interested in attaching my electronics to.

With the circuit/system just described, you can obtain the same experience, as well.

Some additional modifications that can be made to this circuit include being able to convert the system into a force meter where mechanical strains for different metals can be measured. Attach an audible output device for monitoring critical measurement levels.

An electronic strong man game can be created where applying a force using your figures can be registered on a DVM. The one with the highest reading is the winner of the game.

This circuit can also be used in science projects/demonstrations for students.

A trip to the public library's science and technology section will provide other applications for strain gauges and instrumentation amplifiers. Finally, another useful source for obtaining science applications related to this circuit is the Society For Amateur Scientist.

The Society for Amateur Scientists

A source for science projects for the electronics hobbyist or amateur scientist is the "Society For Amateur Scientists" or SAS. Under the direction of Shawn Carlson, Executive Director, other applications for this circuit can be obtained through this organization. I'm a member of this unique and wonderful society, and I have found solutions to a lot of my science-related projects, some of which I will present in this column.

Forrest Mims and *Nuts & Volts* contributing writer Harry Helms are on the Advisory Board of SAS. One thing about SAS is, in order to receive the maximum benefit of this organization, participation from the individual is necessary. Membership fee to join is $35.00 a year. This fee allows you to receive the quarterly newsletter entitled *"The Amateur Scientist Bulletin."* This newsletter is jammed full with all sorts of science projects, electronics, membership activities, and lists of other organizations to join. If you have access to E-Mail, the Electronic Forum allows the amateur scientist to converse with professional scientists and other individuals interested in conducting real science projects and experiments.

The Society For Amateur Scientists can be reached at (619) 239-8807. Tell Shawn Carlson I sent you. Enuff said, see ya next month in the breadbox!!! **NV**

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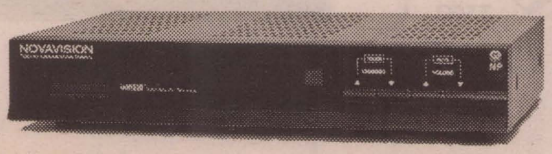

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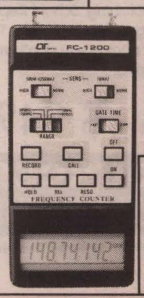

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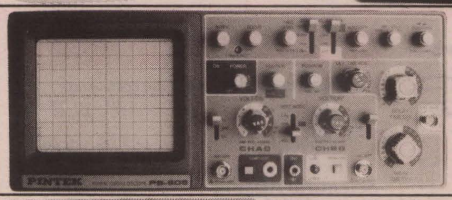

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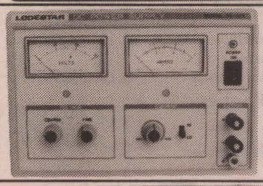

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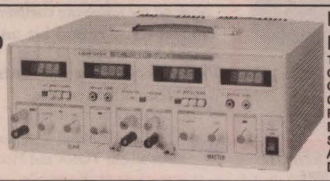

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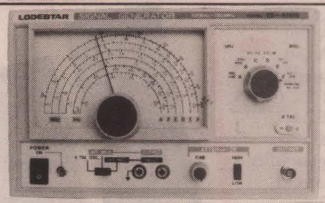

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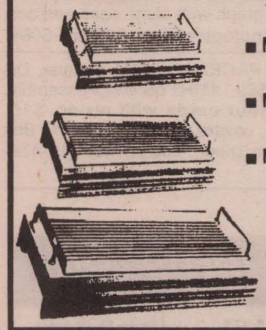

- Mdl. 4200 4-Ch 4X75 Watts- 2Ohm Rtl $499.95
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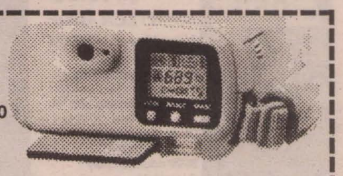

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RF EQUIPMENT: HP 5342A/1 18GHz microwave counter (oven time base) $2,200. **Tek TR 503** .1 to 1800MHz tracking generator, calibrated $1,250. **HP 3403C/3,6** true RMS digital voltmeter (DC 100MHz, autoranging, remote control, dB display) $375. **HP 8660C/005,100** synthesized signal generator mainframe $1,700. **HP 86222B** .01 to 2.4GHz sweep oscillator plug-in $1,600. **HP 8505A** RF network analyzer, .5 to 1300MHz, 100dB dynamic range, with phase-lock option 005 and HP 8501A storage normalizer. Bright CRT, $3,700. **Tek P6201** 900MHz active probe $350. Excellent condition, with warranty. Pepper Systems, 214-353-0257.

TEST EQUIPMENT LIQUIDATION. We are liquidating several electronic test equipment companies at this time. If interested, we will provide your company with an extensive inventory list. We at AMS specialize in liquidating all types of test equipment & electronic parts. 603-431-4217 FAX/Voice or mail to: AMS, PO Box 282, Rye, NH 03870.

TEKTRONIX TM504 4-slot module power supply $150. TEK TM501 1 slot. $125. 818-989-3848.

TECHNICAL ARTS US-II non-contact laser inspection system, open to offers. Dexis 612-944-7670.

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.

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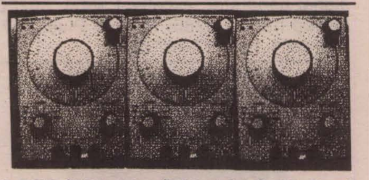
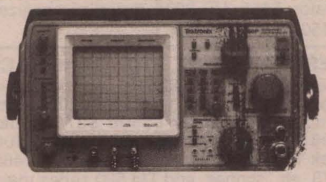
HP TEST Equipment, HP 432A, cable and mount power meter, $300, opt 01, $350; HP 8411A opt 018, $500; HP 8555A, $900; 8554B, $600; 141T, $500; 8552B, $700; 8553B, $500, 8556A, $500; HP 8698B, $300, HP 8660A, $600; HP 8709A syncronizer, $200; HP 8731B pin modulator .8-2.4 GHz, $200; HP 8755A swept ana, $200 HP 626A sig. gen. 10-15 GHz, $250, HP 628A sig. gen. 15-21 GHz, $250; HP 200CA, $80; HP 200 CD, $125; HP 651A, $150; HP 651B, $200; HP 653A, $200; HP 654A, $200, HP 8403A modulator, $150; HP 8405A vector Z meter, $550; HP 4800A Z meter, $550; HP 8407A network ana, $400. Send for test equipment sales list. A-Comm Electronics, 7198 S. Quince St, Englewood, CO 80112. 303-290-8012, 303-290-8133 FAX.



3 FOR $300, 2 for $220, 1 for $125. Small (5"x6"x8") HP 204C sinewave oscillators, 5Hz to 1.2MHz, synchronized input or output. Gary, N6ZD. 408-385-0301. Fax 408-385-0261.

THERMOTRON PRODUCT Saver. Protect –125 to +375 degrees F. $150. 818-989-3848.

SPECTRUM ANALYZER SALE. Hewlett Packard 141T with 8552B IF & 8553B RF $1,245 with complete manuals $1,290; **141T, 8552B, 8555A** $1,785 with manuals, call for price with 8445B preselector. 141T frame, $500. 8552B $425. 8553B from $225-$450. 8555A $825. All with warranty. Offers call. Psitech Plus, 707-745-4804, Fax 707-747-5277.



TEKTRONIX 492 PORTABLE SOLID-STATE SPECTRUM ANALYZER. Frequency range: 50KHz to 21GHz to 220GHz with external mixers (not supplied). Built-in digital display storage (Option 2). Built-in RF preselection (Option 1). Built-in frequency stabilization and 100Hz accuracy. Sensitivity: –95dBm to –115dBm (Option 3) depending on option and frequency, at 1KHz resolution. CRT read-out of display parameters. Dynamic range (on screen) 80dB. CRT size: 8x10 cm. Resolution bandwidth: 1MHz to 1KHz (100Hz Option 3). Power: 210 watts, 115V/60Hz. Weight: 44 lbs. Size: 6.9"x12.9"x19.7". Price: Options 1, 2, 3 $5,995. Don Phelps, 909-279-7347.

UNHOLZ DICKIE D11 Charge amplifier. 4 available. $100 ea. More Unholz available. 818-989-3848.

TEST EQUIPMENT: HP 5326B, counter DVM, $200; HP 5327B, $250; HP 8412A, $200; Plasma therm HFP-5000D; HP 8414A, $200; HP 4260A universal bridge, $200; Tektronix TM506, $200; HP 8750A storage normalizer, $200; HP 3710A, HP 3702A, 3705A, $1,500; Boonton 92A-S2, $150; NewPort research 820 laser power meter, $100; Julie Research DR100 precision decade box, $200; MIL/Taffet Electronics ZM-4B/resistance bridge unused with manual; $60 ea., 15 available. Send for test equipment sales list. A-Comm Electronics, 7198 S. Quince St., Englewood, CO 80112. Phone 303-290-8012, Fax 303-290-8133.

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¼" x 2"	1-9	12.50
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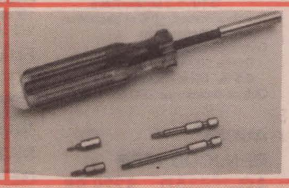
These security bits are compatible with all the following companies:

Pioneer 6300 round bit (tri-notch)	13.95
Avsafe #4 round "D" bit	13.95
Pioneer round bit (no notches)	13.95
NEW Jerrold Flower-head Security Screwdriver–7"	16.50
NEW Hex-drive Hand Ratchet Fits all our TORX and Hex bits	9.95

Steel-shank magnetic screwdriver for Hex-insert bits 5.35



KIT Includes Screwdriver and any four 1" TORX bits (also shown: 2" and 3" bits)
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Remotes compatible with these companies:

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RD3Z	8.35	7.15
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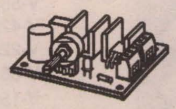
LCD TEMPERATURE METER KIT
(CELSIUS ONLY)

Designed using a single IC that contains Analog & Digital sections to provide a simple yet versatile LCD meter. Other components convert the basic meter to read Temperature (degrees "C"). With power switch. Runs on 9V battery.

L: 3-3/4" **W:** 2-1/4" **H:** 3/4" **WT:** .3

STOCK #	DESCRIPTION	PRICE
6002-KTN	Temp. Meter Kit	$29.95

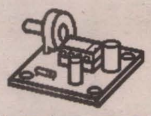


POWER SUPPLY KIT

Basic circuit designed around 2 fixed TO-220 regulators. Provides a fixed output of +5V & a variable from +5 to 2V under the input voltage. Terminal strip output, solder pads & 3.5mm mini phone jack for input. 7-30V DC or 7-20V AC input.

L: 3-1/8" **W:** 2" **H:** 1" **WT:** .22

STOCK #	DESCRIPTION	PRICE
6004-KTN	Linear P/S Kit	$18.95



1 WATT AMPLIFIER KIT

Circuit designed around a single TDA7052 IC. Ideal part for larger projects. Drives 8 ohm speaker (not supplied) Ideal for battery powered circuits, Operates on 3-15 VDC solder pads for all connections.

L: 1-1/4" **W:** 1-1/8" **H:** 7/8" **WT:** .05

STOCK #	DESCRIPTION	PRICE
6027-KTN	1W Amp Kit	$7.95

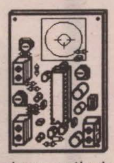
Featured in "Electronics Now"

POWER SUPPLY KIT

Basic circuit designed around 2 fixed TO-220 regulators. Provides fixed output of +5V & a variable from +5 to 2V under the input voltage. Terminal strip output, solder pads & 3.5mm mini phone jack for input. 7-30V DC or 7-20V AC input.

L: 3-1/8" **W:** 2" **H:** 1" **WT:** .22

STOCK #	DESCRIPTION	PRICE
6004-KTN	Linear P/S Kit	$18.95



PIR MOTION DETECTOR KIT

Circuit designed around a recently developed IC. Circuit utilizes PIR detector, & a light dependent resistor to provide a optimized circuit that will detect motion in the 3-4 meter range. Operates on 9-12 VDC

L: 3" **W:** 2" **H:** 1-1/4" **WT:** .1

STOCK #	DESCRIPTION	PRICE
6030-KT	PIR Motion Kit	$34.95

FM WIRELESS MIKE KIT

Powerfull 2 stage, wireless mike kit transmitts over 1/2 mile (up to 1Km in the open)Tunable to the upper part of FM broadcast band. Circuit does require the ability to "Tweak" RF circuits by stretching or compressing coils. With mike & 9V battery clip. Operates from 6-12V DC.

L: 2-3/4" **W:** 5/8" **H:** 1/2" **WT:** .06

STOCK #	DESCRIPTION	PRICE
6032-KTN	FM Mike Kit	$10.95

COMBINATION LOCK KIT

Easy introduction to electronic locks. 2 boards; one with 1-9 touch pads & connected to 2nd board by 3ft. cable. 2nd board has decoding IC's, matrix to set 4 number code, & relay to control external loads. Auto reset if wrong number entered. Runs on 9V battery.

L: 3" **W:** 2-1/2" **H:** 1" **WT:** .17

STOCK #	DESCRIPTION	PRICE
6029-KTN	Combo Lock Kit	$18.95

9V DC FM TRANSMITTER KIT

Powerfull, FM Xmitter. Transmits over 100 Meters in building & over 500 M outside using 1/4 or 1/2 wave length of wire. Transmitts to the upper part of FM broadcast band (100-108 MHz). Circuit requires the ability to "Tweak" RF circuits. Runs on 9V DC.

L: 1-3/4" **W:** 3/4" **H:** 3/8" **WT:** .05

STOCK #	DESCRIPTION	PRICE
6018-KTN	9V FM Xmitter	$9.95

OP-AMP FUNCTION GENERATOR KIT

Circuit designed around a Quad Op-Amp connected as oscillator & wave shapers. Oscillator generates a Square Wave over 6Hz to 6KHz. range. The other amps then produce the Triangle & pseudo Sine outputs. Solder pad outputs. Runs on 9V battery.

L: 1-7/8" **W:** 1-5/8" **H:** 7/8" **WT:** .07

STOCK #	DESCRIPTION	PRICE
6023-KTN	Function Gen.	$8.95

ULTRASONIC MOTION DETECTOR KIT

2 boards; one with Matched pair of Ultrasonic transducers to detect motion from 4-7m away. 2nd board contains Xtal controlled osc. & all circuits. Switchable latch, red LED indicator. Solder pad output to drive external relay or circuits. Runs on 9V battery. Main Board: 2-3/4" X 2" X 3/4" Transducer Board: 2-3/4" X 5/8" X 7/8"

WT: .1

STOCK #	DESCRIPTION	PRICE
6020-KTN	Motion Detector	$29.95

SWITCHING POWER SUPPLY KIT

Basic step-up switching supply circuit designed around single IC. Selectable 1.5 or 3 VDC input. Provides a fixed output of 9V @ 18mA from a 1.5 V "AA" cell. Solder pads for input & output. 1 cell & 2 cell "AA" holders supplied.

L: 1-5/8" **W:** 3/4" **H:** 1/2" **WT:** .08

STOCK #	DESCRIPTION	PRICE
6035-KTN	Switching P/S	$8.95

"STAIRWAY TO HEAVEN" GAME KIT

Uses 6 red & 1 bi-polar LED's to test your hand-eye coordination. You must press the switch each time the green part of the bi-polar LED lights. If you are successful over many tries the red LEDs light up in sequence.; But miss & you start over! 9V battery operation.

L: 3-1/8" **W:** 2" **H:** 3/4" **WT:** .17

STOCK #	DESCRIPTION	PRICE
6005-KTN	Stairway Game	$15.95

TELEPHONE TRANSMITTER KIT

Phone line powered & activated when handset is lifted. Uses phone wires for antenna. Transmitts over short distance (<100ft) to the lower part of FM broadcast band (90-95 MHz). Circuit does require the ability to "Tweak" RF circuits.

L: 1-7/8" **W:** 5/8" **H:** 3/8" **WT:** .06

STOCK #	DESCRIPTION	PRICE
6016-KTN	Phone Xmitter	$9.95

VOX SWITCH FM TRANSMITTER KIT

Sound activated circuit with FM Xmitter. Sensitive electret mike picks up audio which is amplified & used to modulate FM RF Xmitter. Circuit require the ability to "Tweak" RF circuits by stretching/compressing coils. Operates on 6V DC, 4 cell "AA" battery holder supplied.

L: 2-1/2" **W:** 1-1/2" **H:** 5/8" **WT:** .09

STOCK #	DESCRIPTION	PRICE
6028-KTN	FM VOX Xmitter	$12.95

SIREN KIT

Circuit designed around a Dual Op-Amp connected as oscillator & driver. Oscillator is off until you press the switch then a rising tone is produced until a steady value is reached. If switch is released the tone starts dropping until it cuts off. Runs on 9V battery. Speaker & switch supplied.

L: 2" **W:** 3/4" **H:** 1/2" **WT:** .17

STOCK #	DESCRIPTION	PRICE
6031-KTN	Siren Kit	$6.95

TAPE RECORDER VOX SWITCH KIT

When sound is detected, kit will turn on cassette recorder or other low voltage load. 6 second turn-off delay allows for pauses in conversation. Requires recorder with "REMOTE" control jack. An external relay (not supplied) can be added to handle heavier or line loads.

L: 4-5/8" **W:** 3/4" **H:** 1/2" **WT:** .1

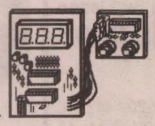
STOCK #	DESCRIPTION	PRICE
6013-KTN	Tape VOX	$12.95

3VDC FM TRANSMITTER KIT

Small FM Xmitter teaches basic construction & set up of tuned circuits. Transmits over 100 Meters in building & over 500 M outside. Circuit requires the ability to "Tweak" RF circuits by stretching/compressing coils. Operates on 3-9V DC, Holder for 2 "AA" cells supplied.

L: 1-3/4" **W:** 3/4" **H:** 1/2" **WT:** .1

STOCK #	DESCRIPTION	PRICE
6007-KTN	3V FM Xmitter	$9.95



3 DIGIT LED COUNTER KIT

2 board basic event counter. Main board has the 3 digit counter circuit while the 2nd. board has Count & Reset push button switches & debounce circuit. Can be cascaded with other boards to provide more digits. Runs on 9V battery.

L: 3-1/8" **W:** 2" **H:** 1" **WT:** .22

STOCK #	DESCRIPTION	PRICE
6001-KTN	3 Digit Counter	$26.95

DOOR CHIME SOUND KIT

IC chip direct bonded to board. Produces 16 Door Chime melodies. At power up the first tune is played; each subsequent push of the button causes the next song to be played in sequence. Some tunes are: "Farmer in The Dell", "Die Lorelei", "Lovers Concerto". Components supplied for operation on 3V DC (battery holder for 2 "AA" supplied), but circuit will operate from 2.5-5VDC.

L: 1-1/8" **W:** 5/8" **H:** 3/32" **WT:** .2

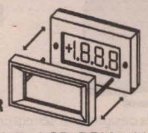
STOCK #	DESCRIPTION	PRICE
6103-KTN	Door Chime	$7.95

TRAIN SOUND KIT

IC chip direct bonded to board. Produces 4 selectable, common sounds assocated with trains; Whistle blowing (repeats 3 times), Crossing bell, Chugging, and "Clickety-Clack". Components supplied for operation on 3V DC (battery holder for 2 "AA" supplied), but circuit will operate from 2.5-6VDC. Two boards can be cascaded to produce a sequence of sounds from a single switch.

L: 1-1/8" **W:** 5/8" **H:** 3/32" **WT:** .2

STOCK #	DESCRIPTION	PRICE
6101-KTN	Train Sounds	$7.95

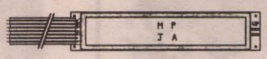


DIGITAL PANEL METER

Compact 3-1/2 Digit LCD DPM with black plastic bezel & face plate. 1/2" character height, 200mV DC input, adj. decimal point, auto polarity, > 100Mohm input imp. 2 readings/sec., 9 VDC powered, .5% accuracy. Through panel mounting. Holes on board to add scale resistors

W: 2-5/8" **H:** 1-3/4" **D:** 3/8" **WT:** .1

STOCK #	DESCRIPTION	PRICE
6929-MEN	LCD Meter	$9.95



40 CHAR. X 2 LINE INTELLIGENT LCD DISPLAY

Optrex DMC40218, 5 X 8 X .21" char. ht. dot matrix display, on-board CPU, RAM & ASCII char. generator IC, C-MOS/TTL signal level, 11 instructions, +5 VDC for logic & -12 (Max) VDC for contrast adj., 14 I/O/power pins. 8" flat cable leads, Data

L: 7-3/16" **W:** 1-5/16" **T:** 3/8" **WT:** .2

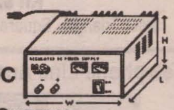
STOCK #	DESCRIPTION	PRICE
5120-OPN	2X40 Display	$9.95

THERMOELECTRIC MODULE

Peltier Effect cooling module with 71 Pairs of couples. When powered one side gets cold while the other is hot. With proper heat sink & insulation will cool below 0 C°. 3.4A max, 8.0V max, 59 C° Max temp. Differential, 18W heat pumped (~55 BTU). Similar to Melcor CP-1.4-71-10L

Dimn: 1-3/16" Sq. **T:** .18" **WT:** .03

STOCK #	DESCRIPTION	PRICE
7075-PMN	Peltier Module	$16.95

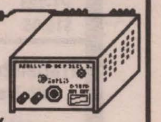


30A 13.8VDC REGULATED BENCHTOP SUPPLY

MFG: MG
P/N: PS32
Input: 115 VAC
Output: 13.8V 30A(32A Surge)
Specifications/Features:
Short Circuit & Overload Protected-With Metal Case, Power Cord, Line Fuse Switch & Output to Binding Post.

L: 12.5" **W:** 8" **D:** 6" **WT:** 23

STOCK #	DESCRIPTION	PRICE
6688-PSN	30A Bench P/S	$149.95



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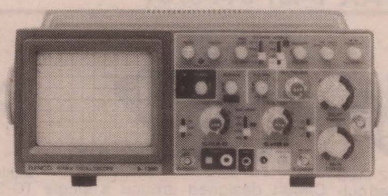

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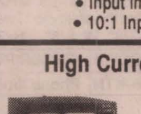

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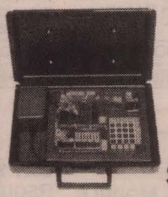

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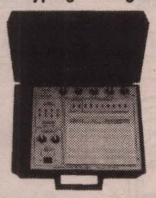

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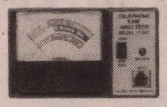

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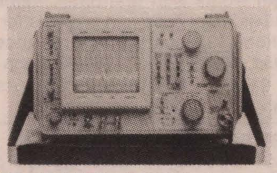

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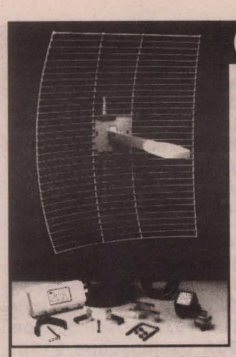

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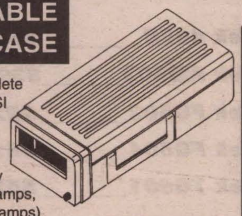

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30' CABLE

A GREAT DEAL!

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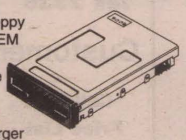
720K 3.5" INTERNAL FLOPPY DRIVE



Sony # MP-F11W-2Z Brand new 720 KB floppy drives. Built for an OEM product, these are, in every way, compatible with PC/XT/AT computers except that the faceplate is slightly larger than those on exact replacements. The faceplate size on these is 4.04" X 1.23". (Normal size is 4" X 1"). The faceplate is removable and can be trimmed if desired. In some cases it may work without trimming. Also, we have found that, when used in 5.25" bays with the adapter kit below, the adapter can easily be modified to accommodate the unit. Because of this slight inconvenience, we are selling these drives at an incredibly low price.

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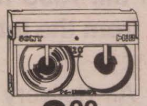

SONY Hi-8 Top quality, metal particle 120 minute video cassettes. Used for a short time, then bulk-erased. Each cassette has its own plastic storage box. *Satisfaction Guaranteed!*

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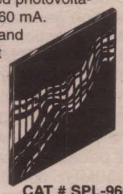
9 VOLT 60 MA SOLAR PANEL



These 6" X 6" glass enclosed photovoltaic panels produce 9 Vdc at 60 mA. Ideal for charging batteries and powering small devices. Put two or more together for more current and voltage. Includes metal connectors and instructions for soldering directly to panel.

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CAT # SPL-960

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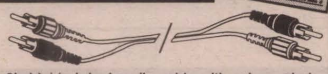

9' shielded dual audio cable with color coded (red and yellow) RCA style pin plugs either end. Black cable.

$1.00 each

CAT# DCB-108

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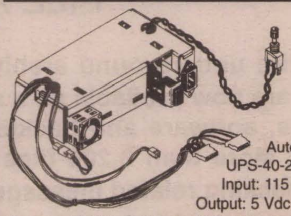

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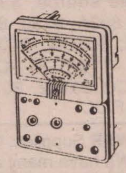
APPLIED MICRO systems model EL3200, EP8001/3 emulator pod. 1992. Entire system was $45,460. $12,000. 818-989-3848.



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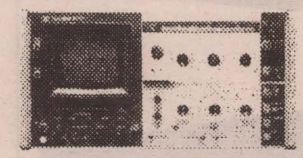

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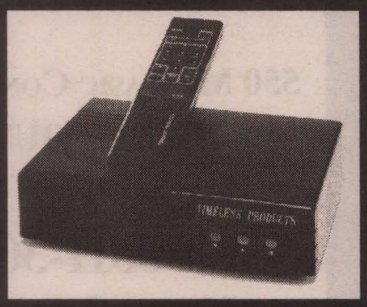

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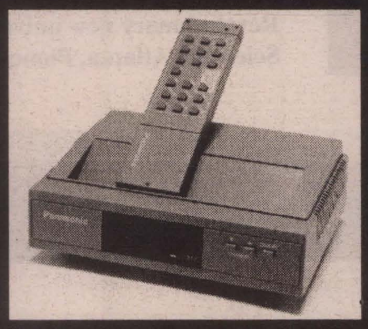

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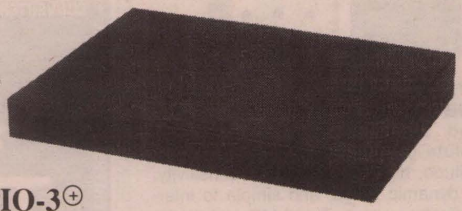

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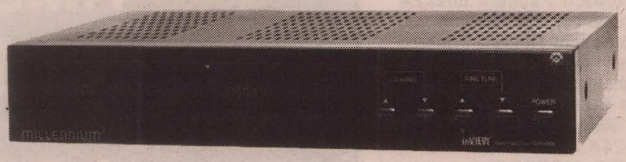

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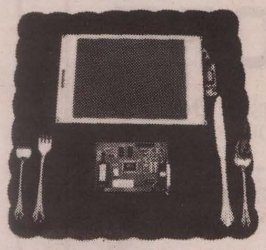

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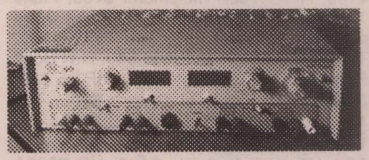

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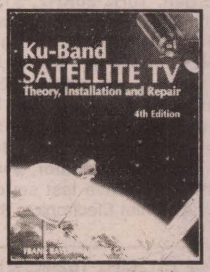

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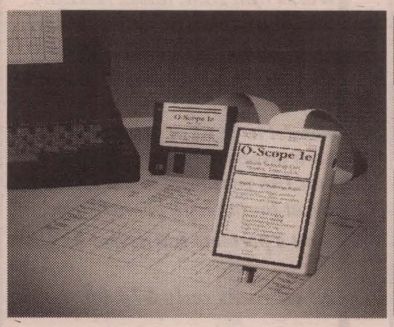
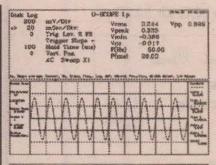
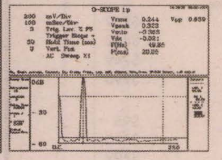




Screen Capture of Sine Wave



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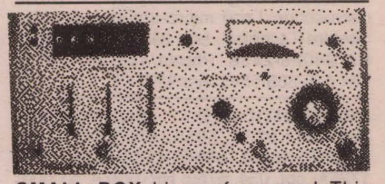

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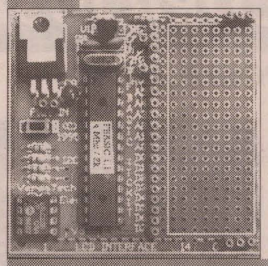

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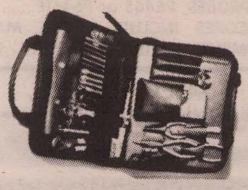

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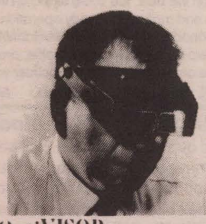

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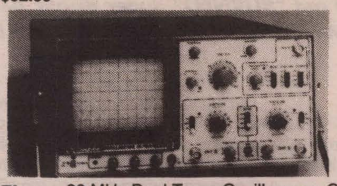

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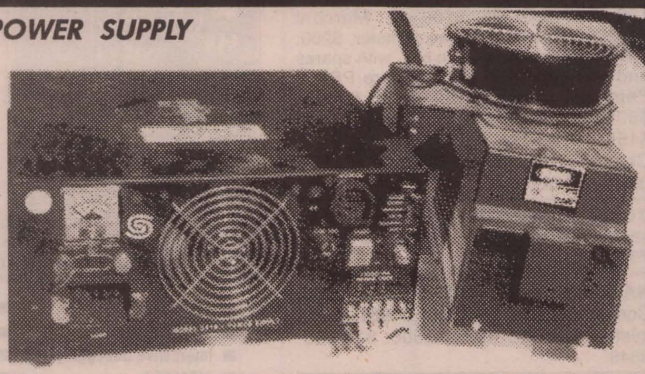

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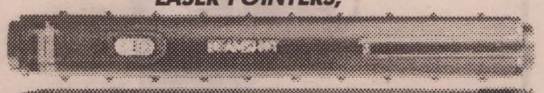

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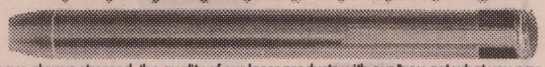

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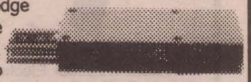

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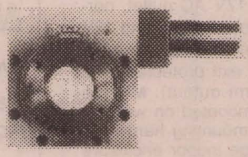

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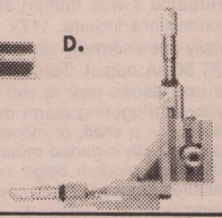

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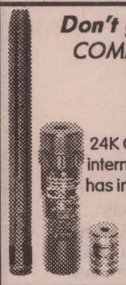

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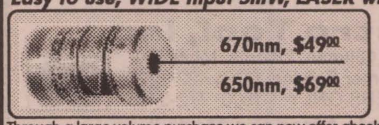

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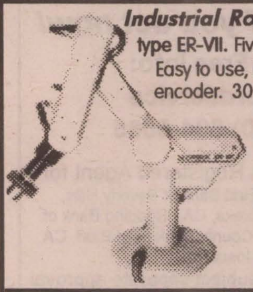
Through a large volume purchase we can now offer absolutely the best value and best quality available on our commercially made, 670nm and 650nm, subminiature, laser diode modules. A glass collimating lens provides adjustment free <1.5mRad performance. (comparable to HeNe lasers.) NEW wide input range, internal surface mount power supply operates from 3 to 6 Volts DC. The package is machined brass for excellent thermal characteristics. These are THE quality laser modules.

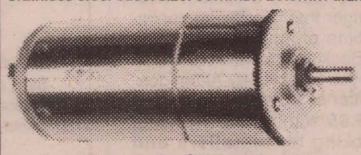
Industrial Robot, Eshed Robotec, type ER-VII.



Five Axis plus gripper, Easy to use, DC Servo motor with encoder. 30 inch reach. All cast aluminum. Very rugged. Weighs about 80 lbs. You supply a simple DC servo controller. Like New Condtion. Only two left! .....**$3500ea. Both for $6000**

ESCAP SWISS GEARMOTOR

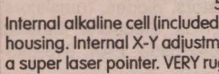
Superior quality **brand new** motors. Both the motor and 64:1 gearbox are ball bearing. Can deliver over 14oz/in of torque @ 112RPM, 6VDC @100mA! Can be operated from 1.5VDC to 12VDC. Stainless steel case. Size: 58mmL x 23.8mm diam. With 3mm diam. shaft. Perfect as a drive motor for our linear slides or for robotics.



Escap price $200ea. Our Price.....$19.95ea.

LAB STYLE DIODE LASERS

635nm, 650nm, 670nm

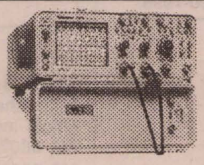


5mW, diode laser, Fully self- contained with Internal alkaline cell (included) and, po./po. switch. Black anodized alum. housing. Internal X-Y adjustment screws. Superior quality. Can also be used as a super laser pointer. VERY rugged. SIZE: .75" diam.x2.85"L
670nm, $89, 650nm, 5X BRIGHTER, $119,-635nm, 10X BRIGHTER, $149

HP OPTICAL ENCODER, HEDS-7500,

NEW, 1000 count quadrature, TTL compatable, A & B output for count and direction, 5VDC @20mA power. With Data. Perfect for do it yourself motion control. (such as featured in N&V)Size : 1.13"diam x 87"d .....***$15ea. 2 for $25***

100MHz, TEK 2336,



NEW STYLE, Dual trace, Delayed Sweep, 50ns/div. Sweep Rate, 5mV Vert. Sens. Differential Time meas. on LCD display. Extra rugged, perfect for field work. All in Excellent condition. NIST CAL. available. Package includes 2 probes and manual.
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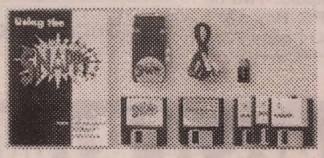

Even includes the battery!

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What You'll Need

IBM PC compatible, desktop or laptop
386 or better
Windows 3.1 or later
4 MB of RAM
8 MB of available hard drive space
Minimum display
VGA - 640 x 480/16 color
Optional Accessories
S-Video input adapter

- No tools required
- No jumpers
- No slots used
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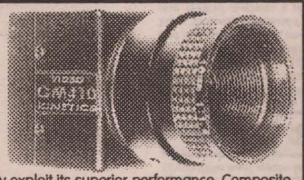
- Create awesome Hollywood effects

Specifications

Image Resolutions:	1500 X 1125, 640 X 480, 320 X 240
Colors:	16.8 million (24-bit)
Freq. Response:	more than 12.5MHz
Capture Modes:	Field, Frame or Multi-Frame
Video Input:	Any NTSC video source
Capture Modes:	Field, Frame or Multi-Frame
Warranty:	Two years
Dimensions:	2.5" W x 4.9" L x .85"H
Connectors:	2 RCA Video, 1 DB25

SUPER SENSITIVE, C - MOUNT MINI CCD CAMERA.



Perfect for scientific applications. GM-410, B&W camera, 38mm SQ. x40mmD, 1/3" CCD, over 270,000 Pixels, 410 Lines Res., Sens. 0.05 LUX., AGC and Electronic Shutter. 12VDC @100mA power. Three lens options fully exploit its superior performance. Composite out. IR SENSITIVE, RCA video connector and jack for DC power. When you need performance not hype, there is no substitute for a good lens! This camera will out-perform any camera in this magazine guaranteed! **BRAND NEW!, without lens...$189ea.**
with 16mm, f1.6, (15deg. FOV) .....$219ea.
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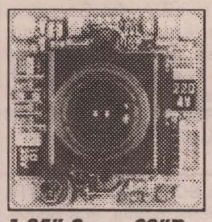
with 4mm, f1.4, (56deg. FOV).....$239ea.

ACTUAL SIZE



1.25" Sq. x .99"D

CCD MICRO CAMERA, Chinon model 060. Black and White, 1/3" CCD, with a full 250,000 PIXELS!, 380 Lines Resolution. Sens. 0.3 LUX. AGC and Electronic Shutter. Low Power 9VDC @100mA ALL lensesincl. pinhole, can be focused! FOV, 4mm, 78°, 3mm 110°, Pinhole 91°, 10mm to infinity) A real glass lens! You get what you pay for. A little more, for a lot more quality. Standard video out. 1/2 once! IR SENSITIVE! A brand name camera. Mating Connector w/ cable included. One price!
with 3 or 4mm.Lens.....$149ea.
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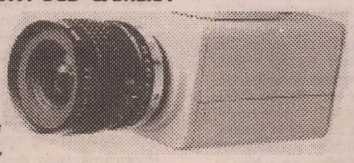
Black,textured ABS. 1"x1.5"x2".....$15.95

NEW! CCD CAMERA



PROVIDES ON-SCREEN CROSS HAIR INDICATOR

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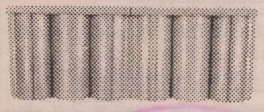
The GM-440-LN, B&W camera, 50mm SQ. x110mmL, 1/3" CCD, over 270,000 Pixels, 410 Lines Res., Sens. 0.05 LUX., AGC and Electronic Shutter. 12VDC @100mA power. Switchable gamma correction. Composite out. IR SENSITIVE, internal or external sync.Interlaced or Non-Interlaced operation. Video out on BNC, DC input std. barrel jack **BRAND NEW!, without lens.....$299ea.**
w/16mm, f1.6, $329ea., or 8mm, f1.3, $349ea., or 4mm, f1.4,$349ea.



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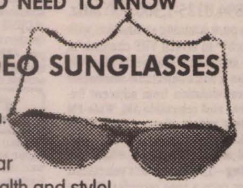
Metal box of 4/$39

FOR THOSE WHO NEED TO KNOW AT ANY COST....

COVERT VIDEO SUNGLASSES



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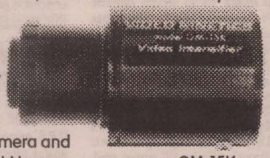
The system provides virtually undetectable, low light color or B/W video as well as audio. Specs: 1/3 " CCD, 330 lines color, 380L B/W, 510 x 492 pixels, 2lux color, 0.2lux B/W. 12VDC powered. Includes: Internal NiCd battery, charger, cig lighter adapter and custom carry case.Photo sensitive, or prescription lenses at extra cost. Video Pen also available. Same specs. and cost.
COLOR.....$3600.00 B/W.....$3400.00

C-MOUNT, CCD IMAGE INTENSIFIER

Now A MINI HAND HELD VIEWER AS WELL



Our EXCLUSIVE GM-15K, U.S. made 2nd GEN. I^2 system provides 15,000X **gain.** True night vision and super IR capability to any quality CCD camera. Simply install between camera and your C-mount lens! Now you can use your GM-15K as a hand held viewer with our new eyepiece with clip on battery option. Your intensifier is twice as usefull. Provides you with one of the smallest viewers available! Truly fits in the palm of your hand. 2"D x 3.4L
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DC-500MHz, BROADBAND AMP

Comlinear, CLC100, Machined alum. housing.

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SMA CONNECTORS	PWR: ±15VDC @ 40mA.

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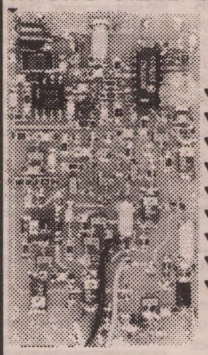
NEW! UHF VIDEO TRANSMITTER

MICRO SIZED SMT DESIGN, with AUDIO!



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- ▼Completely assembled, brand new.
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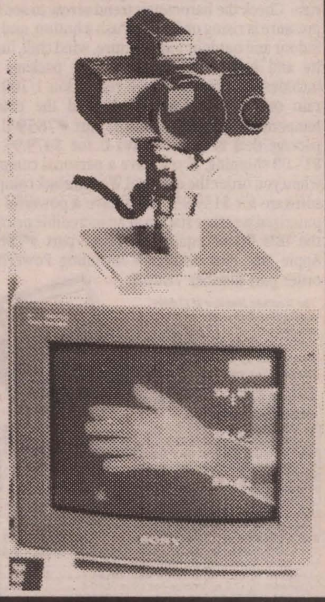
HUGHES PROBEYE MODEL 7300



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The Bearcat 9000XLT gives you pure scanning satisfaction with amazing features like TurboSearch™ to search VHF channels at 300 steps per second. This base and mobile scanner is ideal for surveillance professionals because it has a selectable attenuator to help eliminate annoying intermodulation from adjacent frequencies in highly populated areas and selectable AM, Wide FM and Narrow FM modes that allow you to change the default receiving mode of the BC9000XLT. Other features include ***Auto Store*** – Automatically stores all active frequencies within the specified bank(s). ***Auto Recording*** – This feature lets you record channel activity from the scanner onto a tape recorder. **Hi-Cut filter** to help eliminate unwanted static noise. You can even get an optional ***CTCSS Tone Board*** (Continuous Tone Control Squelch System) which allows the squelch to be broken during scanning only when a correct CTCSS tone is received. For maximum scanning enjoyment, order the following optional accessories: **PS001** Cigarette lighter power cord for temporary operation from your vehicle's cigarette lighter $14.95; **PS002** DC power cord - enables permanent operation from your vehicle's fuse box $14.95; **MB001** Mobile mounting bracket $14.95; **BC005** CTCSS Tone Board $54.95; **EX711** External speaker with mounting bracket & 10 feet of cable with plug attached $19.95. The BC9000XLT comes with AC adapter, telescopic antenna, owner's manual and one year limited warranty from Uniden.

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The Maxon GMRS 210+3 transceiver is a PLL synthesized 10 channel radio on General Mobile Radio Service frequencies. It's the ideal radio for long range communications. Two repeater channels are programmable and one channel (462.675 MHz.) is set aside for emergency and safety communications. The seven remaining interstitial frequencies 462.5625, 462.5875, 462.6125, 462.6375, 462.6875 & 462.7125 MHz are all-purpose GMRS radio channels. 2 watts of RF power for exceptional transmitting range. Up to 5 watts when used with the supplied 12 volt vehicular DC power cord. CTCSS built-in. Includes 450mAh Ni-cad rechargeable battery pack, AC/DC wall battery charger, owner's manual, FCC license application, belt clip, antenna. Call 1-800-USA-SCAN to order.

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VHF Transceiver

RELM® WHS150-U Transceiver/SPECIAL
Mfg. suggested list price $481.67/CE price $299.95

Police and fire departments depend on the RELM WHS150 transceiver for direct two-way communications with their police, fire department, civil defense agency or ham radio repeater. The WHS150 is our most popular programmable five watt, 16 channel handheld transceiver that has built-in CTCSS, which may be programmed for any 39 standard EIA tones. Frequency range 148.000 to 174.000 MHz. Will also work 144.000-148.000 with slightly reduced performance. The full function, DTMF compatible keypad also allows for DTMF Encode/Decode and programmable ANI. Weighing only 15.5 oz., it features dealer programmable synthesized frequencies either simplex or half duplex in both 5.0 and 6.25 KHz. increments. Other features include scan list, priority channel, selectable scan delay, selectable 5 watt/1 watt power levels, liquid crystal display, time-out timer and much more. When you order the WHS150 from Communications Electronics Inc., you'll get a complete package deal including antenna, battery, belt clip and user operating instructions. Other accessories are available. A leather carrying case with swivel belt loop part **#LCWHS** is $49.95; rapid charge battery charger, part **#BCWHS** is $69.95; speaker/microphone, part **#SMWHS** is $54.95; extra ni-cad battery pack, part **#BP007** is $59.95. The radio technician maintaining your radio system must order programming instructions part **#PI150** for $18.00 to activate this radio. FCC license required for United States operation.

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by Karl Lunt

AMATEUR ROBOTICS

Keith Payea, one of the electronics wizards in the Seattle Robotics Society, usually comes up with very cool robotics projects. This month, I'll describe one of his recent designs — a simple switching power supply.

And I do mean simple. You should be able to lash one of these switchers together in an evening, using parts from your junk box or a busted PC power supply. For lack of a better name, I'll refer to this project as the Junk Box Switcher, or JBS.

Inside the JBS

Keith designed this supply to meet requirements specific to robotics. It had to be cheap to build, and it had to provide an adjustable output voltage. He also wanted a supply that would provide its rated output, with little or no overhead. This means that you can set a JBS to supply +5 VDC, connect it to a 6V gel-cell, and get +5 VDC out, even as the battery's voltage sags due to usage.

A glance at the accompanying schematic will show how successful Keith was in keeping his design simple.

Note that Keith's original circuit used a zener diode to select the output voltage level. The trimpot adjustment shown here was suggested by Bill Bailey, another of the club's electronics gurus.

The LM393 comparator, U1, samples the output voltage through the voltage divider formed by R5. This voltage is compared against the 0.6 VDC reference voltage at the junction of D1 and R1. If the sampled voltage is below 0.6 VDC, U1 turns on, bringing its output pin low. This turns on Q1, which switches the entire Vin voltage into L1. This voltage appears on the output pin, where it causes the sampled voltage to start rising. When the sampled voltage rises above 0.6 VDC plus a small hysterisis value, U1 turns off, raising its output pin to Vin through R2. This voltage also turns off Q1 and removes Vin from L1. Eventually, whatever load is hooked to the output will pull the sampled voltage back below 0.6 VDC, causing the entire process to repeat.

One element of this design should be immediately apparent; at any given moment, the switcher's frequency is unknown. U1 turns on and off at a rate determined by the load current, input voltage, setting of R5, value of L1, and the value of C1. Heck, the phase of the moon probably figures in, as well.

Since the switching frequency is unknown, there isn't any real concern over most component values. L1 can be nearly anything over 100 uH, and C1 can be almost anything over 100 uF.

You can use just about any P-channel MOSFET you want, as well. However, you should choose a device with the lowest possible RDSon, as this parameter limits the amount of current you can draw from the switcher.

This limitation comes from the amount of power a MOSFET can dissipate. The typical TO-220 case can handle about 1 watt of power without needing a heatsink. This power, divided by RDSon, gives the square of the amount of current the device can handle.

For example, a JBS using a MOSFET with RDSon of 0.6 ohms can supply:

1.0 watts/0.6 ohms = 1.67 amps squared, or 1.3 amps without needing a heatsink

Be aware that this is a ballpark figure only. It gives you a rough guide on which to base your supply's current capacity, but it does not take into account some switcher characteristics.

Note that you can boost the JBS' current capabilities by adding one or more MOSFETs in parallel to Q1, or by heatsinking Q1.

Besides the IRF9520 called out in the schematic, I have also used the IRF9Z30 device. This MOSFET sports an RDSon of only 0.14 ohms, giving you about four times the current capacity of the 9520. Price for the IRF9Z30 MOSFET is about $3.00 each.

The current rating of L1 will also limit the current supplied by the JBS. You need to use an inductor rated for about 50% more current than you intend to draw in normal use. For example, you should use a 3-amp inductor if you expect to routinely draw 2 amps from the supply.

If you've ever leafed through a Digi-Key catalog, you know that such inductors aren't cheap. Where do you go then, to find suitable inductors?

Many surplus stores and mail-order houses sell power inductors of various ratings. You can use just about anything over 100 uH, which simplifies the task of finding a useful inductor.

You can also tear apart a blown-out PC power supply. These are easy to come by, and offer scads of parts that you can use. You will find several inductors that should work in a JBS. Just pick one made of at least 18 AWG wire and give it a try.

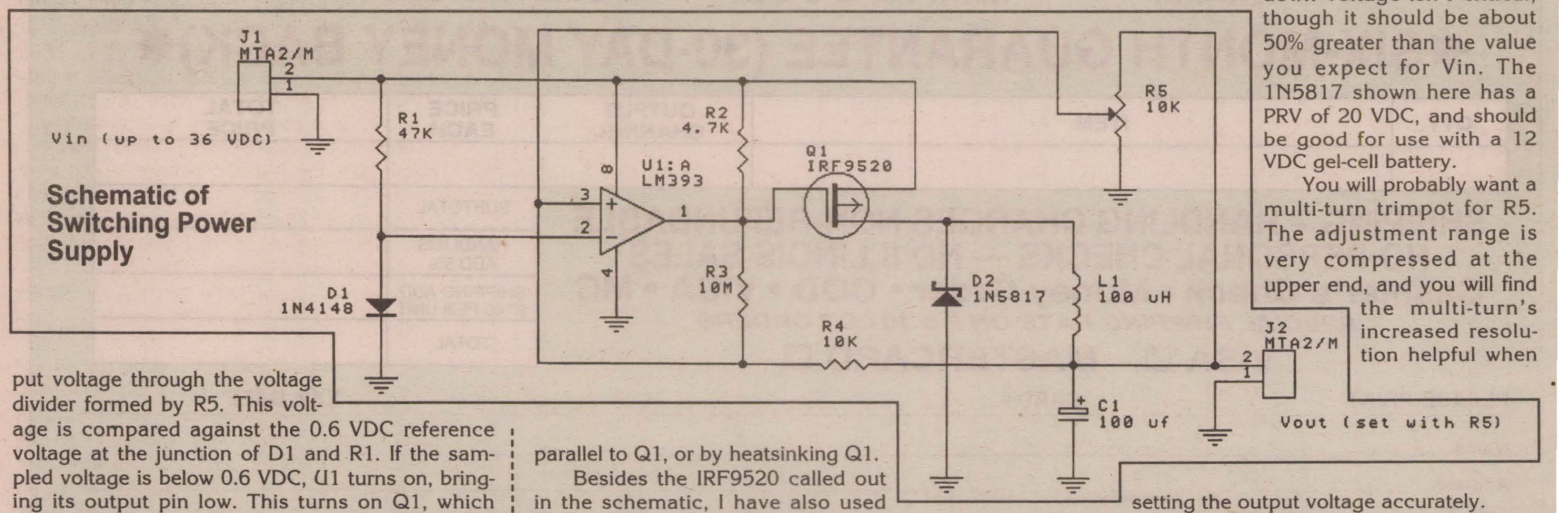
Besides high-current inductors, a junked PC supply will have a Schottky diode suitable for D2, as well as a high-value filter capacitor that you can use for C1.

Despite the intentional simplicity of this design, you do need to watch for a couple of possible problems. R3 determines how much ripple your output voltage shows. The specified value of 10 Mohms should yield a ripple of about 60 mV in a +5 VDC supply. Using lower values of R3 will produce greater levels of ripple.

If your project draws a lot of current, the switching frequency can easily exceed 1 KHz as Vin starts to drop closer to Vout. This increased switching frequency can cause C1 to overheat. If you expect to draw a lot of current from a JBS, use a high-quality cap for C1. Suitable parts include the Panasonic HF or HFU types, the Rubycon G2A series, or the Nichicon PX units.

You must use a Schottky diode for D2. This device acts as a catch diode for the inductor, and must handle high-switching speeds. The breakdown voltage isn't critical, though it should be about 50% greater than the value you expect for Vin. The 1N5817 shown here has a PRV of 20 VDC, and should be good for use with a 12 VDC gel-cell battery.

You will probably want a multi-turn trimpot for R5. The adjustment range is very compressed at the upper end, and you will find the multi-turn's increased resolution helpful when setting the output voltage accurately.



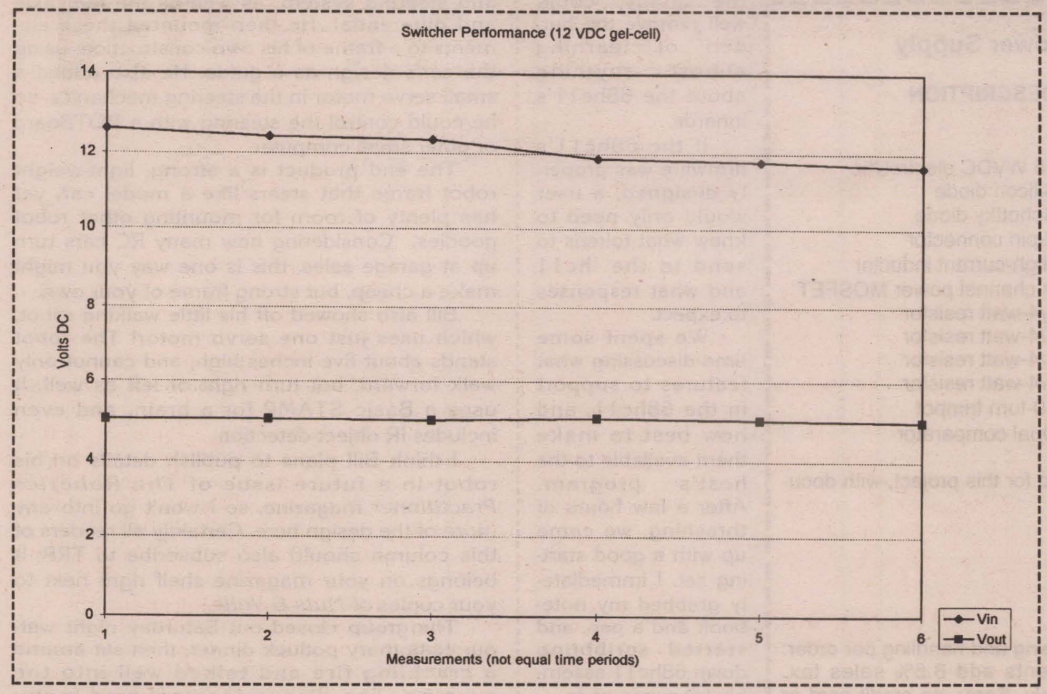
Schematic of Switching Power Supply

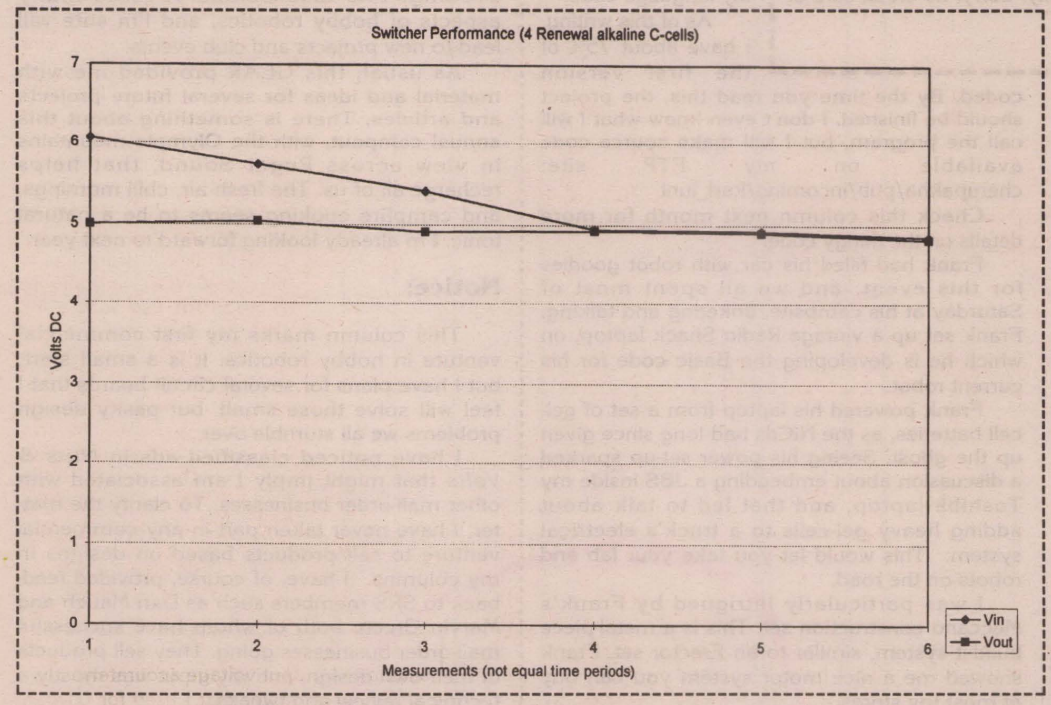
The LM393 comparator that I used for U1 can handle Vin values of up to 36 VDC. This should be more than adequate for most robot needs. If you intend to use Vin greater than 36 VDC, you should select a different device for U1.

This circuit fits comfortably on half of a Radio Shack experimentor board (276-148). You can use just about any 2-pin connector for J1 and J2. If you want, you can just bring two twisted-pair wires onto the board for hookup.

You can also order a blank etched and drilled circuit board for this project from me. Cost for the board and documentation is $6.95, plus $1.50 shipping and handling per order. Washington state residents add 8.5% sales tax. Be sure to specify RPB-01 on your order. Sorry, but I don't take plastic, COD, or foreign funds.

The board I sell measures just 1.5" x 2.0", making it small enough to mount just about anywhere on a robot frame. It includes





four 1/8" holes, pre-drilled for mounting with 4-40 hardware.

Testing the JBS

After I built a working unit, I hooked it up to a 12-volt gel-cell and started playing around with it. Like most switchers, you have to add a load to the JBS's output before you can take accurate voltage measurements.

In my case, I hooked the coil of a 5 VDC relay, with a coil resistance of 125 ohms, to the JBS's output terminals. I then set the output for a value of 5.0 VDC.

I left this set-up running on my lab bench for a couple of days, taking periodic measurements of the battery voltage and the switcher's output voltage. As shown in the accompanying chart, the gel-cell's voltage dropped from 12.63 VDC, down to 11.64 VDC, but the JBS's output only varied between 5.07 and 4.99 VDC.

I repeated the experiment, instead using a set of four Renewal alkaline C-cells. This provided an initial battery voltage of 6.06 VDC.

I re-trimmed the switcher's adjustment, then repeated the measurements over a period of about 36 hours. This time, the battery's voltage dropped down to 4.86 VDC, yet the switcher's output remained as close to 5.00 VDC as possible. Refer to the accompanying chart. In fact, the output stayed at 5 VDC until the battery voltage dropped below 5 VDC, at which point the output voltage simply followed the input voltage.

This exercise shows a strong feature of the JBS; it has essentially zero overhead voltage. This means you can get a regulated 5 VDC output from just about any voltage source of 5 VDC or greater.

Note that there is nothing magical about the output voltage; it doesn't have to be 5 VDC. You can set the output voltage to anything from 0.6 VDC up to the input voltage, and the JBS will try to maintain that output voltage.

You could, for instance, replace the trimpot with a large multi-turn pot and knob, creating a simple bench supply. Your JBS bench supply could run from nearly any source of DC voltage, such as a battery, a wall-wart, or even a solar panel.

If you use a battery as the DC source, you end up with an adjustable bench supply that runs from your car battery or an external gel-cell. The bench supply would be fully portable, letting you do robots on vacation.

A JBS built on one of my circuit boards would be so small that it would fit inside many battery-powered devices. You could then use a wall-wart to make an efficient line-powered supply for the device. I intend to do just this with my old Toshiba laptop, replacing the defunct NiCd packs and original AC supply.

At first glance, it might seem that you could do all of the above with a LM317 variable regulator and a few parts. You can, if you are willing to overlook the horrible inefficiency and high-overhead requirements of such a supply.

Linear regulators such as the 7805 and the LM317 generate a specific lower voltage from a higher input voltage, wasting the difference as heat. For example, a 7805 hooked to a 12 VDC battery will provide 5 VDC output by converting the remaining 7 VDC, at whatever current your circuit draws, into heat. This means the best efficiency you can hope for with a 7805 in such a circuit is 5/12, or about 42%. The LM317 is no more efficient, it is just adjustable. And these older regulators require a certain amount of "headroom" on the input voltage, typically about 2 VDC. Thus, you could not even use a 7805 regulator if your input voltage was less than 7 VDC, which eliminates the chance to use a 6 VDC gel-cell battery.

By contrast, the JBS needs no headroom, and will even follow the battery voltage down as it drops below the specified output voltage. This can be critical in those cases where your robot needs just a few more minutes of run-time, even though the batteries are nearly dead.

True, you can get very low dropout regulators today, but you still have to contend with the heat problem.

As an extreme example, consider the power supply developed by one of the club's members. He was using a 7805 to generate 5 VDC, using 24 VDC as his supply voltage. This resulted in an efficiency below 21%; the remaining power was dissipated as heat. And a lot of heat at that! When he tried substituting a JBS supply for his 7805, he was surprised with the difference. The MOSFET in the JBS ran at ambient temperature, without a heatsink, yet the supply delivered all the power of his original unit.

Try wiring up a JBS for your next robo-project. I think you'll like the difference a switcher makes.

5th GEAR

I just got back from three days in the woods, vacationing with other members of the Seattle Robotics Society (SRS). We ate lots of food, consumed a brew or two, and talked

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Parts List for the Switching Power Supply

DESCRIPTION	QTY.	COMPONENT NAME(S)	DESCRIPTION
100 uF	1	C1	25 WVDC electrolytic
1N4148	1	D1	Silicon diode
1N5817	1	D2	Schottky diode
MTA2/M	2	J1, J2	2-pin connector
100 uH	1	L1	High-current inductor
IRF9520	1	Q1	P-channel power MOSFET
47K	1	R1	1/4-watt resistor
4.7K	1	R2	1/4-watt resistor
10M	1	R3	1/4-watt resistor
10K	1	R4	1/4-watt resistor
10K	1	R5	10-turn trimpot
LM393	1	U1	Dual comparator

A blank etched and drilled printed circuit board for this project, with documentation, is available. Order item RPB-01 from:

Karl Lunt
2133 186th Pl., SE
Bothell, WA 98012
(206) 483-0447

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at length about things robotic.

The SRS holds these annual events, called GEARs, each year around the end of July. A GEAR (for Great Escape and Retreat) gets you away from work and chores, and gives you ample time to kick around ideas for that new 'bot or compare notes with friends.

I find the GEARs a perfect place to recharge my own batteries, to come up with new projects, and to get revved up again. Long-time readers of this column will recall that 3rd GEAR spawned my 68hc11 tiny4th, while 4th GEAR was the springboard for Max' motor adapter.

This year proved to be just as rewarding. Keith Payea, Frank Haymes, and Bill Harrison and his daughter, Isa, joined Linda and I on Whidbey Island at our usual campground. Bill and Frank brought lots o' robots to work on and talk about.

During the discussions, Frank described a simple device that he had been waiting to see developed. He envisioned a 68hc11 board, such as Marvin Green's BOTBoard, permanetly connected to a PC's serial port. The PC would issue commands to the 68hc11 which, in turn, would twiddle its output ports, or read its input ports and relay the results to the PC. Thus, the 68hc11 would become an I/O expansion port for the PC, hooked to its host via an RS-232 cable.

Frank couldn't believe that such a device didn't already exist, and asked me about it. Not only had I never heard of such a device, I was shocked that I hadn't already come up with such an obvious gadget myself.

I mean, think about it. You could use the 68hc11 as the control end of a tethered robot. The PC would do the intelligent part, while the 'hc11 moved the motors or read the sensors.

And the PC wouldn't even have to be a PC. You could use a Mac, a TI 99, or anything else with a serial port on it. And you could even write the PC's program in just about anything you liked: Forth, Basic, C, or Pascal. You might even be able to cobble together a text file, and just send it down the serial line using the DOS COPY command.

Frank's concept, which we promptly dubbed the "thingy," could well remove the burden of learning almost anything about the 68hc11's innards.

If the 68hc11's firmware was properly designed, a user would only need to know what tokens to send to the 'hc11 and what responses to expect.

We spent some time discussing what features to support in the 68hc11, and how best to make them available to the host's program. After a few hours of thrashing, we came up with a good starting set. I immediately grabbed my notebook and a pen, and started scribbling down 68hc11 assembly language code.

As of this writing, I have about 75% of the first version coded. By the time you read this, the project should be finished. I don't even know what I will call the program, but I will make source code available on my FTP site: cherupakha/pub/incoming/karl_lunt

Check this column next month for more details on the thingy code.

Frank had filled his car with robot goodies for this event, and we all spent most of Saturday at his campsite, tinkering and talking. Frank set up a vintage Radio Shack laptop, on which he is developing the Basic code for his current robot.

Frank powered his laptop from a set of gel-cell batteries, as the NiCds had long since given up the ghost. Seeing his power set-up sparked a discussion about embedding a JBS inside my Toshiba laptop, and that led to talk about adding heavy gel-cells to a truck's electrical system. This would let you take your lab and robots on the road.

I was particularly intrigued by Frank's Meccano construction set. This is a metal-piece build-it system, similar to an Erector set. Frank showed me a nice motor system you can buy at most toy stores.

It consists of a 6 VDC motor in a special housing, with a small selection of brass pinion and drive gears, and some mounting hardware for bolting the motor to other Meccano elements. The motor system costs about $20.00, and deserves a look-see if you need a drop-in motor design for your next project.

You can also find details on the Meccano construction set by leafing through the Metal Construction Set FAQ in comp.robotics. Jeff Duntemann maintains this collection of tips and pointers, and it should help get you started with this intriguing robotics resource. Note that the FAQ covers several construction sets besides Meccano, including Erector and Temsi.

Speaking of drive systems, Bill Harrison showed off a robot frame he had made, using key elements from a torn-apart RC car. He had dismantled the car and pulled out the front axle and steering system, as well as the rear axle and differential. He then mounted these elements to a frame of his own construction, using the car's design as a guide. He also added a small servo motor in the steering mechanics, so he could control the steering with a BOTBoard or other small computer.

The end product is a strong, light-weight robot frame that steers like a model car, yet has plenty of room for mounting other robot goodies. Considering how many RC cars turn up at garage sales, this is one way you might make a cheap, but strong frame of your own.

Bill also showed off his little walking robot, which uses just one servo motor! The robot stands about five inches high, and cannot only walk forward, but turn right or left as well. It uses a Basic STAMP for a brain, and even includes IR object detection.

I think Bill plans to publish details on his robot in a future issue of *The Robotics Practitioner* magazine, so I won't go into any more of the design here. Certainly all readers of this column should also subscribe to TRP; it belongs on your magazine shelf right next to your copies of *Nuts & Volts*.

The group closed out Saturday night with our customary potluck dinner, then sat around a crackling fire and talked well into the evening. The discussions covered many aspects of hobby robotics, and I'm sure will lead to new projects and club events.

As usual, this GEAR provided me with material and ideas for several future projects and articles. There is something about this annual campout, with the Olympic mountains in view across Puget Sound, that helps recharge all of us. The fresh air, chill mornings, and campfire cooking seems to be a natural tonic. I'm already looking forward to next year.

Notice:

This column marks my first commercial venture in hobby robotics. It is a small start, but I have plans for several circuit boards that I feel will solve those small, but pesky design problems we all stumble over.

I have noticed classified ads in *Nuts & Volts* that might imply I am associated with other mail-order businesses. To clarify the matter, I have never taken part in any commercial venture to sell products based on designs in my columns. I have, of course, provided feedback to SRS members such as Dan Mauch and Marvin Green, both of whom have successful mail-order businesses going. They sell products of their own design, and my input was mostly a technical review and tweaks.

But, I have never worked with anyone to develop, for example, a commercial version of my Max robot platform. I described the design of my Max robot in an earlier article, and others may have developed a similar design, but I have never worked with anyone to make Max a commercial product.

If I ever do help create such a commercial product, I will let you know, in this column, of the details. Until then, however, you can assume that anyone advertising a product based on my designs does so without my personal involvement or support. **NV**

As always, you can reach me at:
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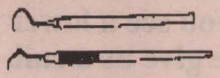

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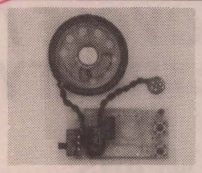

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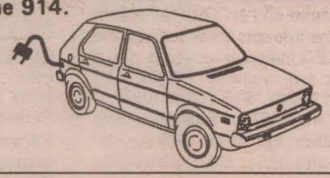

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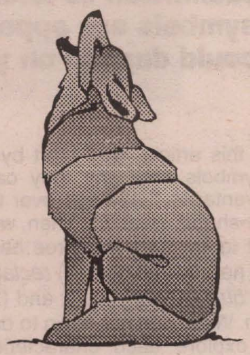

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Interpreting the IEEE/IEC Logic Symbols: *It's a Lot Easier Than You Think*

by Ronald Reis

Ah, yes — those symbols. I thought they had come and gone — another casualty of the 1980s? No, actually the IEEE/IEC logic symbols, fully developed in 1984, are alive and well, thank you. Moreover, it's clearly in the interest of every hobbyist and electronics technician to know how to read and interpret them. After all, questions about the new symbols are appearing on company entrance exams — getting a new job or promotion could depend on your being IEEE/IEC-literate.

In this article, we'll start by explaining what the symbols are, why they came about, and the advantages they have over traditional, or distinctive-shape, symbols. Then, we will survey the subject to illustrate the three basic characteristics of the new symbology: (1) *rectangular symbol layout;* (2) *qualifying symbols;* and (3) *dependency notation.* We'll then get down to detail, using examples to explore each characteristic in more depth. When you have completed this article, you should be IEEE/IEC-symbol ready.

The IEEE/IEC Symbol Advantage

In 1984, the IEEE (Institute of Electrical and Electronics Engineers), in conjunction with the IEC (International Electrotechnical Commission), developed a new standard for logic symbols and circuits. It was felt that a new graphic language was required to show more concisely the behavior of digital circuits. With the use of IEEE/IEC logic symbols, the relationship of inputs to outputs is specified so that the logic operation of a given device can be determined solely from its logic symbol; **no internal logic need be revealed.**

The IEEE/IEC logic symbols offer two clear advantages over the distinctive-shape symbols.

1. The new symbols are much simpler, since no internal logic is depicted.
2. With the IEEE/IEC logic symbols, many circuit characteristics for which there were no previous symbolic representations can now be portrayed — open-collector, open-emitter, and three-state outputs, to name just a few.

In this article, we cannot hope to cover this vast subject in its entirety. What we will do, is introduce the basic characteristics of the new symbology and give you a "feel" for how the symbols are interpreted. To become fully knowledgeable, you'll need to take two additional steps. First, practice reading the new symbols by contrasting and comparing them to the distinctive-shape symbols you are more familiar with. Second, obtain a copy of the IEEE Std. 91-1984 bulletin, *IEEE Standard Graphic Symbols for Logic Functions,* and study it.

Write to or call The Institute of Electrical and Electronics Engineers, Inc., 345 East 47th Street, New York, NY 10017 (212-705-7900), for details on how to obtain your copy. It's sure to be your reference bible for years to come.

Symbol Characteristics — an Overview

In Figure 1, we see the distinctive-shape and IEEE/IEC logic symbols for two digital ICs: a 74LS01 quad two-input NAND gate with open collector and a 7475 quad bistable latch. As shown in the figure, and mentioned previously, the IEEE/IEC symbols have three characteristics: rectangular symbol layout; qualifying symbols; and dependency notation.

The **rectangular symbol layout** is used primarily because it is easy to draw. It usually consists of stacked rectangular elements (Figure 1A) or an upper block with notched corners over stacked elements (Figure 1B). The upper, notched block is known as the *control-block;* the lower elements, the *controlled region.*

The **qualifying symbols** qualify, or identify, the function associated with the rectangular block. As we see, in Figure 1A, the &, ◺ ,and ◇ symbols are the qualifiers for the 74LS01 IC. The & symbol tells us that the two inputs to each block (NAND gate) are ANDed. The ◺ symbol says the outputs are inverted (AND gate plus inverter equals NAND gate). The ◇ symbol reveals that the outputs are NPN open collector.

Dependency notation describes functions that affect only some of the circuit's signals. Referring to Figure 1B, we note the use of dependency notation. The C1 in the control block section tells us that control input number 1 "controls" data input 1D in the first two blocks of the controlled region. In other words, 1D is "dependent" on C1. The C2 in the control block tells us that control input number 2 "controls" data input 2D in the third and fourth blocks of the controlled region. Thus 2D is "dependent" on C2.

Let's now take a more detailed look at these three symbol characteristics.

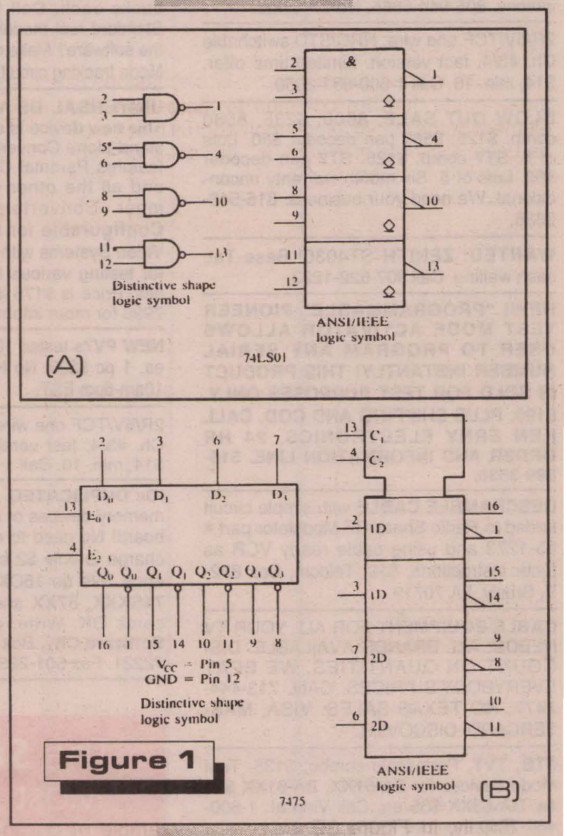


Figure 1

The Rectangular Symbol Layout

The length-width ratio of rectangular layouts is arbitrary. We just have to be sure that there is enough room to include all the necessary input and output lines. Within the outline (or outlines), is one or more qualifying symbols. The concept is illustrated in Figure 2.

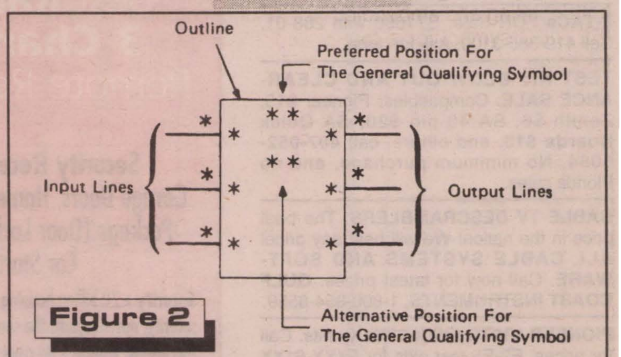


Figure 2

NOTE 1: The single * denotes possible positions for qualifying symbols relating to inputs and outputs.
NOTE 2: If, and only if, the function of an element is completely determined by the qualifying symbols associated with its inputs or outputs or both, no general qualifying symbol is needed.

In order to reduce the space required for the representation of a group of associated elements, the outlines of the elements may be abutted or embedded.

When elements are abutted, there is no logic connection between elements if the line common to their outlines is in the direction of signal flow (Figure 3A). There is at least one logic connection, however, when the line common to two outlines is perpendicular to the direction of signal flow (Figure 3B).

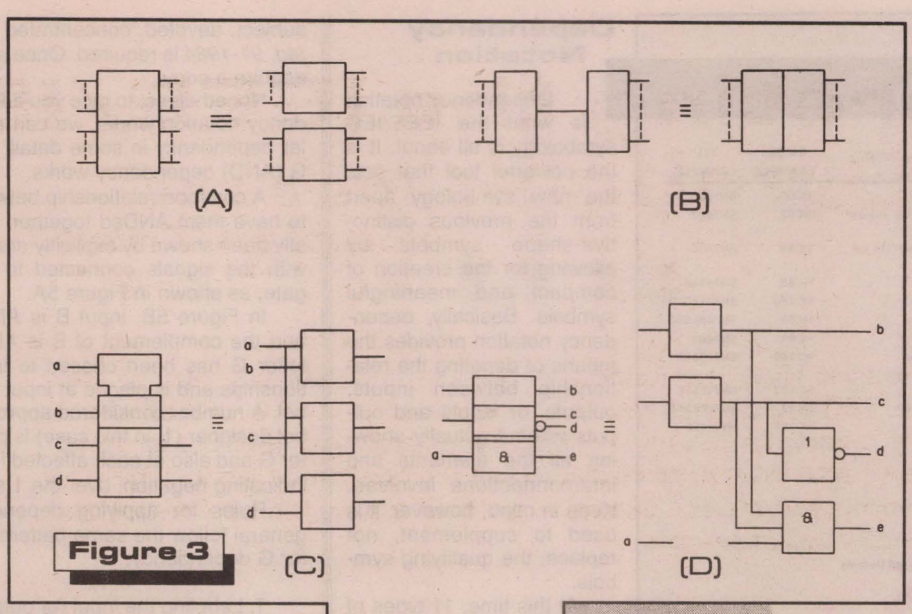
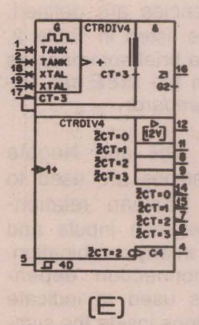


Figure 3

As mentioned earlier, when a circuit has one or more inputs that are common to more than one element of the circuit, a common-control block may be used. Observe in Figure 3C, the common-control block is notched, making it the only distinctive shaped element in the IEEE/IEC logic system. Notice, in the figure, unless otherwise qualified by dependency notation, an input to the common-control block is an input to each of the elements in the controlled region.

The rectangular symbol layout also allows for a common output that depends on all elements of the array. As shown in Figure 3D, its visual feature is the double line at the top of the output element. Notice that the common output element, like any element, must have at least one qualifying symbol to indicate its function. The "&" is the qualifying symbol for AND.

Finally, in Figure 3E we see an example of both abutting and embedding in the rather complex IEEE/IEC symbol for a four-phase, clock generator/driver.



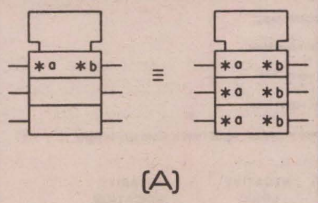


Figure 4

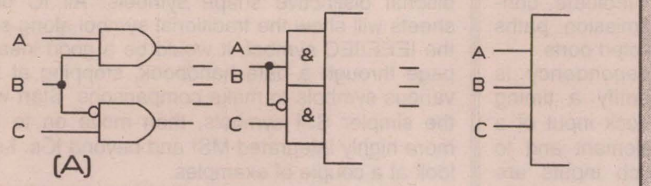
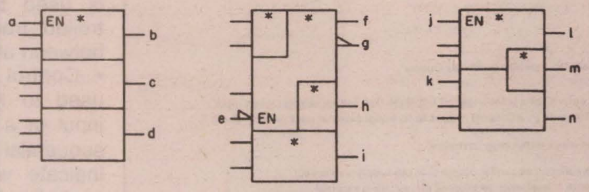


Figure 5



Qualifying Symbols

Qualifying symbols, you will recall, identify a function associated with a rectangular block. The symbols can be divided into three categories: (1) general qualifying symbols; (2) qualifying symbols for inputs and outputs; and (3) symbols inside the outline. Let's examine each in more detail.

In Table 1A we have a few of the *general qualifying symbols* as defined by the IEEE/IEC standard. The preferred location for the symbol (Figure 2) is near the top center. Alternately, the geometric center can be used. Remember, these general qualifying symbols define the basic function of the device represented by the symbol or element.

Most of the symbols are self- explanatory. The "&" is obviously an AND indicator. ROM is, of course, read-only memory. Less obvious, and requiring some memorization, are symbols for the OR gate and a multiplier, for instance.

Examples of *qualifying symbols for inputs and outputs* are shown in Table 1B. Most should be familiar to you except, perhaps, for the logic polarity and analog signal indicators. In many cases, with the use of such qualifying symbols, a statement of whether positive logic (1=H, 0=L) or negative logic (1=L, 0=H) is being used, is required or must be assumed.

In a group of elements, if the same general qualifying symbol and the same qualifying symbols associated with inputs and outputs would appear inside each of the elements of the array, these qualifying symbols are usually shown only in the first element. This is done to reduce clutter and to save time in recognition. Figure 4A illustrates the point.

In Table 1C we show representative examples of *symbols used inside the outline.* Note that the open-collector, open-emitter, and three-state outputs have distinctive symbols.

Particular attention should be paid to the EN, enable input, symbol. When this input is at its internal 1-state, all outputs stand at their normally defined internal logic states and have their normally defined effect on outputs. When the EN input is at its internal 0-state, all open-circuit outputs are at their high-impedance states and all three-state outputs are at their normally defined internal logic states.

When the enable input is part of a "composite symbol," outputs not otherwise shown to be influenced by the unsubdivided portion of the symbol containing the EN input are excluded. We see this concept illustrated in Figure 4B.

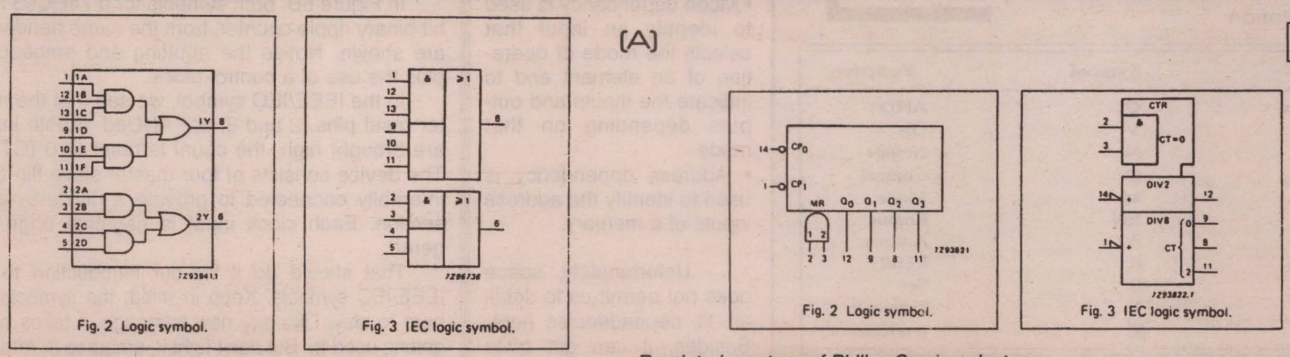


Figure 6

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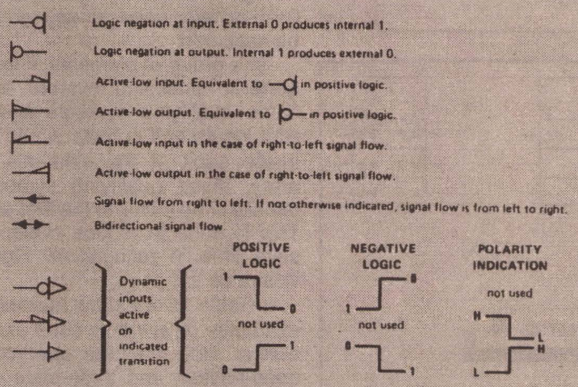
Table 1

SYMBOL	DESCRIPTION	CMOS EXAMPLE	TTL EXAMPLE
&	AND gate or function.	*HC00	SN7400
≥1	OR gate or function. The symbol was chosen to indicate that at least one active input is needed to activate the output.	*HC02	SN7402
1	Exclusive OR. One and only one input must be active to activate the output.	*HC86	SN7486
	Logic identity. All inputs must stand at the same state.	*HC86	SN74180
2k	An even number of inputs must be active.	*HC280	SN74180
2k+1	An odd number of inputs must be active.	*HC86	SN74ALS86
1	The one input must be active.	*HC04	SN7404
▷ or ◁	A buffer or element with more than usual output capability (symbol is oriented in the direction of signal flow).	*HC240	SN74S436
⊓	Schmitt trigger, element with hysteresis.	*HC132	SN74LS18
X/Y	Coder, code converter (DEC/BCD, BIN/OUT, BIN/7-SEG, etc.)	*HC42	SN74LS347
MUX	Multiplexor/data selector.	*HC151	SN74150

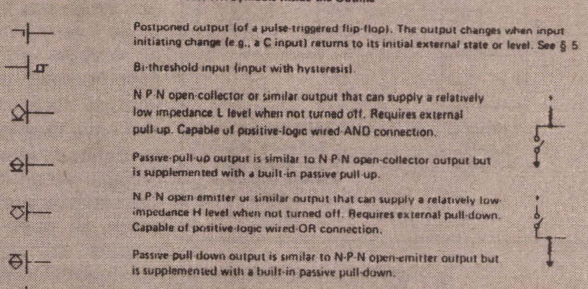
(A)

Table II. Qualifying Symbols for Inputs and Outputs



(B)

Table III. Symbols Inside the Outline



(C)

Table 2

Dependency notation

	Symbol	Function
Boolean functions	G	AND
	V	OR
	N	Negate
Enable functions	C	Control
	M	Mode
	EN	Enable
	A	Address
Bistable functions	R	Reset
	S	Set
Other functions	X	Transmit
	Z	Interconnect

Dependency Notation

Dependency notation is what the IEEE/IEC symbology is all about. It is the powerful tool that sets the new symbology apart from the previous distinctive-shape symbols by allowing for the creation of compact and meaningful symbols. Basically, dependency notation provides the means of denoting the relationship between inputs, outputs, or inputs and outputs without actually showing all the elements and interconnections involved. Keep in mind, however, it is used to supplement, not replace, the qualifying symbols.

At this time, 11 types of dependencies are defined. They are listed in Table 2. Here is a brief summary, as stated in the *IEEE std. 91-1984 Standard:*

- AND, OR and Negate dependencies are used to denote Boolean relationships between inputs and outputs, in any combination.
- Interconnection dependency is used to indicate connections inside the symbol.
- Transmission dependency is used to indicate controlled transmission paths between affected ports.
- Control dependency is used to identify a timing input or a clock input of a sequential element and to indicate which inputs are controlled by it.
- Set and reset dependencies are used to specify the internal logic states of an RS bistable element when the R and S inputs both stand at their internal 1-states.
- Enable dependency is used to identify an enable input and to indicate which inputs and outputs are controlled by it (for example, which outputs take on their high-impedance state).
- Mode dependency is used to identify an input that selects the mode of operation of an element and to indicate the inputs and outputs depending on that mode.
- Address dependency is used to identify the address inputs of a memory.

Unfortunately, space does not permit us to detail all 11 dependencies here. Besides, it can get quite complicated. To master the subject, devoted, concentrated study of the *IEEE std. 91-1984* is required. Once again, I urge you to acquire a copy.

Nonetheless, to give you a feel for how dependency notation works, we can examine a particular dependency in some detail. Let's see how the G (AND) dependency works.

A common relationship between two signals is to have them ANDed together. This has traditionally been shown by explicitly drawing an AND gate with the signals connected to the inputs of the gate, as shown in Figure 5A.

In Figure 5B, input B is ANDed with input A and the complement of B is ANDed with C. The letter G has been chosen to indicate AND relationships and is placed at input B, inside the symbol. A number considered appropriate by the symbol designer (1, in this case) is placed after the letter G and also at each affected input. Note the bar, indicating negation, over the 1 at input C.

Rules for applying dependency notation in general follow the same pattern as was illustrated for G dependency:

1. Labeling the input (or output) *affecting* other inputs or outputs with the letter symbol indicating the relationship involved (e.g., G for AND) followed by an identifying number, appropriately chosen.
2. Labeling each input or output *affected* by that affecting input (or output) with that same number.
3. If it is the complement of the internal logic state of the affecting input or output that does the affecting, then a bar is placed over the identifying numbers at the affected inputs or outputs.

A Couple of Examples

An effective way of getting to know the IEEE/IEC symbols is to compare them with the traditional distinctive shape symbols. All IC data sheets will show the traditional symbol along side the IEEE/IEC symbol. It would be a good idea to page through a data handbook, stopping at the various symbols to make comparisons. Start with the simpler SSI symbols, then move on to the more highly integrated MSI and beyond ICs. Let's look at a couple of examples.

In Figure 6A, we see both types of logic symbols for a 74HC58 dual AND-OR gate as they appear in the high-speed *CMOS Logic Family Data Handbook* from Phillips Semiconductors. Note, in the IEEE/IEC symbol, the abutted rectangles. Remember, no logic connection exists between elements if the line common to their outlines is in the direction of signal flow. Since each AND gate is separate from the other, a horizontal line (direction of signal flow) isolates the gates.

On the other hand, since there is at least one logic connection when the line common to two outlines is perpendicular to the direction of signal flow, and two AND gates feed one OR gate, in our example, we use a vertical line.

In Figure 6B, both symbols for a 74HC93 four-bit binary ripple counter, from the same handbook, are shown. Notice the abutting and embedding, plus the use of a control-block.

In the IEEE/IEC symbol, we see that the master reset pins, 2 and 3, are ANDed. If both inputs are brought high, the count is reset to 0 (CT=0). The device consists of four master-slave flip-flops internally connected to provide a divide-by-eight section. Each clock input is negative edge-triggered.

That should do it for our introduction to the IEEE/IEC symbols. Keep in mind, the symbols are here to stay. Like any new language, it takes some getting used to. But don't fight it, embrace it. After all, we don't want to be IEEE/IEC-symbol illiterate. **NV**

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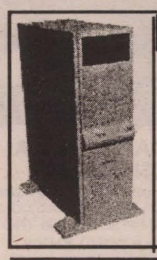

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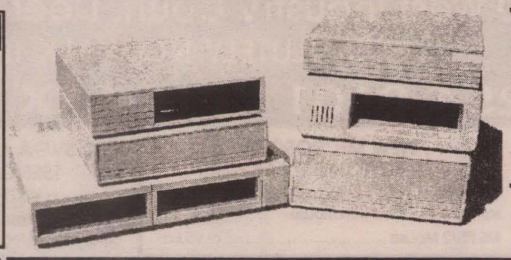

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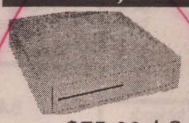

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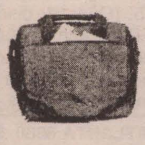

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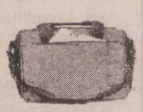

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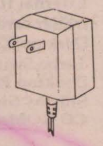

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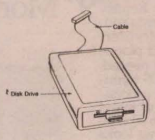

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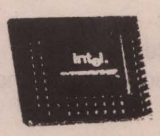

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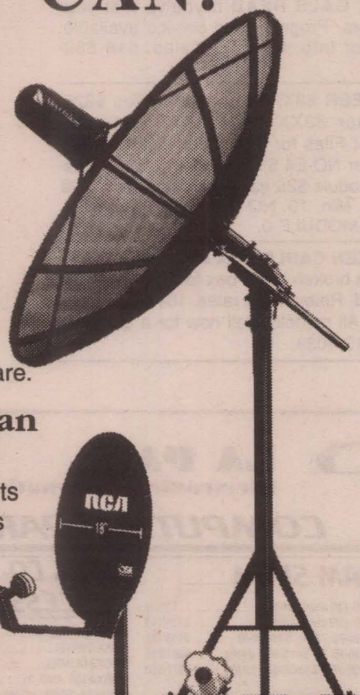

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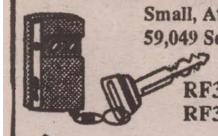

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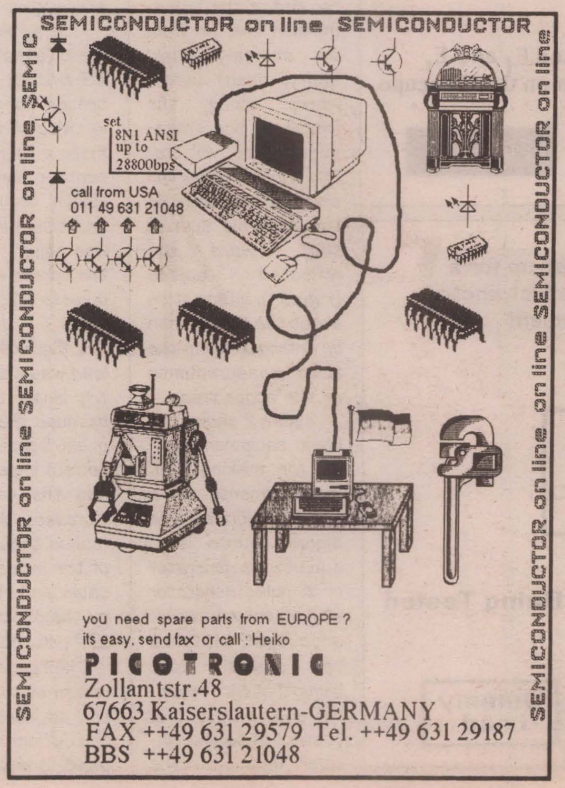

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Experimenting With Transmission Line Time Domain Reflectometry

Open Channel

by Joseph J. Carr
K4IPV

Time domain reflectometry (TDR) is a means for evaluating transmission lines from one end (i.e., without access to the other end) using only a pulse generator and an oscilloscope. Such a capability becomes very important when one cannot gain access to both ends of an installed coaxial cable simultaneously. Examples of such applications include radio antennas, cable TV transmission lines, telephone, and other communications transmission lines. I've witnessed telephone engineers using sophisticated TDR analyzers to troubleshoot a defect on a section of transmission line over 33 miles long.

Similarly, a friend of mine used simple TDR methods very much like those in this article to troubleshoot a long TV antenna transmission line. His wife's parents lived in a "holler" (i.e., valley) in a remote county in the southern portion of West Virginia. In the years before satellite TVRO and direct satellite TV, the only solution was a mountain top antenna aimed at the only available TV station (which happened to be Channel 3).

The 23-element single-channel (Channel 3) Yagi was installed at the top of the mountain with a solar powered 60-dB amplifier to make up for the losses in nearly three kilometers of 75-ohm low-loss coax running through the woods down the side of the mountain. He fixed a 75-ohm dummy load to the receiver end of the coax, and then took his battery powered Tektronix 300-series oscilloscope and a homebrew squarewave generator to the head end (an "easy" drive up a road intended more for billy goats than Jeep Cherokees!).

By using TDR, he was able to drive back down the mountain a distance approximately where the break occurred, and then exit the road and crash through the bush a few dozen meters rather than trek through the snake-infested (rattlers and copperheads abound) thornbush and honeysuckle the entire distance. He located the break within a short distance where his crude measurement indicated it would be!

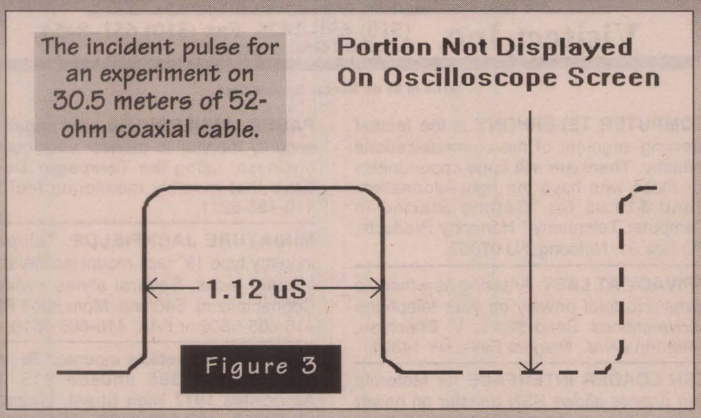


Figure 3

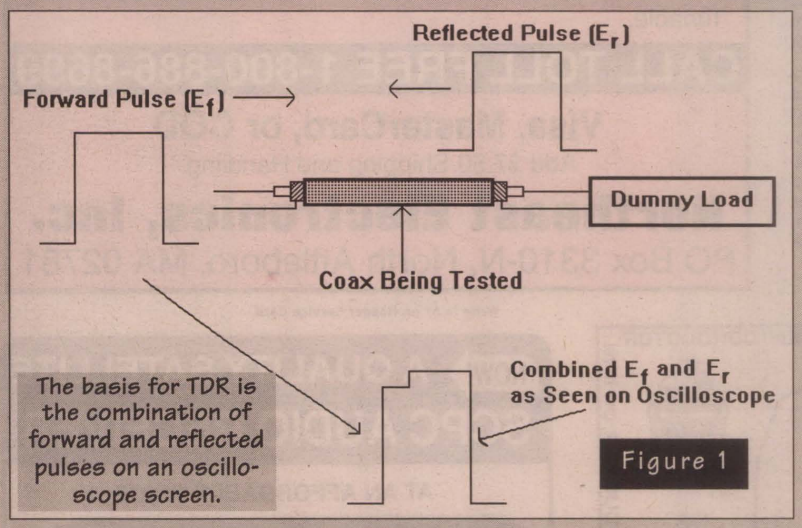


Figure 1

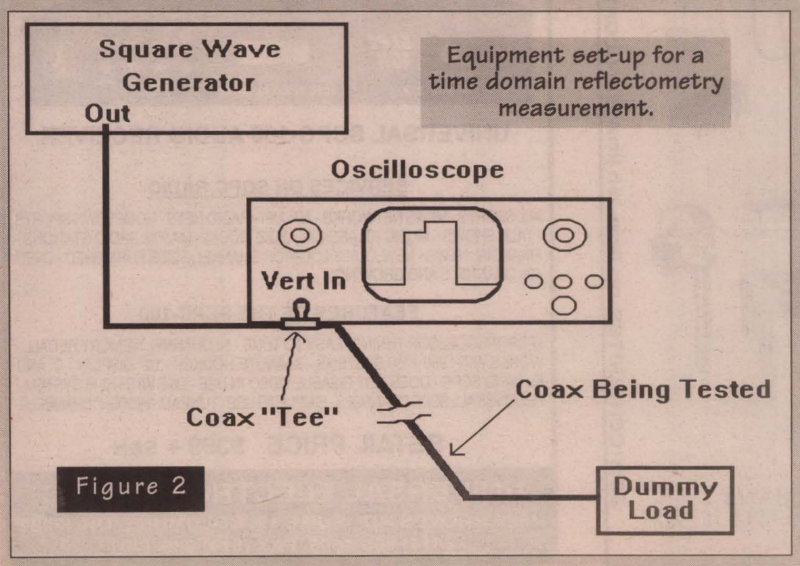


Figure 2

Another friend told me that he had heard that electrical power company engineers used methods that sound a bit like TDR to find broken long-distance high-voltage power lines.

TDR works on the principle that a reflection from the far end of the transmission line, or from an anomaly (kink, short, open) somewhere along the length of the transmission line, will create a pattern on the oscilloscope that is the algebraic sum of the forward and reflected pulses (Figure 1). Information about the system can be inferred from the time measurements on the 'scope trace.

Figure 2 shows the basic equipment set-up for making TDR measurements on a transmission line. The signal source is a squarewave generator or a pulse generator with an output impedance that matches the coaxial cable being tested. The signal source output is connected to the vertical input of the oscilloscope through one port of a coaxial "tee" connector; the remaining port of the "tee" connector is where the coaxial cable under test is connected. This oscilloscope display will be the combination of the forward pulse created by the signal generator and the reflected pulse (if any).

Figure 3 shows the oscilloscope display when no coax is connected to the other "tee" port. This signal is the "raw" pulse from the signal generator. What is displayed is one-half of the squarewave (note the dotted lines representing the missing half of the squarewave that is not displayed). The time-base of the oscilloscope, and the frequency of the signal generator, are adjusted so that only one-half of the squarewave is shown given the approximate length of the cable.

In an experiment performed when preparing this month's material, a 100-foot (30.5 meters) length of RG-8/U 52-ohm polyfoam dielectric coaxial cable was tested. For purposes of calculation, the overall length is twice the physical length because the pulse must make a round trip; thus our 30.5 meter cable represents a round trip transit length of 61 meters. For this length, the appropriate frequency was between 450 and 550 KHz, and the time base of the oscilloscope was adjusted to 0.2 µS/cm. The width of the pulse on the screen was about 5.6 cm, so the duration of the pulse is 0.2 µS/cm ˇ 5.6 cm = 1.12 µS = 1.12 ˇ 10^{-6} seconds.

Figure 4 shows the pattern found when a 100-ohm load was connected to the end of the 61-meter round trip length of coaxial cable. The pulse shape changed because the reflected pulse is added to the forward pulse. Because the load impedance is higher than the correct impedance (100 Ω > 52 Ω), the reflected pulse has the same polarity as the forward pulse, so increases the amplitude of the displayed pulse. The reason the displayed pulse is not twice the amplitude of the incident pulse is due to: a) attenuation in the cable; and b) absorption of some of the forward energy by the mismatched load impedance (reflection is not 100 percent).

In Figure 4, the rise in the display pulse due to the return of the reflection occurs at approximately 1.25 cm, as interpolated on the oscilloscope screen from the 0.2 cm marking ticks. Thus, the return time of the pulse for the 61-meter round trip was 1.25 cm ˇ 0.2

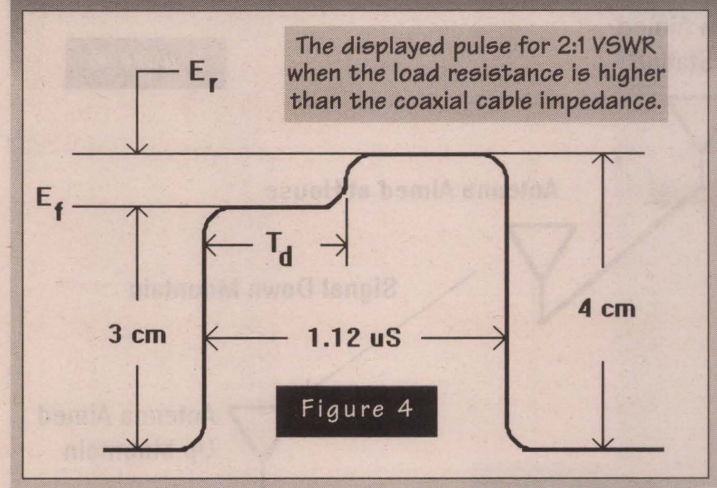


Figure 4

µS/cm = 2.5 ˇ 10^{-7} seconds.

In free space a radio signal travels at the speed of light ($c \approx 3 \times 10^8$ m/s). Thus, we can expect the signal to travel 61 meters in free space in 61 m/3 x 10^8 m/s = 2.03 x 10^{-7} seconds. The signal will travel slower in coaxial cable, and the ratio of the velocity in the cable (v) to the free space velocity (c) is called the *velocity factor* (V) of the cable (V = v/c). For the type of cable used for this experiment, the rated value of V is 0.8 (according to the catalog). The ratio obtained in the experiment done for this article with a 30.5 meter long cable was (2.03 ˇ 10^{-7} s)/(2.5 ˇ 10^{-7} s) = 0.81, which for the accuracy expected of this simple bench-top experiment is quite good agreement with physics.

The situation in Figure 4 represents a VSWR of 2:1 because the load impedance is twice the source impedance (100 Ω/50 Ω = 2:1). This situation was set up by design for the purposes of the experiment, and to make the oscilloscope waveform photographs shown. The VSWR can be calculated from the trace, which is shown drawn in Figure 4. The pedestal created by the reflected pulse was 4 cm above the base line, while the incident pulse was 3 cm. These values represent voltages, but we can use just the relative heights to make VSWR calculations. Thus, the forward voltage pulse (EF) is 3 cm high, and the reflected voltage pulse (ER) is the difference between the "back porch" (4 cm) and the incident pulse (3 cm), or 1 cm. VSWR can be calculated from:

$$VSWR = \frac{E_F + E_R}{E_F - E_R}$$

$$VSWR = \frac{3+1}{3-1} = \frac{4}{2} = 2:1$$

Figure 5 shows several different responses that represent different loads connected to the 30.5 meter length of coaxial cable. The raw pulse is shown for reference in Figure 5A. This pulse has a frequency around 450 KHz, and was from the 50-ohm output of an Elenco Model GF-8026 function generator.

The same pulse is shown in Figure 5B with the coaxial cable being tested connected to the signal generator and oscilloscope, and with the coax terminated in its characteristic impedance (50 ohms). The trace in Figure 5C represents a 100-ohm load, which makes for a 2:1 VSWR between the load and cable. Note the similarity to Figure 4. A VSWR of 6:1 is represented in Figure 5D, and represents the situation when the 50-ohm cable is connected to a 300-ohm load. The "back porch" of the pulse is higher than in Figure 5C because a 6:1 VSWR reflects more signal than a 2:1 VSWR.

The traces discussed above represent a VSWR created when the load impedance is higher than the cable impedance. In Figures 5E and 5F, which represent loads of 22 ohms and 6 ohms, respectively — lower impedance loads are represented. Notice that the "back porch" of the pulse is a drop rather than a rise. This is caused by the fact that situations where the load impedance is less than the source impedance inverts the reflected pulse.

Two opposite situations are shown in Figures 5G and 5H. In Figure 5G, the trace represents a load that is shorted (i.e., load impedance zero ohms), while in Figure 5H it is open (load impedance "infinite").

In Figure 5I the coaxial cable was shorted half-way, or at about 15.25 meters (30.5 meters round trip). Once experience is gained, one can predict the location of the shorted or opened cable by noting the time for the pulse to reach it and return. A rule to follow is:

$$L_{meters} = \frac{V C T_d}{2}$$

Where: L_{meters} is the length of the path in meters, V is the velocity factor of the coaxial cable, and T_d is the time for a round trip excursion of the pulse. For most common cables, the velocity factors are:

Type of Cable	Value of V
Polyethylene dielectric	0.66
Teflon dielectric	0.70
Polyfoam dielectric	0.80

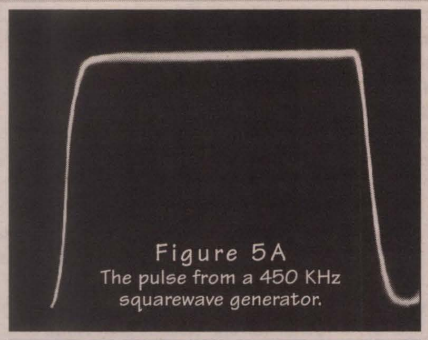


Figure 5A
The pulse from a 450 KHz squarewave generator.

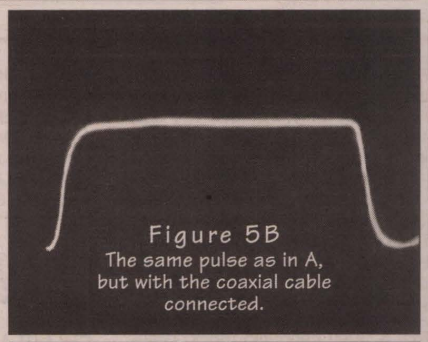


Figure 5B
The same pulse as in A, but with the coaxial cable connected.

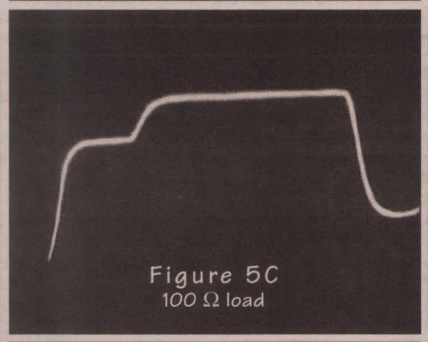


Figure 5C
100 Ω load

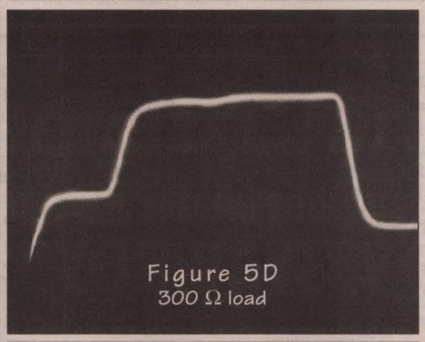


Figure 5D
300 Ω load

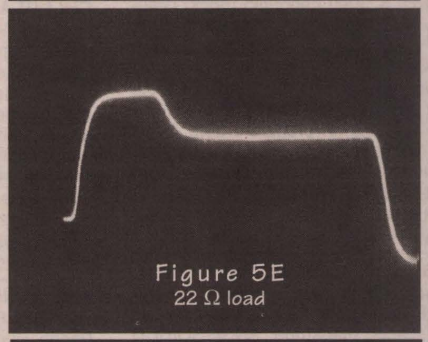


Figure 5E
22 Ω load

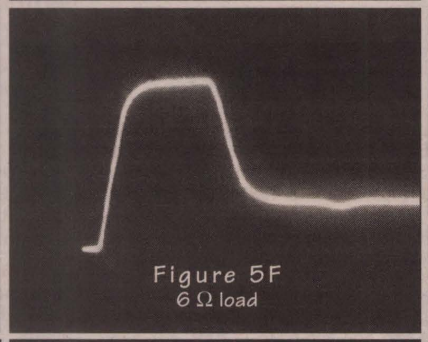


Figure 5F
6 Ω load

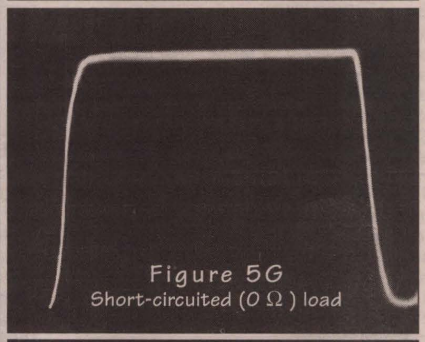


Figure 5G
Short-circuited (0 Ω) load

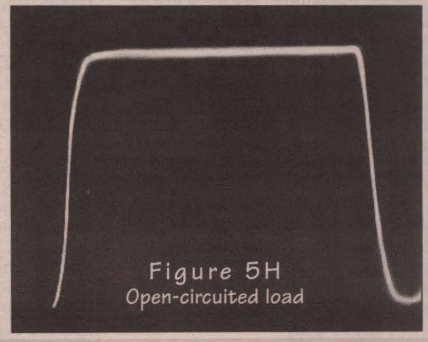


Figure 5H
Open-circuited load

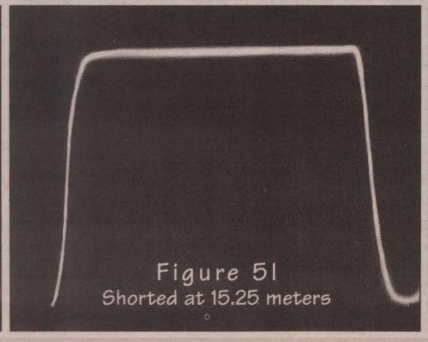


Figure 5I
Shorted at 15.25 meters

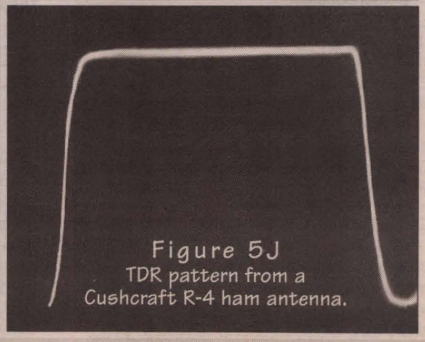


Figure 5J
TDR pattern from a Cushcraft R-4 ham antenna.

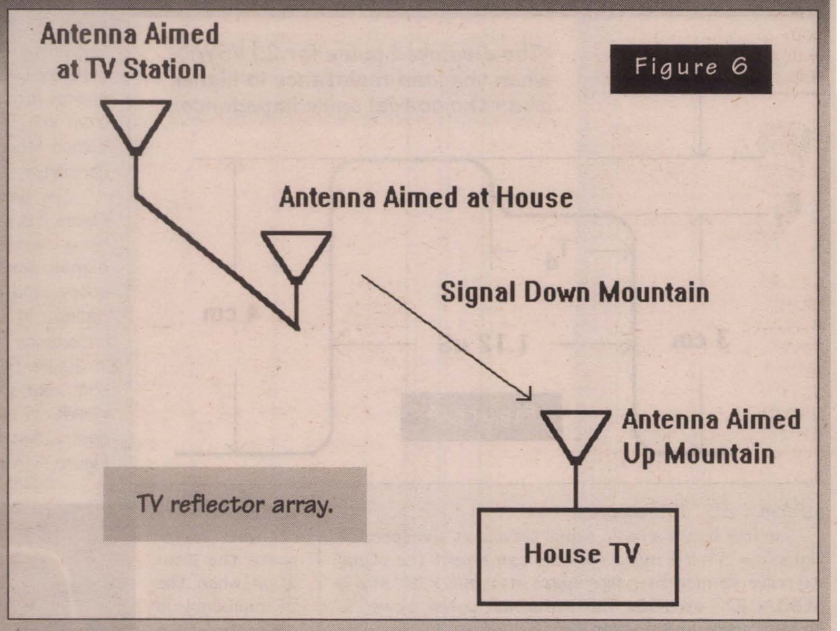
One final trace is shown in Figure 5J. This trace was obtained by connecting the transmitter end of the coaxial cable to my Cushcraft Model R-4 ham radio antenna. This antenna is a half-wave vertical with an impedance matching network at the base of the antenna. Note that the antenna is pretty well matched. I suspect the far right edge anomalies are due to the inductive and capacitive reactances in the impedance matching network and the band traps. Similar responses were noted when various L-C-R combinations were used on the 30.5 meter test cable.

Conclusion

Simplified time domain reflectometry is easy to do, and can yield information about a transmission line system that will go a long way towards troubleshooting problems and understanding performance problems. In many cases, the usefulness of the simple TDR is enhanced if the system is mapped before trouble develops. Make the TDR measurements both with a dummy load attached to the end of the transmission line and with it connected to its regular load. If you lack an oscilloscope camera, then make an **accurate** sketch on a piece of fine grid graph paper, and then store the record for future use, when and if trouble develops.

Afterword

My friend with television starved kin in the mountains actually found another solution later on that eliminated the need for all that coaxial cable (not to mention the possibility of tangling with rattlesnakes and copperheads). Figure 6 shows the passive solution. A mountain top rig consisted of one 23-element Channel 3 Yagi aimed at the TV station, connected by direct coaxial cable to an identical antenna aimed at the house down at the foot of the mountain. A third 23-element Channel 3 Yagi antenna was aimed up the hill (at the "downhill" antenna) from the house. The house antenna was equipped with a preamplifier. Good reception was reported.



I called my friend to confirm the details of his TDR experience (it's been since the early 1980s), and he related the details above. He also said the Channel 3 antennas were replaced with a satellite dish, and averred that the large TVRO and small direct satellite dishes are now competing with each other for the title of the "West Virginia State Flower" because of the large numbers now found in the mountain state. NV

The author can be reached at P.O. Box 1099, Falls Church, VA 22041.

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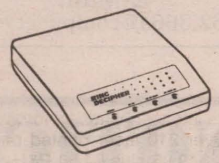

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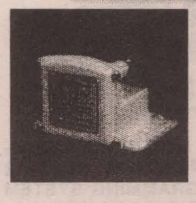

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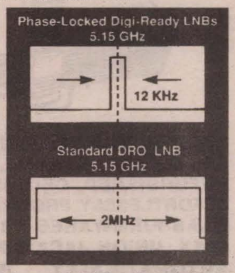

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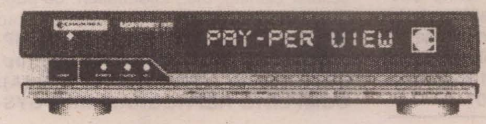

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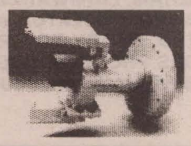

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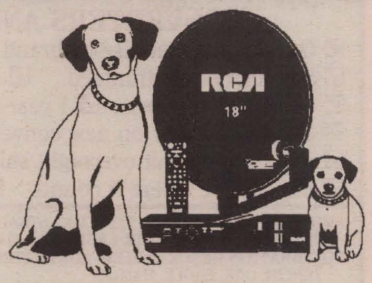

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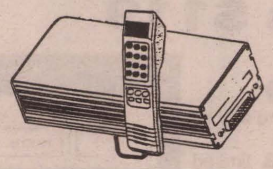

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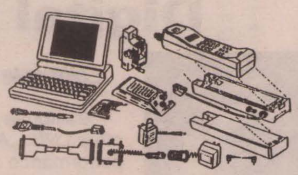

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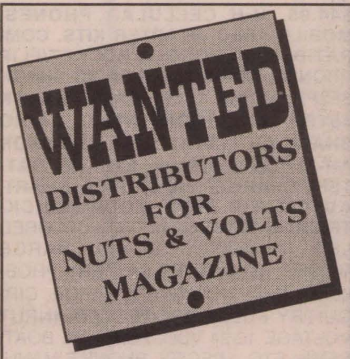

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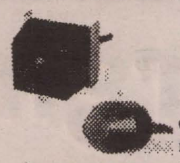

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Part 18

Electric Car Charging & Maintenance

Even a champion thoroughbred can't win races if it doesn't get the proper nutrition and exercise. Likewise, your electric car needs the proper care and feeding to give you optimum performance.

Opportunity Charging

Unlike the small nickel cadmium batteries in such things as laptop computers, electric car batteries do not develop a charging "memory," so they don't need to be drained completely before recharging. In fact, it's better for the batteries NOT to sit around partially discharged.

You can easily test individual batteries with a handheld multimeter.

For that reason, it is best to charge them as soon as possible after every use, even if you only drove a few miles. When this is done away from your home base — at work, or at a friend's house — it's called *"opportunity charging."*

Many employers are surprisingly cooperative about installing a 110 volt charging outlet. In the future, there may be special electric car parking spaces with meters you can plug into.

Most cars get their main charge at home, at night. If the car's range has been fully exhausted, it might take up to 12 hours to recharge using a 110-volt input charger. If the car has only used part of its capacity, or has a 220-volt charger, it will recharge faster.

Any good commercial charger will be designed to sense the battery pack's voltage level and taper its current output accordingly, to avoid damaging the batteries. Some chargers end up at a low-amp "finish charge" rate. Others turn off automatically.

Although a car should not be left on the finish charge for long periods, a few hours doesn't hurt anything. There's no need to get up in the middle of the night to unplug the charger when the car is done.

If you drive the car at all during the day, you should charge it that night, even if you only drove a few miles. A car that is driven 10 miles a day and is charged every night will give you 60 to 80 miles in a single day if you need it sometime. However, a car that is driven 10 miles a day and charged once or twice a week might only give you 40 miles in a day. Fortunately, the effect of this neglect is temporary. If you put the car back on a proper charging schedule, it will regain full range in a couple of days.

Dormant Cars

If the car sits unused for several days, you will notice a slight deterioration in range. This can be countered by an hour's charge before use to "perk up" the pack. Even more effective, if convenient, is a good hard drive of a mile or two, followed by charging.

If the car needs to sit dormant for a long period of time, it should be fully charged first. Trickle charging is not recommended. Anything more than milliamps, if applied continuously, will damage the batteries.

Instead, the car should be allowed to self-discharge normally as it sits. Then, about once a month, it should be put through a normal charging cycle.

Extended dormancy is never good for the batteries, but this technique can minimize the problem.

Battery Failures

If a battery fails, your first clue might be a decrease in power and range. You might also notice that the car is drawing more current than usual on a known part of your regular route.

Your first step should be to check tire pressures. Low tires are much more common than bad batteries.

Another warning sign is a charger that seems to run longer than usual before reaching its finish charge. You might also notice that most of your batteries tops have a film of moisture on them after charging, but one battery is dry. The dry one is the culprit.

All the strong batteries are actually getting overcharged while the charger struggles to bring up the weak one. They are boiling and gassing, which is the source of the liquid film.

You can test the batteries quickly with a simple handheld multimeter. The test should be done when the car is fully charged, but has "rested" off the charger for an hour or so.

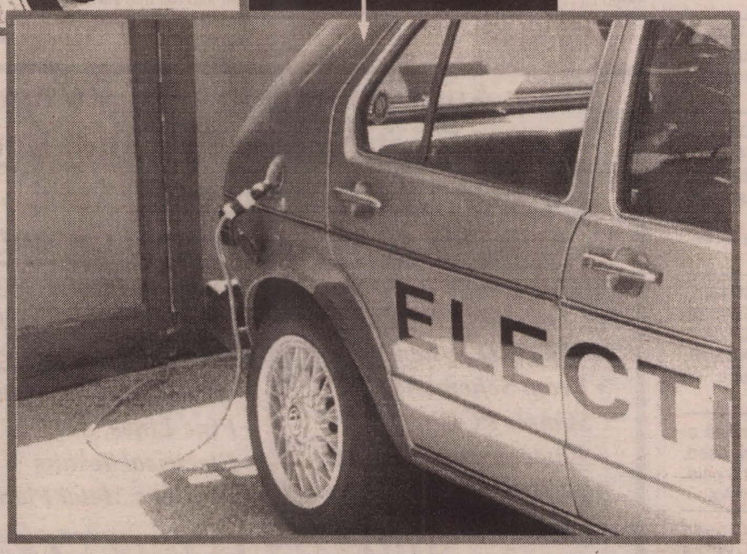
It's handy to number your batteries so you can test them in a systematic manner and compare results from one test to another. A fully charged six-volt battery should read about 6.3 volts on the meter.

Sometimes batteries can fool you. They look fully charged, but won't hold up under load. To test for this, give the car a good, hard drive of a few miles, then check the voltages again.

The most conclusive test is a specific gravity test, done with a hydrometer. This is a glass syringe with a squeeze bulb on top and a calibrated float inside. (Don't use the cheap ones with colored balls. They're not precise enough.)

The test is done by sucking enough electrolyte into the syringe to let the scale inside float free — not resting on the bottom or touching the top. Holding the hydrometer vertically at eye level (and wearing safety glasses), you read the calibration at the fluid level on the float.

Both 6-volt and 12-volt batteries should have a specific gravity of about 1.265 in each cell when fully charged. However, temperature affects specific gravity. Batteries get warm while charging and discharging, and hold that heat for a long time. You can use a thermometer to measure the electrolyte temperature, then refer to a chart for the proper correcting factor in the specific gravity. An easier



Refueling an electric car is easy — just plug it in.

Testing specific gravity with a hydrometer will pinpoint weak batteries.

method is using a hydrometer with a built-in thermometer and correcting scale.

Replacing Batteries

If a battery fails in the first year or two of use, you can replace it with a new one. There may be some pro-rated warranty on the failed battery. The new one will need to be equalized with the rest of the pack, or you will have the same gassing problem described above.

To equalize the pack, test the specific gravity of the old batteries and the new one. Install the new battery, but don't wire it into the circuit yet. Charge the old batteries until their specific gravity matches the new battery. Then wire it into the circuit and put them back on the charger to finish together.

If one or more batteries fail into the third year of use or later, you might consider replacing the whole pack. It is probable that the rest of the pack will begin to fail soon. Normal lifespan varies between three and a half to five years, depending on model and usage.

Once the pack reaches the last half or quarter of its life, it's not possible to fully equalize new batteries with old ones. This means the newer batteries will be getting overcharged as the charger tries to bring up the old ones. This will shorten the life of the new batteries.

Battery Maintenance

At first, you should check your battery terminals and fluids once a month. As you get to know the car, you may find that they only need attention three or four times a year.

The important things to check are the connections and fluid levels. The connections should be snug and clean, and free from corrosion. Loose or corroded connections will generate resistance and heat that can melt the terminal right off the battery under a load. Using precision tension Belleville washers and some kind of anti-corrosion treatment on the terminals can all but eliminate this problem.

If the fluid level has fallen below the level of the plates, add enough water to cover the plates by 1/8" BEFORE charging, and be sure to check the level more often in the future. Otherwise, add water as necessary AFTER charging to bring the level to 1/4" below the fill neck. Distilled water is best, but you can use any clean water that does not have a high level of minerals. Don't use any metal containers for the water.

While you're checking the batteries, wipe off the tops with a mild baking soda solution or cleaning fluid such as Simple Green. A thin film of acid or dirt on the battery tops can create a conductive path to the chassis, which can trip the ground fault interrupter on the charger.

Mechanicals

The most important maintenance you can do is a regular tire check. At least once a month, check the pressure and tread wear. Nothing will affect performance as quickly as soggy tires or a bad alignment.

Check the brakes every six months until you learn how they are wearing on your car. The car is heavier, but you may find you actually use the brakes less as your electric driving style develops.

Seasonal Variations

You will notice changes in your car's performance with the seasons. The batteries prefer warm weather. If you can park your car in a garage, this will help winter performance. The controller, on the other hand, likes to be cool. In a hot climate, you might run into the high temperature cutout on the controller, especially on extended grades. If this is your normal driving environment, you may want to upgrade to a controller with a higher duty cycle.

A fully charged 96-volt battery pack will actually show more than 103 volts. (The meter probes are inserted into test leads installed for this purpose.)

A Little TLC

An electric car really doesn't ask for much care and feeding. Paying attention to the few things it does need will reward you with optimum performance and reliability. **NV**

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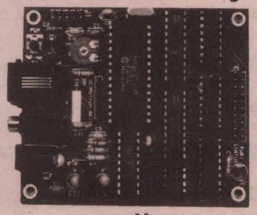

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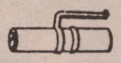

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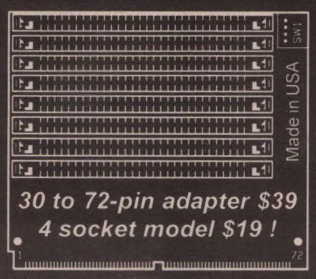

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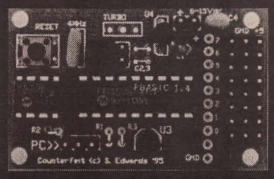
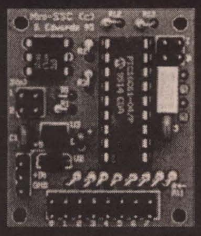


The Counterfeit is easy to build, with its new, high-quality double-sided circuit board. It's also easy to program, thanks to genuine Parallax BASIC.



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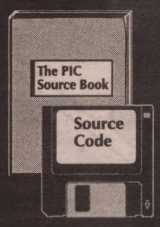
Curious about the inner workings of the BASIC Stamp? Programming the PIC in assembly language? This book/disk combination provides assembly-language source code cloned from more than 30 BASIC Stamp instructions. Shows how to perform serial I/O, read resistance, generate sounds, measure pulses, perform 16-bit math, and more. The package is $39. (Nuts & Volts, September '94)



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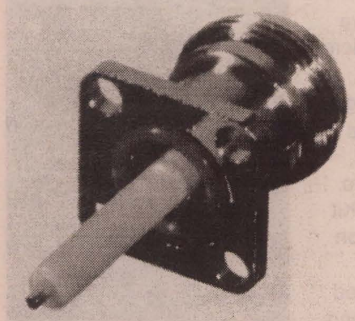

RF Industries announces the availability of its space saving "N" female, four-hole flange connector.

The flange, which is smaller than the typical flange, enables you to place the connector in areas where the standard flange may not fit. This connector is currently available in two different configurations; RFN-1021-4 and RFN-1021-5. The difference between the two is the length of the extended dielectric. The RFN-1021-4 is 1.58" long and the RFN-1021-5 is 1.18" long. Both connectors include an "O" ring for sealing against moisture and are manufactured at an ISO-9002 facility.

For more information, contact:

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TURBO VAMPIRE

The Turbo Vampire handheld vacuum pick-up tool is ideal for picking up and moving electronic components, large and small. It is durable, lightweight, and completely portable. The Vampire's fountain pen dimensions easily fit into your pocket. New high power probes have longer holding action for inserting components in sockets.

The Turbo Vampire has sleek European styling and is ergonomically designed for comfort. It is ESD safe £100KW and lifts up to 120 grams. No batteries are required for the Turbo Vampire.

Both angled and high-power probes are available for the Turbo Vampire. Additional probes can be ordered. The basic unit comes complete with two high-power probes (one angled and one straight), as well as a straight-needle probe with 4 mm cup.

A special spare parts set includes a straight and angled probe with 9 mm cups along with the straight-needle probe.

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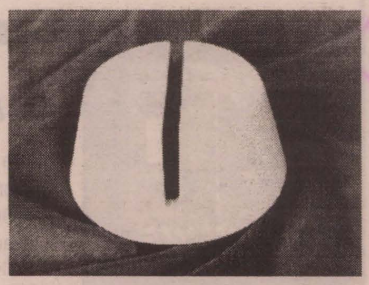
THE DISK ZAPPER



Future-Bot Components introduces THE DISK ZAPPER, a handheld portable computer floppy disk eraser and virus killer. The Disk Zapper was designed for data security to permanently erase proprietary data on floppy disks to keep your data safe.

With over 3,000 known computer viruses today — that number grows each day — it will help guard against various stealth and polymorphic computer viruses which seek to hide from attempts to be analyzed or erased from floppy disks by conventional means or which may mutate into new unrecognized viruses with each new infection.

Made especially for use on 3.5 inch floppy disks, but will work on 5.25 inch disks also, The Disk Zapper is very easy to use. Size is 3.25 inches in diameter and 1.5 inches tall, it is high powered, never needs batteries, erases floppy disks fast, and has a lightweight, portable, and rugged construction.

Price for the Disk Zapper is $29.95 for single units with OEM pricing available.

For more information, contact:

FUTURE-BOT COMPONENTS
106 COMMERCE WAY A8
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JUPITER, FL 33458
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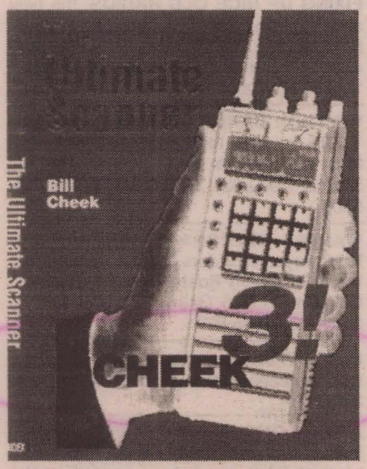
THE ULTIMATE SCANNER CHEEK3



Bill Cheek's *THE ULTIMATE SCANNER* represents the comprehensive and up-to-date successor to his two earlier books *(Scanner Modification Handbook, Volume 1 & 2)*. It combines the experience of many hundreds of serious scannists with Cheek's own expertise and familiar style, and is essential for every dedicated and wannabe scanner hacker.

THE ULTIMATE SCANNER begins where Cheek's earlier books end, adding channels (up to 25,600), restoring cellular, extending frequency bands, enhancing sensitivity, improving control, decoding SCA, optimizing everything — with step-by-step instructions and specially prepared photos, charts, diagrams, and schematics.

Contents (partial) include: 25,600 channels and more; computer control; S-meters; cellular coverage; SCA decoders; autoreject undesired signals; tweaking and peaking; antennas; finding other scannists; auto tape recording; autolog "hits;" shielding; DC power options; frequency standards; hacking; adjustable delay; RS-232 interface; audio improvements; adjustable scan speed; autoprogram memory; parts; supplies; resources; tech support and help; and a glossary.

THE ULTIMATE SCANNER has a large format (8½" x 11") and is priced at $29.95.

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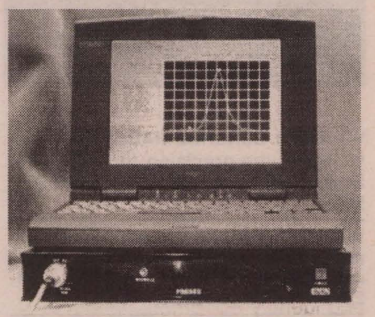
PA2500 SPECTRUM ANALYZER



The PA2500 turns your notebook or desktop PC into a powerful full-featured spectrum analyzer. Consuming less than 10 watts, it covers the 100 KHz to 2.4 GHz range. The case is roughly the size of a notebook computer. This allows the unit to fit compactly under your notebook PC using the parallel port for control. With the optional internal battery pack/charger, cord-free operation for more than two hours is possible.

The instrument features fully synthesized tuning using a crystal reference and under 2 Hz frequency resolution provided by a direct digital synthesizer. Programmable video bandwidth and resolution bandwidths from 300 KHz to 500 Hz make for precise measurements. All functions are programmable via the host PC with custom programming available.

With a spurious free dynamic range of 80 dB and the optional internal programmable 50 dB step attenuator signals from -135 dBm to +20 dBm can be accurately measured. A switchable preamp accommodates low-level signals and high-level signals. Internal gain compensation and power calibration give power accuracy to ± 2 dB. In addition, wide and narrow FM demodulators provide audio for use in directed search surveillance applications.

The software supports features such as marker functions, trace math, overlays, autologging, and hard copy to your printer. Ten spectrum memories are provided along with 10 instrument state memories. Features like signal track, peak search, and delta marker make for easier operation while MAX hold and spectrum averaging allow special measurements to be made.

The cost is $6,995.00.

For more information, contact:

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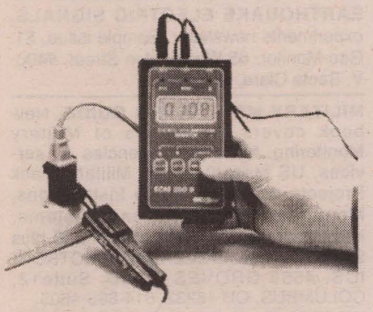
805-581-5771 FAX: 805-583-8270

New Product News

ECM-200 POWER CONSUMPTION MONITOR



Jensen Tools Inc. is offering a power consumption monitor that provides a fast, safe, and reliable way to determine electrical consumption on AC lines. The new ECM-200 power consumption monitor can be used to find energy guzzlers, detect overloaded circuits, and identify equipment needing service or repair.

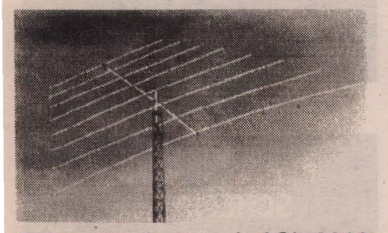
The instrument has probes that clamp around the insulation of a line to provide the tester with a signal at a fraction of the voltage being monitored. Simply enter the cost per unit and the ECM-200 displays incremental costs of the electricity being used, the total time the load has been monitored, the kilowatt hours consumed, and instantaneous kilowatt power. The ECM-200 achieves a reliable degree of accuracy by using "true power" not "apparent power," (the same method employed by utility companies) to compute consumption values.

Jensen offers the ECM-200 power consumption monitor in kit form for $349.00. Included is the monitor unit, clamp-on probe, wall plug adapter, AC adapter, and manual. All are housed in a sturdy foam-filled case. An optional clamp-on probe allows testing of second line or 240V testing.

For more information, contact:

JENSEN TOOLS, INC.
7815 S. 46TH ST., DEPT. NV
PHOENIX, AZ 85044-5399
602-968-6241 1-800-426-1104

ASL-2010 SKYLOG LOG PERIODIC ANTENNA



The new Cushcraft ASL-2010 SkyLog Log Periodic antenna is for hams who would like to have a single antenna that covers 10 meters through 20 meters (actually 13.5 through 32 MHz). This design eliminates the need for two Yagis to cover both the traditional bands, and 12 and 17 meters. It uses a single feed line (balun included) and thus there is no need to switch antennas when changing bands.

This design does not use traps of any type thus the wind load is reduced significantly (10.1 sq ft). The antenna is not power limited and will easily operate at full legal limit continuously. The ASL-2010 boom is 18 feet (5.48M) long. The gain of the antenna is 6.4 dBd. There are eight elements, the longest is 38 feet (11.58 M). The ASL-2010 has 6063-T832 aluminum tubular elements and boom. Brackets and mounting plates are aluminum, as well. All u-bolts and worm clamps are entirely stainless steel.

The ASL-2010 is a cost-effective, high-gain, five-band antenna. It is easy to install on your tower and provides superior performance at a modest price. List price is $800.00.

For more information, contact:

CUSHCRAFT CORP.
P.O. BOX 4680, DEPT. NV
MANCHESTER, NH 03108
603-627-7877 FAX: 603-627-1764
E-MAIL SALES@cushcraft.com

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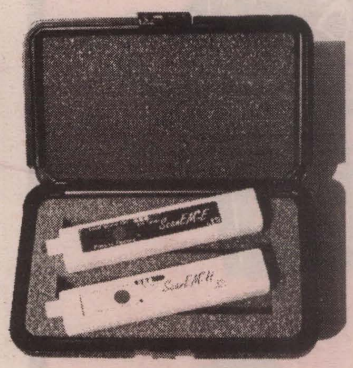


Credence Technologies, Inc., introduces the ScanEm® Probe Kit model CTK010, a set of two complementary near-field EMI probes that pinpoint sources of electromagnetic emission and simplify compliance with FCC p. 15 and other agencies' requirements. The kit contains ScanEm®-E, an electric field probe, and ScanEm®-H, a magnetic field probe. Both probes detect the presence of an electromagnetic field and provide audio and visual indication of its relative strength.

Compliance with agencies' requirements regarding EM (Electro-Magnetic) emission such as FCC p. 15 in the U.S. and CE, VCCI, CISRP, etc., in Europe and in Japan is always a very challenging and expensive task. One pass at testing at a qualified laboratory may bring up a bill of $2,000 to $5,000. Should the product fail the test, lab results generally would be of little help in locating the exact source of the problem. The worst part is that this discovery usually comes near the end of a project when time is at a premium and there is no room for error.

Enter ScanEm, an affordable near-field EMI probe kit. ScanEm probes will quickly find "hot" EM emission spots within the required frequency band down to the exact source of the radiation. ScanEm probes are fully self-contained and don't require any additional equipment or cords.

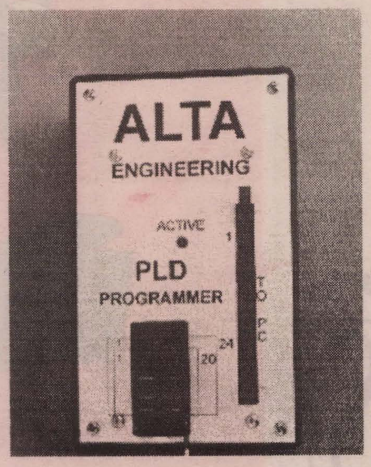
ScanEm probes are excellent tools to pinpoint the precise location of a component, circuit area, or a trace with high-emission levels, find EM leakage on cables, connectors and enclosures, predict radiated EMI test results, pre-scan the product prior to the FCC tests, and quickly troubleshoot a product that failed the FCC test.

The ScanEm kit is available at only $299.95 MSRP. Each ScanEm probe fits in the palm of a hand (5 ¾" x 1¼" x ¾"), weighs 2 oz and can be carried in a shirt pocket. Both probes are packaged in a durable plastic storage case. Batteries are included.

For more information, contact:

CREDENCE
TECHNOLOGIES, INC.
P.O. BOX 5146, DEPT. NV
SANTA CRUZ, CA 95063
408-459-7488 FAX: 408-427-3513

THE ALTA ENGINEERING PLD PROGRAMMER



The Alta Engineering PLD Programmer allows you to get started using programmable logic for hundreds of dollars less than the cost of a universal programmer.

Programmable logic is ideal for the small scale hardware designer, but until now, the cost of a device programmer has been prohibitively expensive.

The programmer can program the GAL16V8A/B, GAL20V8A/B, and GAL22V10/B from Lattice, National Semiconductor, and SGS-Thompson.

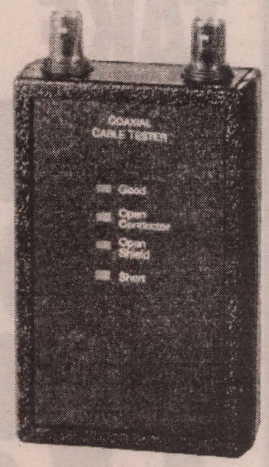
The GAL (which stands for Generic Array Logic, a trademark of Lattice Semiconductor) is a second generation PLD and offers several advantages over traditional discrete logic and older PAL devices.

The Alta Engineering PLD Programmer is made up of two parts, a multipurpose interface board that is installed in a PC and the PLD module that is connected to the interface board via a 50 conductor ribbon cable. The programmer software accepts standard JEDEC files that are produced by all logic compilers.

The complete kit is $179.00, plus shipping and handling ($5.00 within the U.S. or $10.00 outside the U.S.). Partial kits available.

For more information, contact:

ALTA ENGINEERING
58 CEDAR LN., DEPT. NV
NEW HARTFORD, CT 06057
203-489-8003



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With this convenient, low-cost cable assembly tester from RF Industries, the bench and field technician can quickly and easily test cables with BNC male ends. Adapters (sold separately or packaged in the RFA-4017 kit) enables the technicians to test cables with termination other than BNCs.

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For additional information, contact:

RF INDUSTRIES, LTD.
7610 MIRAMAR RD., DEPT. NV
SAN DIEGO, CA 92126-4202
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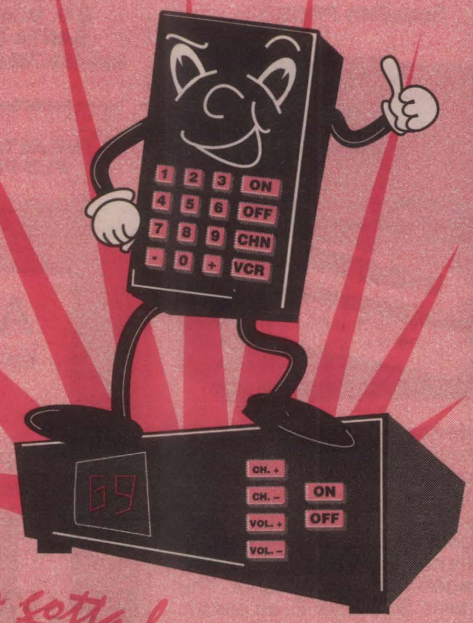

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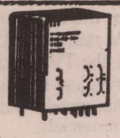

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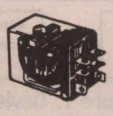

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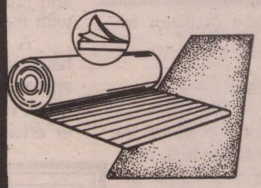

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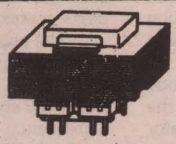

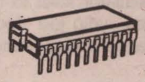

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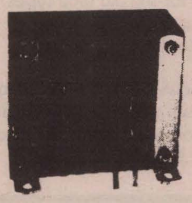

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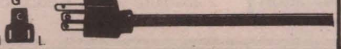

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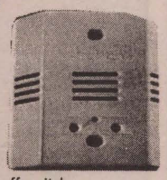

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Set your Dev with an Audio Oscillator

by Jim Ford

If you have an audio oscillator and access to a multimode transceiver, you can easily set or determine your FM deviation. The technique involved uses Bessel functions, named after the mathematician. Its accuracy is primarily limited by readout of your audio frequency oscillator dial. Sounds like it might be complicated? Here's how it works . . .

Frequency modulation (FM) consists of a carrier and multiple (in theory, infinite) sidebands. The first three or four sidebands on either side of the carrier are the significant ones that are needed for good fidelity.

Bessel functions describe the percentages of power in each of these sidebands and the carrier based upon modulation index. (Modulation Index = Frequency deviation/Modulation frequency.) For example, if the maximum frequency deviation of a transmitter is 4,000 Hz and the modulating frequency is 2,000 Hz, then the Modulation Index = 4000/2000, or 2.

Depending upon the modulation index, the power in the carrier and sidebands will vary. Interesting, but so what? Well, it just so happens that certain modulation indexes are very useful in determining your FM deviation. When you transmit with a modulation index of 2.404, or 2.4 for short, there is no power in the carrier!

This is technically called the first carrier null. We can use this fact to determine or set your deviation. By rearranging, the Modulating Frequency = Frequency Deviation/2.4. Or, in the above example, 4000/2.4 = 1667 Hz. Therefore, if your deviation is 4,000 Hz with a frequency of 1,667 Hz in the mike jack, your carrier will go away!

You will still have sidebands, and your wattmeter will still stay the same, but the carrier component of your signal will be gone. You can re-work the algebra again to say Frequency Deviation = Modulating Frequency (mike input) x 2.4. Table 1 shows null audio frequencies for various deviation settings.

To use this fact, all you need to do is to detect when the carrier goes away. One way to detect carrier nulls is to build the circuit in the ARRL Handbook. It is not complicated, but requires installation in the IF section of your receiver, and some calibration.

Another, simpler way is to use a multimode transceiver in the SSB receive mode to detect when the carrier goes away. Check the test set-up in Figure 1 and follow the procedure below.

1. Set your audio oscillator to approximately 2 KHz input to your mike jack.
2. With your multimode transceiver in the FM mode, increase the audio oscillator level to the tested transceiver, until your received audio just stops getting louder. This represents saturation and maximum deviation.
3. Put the multimode transceiver in the SSB mode and key your transceiver with no audio input and the mike jack pin grounded (don't touch the audio oscillator level).
4. Tune the multimode transceiver until you get approximately a 1 KHz note. Memorize this tone since it represents the carrier to be nulled.
5. Reconnect your audio oscillator, key your transceiver, and vary the audio oscillator until the 1 KHz tone goes away.
6. Your FM deviation is the audio oscillator frequency times 2.4.

Deviation (KHz)	Null Audio Frequency (KHz)
2.0	.833
2.5	1.042
3.0	1.250
3.5	1.458
4.0	1.667
4.5	1.875
5.0	2.083
5.5	2.292
6.0	2.500
6.5	2.708
7.0	2.917

Table 1. Null Audio Frequencies vs. Deviation

Testing Caviats

It is very important that you don't overload the mike jack input, otherwise poor or confusing nulls will result. Most audio oscillators can output a couple of volts, but the mike input only requires low millivolt range audio. It might be advisable to series in an attenuator as shown in Figure 2, if your oscillator doesn't already have one built in.

This attenuator is designed to be 30 dB and to match the 600 ohm output of most audio oscillators. Even if an attenuator is not necessary, the output level control may be too touchy.

An alternative to direct mike input is acoustic coupling with the audio oscillator driving (using a matching transformer, if necessary) a small 2" speaker.

I found the best success was with the mike and speaker put in a small inverted bowl on a table. The bowl helped keep out extraneous noises and somehow purified the tones to make deeper nulls although the nulls were definitely not as good as the direct connection.

The acoustic method has the advantage of not requiring any hook-up cable. You can increase your accuracy by hooking up your audio oscillator to a frequency counter after nulling. Even if you don't have a frequency counter, some of the newer digital voltmeters have a frequency counter mode that will count at least up through all of the audio frequency range.

Even though the nulls are deep, particularly with the direct mike connection, the RF signal level from your transmitter must not be so large that you can't recognize the null. That means you might have to short your antenna input terminals of the multimode transceiver. Just below full scale on your S meter would be the ideal input level before nulling. Even if you don't have a multimode transceiver you can do this over the air via speaker phone listening to your friend's transceiver.

How much deviation is right?

A rule of thumb says your FM bandwidth = 2(Dev + highest audio frequency). For example, if your deviation is 5 KHz and your highest audio passed by your transceiver audio stage is 3 KHz, then your bandwidth is 2(5+3), or 16 KHz. This is quite a bit if you live in areas where there is a lot of radio congestion, such as Southern California with 15 KHz channel spacing.

This shows the reason why 20 KHz channel spacing has some merit. Certainly 5 KHz would be an absolute voice maximum, with 4.5 KHz deviation better. If you use your transmitter exclusively for packet radio, then the range of 3-4 KHz seems to work best. If you use your transmitter for both packet and voice, then 4 KHz is a good compromise.

There are other reasons not to have too much deviation. Many repeaters have narrow IF filters which will not pass more than 5 KHz deviation. Have you ever heard a station that causes your busy light to go out and the signal to go away when they talk loud? It is possible they are off frequency, with signals deviating out of your passband, but it might be they have too much deviation or both. This is more pronounced when the squelch is set tight for only strong signals.

It is important to remember that FM uses limiters for both receiving and transmitting. The transmitting limiters precede the actual FM modulator. These stages are supposed to limit the maximum audio going to the modulator. How much drive or overdrive (clipping) to these limiters determines the density of modulation.

Density is important in the perception of how much audio is on the received end. Television audio is FM.

Have you ever noticed TV commercials seem much louder than non-commercials? Also, have you heard the TV stations claim the commercials aren't any louder? Well, the TV station is technically correct in that the peak deviation is the same for both commercials and non-commercials, but the density is much greater with the commercials.

A similar situation exists in amateur radio FM. I have noticed that some transceivers (including some repeaters), particularly ones around 15 years old or more, don't have their limiter stages set with the proper drive level, resulting in low density and perceived audio. What is often done to fix this is to increase the deviation to get the louder audio. This is the wrong solution. It causes adjacent channel interference and "squelching out" of the passband of the receiver.

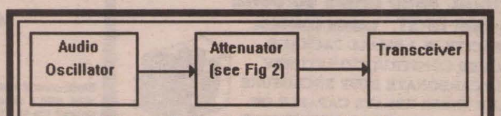

Figure 1. Deviation Test Set Up

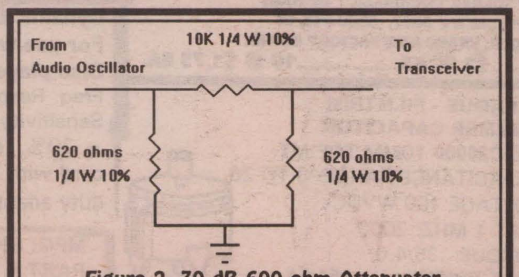

Figure 2. 30 dB 600 ohm Attenuator

The right answer is to set the deviation correctly and then find out a way to increase the audio drive to the limiter stage of the FM modulator.

For example, you might change microphones to one with higher output, or adjust the transmit audio gain pot without changing the deviation pot. Unfortunately, many transceivers have only one adjustment pot and that is the deviation pot.

If this is your problem and a new microphone doesn't fix the problem, then some minor circuit changes to get more audio drive may be necessary.

Fortunately, most newer transceivers don't suffer from a density problem. If you don't have an audio oscillator, consider purchasing one at a swap meet, since they are inexpensive.

This is particularly true for the old tube types. The old tube types often put out better quality audio then some of the newer digitized ones that have tiny stairsteps in their output.

The new oscillators, however, are very adequate for this job. With this method, you can set your deviation with an accuracy as good as or better than expensive commercial gear. Good luck. **NV**

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FREQUENCY STANDARD CALIBRATION TECHNIQUES

by Corby Dawson

You've just returned from a hamfest or maybe a surplus auction with a nice looking frequency standard or frequency counter. Now, you want to fire it up and see just how accurate it is . . .

- Your Quartz/Rubidium/Cesium standard is working fine, but you are curious about how close to perfect it is.
- Repairs have just been finished on your standard, and you want to calibrate it to a known accuracy.
- You are calibrating instruments that require NIST traceability.
- You have a precision electronic clock that needs its time base adjusted.

These situations require some method of comparing your standard to a known accurate frequency source and determining the difference between the two. This article will describe the various signals and methods available to perform this task.

REFERENCES

To accomplish a measurement on your standard, you must have access to a reference source of comparable or superior accuracy, or a method of making a remote comparison to such a reference standard. Some commonly available references for comparison are:

- A local Cesium standard or a Rubidium standard that has already been verified against a reference.
- WWV/WWVH RF transmitted signals at 2.5, 5, 10, and 15 MHz. (WWV also at 20 MHz.)*
- WWVB RF transmitted signal at 60 KHz.*
- LORAN-C RF transmitted navigation signals at 100 KHz.
- GPS (Global Positioning System) RF transmitted satellite navigation signals at 1227.6 MHz and 1574.42 MHz.

A * indicates direct NIST traceability. Local References, as well as LORAN-C and the GPS, can be made traceable by utilizing proper methods.

LOCAL CESIUM OR RUBIDIUM

This is usually what happens if you send your unit to a calibration lab. They compare your unit to their standard and adjust your unit to match. The accuracy obtainable is determined by the accuracy of the local reference. This method, as we'll see, has the advantage of the shortest measurement time, as well as not having to depend on RF reception conditions. If the reference was verified against a NIST station the calibration is considered "traceable."

Having access to a local reference enables you to use a variety of comparison techniques:

A. Direct counting on a high-resolution frequency counter (Figure 1). Resolution can be 1 x 10-11 per second or better depending on counter used. (DUT) is Device Under Test.

B. Comparing error multiplied signals #1 (Figure 2). Since the time required to reach a certain precision is inversely related to the measured frequency, this example allows a measurement to be made 100 times faster. The frequency offset is determined by dividing 2 x 10-9 (the period of one cycle of 500 MHz) by the beat period in seconds. If the beat period was, say 17 seconds, the offset would be 1.17 x 10-10. The zero beat should be approached from a known direction on the DUT to insure that you know the polarity of the offset.

Comparing error multiplied signals #2 (Figure 3). This method gives the highest resolution per measurement time. Since 1 Hz is 1 x 10-6, counting it to a resolution of .000001 Hz allows a resolution of 1 x 10-12. Although a reciprocal counter is shown giving a direct readout in Hz, a conventional counter can be used in the period mode with the conversion being done manually. Assume the reciprocal counter read 1.000123 Hz. This converts directly to an offset of +1.23 x 10-10. A period counter would read .999877 second and be converted by dividing it into 1.

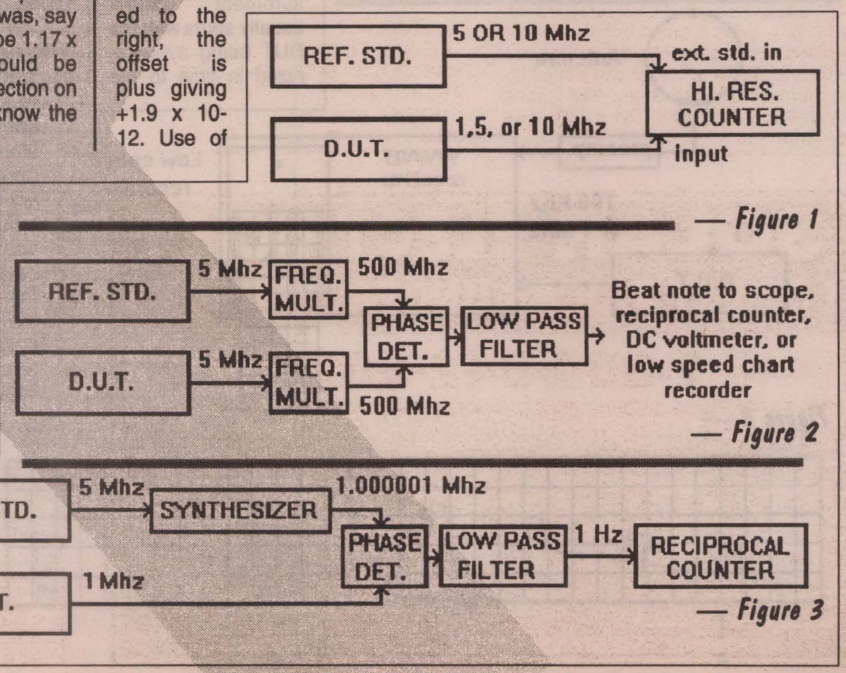
C. Measuring rate of drift on a high sweep speed oscilloscope (Figure 4). With the scope synced on the device under test, adjust the A trace gain so that the zero crossings of the displayed signal are almost vertical lines (typically 50 Mv/div.). The horizontal sweep speed is then set to a very fast value (typically 5 ns/div.). Then use the horizontal position control to place a zero crossing on the center vertical graticle line. The time is then noted. After a period of time has elapsed, the amount of horizontal drift is measured and converted to time. The frequency offset is equal to the time drift divided by the measurement time in seconds. For example, when using a sweep speed of 5 ns/div. and after two hours, the trace has shifted to the right by 2.75 div. This equals 2.75 x 5 ns or 13.75 ns.

Plugging the time (7,200 seconds) and drift into the formula yields an answer of 1.9 x 10-12. Since the trace shifted to the right, the offset is plus giving +1.9 x 10-12. Use of the 1 MHz or even the 100 KHz outputs is preferred. The resolution per time period using this method is the same regardless of the frequency used, however, using the lower frequencies will prevent the possibility of measuring the wrong zero crossing! This occurs more readily at 5 MHz as the next crossing is only 200 ns away. Suppose you took a coffee break and the DUT drifted 210 ns while you were gone. When you returned it would appear that the drift was only 10 ns!

D. Using a phase comparator and charting phase difference (Figure 5). (Usually on a low-speed chart recorder.)

This method frequently utilizes a flip flop that is alternately set and reset by the two input frequencies. This action generates a pulse train at 5 MHz with the pulse width between zero and 200 ns. The pulse width will vary at the difference frequency rate and is routed through a filter that passes the average DC value. The output of the filter is a positive or negative going ramp whose slope is directly proportional to the frequency difference between the units.

The frequency offset is again the



time drift divided by the measurement time in seconds. For example, the chart recorder traces a sawtooth whose period is 2.3 hours. Since the peak-to-peak time difference is 200 ns, the frequency offset is 200 x 10-9 divided by 8,280, giving 2.42 x 10-12. The direction of the slope indicates the polarity of the offset with positive going slope indicating a + offset. This makes the measurement equal to +2.42 x 10-12. You do not have to wait for a complete sawtooth cycle to make a measurement. Just multiply the fraction of full scale that the trace did move by 200 ns to determine the time drift.

E. Utilizing time difference comparisons (Figure 6). (Assumes that both standards offer 1 PPS outputs.)

This is really a special case of technique C. As mentioned, the resolution per time period is the same regardless of the frequency used.

When using the 1 PPS (Pulse Per Second) outputs, the frequency being used is 1 Hz! The advantage here is that the 1 PPS outputs are fast rise time digital signals which allows a less ambiguous measurement of the time delay on the scope. Digital outputs also allow easy interface to time interval counters or computers for direct counting of the time drift. The measurement routine usually starts with the DUT being synchronized in time to the reference 1 PPS, and the time being noted. This starts the measurement with the DUT 1 PPS at zero delay. As the DUT drifts, its 1 PPS will either advance or retard in relation to the reference 1 PPS. After some measurement of time has elapsed, the amount of drift is measured and the offset is computed. The time drift is again divided by the measurement time in seconds.

Let's say that after being synchronized, the DUT drifted 1.35 uS in 48 hours. That would equate to 1.35 x 10-6 divided by 1.728 x 10+5 giving 7.81 x 10-11. If the DUT 1 PPS occurs prior to the reference 1 PPS, the offset is positive making the answer +7.81 x 10-11.

WWV/WWVH RECEPTION

These stations transmit from Ft. Collins, CO, and Kauai, HI. Although the transmitted accuracies are about 1 x 10-11, the received accuracy is only usable to about 1 x 10-7 due to propagation effects. Not very accurate, but that equates to .00001%. This makes this method suitable for calibration of frequency counters for use in commercial or "Ham" radio, as their requirements are usually in the neighborhood of ±.001%.

The advantage here is worldwide reception using simple receivers, as well as simple comparison techniques. The use of received signals from these stations is straightforward. Shown in the diagram is one scheme for calibration using this method — **audible or visual beat note nulling using a shortwave receiver (Figure 7).**

The specifics of this method will vary slightly depending on your receiver. Just remember that the beat note is not directly audible as it will lie below 1 Hz.

First you tune in WWV or WWVH at 10 MHz on a suitable receiver. Then connect a short length of insulated wire stripped on one end to the 10 MHz output of your standard. With the standard tuned off in one direction by 2 or 3 Hz, position the wire near the antenna input of the receiver. Find a position that allows you to hear the background sounds fluttering at the 2 or 3 Hz beat frequency. If the receiver has an "S-Meter," position the wire for the best visual indication of the beat on the meter. Now, slowly adjust the DUT back toward 10 MHz. You should see/hear the beat slowing down as you approach a match. Once the beat period is 10 seconds or longer, you're done!

Since the accuracy using this method is no better than 1 x 10-7, it's not suitable for calibrating other than general-purpose quartz standards, like those used in many frequency counters. To use this method with a 5 MHz standard, tune in WWV/WWVH at 5 MHz.

WWVB RECEPTION

Reception and use are usually done with commercial receivers built specifically for this application. Some homebrew rigs have also performed well. The antenna can be a five-foot whip, a ferrite loopstick, or a multi-turn shielded loop, depending on the receiver design, the proximity to Colorado, and the noise level in your area **(Figure 8)**.

Once the standard is connected and the receiver is locked, you run the chart recorder to make a phase plot. The deflections occurring every hour, are deliberate phase shifts, transmitted by the station at 10 minutes after each hour, and lasting five minutes. These offer a quick "sanity check" of proper operation. To determine your frequency offset from such a chart, you measure how much phase change has occurred during a particular time period. For example, from point A to point B is four hours or 14,400 seconds. The amount of phase change from A to B was 4 uS. (Full scale in this example is 10 uS, but can vary with different manufacturers.)

The frequency offset equals the phase change divided by the measurement time in seconds. In this case, the answer is +2.78 x 10-10, with the polarity being determined by the plus going slope.

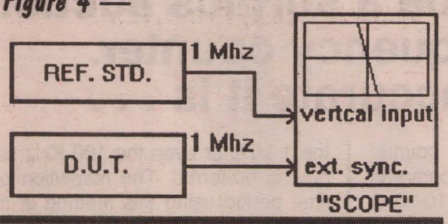
Reception during the period surrounding sunrise and sunset between you and Colorado will be very erratic and not generally useable. Comparisons from day to day at the same time during periods of good reception allow long term tracking down to the baseline resolution of ±5 x 10-12.

LORAN-C RECEPTION

Receivers for this application are utilized the same as the WWVB receiver already described. Most have similar type chart recorders built in, but some have an analog panel meter to monitor the phase. The newer instruments have built in microprocessor control and direct readout of frequency offset on an LCD readout. Don't confuse these units with the navigation receivers popular in boating!

All the LORAN-C stations transmit on 100 KHz. Since the signal is a short group of eight or nine bursts of 100 KHz, and each chain of stations utilizes a different GRP (Group Repetition Period), interference between chains is minimized. Unless the receiver has automated acquisi-

Figure 4 —



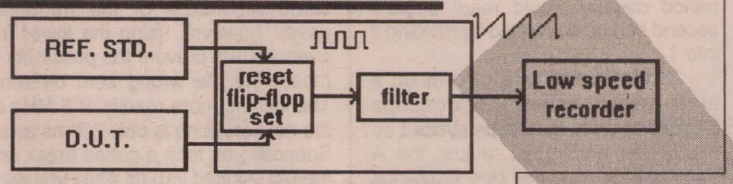
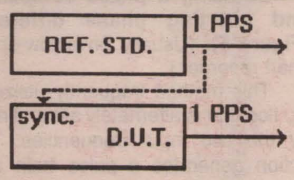
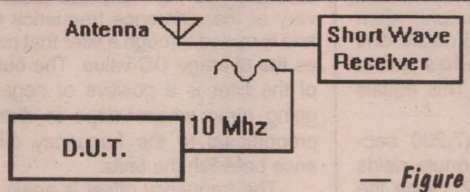


Figure 5 — Frequency Comparator



— Figure 6



— Figure 7

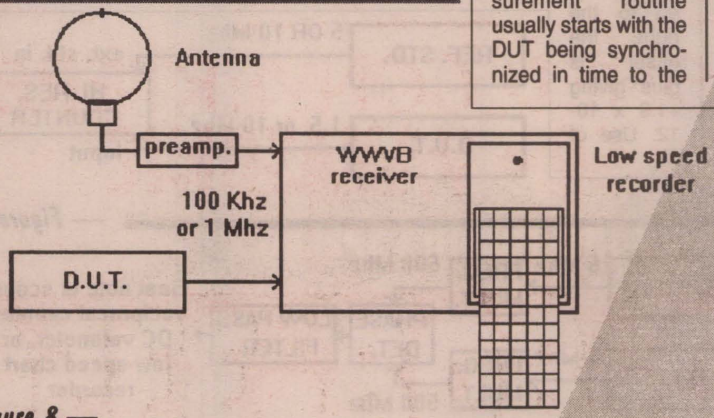
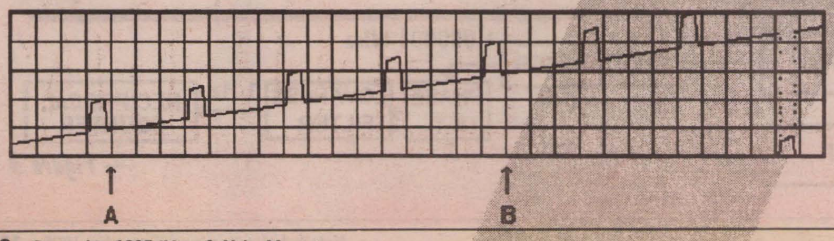


Figure 8 —



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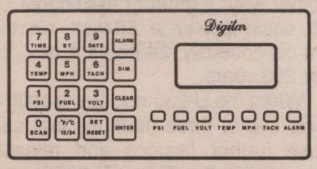

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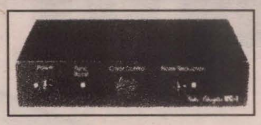

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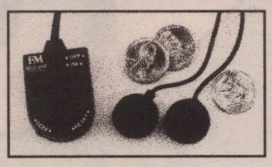

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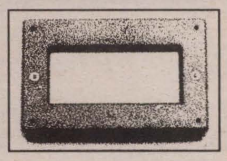
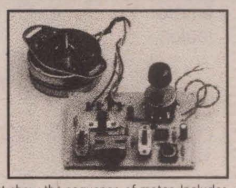


This meter has many useful applications such as Voltmeter, Thermometer, Db Meter, Watt Meter, Current Meter, Capacitance Meter, Lux Meter and LCR Meter. Features include: 200mV full scale input sensitivity, single 9VDC operation and decimal point selectable. In addition, it has 13mm figure height, automatic polarity indication, guaranteed zero reading for 0 volt input and high input impedance (>10OOM ohms). Specifications: Max input 199.9mV DC-Max. Display: 1999 counts (3-1/2 digits). Measuring method: Dual slope integration A-D converter system, plus many other features.

CAT #PM-1 **$9.95 each**

STEPPER MOTOR CONTROLLER KIT



This kit allows you to adjust the speed and direction of a stepper motor. You can move the motor in one step increments or rotate it at a constant speed. There are a set of visual indicators that show the sequence of motor. Includes stepper motor, pc board, parts and instructions.

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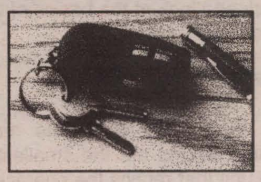

Records and plays messages up to 16 seconds (i.e. parking spaces, things to do, etc.) 16 seconds is a long time to dictate! Measures 3" x 1.25". Battery operated (included).

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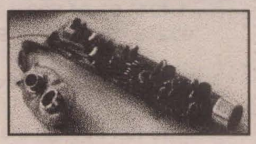
FM WIRELESS MIKE KIT

POWERFUL



2 stage, wireless mike kit transmits over .5 mile (up to 1 Km in the open) Tunable to the upper part of FM broadcast band. Circuit does require the ability to "Tweak" RF circuits by stretching or compressing coils. With mike and 9V battery clip. Operates from 6-12V DC. 2.75" x .625" x .5" WT .06

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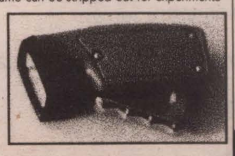

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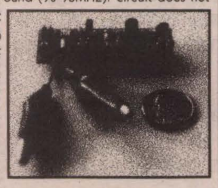

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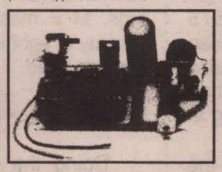

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by John Iovine

Nuclear Power

In the past few months, we have built a Geiger counter and learned to interface it to the IBM computer. The words radioactivity and nuclear power go hand in hand. Since we spent so much time building a Geiger counter and using it, perhaps it's time to step back and look at the basics of nuclear energy.

Matter and Atoms

Every day matter is made of atoms. Atoms are the smallest divisible unit that retains the characteristics of that particular element. Atoms themselves are made up of smaller units called subatomic particles. The three basic subatomic particles are the neutron, proton, and the electron. For our purposes, we need not delve deeper into the quantum nature of matter, quarks, or the bag theory of particle physics. Classical physics serves us well enough.

Protons and neutrons make up the nucleus of the atom, called nucleons, which are surrounded by electrons. The proton carries a positive charge of +1, while the electron carries a negative charge of -1. In neutral atoms, the number of protons equals the number of electrons.

The masses of these subatomic particles are very small. For instance, the rest mass of a neutron is 1.675 x 10^-24 gram (or .0000000000000000000000001675 grams). The mass of a proton is close at 1.673 x 10^-24 gram. The rest mass of the electron is much smaller than the proton or the neutron weighing in at 9.109 x 10^-28 gram.

If you divide the weight of the electron into the weight of a proton, you will find that the proton is approximately 1,838 times more massive than the electron. Despite the difference in mass, the electrical charges carried by both the proton and electron are equal, but opposite. Neutrons do not carry an electrical charge, there are electrically neutral.

There is another way the mass of a subatomic particle is measured. It is called the Atomic Mass Unit (u), which is defined as 1/16 the mass of an oxygen nucleon. Using this measure, the neutron is 1.008982 u and the proton equals 1.007593 u.

Binding Energy

An interesting thing happens when neutrons and protons combine in a nucleus — a little mass is lost. For instance, the nucleus of the deuterium atom that consists of a single proton and neutron only weighs 2.014194 u. We have a loss in mass equal to .002381 u, which is called a mass defect.

When a proton and neutron combine to form a nucleus, a certain small amount of energy is emitted. It is this emitted energy that accounts for the mass defect. If we wanted to split the nucleus into its component parts, we would need to supply energy equivalent to the mass defect. This is called the ***binding energy*** of the neucleus.

The greater the binding energy of the nucleons, the more stable the atom. To calculate the binding energy, we may use Einstein's famous equation E=Mc^2. Where E = energy in ergs, M = mass in grams, and c = velocity of light in centimeters per second, squared.

(3 x 10^10)^2 = 9 x 10^20 cm/sec^2

Doing the equation for 1 mass atomic unit:

1 Atomic Mass Unit equals 1.66 x 10^-27 K grams

or 1.66 x 10^-24 grams

(1.66 x 10^-24) x (9 x 10^20) = 1.494 x 10^-03 ergs

An erg is a unit of energy equal to moving one gram a distance of a centimeter. We can easily convert ergs to joules.

1 joule = 10^7 ergs

(1.494 x 10^-03) / 10^7 = 1.494 x 10^-10 J

Now convert joules to electron volts. We get:

1 eV = 1.602 x 10^-19 joules

1.494^-03 / 1.602 x 10^-19 = 932584269.7 eV or 932 MeV

(MeV = Million electron volts).

If we run through the same equations for the missing mass in the deuterium nucleus, we find that it is equal to 2.22 MeV. The calculated binding energy of deuterium has been confirmed by experiments that show that the minimum energy a photon must have in order to disrupt a deuteron (deuterium nucleus) is 2.22 MeV.

There is an easy conversion factor you may use to convert the mass defect to the binding energy — it is 1 Atomic Mass Unit equals 933 MeV. Re-doing the equation with this conversion factor gives the same approximate answer:

(.002381 u) x (932 MeV) = 2.21 MeV

U-235

Natural uranium is composed of 99.3 % U-238 and .7 % U-235. It is the smaller amount of uranium, the U-235, that is a fissionable material. Fissionable material, meaning that in pure enough form it can sustain a chain reaction. The binding energy for U-235 is 7.6 MeV per nucleon in its nucleus. If we split the U-235 nucleus, the resulting atomic fragments make atoms of krypton and barium, each with a higher binding energy per nucleon than the U-235 atom. The difference in energy is about .8 MeV per nucleon. Thus, the total energy output of splitting the U-235 equals:

.8 MeV x (235 nucleons) = 188 MeV.

This is a tremendous amount of energy. One pound of U-235 can produce the same amount of energy as three million tons of coal. To look at it another way, 1 gram of fissionable U-235 could power a 60-watt electric light continuously, 24 hours a day, for over 200 years.

When the U-235 nucleus is split, it ejects two or three neutrons that can cause further fissions and release more energy. If sufficient U-235 is present, a self-sustained chain reaction is produced, see Figure 1.

If we assume two neutrons are emitted in each fission, and that these neutrons will each cause another fission reaction in 10^-8 seconds, a chain reaction would result from a single neutron releasing 2 x 10^13 joules of energy in less than 10^-6 seconds. Such an uncontrolled chain reaction is the basis of the atom bomb.

Nuclear Reactors

By controlling the fission process and sustaining the chain reaction, a constant power output is possible that is a very efficient source of energy. The device in which a controlled chain

reaction can be started and maintained is called a nuclear reactor.

In conventional fossil fuel power plants, gas or coal is burned to boil water, creating steam to drive turbines that produce electricity. The nuclear power plant uses nuclear fission to generate the required heat, see Figure 2.

The core of the nuclear reactor contain fuel elements containing enriched uranium. The "enriched" uranium is typically 3-6% U-235 (far below the U-235 enrichment required for weapons).

When U-235 undergoes fission, it releases neutrons. The emitted neutrons are traveling too fast to initiate another fission reaction. U-235 doesn't capture fast neutrons effectively. Fission reactions in U-235 are initiated by slow moving neutrons. Uranium U-238, on the other hand, doesn't capture slow neutrons but absorbs fast neutrons. Therefore, fast neutrons in the reactor are more likely to be absorbed by the U-238 which doesn't contribute to the chain reaction and are thusly wasted.

To slow the fission neutrons down, the fuel elements in a reactor are surrounded by a moderator. A moderator is a material that slows fast moving neutrons without absorbing them. When a fast neutron collides with another nucleus, some of its kinetic energy is transferred to the other nucleus. How much energy is transferred depends upon the particular interaction, but in general, the more nearly equal the masses of the particles, the more energy is transferred. Applying this principle, hydrogen appears to be the best moderator.

Nuclear reactors capitalize on this fact by using ordinary ("light") water. Water molecules contain two hydrogen atoms. The water also serves double duty as a coolant and transfers heat to the turbines. One disadvantage of using light water is when a neutron collides with a hydrogen proton, it may become attached to it, forming a deuteron (heavy hydrogen, isotope) atom. The neutron losses in the light-water reactor make it necessary to use enriched uranium fuel (3-6% U-235).

To limit and control the fission reactions inside the reactor, control rods are raised or lowered inside or in between the fuel elements. The control rods are made up of materials that readily absorb neutrons, such as cadmium and boron, that effectively quench the fission reactions.

Although we are using a low grade fuel (3-6% U-235) in the reactor, as compared to the material used in weapons (95-98% U-235), can a reactor generate a nuclear explosion? Very unlikely. Let's examine why.

First of all, it uses low grade fuel that doesn't become "critical" easily. Even so, let's assume we have enough uranium material to go critical. Now we must assume that our control rods are stuck and can't be lowered. What would happen in this situation? Well the reactor is going to heat up past its normal operating temperature. This boils all the water. The steam pressure builds to a point where it ruptures the walls of the reactor. This is, of course, assuming that our pressure release valves connected to the reactor are jammed or somehow blocked.

Now this rupture isn't a nuclear explosion, just a minor steam explosion. Whether the pressure relief valves work or the reactor wall ruptures, the end result is that the water quickly boils away and the reactor shuts down. Why? Because the water is the moderator and it is no longer in between the fuel elements to slow the neutrons down that maintain the nuclear fission reactions. This is a built-in safety feature.

The China Syndrome

A number of years back a popular movie titled "The China Syndrome" described a potential nuclear reactor disaster. In the disaster scenario, a nuclear reactor goes critical; the nuclear reactor core (fuel) super heats and the reactor begins to melt its way through the earth to China.

Any core melting its way through the earth would stop at the center of the earth. Why? Because at the center of the earth there is zero gravity. Aside from that tidbit of information, the molten core of the earth would quickly dissolve and disperse the radioactive material safely.

If the "China Syndrome" was a viable scenario, I would strongly recommend that the United States build a controlled device designed to burrow a hole deep into the earth to capture an almost unlimited supply of free geothermal energy from the earth's core.

Heavy Water Reactors

There are many types of nuclear reactors. I just want to touch upon one more — the heavy water reactor. The reason being is that you may have heard of heavy water and wondered what is the significance of this material.

Heavy water is an excellent moderator, much better than ordinary "light" water. The heavy water molecules contain the heavy isotope of hydrogen (deuterium). The heavy hydrogen atoms already contain a neutron in their nucleus that many light-water hydrogen atoms would absorb. So, heavy water absorbs far fewer neutrons than light water, consequently, lower grades of uranium (natural) may be used in these reactors.

The Atomic Bomb

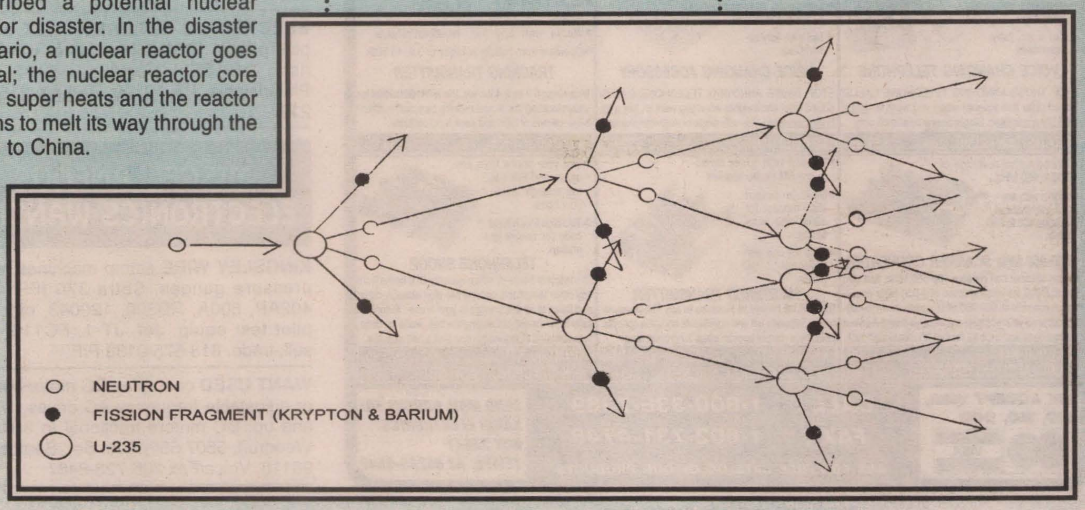
Once the principles of fission are understood, it becomes childishly easy to design an atomic bomb. Take two masses of a fissile material such as U-235, bring the masses together quickly for a long enough time (one millionth of a second is long enough), and an atomic explosion will result.

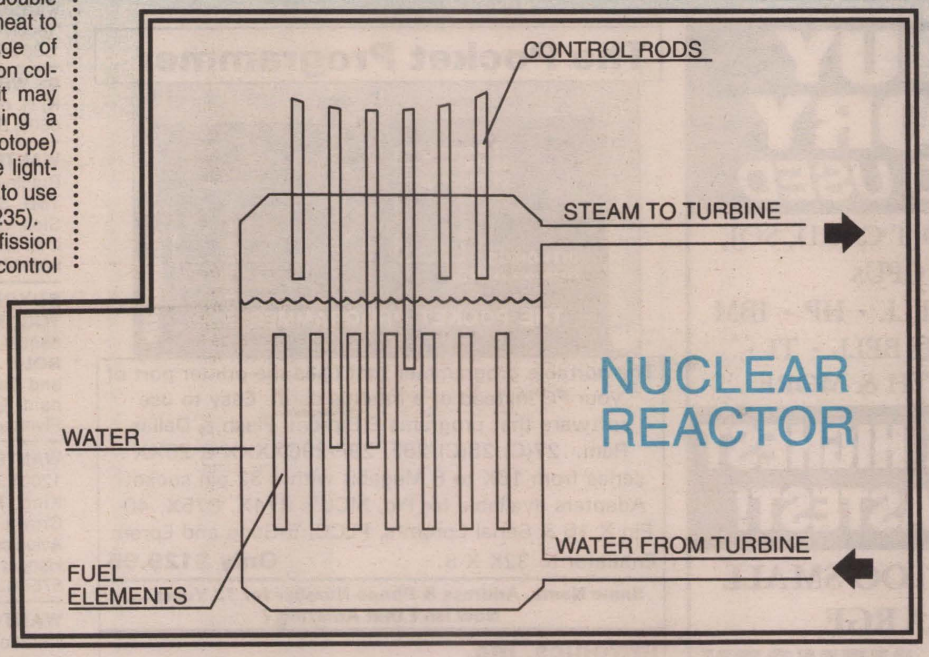
Today, atom bombs (A-Bombs) are considered by the major world powers as obsolete weapons. Fusion bombs, or H-bombs, have much greater destructive power. Strictly speaking, both fission and fusion bombs are considered "atomic bombs." The A-Bombs are still needed as triggers to initiate Hydrogen (H-bombs) bombs.

The massive undertaking during WWII to build the first atom bomb was engaged mostly in purifying enough fissile weapons grade U-235 from natural uranium. The next step was determining how much U-235 material was needed to reach the critical mass needed to make a bomb (code name — The Manhattan Project).

As stated, natural uranium is 99.3% U-238 and .7% U-235. The method used to produce most purified U-235 is gaseous diffusion. In this process, natural uranium is converted to uranium hexafluoride gas. The uranium hexafluoride gas is pushed through semi-permeable nickel membranes. Because of the lower mass of the U-235 hexafluoride gas, it is able to travel (diffuse) through the membranes a little faster than the heavier U-238 hexafluoride gas. The faster moving U-235 gas is continually captured and recycled until it is almost pure U-235 hexafluoride gas. Gaseous diffusion is an expensive process requiring large plants costing millions of dollars.

Fissile grade (or weapons grade) Uranium is 95-98% pure U-235. **NV**





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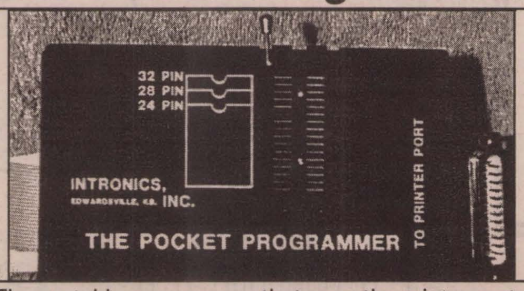

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Cellular Telecom Update

by Damien Thorn

Cellular communications technology presents many challenges to technicians and hobbyists alike, simply because it never seems to remain static. As soon as we have a pretty good handle on the subject, changes take place. Whether it is an industry practice, governmental regulation, or a new product development, it seems inevitable that there is something new happening every time we turn around. Although sometimes an obstacle, this is also what keeps the topic fresh and interesting.

After scrutinizing the stream of mail during the last few months from readers with cellular telecom-related questions, it became easy to spot the recurring trends in questions asked that indicate an informational void of sorts. This article will summarize a number of these questions and address a few issues that we have not previously covered in prior articles.

PROGRAMMING SOFTWARE

The number one topic of correspondence concerns altering the identity of a cellular phone. This is evidenced by the countless people who have expressed an interest in various permutations of PC-based computer software that allows the reprogramming of both NAM and ESN information in cellular phones manufactured by Motorola.

While a few people may have a criminal interest in such software, most people seem to be struggling to simply understand how it all works. The issue has been clouded by a number of kitchen table dealers making wildly varying claims over essentially the same software. This is sad, not only because people get suckered into spending hundreds of dollars for a program they could have downloaded for free, but because it confuses people and sets everyone back in their comprehension of cellular rather than fostering a greater understanding of the technology.

For almost two years, the only available product that performed these functions has been an altered (hacked) version of a European software package apparently authored by an individual known as Anthony Timson. This program made its major debut in the United States as the centerpiece of a $495.00 cellular programming package sold by a Massachusetts company through a Beverly Hills, CA mail drop.

Although the initial distribution contained cable diagrams with inaccurate wiring information, soon many people were selling the software with new, often improvised documentation. Under a different brand name, it could even be picked up at the annual Dayton, OH swap-a-thon from the back of a truck.

There have been a total of three versions of the program both offered for sale and freely available on bulletin board systems and the Internet. Two of the versions, known as v9.9 and v9.11 were thought to be essentially the same software by knowledgeable people, as the difference was minimal. A cellular hardware dealer informed us recently that he believes v9.9 works best with phones containing firmware revisions 9009 through 9110, and v9.11 functions with firmware revisions 9110 through 9121. Although certainly possible, there is no conclusive evidence to support this assertion.

The third version of the software is officially known as "HTH-V2" and was released by the hacking group in New York known as the High Tech Hoods (abbreviated HTH). This particular package was reported to simply be a copy of one of the aforementioned versions that had been edited to display slightly different graphics. In its initial release, it also came with an executable loader program that displayed HTH graphics while bringing up the menu.

Unfortunately, the loader prevented the user from passing the command line string "/ESP/NVR/NAM/E7/LPT1" that allowed the software to function properly, and thus it didn't take long for the actual programming software to be extracted from the loader.

Compounding the frustrations experienced by those who obtained the software from online sources was the erroneous text file that accompanied the software. According to the text, the software operated on firmware versions exceeding 9121. It didn't, and many experimenters were left with phones that had been rendered useless. The current iteration of the HTH package runs just like the original version from which it was supposedly derived.

The next genuine development in the progression of software for programming Motorola brand phones was software known alternatively as "G2" or "AMPS." This package was usually sold pre-installed on a specific model of NEC laptop computer because of the unusual copy protection scheme used by those selling this new tool. The popularity of this program was due to the fact that it was compatible with phones containing firmware revisions above 9121 which had been the "ceiling" which rendered the previous software useless.

The protection used to prevent unauthorized copying of the program was rather unique. Instead of employing standard forms of copy protection, the distributors used a modified version of a software utility called Accumark Gold. Accumark was designed to save an image of a PC's RAM (memory) to a file on the hard disk. Creating this snapshot of the currently executing software would allow the computer to be powered down in the middle of a program, then restarted later and reloaded with the image from disk. This, in effect, restored the system to the exact state it was in when the image was created and the PC powered down. The creation and loading of the memory image was all handled automatically by the Accumark software.

In addition to being a spiffy utility, the software proved to be effective copy protection in a way that the Accumark designers had never intended. The innovative distributors would install the Accumark product on the client's computer and then execute the G2 software from a floppy disk. Once the program was up and running, the disk was removed from the floppy drive and the system powered off. Since Accumark Gold was active, a memory image had been saved to the hard drive, and whenever the computer was restarted it would load the running copy of G2.

Because the actual software was never installed on the computer, it could not be copied and distributed. All the client technician ever really had was a memory image of the software running on his specific computer, and this was not interchangeable with other machines. Beating the protection required another computer that was identical to the machine upon which the software was installed. If an exact twin of the original machine, right down to the BIOS version, could be found, then the entire hard drive could be copied and Accumark would wake up the G2 software image and never notice the difference.

Since a large percentage of the bootleg "copies" of the software were sold along with an NEC notebook computer, we can guess that whoever paid the original $10,000.00 or so to have the software installed from diskette probably owned an NEC system and was anxious to recoup his investment.

Around the summer of '94, another programming package appeared on the market known as "MPC." The MPC program also worked with phones containing firmware above revision 9121, and was protected from unauthorized copying by a hardware key commonly known as a "dongle."

This standard type of copy protection is often used on expensive verti-

cal-market software packages, and requires the presence of a physical device which must be attached to the computer's printer port in order for the software to execute. One manufacturer of such a security device for the software industry was started by a gentleman named Don Gall. The firm claims that this is the origin of the term "dongle," but anyone who has ever observed one or more of these gizmos attached to the rear of a machine can probably think of a more obvious reason why such a digital wart might be known as it is.

While attending HoHoCon in Texas during the New Year weekend, it was privately demonstrated that both the G2 and MPC software had been "cracked" (reverse engineered and modified) to remove the copy protection. Although this happened back in January, as a result both products have begun to surface at a considerable discount from the original advertised prices which ranged from hundreds to thousands of dollars. Much as the original Timson software has been mutilated and freely distributed, these new versions have already begun showing up on the Internet. It won't be long at all before these two programs reach critical mass in the distribution channels and totally become freeware of sorts, with the initial origin and protection all but forgotten.

As with the original Timson software still being copied and sold by a few fast-buck marketeers, there is no doubt that these new programs will also be re-marketed. P.T. Barnum knew quite a bit about suckers, and so do the shammers who prey upon those too ignorant of, or lacking access to online distribution channels where things are archived and free for the asking. Honest people do not download shareware from CompuServe and resell it at $200.00 for a single diskette. This is exactly what is happening now, and the victims are those non-technical people who desire two physical phones attached to their cellular service.

Stepping down from the soapbox and moving away from the cottage industry of cellular software, a hardware device is also available to program Motorola brand phones. Devices to program other models from a number of different manufactures are also available. These units have been advertised under the "CopyCat" brand name at prices ranging from $3,000.00 to $1,200. 00. Prices have been dropping for awhile. Containing about $150.00 in parts, these handheld boxes have an LCD display and a 16-key hex keypad for reading and entering pertinent information. Programming of the phone takes only a few seconds once the data has been entered, and the units tend to be more adept at handling a wide variety of firmware revisions than the often cantankerous computer-based software.

The firmware, or computer code, that makes these devices function is stored within a high-security microcontroller manufactured by Dallas Semiconductor. The key feature of the Dallas chips is that once they have been programmed, the information cannot be removed or read back out of the chip. It has additionally been reported that the software is held in the chip's memory by a small battery, reminiscent of the old VideoCypher hardware. Remove the chip from the battery power for even a moment and the contents are erased. With these protective mechanisms in place, the instructions that comprise the firmware cannot be accessed and thus can't be copied to another chip . . . for now, anyway.

ESN READERS

Another frequent question that arises concerns devices capable of reading the data bursts transmitted by cellular phones which identify them to the cellular system. These short, fast bursts of Manchester encoded data contain the subscriber's mobile identification number (MIN) and the electronic serial number (ESN) of the phone along with some other information.

Other than perhaps a law enforcement agency's need to identify a cellular phone suspected of being involved in some illegal activity, ESN readers really have no legitimate use outside of a cellular repair and installation facility. Since obtaining ESN and MIN pairs from legitimate subscribers' cellular phones is a necessary step in perpetrating cloning fraud, ESN readers have increasingly been coming under fire, and with some justification.

The Curtis CellPhone ESN Reader manufactured by Curtis Electro Devices in Northern California seems to have taken the most heat, as it has become one of the most popular pieces of test equipment abused by cellular criminals. In an article appearing in the *Sacramento Bee,* Dave Daniels, manager of fraud control for California's AirTouch Cellular tends to blame Curtis for some of the industry's cloning fraud problems. John Curtis, president of the small company, responds by noting the his product is a legitimate alternative to bulky and expensive test equipment costing upwards of $10,000.00.

"If our product never existed, the fraud problem would be the same . . . If we went out of business, there would just be a little blip," Curtis is quoted as saying.

In the same article, a spokeswoman for Sacramento's *Cellular One* has a more realistic view of the situation. "He is within his rights and provides a legitimate service. It's not the equipment that's the problem, it's the use," said Nancy Frank, commenting on Curtis.

And John Curtis has not taken the misuse of his equipment lightly. Since it was first introduced in '90, the Curtis CellPhone ESN reader has undergone several stages of re-engineering to make its use as a tool for cloners more difficult. In addition to a usage counter that locks up the unit after 200 captures (or reads), the reader also transmits unique information that can aid investigators in tracking illegitimate use.

If John Curtis' name rings a bell to many hams, it is likely because Mr. Curtis is also the inventor of the popular "Curtis Keyer" integrated circuit used for sending Morse code.

Having met with Mr. Curtis over two years ago, I can attest that he was utterly appalled at the reports that his equipment was being abused. He's taken every possible step to prevent the misuse of the reader, including screening potential customers and denying the sale to those that did not seem to be legitimate cellular installers.

Anyone who thinks that Curtis is at all culpable for the misuse of his product must live in a vacuum. Once you've experienced the almost palpable anger that radiates from this grey-haired gentleman while discussing the subject of fraud, you know that there is no other topic, not even religion or politics, that could possibly get him as fired up.

The mistake made by people like Daniels is to underestimate the ingenuity of cloners at finding ways to circumvent the security measures designed into the reader. It is an absurd contradiction for a carrier to point at another party and make claims of lax security when one can dig through the trash dumpster at an "authorized agent" for that same carrier and pull out carbon copies of subscriber agreements – complete with ESN, MIN, and the subscriber's personal information such as driver's license and social security numbers. (See "Cellular Cloning – the Industry Responds to a Growing Problem," *Nuts & Volts,* June '94.) Cellular bandits are not totally dependent upon high-tech equipment to gather serial numbers.

Hopefully, the controversy surrounding the Curtis ESN Reader has finally been laid to rest. As of May 2, 1994 the instrument was completely redesigned and now requires that the cellular phone being identified or tested be physically under the control of the technician. The reader is no longer capable of promiscuously intercepting the identifying information being transmitted by a cellular transceiver, and cannot be easily modified to do so. The test set is no longer called an ESN Reader. The new unit is positioned as a system analyzer.

THE LEGALITY OF CLONING

When we hear the word "cloning" on the news, it is almost always a reference to illegal activity that results in charges for calls being billed to another cellular subscriber. Obviously this is illegal, as it is theft. In addition to whatever state law such an act may fall under, it also constitutes a crime under federal law and carries very severe penalties.

Until this year, the federal law under which criminal cloners were prosecuted deals with obtaining goods or services and causing the charges to be billed to someone else's account. It was not a cellular specific law. Using someone's credit card number, calling card number, or other account information to avoid payment of charges is a crime under the statute.

Each of these sets of digits that cause someone to be charged for the goods or services fraudulently obtained by another are referred to as "access devices" by the statute (18 U.S.C. 1029). Since the pair of unique numbers stored inside a cellular telephone are what cause billing to take place, these numbers have typically been considered an "access device" similar to credit or calling card numbers when used fraudulently, although the issue wasn't directly addressed by the law.

Passage of the "Communications Assistance for Law Enforcement Act" (commonly known as the "Digital Telephony Bill") earlier this year changed all this.

Most people who are aware of the Digital Telephony Bill know it as the legislation that requires telecommunications carriers to install equipment designed to provide law enforcement agencies with any easy way to intercept (wiretap) any conversation from a remote location when authorized to do so. This is obviously a whole can of worms in and of itself and will be dealt with in a future article if there is sufficient reader interest.

The sneaky thing about the bill is that it also contained a number of provisions that modified various statutes unrelated to its stated purpose. Besides the wiretap-on-demand provisions, and the $500 million tax dollars that have been allocated to pay telephone companies to modify their switching equipment, the bill directly addresses cellular cloning.

While anyone interested in completely understanding this law will need to research the full text, here are some of the changes that have

been made to 18 U.S.C. 1029 by the bill:

1029(a) -

(5) [Whoever] knowingly and with intent to defraud uses, produces, traffics in, has control or custody of, or possesses a telecommunications instrument that has been modified or altered to obtain unauthorized use of telecommunications services; or

(6) knowingly and with intent to defraud uses, produces, traffics in, has control or custody of, or possesses --

(A) a scanning receiver; or

(B) hardware or software used for altering or modifying telecommunications instruments services . . .

Anyone who meets the criteria set forth above is guilty of a federal crime. Depending upon the circumstances, penalties can be as great as a $100,000.00 fine or up to 20 years in prison. The statute now specifically defines an "access device" as ". . . any card, plate, code, account number, electronic serial number, mobile identification number, personal identification number, or other telecommunications service, equipment, or instrument identifier . . ." As used in this section, the term 'scanning receiver' is defined as ". . . a device or apparatus that can be used to intercept a wire or electronic communication in violation of Chapter 119."

The statutory sections above are quoted from issue #6 (May/June, '95) of *Private Line* magazine. Among the many pages of legalese published in that issue is a quote from Tom McLure, director of fraud management with the Cellular Telecommunications Industry Association (CTIA). Here's what Mr. McLure apparently said about the digital telephony bill:

"We lobbied for passage of the Telephony bill, which the President just signed. The bill enhances the language in Title 18, section 1029. That's the Secret Service statute that deals with fraudulent or counterfeit access devices.

Prior to this bill being signed, there was no reference to wireless communications. Now, the language in the statute clearly includes the cellular phones. This has added that tool to the arsenal of the Secret Service."

FIRMWARE MODIFICATIONS

We'll end this article by covering one last topic that has been gamering interest as of late, and that is firmware modifications. Probably the most recent technology in cellular cloning to have made its way up from the underground to the general public are replacement firmware chips that allow the reprogramming of an ESN via the keypad of a phone.

For those with absolutely no experience with things like microcontrollers, understand that in discussing firmware, we're referring to the instructions or program that resides in a PROM or EPROM chip inside each and every cellular phone. This small amount of software basically turns a circuit board full of dumb electronic components into something useful. Using a desktop computer as an analogy, it is easy to visualize how useless a PC would be without having any software loaded inside. Without DOS or some other operating system software running to tell the CPU to check the keyboard to see if you were typing, or to display graphics on the screen, it wouldn't do much besides sit there and waste electricity.

Firmware is of the same importance to a cellular phone as software is to a PC. A phone's firmware is comprised of instructions and information that allows its microcontroller to operate the receiver and transmitter chips, generate tones, send out data, etc. Instead of being stored on a disk (for obvious reasons), this dedicated program is stored in a chip and is not meant to be changed.

What some skilled individuals have done is to re-write small portions of the operating firmware for popular handheld phones such as those manufactured by Oki and Panasonic. The code (program) has been changed to allow one or more strings of digits to be keyed into the phone and stored in an available memory location, such as the space normally occupied by a frequently dialed number.

The portion of the firmware responsible for reading the phone's ESN from its specific location in memory is also altered. Rather than looking in the area where the factory programmed ESN resides, the phone is now instructed to look in one of the areas where the string of digits has been stored. This string of digits is then used by the remaining sections of the phone's software as though it were the factory ESN.

Modifying a phone to use such firmware doesn't involve much more than removing one chip and replacing it with another. The two phones mentioned have become fairly prevalent due to their small size and the fact that the firmware chip is socketed. This eliminates the need to perform delicate soldering on surface-mounted integrated circuits.

In summary, these phones that are empowered with keypad ESN entry aren't any different than other cloned phones. They just don't require any outboard equipment such as a computer to program another ESN. The only major technical difference is that the factory ESN is never altered, it is simply ignored and another number sent in its place. This used to make a difference in terms of violating FCC rules. This is no longer the case, as we'll see next time. **NV**

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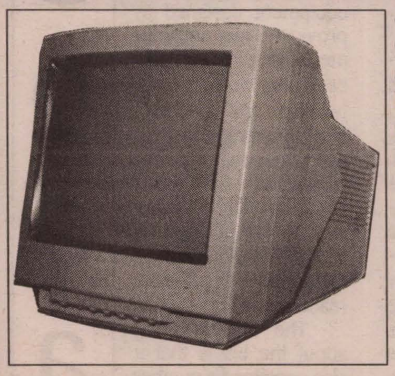

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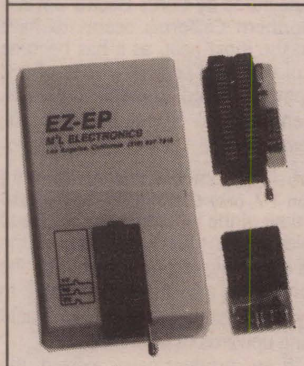

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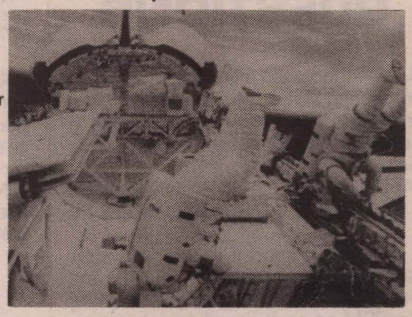

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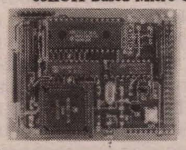

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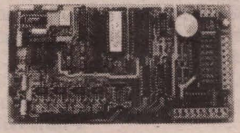

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& Answers

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QUESTIONS

In the February '95 issue of Nuts & Volts there was an article about ham crossband remote base units. Where can I get information on changing a Kenwood TM631A to operate this way?

9951 **Walt Johnston**
Gainesville, FL

I want to know if the circuit cards for two hard drives (CMI 5412 and 6426) are interchangeable, accepting the ROM on each board. I am trying to recover data from the 6426.

9952 **Ernst C. Land**

I need a schematic to construct an AC wattmeter. Any information regarding AC wattmeter kits or designs would be appreciated.

9953 **Douglas Cranston**
Lakewood, CA

I have two questions: 1) I recently acquired a Xerox 4045 Laser Printer which seems to be in pretty decent condition. It has parallel inputs and expanded memory board. However, none of my software has drivers for this printer. I use Windows pretty exclusively and have been unable to find any Xerox drivers. The manuals I received with the unit, state that an Epson Emulation Cartridge can be purchased, but Xerox is not too "user friendly" with the home hobbyist and wants a service contract before giving any assistance. Does anyone have any lowdown on this emulation cartridge or where I can get drivers for this machine? Or, is it just another boat anchor for the local landfill?

2) I bought from a "second hand" store, a Code-A-Phone Model CAP-3400 answering machine. This unit has the outgoing message stored in RAM, and the incoming message on a microcassette. It seems to work fine. However, I did not receive the instructions with the unit and don't know how to access the remote functions. I do know the access code to the unit and it seems to work, but what touchtone keys do what? I tried calling Code-A-Phone, but they are out of business.

9954 **Mark W. Albanese**
Plantsville, CT

I have two questions: **1)** I have a TRS-80 Model II that appears to have a dead keyboard. When I turn the computer, on the CAPS Lock and Shift Lock LEDs come on immediately and the computer seems to be getting a long row of "mmmmmmmmmmmmmmmm's." This keytronic relic uses a 8021 to send info serially to the CPU. Does anyone have any information on a replacement or cure, (No jokes please), or a schematic of this computer?

2) I have a 25X80 alpha numeric LCD panel from an old "Datavue 25" portable computer. The display looks like it should be re-usable. The LCD circuit board has a 25-pin edge connector and the following on the back, "DMF614," and "OPTREX," does anyone have a pin-out and specs?

9955 **Ted Stowe**
Seattle, WA

What is a good substitute or replacement for the rubber bands that drive the capstans on small tape recorders? Regular rubber bands don't work — too much wow.

9956 **Anonymous**

We would like to generate command signals for automatic dialing to be fed into and control a Motorola flip phone (through the eight-pin option socket at its base). We are having trouble getting the interface code and protocol for the Motorola phone. (For dialing digits, pick-up, hang-up, and the other function keys.)

9957 **Dexter Richards**
Milpitas, CA

ANSWERS

ANSWER TO #8953 - AUGUST 1995

Audio amplifiers do not need matched impedance load. Transmission line effects are not significant at audio frequencies. Connecting a 40 ohm speaker to an 8 ohm output is not a problem, except possibly with a passive speaker, when little power will be delivered to the speaker. Since you are using an amplified speaker, such connection is fine. The reverse connection, 8 ohm speaker and a 40 ohm amplifier, however, would overload the amplifier.

Jan Zaluda
Mountain View, CA

ANSWER TO #79527 - JULY 1995

Your idea to put a video signal through a CB radio could have some interesting applications, if it were in fact simple. The main problem is the relative bandwidth occupied by a typical video signal. Video usually takes 2 MHz (low quality) up to 5 MHz of bandwidth. A typical voice grade radio has filters in it that limit the bandwidth of transmission to 5 to 10 KHz. This is like trying to put 300 pounds of "stuff" in a one-pound bag!

All is not hopeless, though. Major companies have devoted much time and effort on solving this problem, as it is crucial to the future high definition TV systems that are being developed. They use digital processing to extract the important video parameters, then use sophisticated coding techniques to reduce the required transmission bandwidth by a factor of 10 or even 100. At the other end of the system, a special receiver decodes and reconstructs the video signal, which can then be displayed on a TV. All this processinng takes a toll, and the rebuilt video image can have artifacts and distortion.

The question didn't state if the video was full motion or still frame. Full-motion video can be compressed and extracted using an "MPEG" algorithm, and still frames of video usually use "JPEG." There are ICs from LSI and others to implement these algorithms, though they are neither simple nor low cost. The price should come down in the future, as high-volume production starts on these products.

Robert Kelly
Poway, CA

ANSWER TO #79517 - JULY 1995

Although 555 timer ICs can certainly be used to generate audible tones, their use as tone generators for DTMF applications is definitely suboptimum for the following reasons:

1) The 555 timer IC generates squarewaves at its output not sinewaves. The large number of harmonics present in the squarewave output could falsely trigger a DTMF decoder circuit. Thus, if a 555 is to be used, its output must first be severely low-pass filtered in order to approximate a sinewave.

2) As the name implies, DTMF (Dual Tone Multiple Frequency) "tones" actually consist of the sum of two sinusoids at specific frequencies as indicated in Figure 1. The outputs of two 555 chips would have to be summed together and low-pass filtered or each filtered and then summed to be used. An op amp could conveniently be used to both filter and sum the outputs.

3) Accuracy/stability may be a problem due to tolerence, drift, and leakage of the RC components. Precision, low-leakage parts should ideally be used.

The solution to all these problems is to use an IC that is specifically designed for touch-tone telephone systems. The classic DTMF encoder chip (originally made by Mostek as the MK5087 and MK5089) is still available from Plessey Semiconductor and also from Texas Instruments. The TI part goes by the similar name TCM5087 and TCM5089. Both parts come in 16-pin DIP packages and require only a +5V supply, keyboard, and standard 3.579545 MHz TV color burst crystal to operate. Note that the crystal controls the stability of the output frequencies much better than any RC time constant such as used in the 555 timer circuits. The two parts are almost identical with the 5087 part better suited for keyboard input (any standard matrix keyboard will work) whereas the 5089 part is better suited for electronic or microprocessor control since it requires the older 2-of-8 telephone type keypad that both connects a row and column input together and grounds the common connection as well. Motorola used to manufacture DTMF encoders, but seems to have discountinued their line of parts. However, they still make a DTMF

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decoder chip that goes by the name MC145436. Figure 1 shows the standard DTMF frequencies.

	1209 Hz	1336 Hz	1477 Hz	1633 Hz
697 Hz	1	2	3	A
770 Hz	4	5	6	B
852 Hz	7	8	9	C
941 Hz	*	0	#	D

FIGURE 1

One source for both parts is BG Micro, P.O. Box 280298, Dallas, TX 75228. Phone 1-800-276-2206.

Jay Rabkin
Pasadena, CA

ANSWER TO #7958 - JULY 1995

The LoJack™ system for recovering stolen vehicles uses the Doppler technique of radio direction finding (RDF). The locating antennas on police cruisers consist of four equal-length vertical whips placed in a square footprint on the vehicle roof. An RF switching system connects each whip to the receiver, one at a time in sequence, to simulate the effect of a single whip moving around the square at several hundred revolutions per second. This pseudo-rotating receiver antenna system imposes a periodic frequency change on the incoming signal due to the Doppler effect. The RDF set's control electronics detect the phase of this imposed Doppler information, which gives the direction of the incoming signal.

Low-cost Doppler RDF sets for VHF have been around for over 20 years and are used by many ham radio operators for their "foxhunts" and "T-hunts." The antenna system can have from 3 to 16 whips, depending on the design. Doppler sets work best in the range 140 to 225 MHz. LoJack operates near 170 MHz.

An add-on Doppler RDF set for ordinary VHF narrowband FM transceivers and scanners can be homebrewed for about $100.00. Complete plans for such a unit are in the book *Transmitter Hunting — Radio Direction Finding Simplified* by Moell and Curlee, published by Tab/McGraw-Hill, ISBN number 0-8306-2701-4. Bare circuit boards for the project are available.

The whip antennas used in Doppler sets have low gain and there are losses associated with the switching. This makes Doppler sets less sensitive than VHF RDF gain antennas such as yagis and quads. LoJack transmitters put out 2 watts in order to be tracked over a five-mile range. If you cannot provide that much transmitter power, consider using rotating quad or yagi antenna for RDF instead. Such gain antennas are preferred by RDFers working with weak signals.

For instance, researchers use beams to track endangered animals. Beacons on these critters usally put out only microwatts or milliwatts due to battery size limitations. Bearings are obtained by rotating the antenna and determining the direction of maximum signal, using an S-meter or the operator's trained ear. The transmitter hunting book mentioned previously includes plans for a variety of RDF gain antennas.

Your additional request for information on low-power transmitters for 88-108 MHz leads me to believe that you intend to do RDF in this frequency range. If so, you need to know that ordinary FM broadcast receivers are not suitable for RDF of low-power beacons, because their IF bandwidth is about 200 KHz. The Doppler shift produced by a reasonable-size receiving array on the band is about ±2 KHz, which means that the recovered shift on an FM broadcast receiver will be too small to be useful. The signal-to-noise ratio of a Doppler RDF system will be unacceptable with such a receiver and this wide bandwidth will also reduce the range of RDF with yagis and quads. If you wish to use 88-108 MHz for RDF, make sure you use a scanner or receiver such as the Regency MX-7000, which can be switched to narrowband FM reception (IF bandwidth about 15 KHz).

For more information on RDF, read the monthly "Homing In" column in 73 Amateur Radio Today magazine. The LoJack system was detailed in the May '91 issue. Doppler RDF was covered in the Feb '92, April '95, and June '95 columns. Tracking with beams and quads has been discussed in many installments, including June '94, and August '95. Back issues of 73 Amateur Radio Today are in many public libraries.

Joe Moell
Fullerton, CA

ANSWER TO #79524 - JULY 1995

GPS time and position information is a digital data stream, C/A coarse acquisition and P precision code. Therefore, it is possible to transmit false digital data to implement selective availability. If the false information is coordinated between all satellites, no algorithm or averaging will defeat it. The higher accuracy P signal is also transmitted on a different frequency, and commercial receivers are not supposed to be able to decode the encrypted P data. Selective availability can be defeated using differential GPS, by having a station at a know location broadcast a correction information at a low frequency. GPS needs data from at least four satellites to solve four position equations for x, y, z, and t.

Jan Zaluda
Mountain View, CA

ANSWER TO #8954 - AUGUST 1995

"Bishop Graphics" went out of business in 1993. Before they did, they sold the line of Printed Circuit Design Aids, including copper "Stikons," to Chartpak in Leeds, MA, 1-800-628-1910. Chartpak is now the manufacturer of this product.

C. Baumgart
Simi Valley, CA

ANSWER TO #8952 - AUGUST 1995

CB uses AM or SSB type of modulation. 10 meter is usually FM or in some segments of the band SSB or CW. I have made many contracts across the UF from Florida on 10 meter FM. It is quite easy to convert the standard low-cost CB to FM operation. The transmitter is converted by connecting some audio from the mike amplifier to the VCO tuning variactor. This is done by finding a point in the amplifier where .5 to several volts of audio is available. Connect this audio to the top of 10-50 K trimpot. Ground the other end and connect the variable arm to the variactor though a 10-100 K resistor. Value depends on the circuit and amount of deviation required (usually 5 KHz). Bypass the AM modulator by connecting the DC collector on the PA directly to +12 V.

To receive FM, the AM detector may be used as a slop demodulator. However, to get the full benifits of FM, a FM limiter and descriminator should be used. A single IC used for TV audio is usually used to limit and FM demodulate the received signal. A LM/MC1357 or 1358 IC is a good choice. The IC has several stages of IF amplification and limiting. It also contains a balanced FM demodulator and a separate audio preamplifier. All that is required is a small 10 MM IF can (black/white or yellow) and a phase shift capacitor of 68 pFd or so. The IC is connected to the last IF stage at 455 KHz via a small capacitor 10 pF. The audio preamplifier may be used as part of the squelch control. A conversion kit with the FM IC and circuit board is available from Morning Dist. Co. in Hialeah, FL. 305-884-8686. They also have CB Hygain boards and the converson crystal.

The crystal is to change the tuning range of the transceiver from CB to 10 meters. On some CBs, the PLL may tune up to 10 meters by reprogramming the binary code to the PLL frequency set pins. This is done by connecting the higher order input bit from ground to +5 V. Check the service manual for pin connections.

The final part of the converson is to retune the receiver RF coils and the transmitter coils to the new frequency range. The receiver is usually peaked on noise and the transmitter peaked on a wattmeter.

Robert B. Brown
Miami, FL

ANSWER TO #8951 - AUGUST 1995

Programming the OKI-1150 is not too much different than programming the Motorola 8000 phone you've used previously. Accessing the programming mode requires knowledge of the 10-digit access code, which factory defaults to *,1,2,3,4,5,6,7,8,# and must be entered within 30 seconds of power-up. If the code has been changed, the factory "backdoor" code is *,6,2,7,2,9,8,5,4,#.

The first prompt will allow you to change the programming password. Key it in and press store (STO), or press STO by itself to keep the current code. Several self-explanatory prompts will be displayed. You can press the "down" button to skip each, or key in data as desired.

The same bits of data that are required by your Motorola phone are also required by the OKI. Since the OKI has a nice alphanumeric display, you won't need to know cryptic steps like "01,02,03" to understand what each field is for. The one exception is the option byte. Here is what each of the option bits represent, from left to right. Digit "0" disables the option, and "1" enables the option:

#7 Reserved (do not change)
#6 Reserved (do not change)
#5 Reserved (do not change)
#4 MIN Mark
#3 Local Use Mark
#2 Audio Mute
#1 Horn Alert
#0 (right-most bit) Handsfree Mode

To complete programming, press STO then CLR. To program other NAMs within the phone, use the volume down key. You'll only have to reprogram the SIDH, MIN, IPCH, ACCOLC and GIM for each NAM. Everything else is common to all three.

Damien Thorn
Stockton, CA

ANSWER #79513 - JULY 1995

To program a specific channel into any Motorola cellular phone, you must first put it into "Test Mode." You can do this on the bag phone by grounding pin 21 on the 25 pin connector and then powering up the phone (the shell makes a good ground). On the flip phone, you must ground pin 2 of battery connector J6 (on the back of the phone where the battery makes contact, the center terminal that is recessed is pin 2) while powering up. If you do this successfully, numbers will flash across the display. Press #. The display will now show US'.

You must now set the audio path and enable RX Audio. Press 08# to unmute the receiver audio. Press 353# to enable the handset speaker to 351# to enable the external speaker (354# to mute). Volume may be adjusted by pressing 47x# where x = 0 to 7, with 0 being the lowest volume setting.

To select a channel, press 11xxxx# (x = the channel number, will accept 1, 2, 3, or 4 digits). Channels range from 001-799, and 991-1023. You can select a new channel by just entering 11xxxx#. You do not have to go through all of the steps above. To exit Test Mode, press PWR to turn the phone off and remove the ground wire.

Do NOT enter any code numbers other than the ones above, you can inadvertently change setting and programming information that are necessary for the proper operation of your phone. Failure to heed this warning may necessitate a costly trip to your friendly Motorola Service Technician.

LB
Scarsdale, NY

ANSWER TO #79531 - JULY 1995

You have several options to increase the range on your linear brand garage door opener. The easiest is to use a high-gain "bow-tie" antenna on the receiver which will result in approximately doubling your effective control range. Such antennas are available from a wide variety of sources for around $20.00.

Your second option for extended range is to replace the 9 VDC transmitter battery with a 12 VDC battery, or two 6-volt cells tied together. This will give you about 4 to 5 dB more of gain without requiring you to do any type of electronics modification. More than 12 VDC and you'll probably smoke the electronics.

However, if it is real power you want, you need to add a linear amplifier to the circuit. Your estimate of present output power of 15 milliwatts is overly generous. Remember this is a Part 15, FCC approved device with

Continued on page 135

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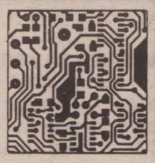

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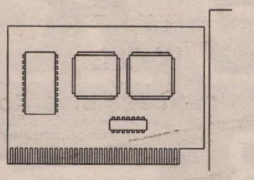

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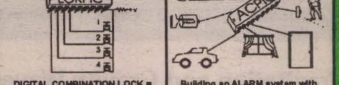

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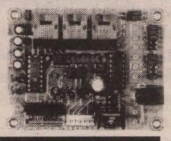

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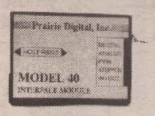

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Conducted by
Anthony Charlton

Welcome! Last month's column about measuring the speed of light drew a lot of interest from the readers. When one writes about a topic, the direction is often a question of whether the reader wants an entertaining read, or a "how-to" set of directions to accomplish something practical (or just for fun!). So, we try and give you a balance of the two kinds of directions to keep it interesting. As always, any comments or suggestions you have are welcomed at The Laser Experimenter's P.O. Box, listed elsewhere in this article, because most of the ideas of greatest intrigue come from you!

Gravitation and Gravity Waves

One fascinating idea comes from Pat Baird, who submitted a draft for a gravity detector. This idea holds real intrigue, as I have always been interested in out-of-the-ordinary things, and gravity and magnetism have been two of these fascinations. Far more stimulating than everyday bureaucracy, eh?

Well, in order to more fully understand how a gravity detector would work, it's necessary to look into the force itself first.

There are four fundamental forces in nature: The strong nuclear force; the weak nuclear force; the electromagnetic force; and the gravitational force.

The strong nuclear force — an attractive one — is felt within the atom. That force is so strong, it is a potential source of great energy. Nuclear bombs and the fission reactions inside stars are the result of the liberation of reactions under the control of nature's strong force.

If atoms were repulsed by this force rather than attracted by it, a mass of them could not be contained inside a solid steel block. This would assume the strong force has a reasonable range. As measured by scientific principles, the strong force is one that interacts with matter only within an extremely short range; after 10 [-13] cm it fades quickly. For reference, a proton is about 8 * 10 [-14] cm. Therefore, this force is one that interacts within subatomic distances, or distances within the radius of an atom, about 3 * 10 [-12] cm. for an oxygen atom.

The weak force is stronger than gravity. It is responsible for the transmutations of the identity of unstable subnuclear particles, and is also felt within only a very short range. That range is only about 10 [-16] cm. This force exerts neither push nor pull upon objects, but will cause transmutations to occur rapidly and with great violence (on a subatomic scale), propelling subatomic particles at high speed in reactions.

It was a rather ephermeral force to identify, being as weak as it is, and only since the early 1980s was it possible to measure the range of this force.

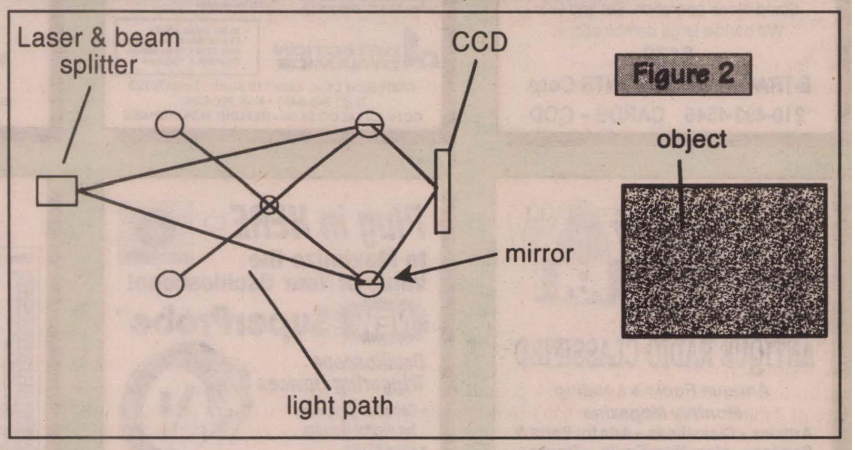

Figure 2

The electromagnetic force obeys the INVERSE SQUARE LAW, which gravity does also. This is a mathematical law, whereby the strength of each force is equal to the inverse square of its distance. Thus the force may be equal to one unit at one foot, to 1/2 unit at two feet, to 1/9 unit at three feet, and so on, out to the point where the force is so diminished, it becomes indistinguishable from the background "noise" of other interacting electromagnetic fields.

While the electromagnetic force may be affected by a strong gravity field, and I mean a *REALLY* strong one, ordinarily the two do not interact. Light is an electromagnetic force, although I realize light is not MAGNETIC in itself like a laboratory magnet. The relationship to magnetism was established by Maxwell's equations in the 1850s.

Light may be bent by a gravity field that exists about massive stars, galaxies, objects called neutron starts, and the oddest objects in the heavens called black holes.

Gravity is our final and most universal player here, and is the weakest of all forces (although it is an attractive one) and has the longest range of influence upon everything in the universe. Gravity increases as the mass, density, and closeness of any two objects under examination increases. So, if I have two styrofoam balls and two lead balls of the same diameter, the lead balls will become more attracted to each other than the plastic ones if both are at the same distance. Why?

Gravity was explained differently throughout history as several concepts. The philosopher Aristotle believed that objects that fell to the ground were simple trying to find their "natural place" in the universe.

Newton gave us the "falling apple" theory of gravity, whose popular conception thereof was actually an insult to the fellow's intelligence. Newton was the man that established that gravity obeyed the "inverse square" law, and quantified the gravitational attraction between two bodies. His theory was that gravity was due to a "force" between two objects of mass, one that is similar to the attraction between two magnets of opposite polarity.

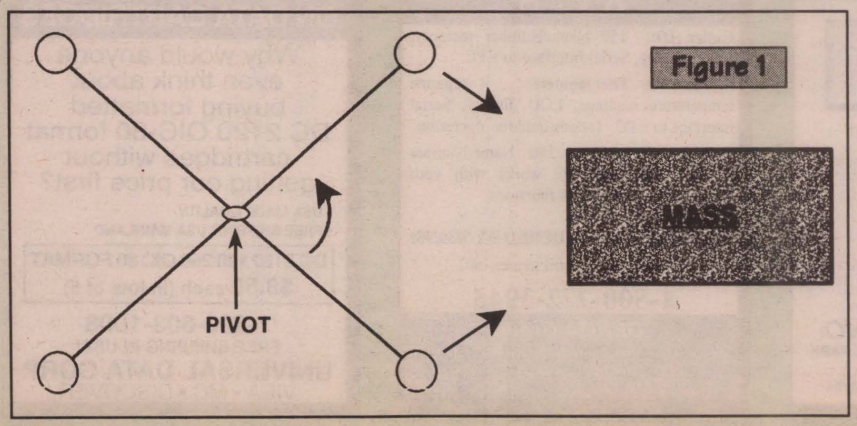

Figure 1

Along came Einstein, who revamped the theory of gravity completely. Einstein declared that gravity was not so much a force, but an ACTUAL BENDING OF THE FABRIC OF SPACETIME, which he called the "Space-Time Contiuum." His ideas, which have held up magnificently throughout almost a century of time and tests, said that the nature of spacetime, sans any mass affecting it, should be considered like a featureless "sheet of rubber." {1}

This elasticity of spacetime, Einstein believed, was responsible for the attraction between any body having any mass at all. Everything would be interacting at once in the universe with everything else, at limitless distance, because of gravitational effect. The heaviest players would, of course, become the most noticed ones.

I cannot imagine an atom's proton having more influence upon a mass than the planet Jupiter, yet the proton actually has a gravitational effect, but it very well may be too feeble to measure with current instrumentation.

Einstein said that in order to picture this spacetime, one needs to imagine that each mass produces a "dimple" in this rubber sheet, and that the larger the mass, the bigger the dimple, and the deeper the slope of the sides of the dimple. So, the earth creates a dimple in space-time which we, the moon, and everything on the planet is pulled towards. The resistance of the earth's surface and the soles of our feet prevent us from being drawn into the center of our planet.

The concentration of the mass is crucial to the gravitational attraction also. Should the earth have all its mass concentrated into an area the size of Manhattan, the gravitational attraction at its surface could well be a thousand times what it currently is. The earth weighs in at 1.317 [25] pounds, so a Manhattan-size earth would sure have some density to it — far greater than uranium, a very heavy, very dense metal.

The moon is drawn towards the earth's center and vice versa. The centrifugal force of the two orbiting bodies prevent them from being drawn together and colliding. Yet, we can see the effect of the moon on the earth clearly by the rising and falling tides, which are caused by lunar gravitational influence. How many quintillions of tons of water are moved every day I don't know, but the force is staggering once you begin to think about it.

{1} Physics devotees: Please forgive the oversimplification. Analogies of the facts of nature often have to be greatly boiled down to be even remotely understandable to us human beings, even though this analogy is a classic one.

At great distances, the dimples' "sides" are so shallow, their influence is lost in the background noise of other forces. But it is interesting to know that as this is being written on a clear evening, the distant stars and planets I see will still have SOME effect on my body, even though it may be too small to measure.

Radio buffs will recognize an analogy here, as their receivers will sometimes only be in a RF field of microvolt intensity, yet, the discriminating circuitry will be able to separate and discern with clarity the different broadcasts. Too bad there isn't such a thing as a "discriminator" for gravity detection, or we could listen to cosmic bodies with "gravity telescopes" like we do radio telescopes!

Quantified, let's take a look at the effect of gravity as measured by several examples, then we'll get into the interplay with lasers in this scene.

Amazing Celestial Gravity Effects

Planet Earth: We say this has a gravity constant of 1.0000, logical enough because we live here, and the assignment of a constant of 1 to measure other gravity effects to, is totally logical. Suppose one goes to Jupiter. There, the gravity constant is 2.64 times that of earth. So, if a person weighed 100 pounds on the surface of the earth, that person would weigh 264 pounds on the surface of Jupiter, and probably couldn't pick oneself off the floor!

Given a distance, any celestial (or otherwise) mass would induce a weight attraction relative to its mass(es) and the distance between those interacting mass(es).

If we consider the sun, its constant is a huge 27.9. That's why all the planets have been trapped into orbiting about it for 4.6 billion years or so. Again, it's the centrifugal force that prevents us from spiralling into a total incineration. Earth's orbital velocity is 18.51 miles per second, or 66,636 miles per hour. Should that be reduced by some gigantic retro-rocket, we would move the entire planet closer to the sun, perhaps fatally closer.

Taken further, massive stars have greater gravitational constants than our sun. There are such objects called neutron starts (and they must exist because measurement of electromagnetic phenomenon of distant celestial objects ties into the theories perfectly, even though we've never set a space probe down on one, nor is that ever possible) where the atoms of the stars have been crushed so hard because of gravitational effects, that the mass comprising the star has changed character. It has turned itself into all neutrons.

Regardless of what the star used to be made out of — hydrogen, helium, carbon, etc. — it has become all neutrons with no-interatomic spacing as with normal elements. This happens when certain types of stars exhaust all their nuclear fuel reactions, and the star collapses in on itself from gravity, much like a balloon would if you could observe it being subjected to millions of times its normal air pressure.

Hard to believe, but the elements under normal conditions are mostly empty space even though this is counter-intuitive. Taking uranium again for example, it is 19.04 times as heavy as water. The material in a neutron star is about 100,000,000,000,000 as heavy as water.

Laser Gravity Detector

It should be possible to build a gravity detector — not to detect neutron stars, but to detect the mass of a man, for example. Figure 1 shows a type of detector that is non-laser that was created by Robert L. Forward, and hence named the Forward Mass Detector. The two dumbells are in the shape of an X, and they are spun about a central shaft. As the forward dumbells pass closest to the mass, they tend to attract towards it, and hence, move the dumbells closer. As they wind away, the rearward ones tend to fly apart a little more than the front ones. A sensitive vibration detector notices this.

A variation on this theme is suggested where the dumbells each have a mirror mounted to them, as shown in Figure 2. As the dumbells are spun (and they don't need to go very fast, but this would have to be determined experimentally), a laser shot is fired at exactly the same interval when the dumbells are in their forward position. By splitting the beams initially with a beam splitter, and then combining them at a CCD semiconductor, an interferometric image could be obtained that would enable one to count the fringes generated. More fringes equals more mass. So a numerical representation of the mass could be obtained with the appropriate counting circuitry.

Simple Laser Gravity Detector Inspiration

One inspiration that immediately struck after seeing Mr. Baird's carefully laid out CAD representation is an easier way to achieve a gravity detector utilizing a stationary sensor. Figure 3 shows this idea of mine. Although it isn't proven yet, I'll work on it, and let you know the results.

Mass M1 is a concrete sphere held aloft by a 1/8" music wire 36" long. Since music wire is so stiff, yet flexible, it logically is the first choice, and the concrete ball was chosen because it's safe to cast into this shape rather than lead. Lead, while nice and "massy," is expensive in quantity and dangerous to handle by the untrained experimenter. Consider manipulating molten lead at 500 degrees or so; that is rather risky.

A laser is split by a beamsplitter, like in the previous figure, and shined onto a mirror glued to the concrete sphere. As mass M2 approaches the sensing mass M1, M1 will attract towards the approaching mass to be measured. In doing so, it will slightly bend the strong, but flexible music wire. That bending will then displace the laser beam by several wavelengths, and the bending will be dynamically sensed when the beams are re-combined at a detector as shown in the figure.

SOURCES

Anderson Lasers, Inc., 2883 West Royalton Road, Broadview Heights, OH 44147. New and surplus industrial and scientific lasers & equipment. Carries high-power commercial grade equipment, not a hobbyist supplier. Professional inquiries contact: Richard Anderson, ph: (216) 237-6629, FAX: (216) 237-0656.

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LNS Technologies, 20993 Foothill Blvd., Suite 307, Hayward, CA 94541. Inquiries: (510) 886-9296, orders: (800) 886-7150. Visible laser diodes and a driver kit, also carries a line of high-technology electronic kits. Accepts major credit cards. Catalog $1.00.

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Images Company, P.O. Box 140742, Dept. N, Staten Island, NY 10314; ph: (718) 698-8305. Carries holography supplies, optical components, components for laser power supplies, stepper motors.

Geo-Monitor, 65 Washington Street #400, Santa Clara, CA 95050; ph: (408) 749-6770, FAX: (408) 249-3780. Publishes a technical newsletter about earth science, and may be useful to those interested in using lasers to record seismic activity.

Edmund Scientific Company, 101 East Gloucester Pike, Barrington, NJ 00807-1380; ph: (609) 573-6250, FAX: (609) 573-6295. Free catalog. Supplier of a wide variety of educational and scientific equipment including lasers and an extremely comprehensive line of optics.

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Michael E. Keller is seeking an inexpensive diode laser for "scribing and marking materials. Writing to paper, or other soft materials like wood (and possibly plastic) are ideal. I don't need the capability of marking metal or ceramics at this time." Any information or lists of devices for sale that would be helpful to Michael can be sent to the Helpline, which will forward all material to him.

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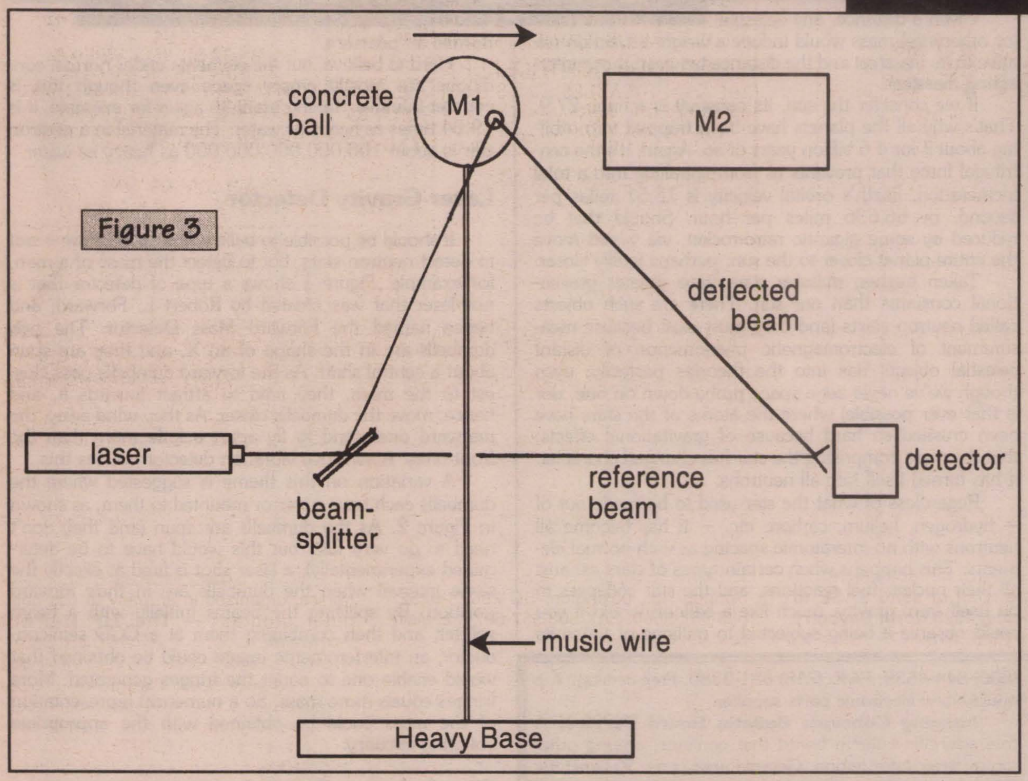

Figure 3

The set-up must be extremely stable, and that is the primary drawback of any such light-based sensing system. Vibration, changes in temperature, even sound-waves present in the experimental area will affect the results.

So, the prime focus is to reduce these effects, and that will be documented next month.

Next Month

We'll be taking a look at gravity waves which are theoretical phenomena associated with cataclysmic celestial events. Ultimately, they supposedly can be seen by a sensitive enough laser detector. And we'll discuss one possible means for their detection by the scientific community.

Plus, we'll let you know how our gravity detector inspiration worked out in the lab — if it did work! (Remember this is a theoretical experiment!)

We'll also be taking a look at the basics of laser video transmission, which is NOT an experiment, and get into building an actual project involving the same over the next few articles. **NV**

CLOSING QUOTE:
"It (space travel) will free man from his remaining chains, the chains of gravity which still tie him to this planet. It will open to him the gates of heaven."

Anthony Charlton is an active electronics and science "do-it-yourself" project designer, does custom R & D, and writes technical articles. Previous work experiences include design of hardware & software for microprocessor-based process control systems and electronic design. His hobbies include lasers, gardening, target shooting, and model rocketry.

The Laser Experimenter is a reader-interactive column. We like to hear from the reader, and in many cases the best projects have come directly from your suggestions. If there is some particular facet of laser science that interests you, we would welcome hearing from you at: The Laser Experimenter, P.O. Box 74, Cornwall Bridge, CT 06754. Questions, comments, suggestions, and material relating to lasers are all welcome. We would like to publish letters in Reader Feedback occasionally. Indicate whether using your name and address is okay. We can now respond to your letters personally on an "as time permits" basis. Your FAX number, which will be kept confidential, will speed replies.

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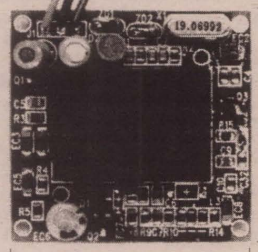

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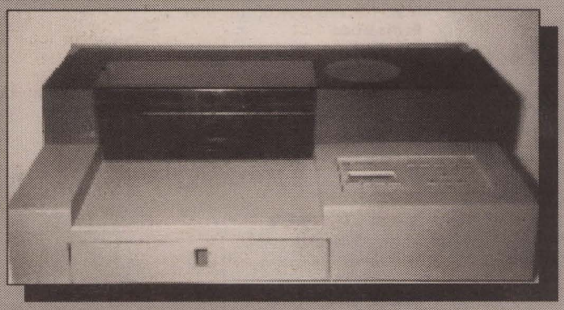

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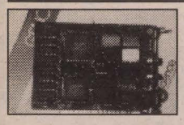

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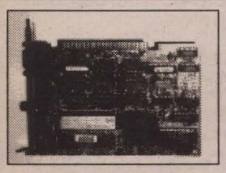

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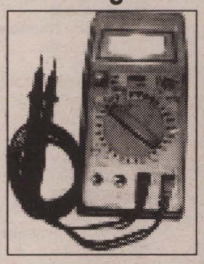

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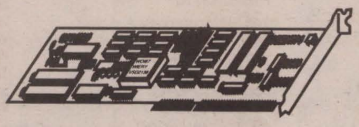

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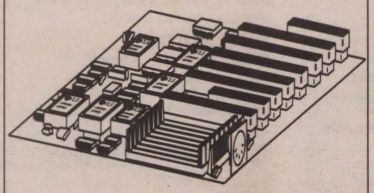

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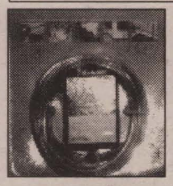

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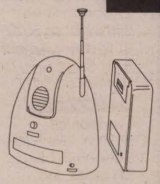

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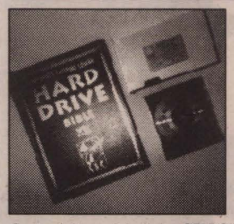

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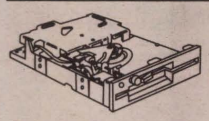

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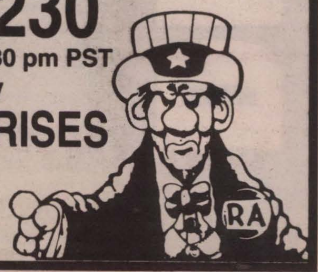

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Continued from page 125

actual power output around a quarter or less of your estimate.

My recommendation is to experiment with broadband amplifiers available through Mini-Circuits, 718-934-4500. You can use a $3.00 MAV-11 for about 11 dB of gain, however, this will require a few blocking capacitors and a resistor on the input power. For simplicity, you can purchase a NAM-1HLNe which is a totally self-contained amplifier, with a cost around $20.00. You need to cut the antenna trace on your transmitter board and match it via small inductor. Use a variable inductor around 10 nH tied to the input of the Mini-Circuits amplifier. Based on your 310 frequency, use a 9-inch length of insulated solid #22 gauge wire as an antenna tied directly to the RF output pin of the added amplifier. Hopefully, the eight-position code setting DIP switch will not be set the same as any of your neighbors on the block!

Laurie Valencic
Lake Forest, CA

ANSWER TO #89514 - AUGUST 1995

There are several ways to create playback of recorded voices similar to the Yak Back box. Below is a partial list of ways to do this.

1. Buy a digital recording module from Radio Shack. This module will record messages/sounds up to 10 seconds in length. It costs $18.99 per unit and is part number 276-1324.

2. If you are good at building circuits you can buy an IC from Radio Shack that can record several messages up to a total message length of 20 seconds per IC. The ICs can be cascaded for longer lengths. These chips are $17.99 each and are part number 276-1325.

3. Still another choice is to get digital voice key chains or so-called voice memos. These are the size of a car alarm activator and can be opened and the module removed from them. These sell for about $9.95 each and can be found from various mail order houses.

4. By far the best place to go is to the local Hallmark Greeting card store. Hallmark sells a card that will allow you to record a message up to 10 seconds long (like the RS module), but comes with microphone, speaker, and batteries. It sells for $6.95. If you are resourceful, you can find coupons to get two greeting cards for the price one (how I buy mine).

Of all the options listed above, the Hallmark greeting card is the best value. These are being used for all sorts of things from voice headlight reminders, ham radio repeater IDers, telephone ringers, and door "bells" just to name a few.

The best thing about the above listed devices is the fact that they can store the message without the batteries attached for about 100 years.

One thing one must not do is exceed the voltage rating. If you decide to used one of the Hallmark cards NO NOT exceed 6.5 volts. If you are going to use a nine-volt battery, be sure to use a voltage regulator.

DO NOT connect multiple speaker outputs directly together to one speaker. If only one speaker and multiple modules are to be used, connect the output ground leads together from each module to one speaker terminal. Then connect a 33 ohm resistor in series with EACH module's output lead and other speaker terminal.

Time Naami
Cary, IL

ANSWER TO #89512 - AUGUST 1995

I have worked with the 8031/51 (8048) for the past 14 years, and have not run into a complete diagnostic routine, however, the only failure modes I have experienced are primarily I/O pin failure, onboard crystal driver instability, and external EPROM/ RAM failures. IO and xtal failures are next to impossible to detect on board and the standard way to check the rest is checksum the EPROM and compare, write and read the internal and external RAM to check for data loss and or replication. If you really wanted to check instructions, timers, etc., I believe you would have to write it.

Breck Ricketts
Lenexa, KS

ANSWER TO #8959 - AUGUST 1995

The NMB ICs marked AAA2801-P-07, 8832 are 256 K x1 DRAMs, in a PLASTIC Dual Inline Package. They were made in Japan during the 33rd week of 1988. They have a 70 nsec access time. They are probably from a PC of 80286 late 1980s vintage.

Since the demand for DRAMs at this density have dropped off in the last several years, NMB is no longer selling and supporting these parts. So, if you request a data sheet, they will turn you away! The big business today is in 4M and 16M density DRAMs, built on .8 and .5 micron CMOS processes. Economics have forced most IC manufacturers to discontinue the 64 K, 256 K and 1M density products. Such is life in the IC business!

Robert Kelly
Poway, CA

ANSWER TO #79534 - JULY 1995

Wyse VY1000 monitor was manufactured by Moniterm in Minnetonka, MN 55343. It is the same monitor as the one used by Sun Microsystems, and surplus units are widely available for $20.00 to $200.00, many in working condition. This monitor uses TTL sync, and ECL video. It is easy to construct a level translator and use this monitor as a 1280 x 1024, 64 KHz display with various VGA cards. Screen is more legible than $1K color monitors, and if you write code, who needs color. Thses monitors are vary modular, and can be repaired without a

Continued on page 140

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Stamp Applications:

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

by Scott Edwards

Encoding and decoding DTMF tones — those musical "touch tones" you hear when you dial the phone — is the current fad in electronics projects. There are gadgets that capture and display or store dialed digits, others that dial stored numbers, and still others that use the hardy dual-tone, multi-frequency digits for data transmission or remote control.

DTMF "Touch" Tones are Music to the Ears of this Stamp Transmit/Receive Circuit

Stamp users are an independent lot, so we're going to buck the trend of one-trick DTMF projects. In this edition of Stamp Applications, we'll look at a universal DTMF send/receive solution that can serve as the basis for decoders, loggers, dialers, and even data transceivers.

A Quick Review of DTMF Principles

All the recent excitement over the decades-old DTMF signaling method makes the first part of my job easy. I can breeze through the explanation of the signals themselves with confidence that the curious reader who wants more background can find it in his or her recent-magazine stack, for example, "DTMF IR Remote Control System," *Nuts & Volts* June '95.

A DTMF signal consists of a mixture of two sinewave tones, often called the *row* and *column* frequencies because of their correspondence to the layout of the phone keypad (Figure 1). Engineers at then-mighty Ma Bell chose these tones carefully to ensure that none had a harmonic relationship with the others, and that mixing the frequencies would not produce sum or product frequencies that could mimic another valid tone. They specified that the tones be free of distortion, and that the high-group frequencies (the column tones) be slightly louder than the low-group to compensate for the high-frequency roll-off of voice audio systems.

Because DTMF was devised in the days before you could hear a pin drop or appreciate Whitney Houston's singing over long distance, it's an exceptionally noise-resistant signaling method. If a properly designed DTMF decoder thinks there's a valid DTMF signal present in some lousy audio, there almost surely is.

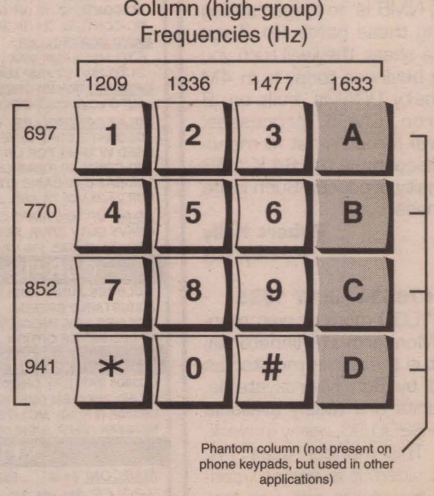
DTMF tones can represent one of 16 different states or symbols, as shown in Figure 1. That is equivalent to four bits of data, also known as a nibble. Most DTMF decoders can process at least 10 tones per second under the worst of conditions, so DTMF can easily convey 40 bits (5 bytes) of data per second. That's nowhere near the performance of a good communications modem, which can operate nearly 600 times as fast (28,800 bits per second), but it's a lot more robust under noisy line conditions.

Note that the numbers and symbols on the phone keypad don't always match the binary values of the DTMF nibbles. Most notably, the "0" on the keypad is represented in DTMF by a value of 10 (decimal) or 1010 binary. Table 1 summarizes the rest of the four-bit values.

Table 1. DTMF Values Keypad Symbols

Binary Value	Decimal Value	Keypad Symbol
0000	0	D
0010	2	2
0011	3	3
0100	4	4
0101	5	5
0110	6	6
0111	7	7
1000	8	8
1001	9	9
1010	10	0
1011	11	*
1100	12	#
1101	13	A
1110	14	B
1111	15	C

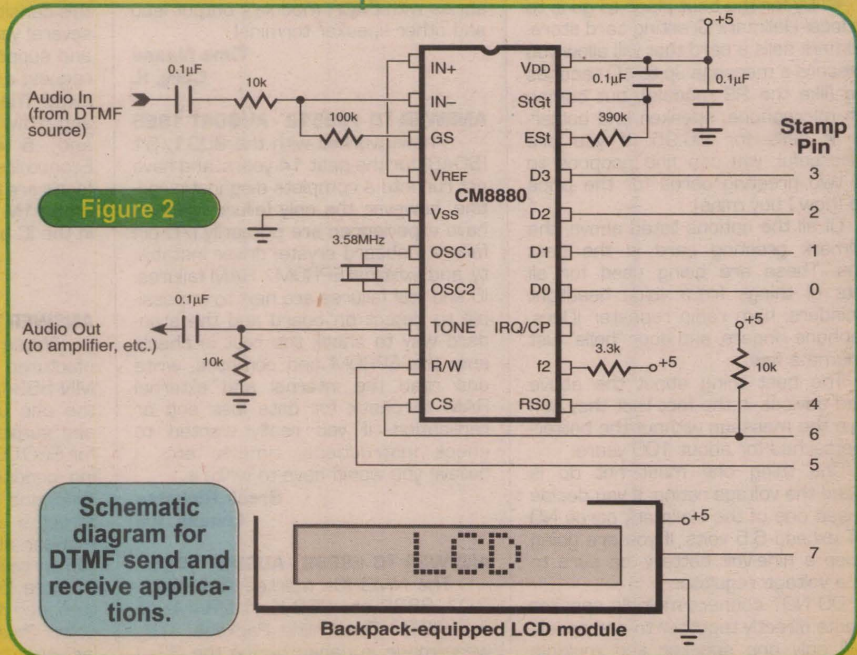
Figure 1



DTMF tones correspond to standard keypad positions. Note the "phantom column" of tones not used in consumer phone gear.

The DTMF tone that's generated when you press a button on the phone keypad consists of a mixture of the row and column frequencies. For example, pressing 9 mixes a column frequency of 1477 Hz with a row frequency of 852 Hz.

Figure 2



Schematic diagram for DTMF send and receive applications.

A DTMF Transceiver: The CM8880

All you need to generate DTMF tones are two precise, low-distortion sinewave oscillators and a mixer. To decode DTMF takes just eight tone decoders and a little glue logic. The circuit board to accommodate all this stuff shouldn't be much more than 4" x 6" and $50.00.

Don't like those numbers? Then you will like the California Micro Devices CM8880 Integrated DTMF Transceiver. For $10.00, or less in single quantity, this chip does everything associated with sending and receiving DTMF tones. The schematic in Figure 2 shows a Stamp hook-up for both send and receive applications. Listing 1 demonstrates DTMF dialing. Listing 2 shows DTMF reception and display.

Rather than rehash the comments from the program listings, I'd like to show you how to set up and use the CM8880 in your own applications.

Listing 2. DTMF Decoder and Display

```
' Program: DTMF_RCV.BAS (Receives and displays DTMF tones using the 8880)
' This program demonstrates how to use the 8880 as a DTMF decoder. As
' each new DTMF digit is received, it is displayed on an LCD Serial
' Backpack screen. If no tones are received within a period of time
' set by sp_time, the program prints a space (or other selected character)
' to the LCD to record the delay. When the display reaches the righthand
' edge of the screen, it clears the LCD and starts over at the left edge.

SYMBOL      RS_p = 4            ' Register-select pin (0=data).
SYMBOL      RW_p = 5            ' Read/Write pin (0=write).
SYMBOL      CS_p = 6            ' Chip-select pin (0=active).
SYMBOL      dtmf = b2           ' Received DTMF digit.
SYMBOL      dt_Flag = bit0      ' DTMF-received flag.
SYMBOL      home_Flag = bit1    ' Flag: 0 = cursor at left edge of LCD.
SYMBOL      polls = w2          ' Number of unsuccessful polls of DTMF.
SYMBOL      LCDw = 16           ' Width of LCD screen.
SYMBOL      LCDcol = b3         ' Current column of LCD screen for wrap.
SYMBOL      LCDcls = 1          ' LCD clear-screen command.
SYMBOL      I = 254             ' LCD instruction toggle.
SYMBOL      sp_time = 1000      ' Print space this # of polls w/o DTMF.

' This code initializes the 8880 for receiving by writing to its
' internal control registers CRA and CRB. The write occurs when
' CS (pin 6) is taken low, then returned high.

let pins = %01111111            ' Pin 7 (LCD) low, pins 0 through 6 high.
let dirs = %11111111            ' Set up to write to 8880 (all outputs).
let pins = %00011000            ' Set up register A, next write to register B.
high CS_p
let pins = %00010000            ' Clear register B.
high CS_p
let dirs = %11110000            ' Now make set the four-bit bus to input.
high RW_p                       ' And set RW to "read."
serout 7,n2400,(I,LCDcls,I)     ' Clear the LCD screen.

' In the loop below, the program checks the 8880's status register
' to determine whether a DTMF tone has been received (indicated by
' a '1' in bit 2). If no tone, the program loops back and checks
' again. If a tone is present, the program switches from status to
' data (RS low) and gets the value (0-15) of the tone. This
' automatically resets the 8880's status flag.
again:
  high RS_p                     ' Read status register.
  low CS_p                      ' Activate the 8880.
  let dt_flag = pin2            ' Store status bit 2 into flag.
  high CS_p                     ' End the read.
if dt_Flag = 1 then skip1       ' If tone detected, continue.
let polls = polls+1             ' Another poll without DTMF tone.
if polls < sp_time then again   ' If not time to print a space, poll again.
if LCDcol = LCDw then skip2     ' Don't erase the screen to print spaces.
let dtmf = 16                   ' Tell display routine to print a space.
gosub Display                   ' Print space to LCD.
skip2:
let polls = 0                   ' Clear the counter.
goto again                      ' Poll some more.
skip1:                          ' Tone detected.
let polls = 0                   ' Clear the poll counter.
low RS_p                        ' Get the DTMF data.
low CS_p                        ' Activate 8880.
let dtmf = pins & %00001111     ' Strip off upper four bits using AND.
high CS_p                       ' Deactivate 8880.
gosub display                   ' Display the data.
goto again                      ' Do it all again.
Display:
if LCDcol < LCDw then skip3     ' If not at end of LCD, don't clear screen.
serout 7,n2400,(I,LCDcls,I)     ' Clear the LCD screen.
let LCDcol = 0                  ' And reset the column counter.
skip3:                          ' Look up the symbol for the digit.
if LCDcol=0 AND dtmf=16 then ret ' No spaces at first column.
lookup dtmf,("D1234567890*#ABC-"),dtmf
serout 7,n2400,(dtmf)           ' Write it to the Backpack display.
let LCDcol = LCDcol + 1         ' Increment the column counter.
ret:
 return
```

Communication with the 8880 takes place over a four-bit bus, consisting of D0 through D3, with three additional bits selecting modes of operation. Those bits are chip select (CS), read/write (RW) and register select (RS0). Table 2 summarizes the effects of all combinations of CS, RW, and RS0.

To sum up the table, the 8880 is active only when CS is 0. The RW bit determines the data direction; 1 = read (data from 8880 to Stamp) and 0 = write (data from Stamp to 8880). The RS bit determines whether the transaction involves data (DTMF tones) or internal CM8880 functions (instructions or status); 1 = instructions/status and 0 = data.

Once the CM8880 is set up, the Stamp writes 000 to CS, RW, and RS0 to send DTMF; or 010 to read DTMF. Simple as that.

Setting up the CM8880

Before you can use the CM8880, you have to set it up. The device has two control registers: A and B. When you put 001 in bits CS, RW, and RS0, the data on D0 through D3 is written to control register A (CRA). Table 3 summarizes the functions of the four bits of CRA.

Looking at Listing 1 — the dialer — we see that 1011 was written to CRA. That works out to (right to left) 1 (tone generator on), 1 (Send DTMF, long tones), 0 (don't generate interrupts), and 1 (next write to CRB). Listing 2 writes 1000 to CRA: 0 (tone-generator off); 0 (receive DTMF); 0 (don't generate interrupts); and 1 (next write to CRB).

Although we don't use it in our applications, the 8880 has a call-progress detection feature, which can be enabled via bit 1 of CRA. Call-progress is a collective term for the dial tone, busy signal, and ringing signal. These tones are all around 400 Hz. The CM8880's call-progress filter accepts audio from the normal input and passes frequencies from 300 to 500 Hz to the IRQ/CP pin. You could add hardware to further filter and detect these tones.

Since both listings also set up register B (CRB), take a look at Table 4 to see how it works.

Listing 1 (dialer) writes 0s to all bits of CRB, meaning burst mode, normal operation, real DTMF, and (if DTMF weren't selected) row tones. Listing 2 (decoder) also clears CRB. Although CRB has little or nothing to do with DTMF reception, it's wise to always initialize it to a known state.

A Few Hardware Notes

To hear the DTMF tones generated by the CM8880, I connected a small speaker/amplifier (Radio Shack part no. 277-1008C) to the audio output. The amplifier's high gain and the 8880's healthy audio output quickly taught me to set the volume control low! I was able to dial the phone by holding the speaker close to the mouthpiece.

I used two approaches to generate DTMF test tones for the decoder application. The first was to connect an old touch-tone phone to a nine-volt battery and the audio-input coupling capacitor (0.1µF shown in Figure 2) to the positive terminal. The polarity of the connection didn't matter, as phones are designed to tolerate wiring mixups. However, this set-up sucked better than 50 mA from the battery.

I found a better DTMF generator at one of my

Table 2. Effects of the CS, RW, and RS0 Bits

CS	RW	RS0	Description
0	0	0	Active: write data (i.e., send DTMF)
0	0	1	Active: write instructions to 8880
0	1	0	Active: read data (i.e., receive DTMF)
0	1	1	Active: read status from 8880
1	0	0	Inactive
1	0	1	Inactive
1	1	0	Inactive
1	1	1	Inactive

favorite surplus dealers. Marlin P. Jones and Associates (MPJA) has a bunch of dialers that were apparently made for one of those early flash-in-the-pan long-distance services. It's preprogrammed to autodial an access number. If you press the manual-dial button (MAN'L) on the keypad, it works like a normal DTMF keypad. Output is through a headphone speaker built into the case.

MPJA also stocks a couple of other essentials for this circuit. The decoder application uses an LCD equipped with one of my LCD Serial Backpacks. This allows the Stamp to display data on it using a convenient one-wire serial connection. MPJA stocks both the Backpack and a range of LCDs from one-line by 16 characters to 2 x 40. See Sources for more information.

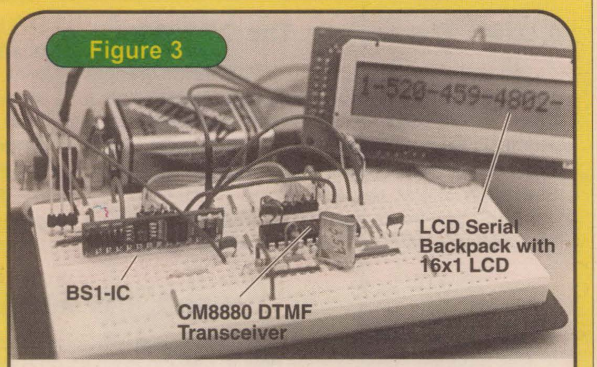


Figure 3

DTMF send/receive breadboard

DTMF and a Glass of Red . . .

It's almost embarrassing to admit that that's all there is to designing DTMF send/receive applications based on the CM8880 and the Stamp. I deliberately skirted issues having to do with direct connection to the phone line, since that's a subject worthy of two (or three!) articles of this size. Your best bet is to see how others have done it successfully, or to purchase a commercially made Data Access Arrangement (DAA) to serve as an interface. One manufacturer of DAAs is Cermetek, Sunnyvale, CA, (408) 752-5000.

Don't limit yourself to phone applications. Remember what I said about DTMF serving as a reliable data-transfer method? You could connect CM8880-equipped Stamps to inexpensive two-way radios to create a wireless network for data acquisition over a 1/4-mile radius.

I experimented briefly with this idea, using the DTMF output from the amplified speaker to trigger the voice-activated transmit feature of a Radio Shack headset walkie-talkie (part no 21-

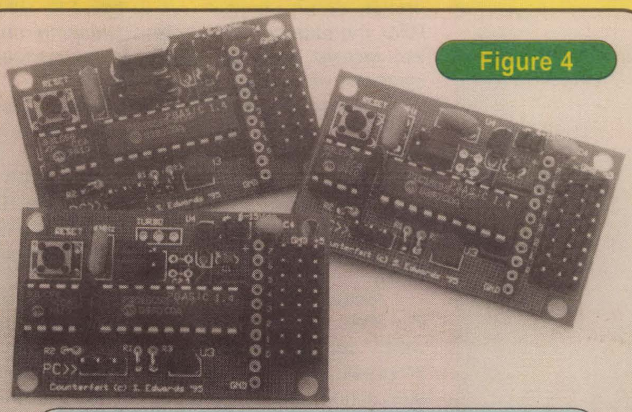


Figure 4

A trio of STAMP-compatible counterfeit controllers with quad-speed (top), double-speed (right0, and normal-speed options.

Table 3. Functions of Control Register A

Bit	Name	Function
0	Tone Out	0 = tone generator disabled 1 = tone generator enabled
1	Mode Control	0 = Send and receive DTMF 1 = Send DTMF, receive call-progress tones (DTMF bursts lengthened to 104 ms)
2	Interrupt Enable	0 = Make controller check for DTMF rec'd 1 = Interrupt controller via pin 13 when DTMF rec'd
3	Register Select	0 = Next instruction write goes to CRA 1 = Next instruction write goes to CRB

Table 4. Functions of Control Register B

Bit	Name	Function
0	Burst	0 = Output DTMF bursts of 52 or 104 ms 1 = Output DTMF as long as enabled
1	Test	0 = Normal operating mode 1 = Present test timing bit on pin 13
2	Single/ Dual	0 = Output dual (real DTMF) tones 1 = Output separate row or column tones
3	Column/ Row	0 = If above = 1, select row tone 1 = If above = 1, select column tone

Listing 1. Stamp-Based Autodialer

```
' Program: DIAL.SRC (Sends a string of DTMF tones via the 8880)
' This program demonstrates how to use the CM8880 as a DTMF tone
' generator. All that's required is to initialize the 8880 properly,
' then write the number of the desired DTMF tone to the 8880's
' 4-bit bus.

' The symbols below are the pin numbers to which the 8880's
' control inputs are connected, and one variable used to read
' digits out of a lookup table.

SYMBOL      RS_p = 4          ' Register-select pin (0 = data).
SYMBOL      RW_p = 5          ' Read/Write pin (0 = write).
SYMBOL      CS_p = 6          ' Chip-select pin (0 = active).
SYMBOL      digit = b2        ' Index of digits to dial.

' This code initializes the 8880 for dialing by writing to its
' internal control registers CRA and CRB. The write occurs when
' CS (pin 6) is taken low, then returned high. See the accompanying
' article for an explanation of the 8880's registers.

let pins = 255            ' All pins high to deselect 8880.
let dirs = 255            ' Set up to write to 8880 (all outputs).
let pins = %00011011      ' Set up  register A, next write to register B.
high CS_p
let pins = %00010000      ' Clear register B; ready to send DTMF.
high CS_p

' This for/next loop dials the seven digits of my fax number. For
' simplicity, it writes the digit to be dialed directly to the output
' pins. Since valid digits are between 0 and 15, this also takes RS,
' RW, and CS low — perfect for writing data to the 8880. To complete
' the write, the CS line is returned high. The initialization above
' sets the 8880 for tone bursts of 200 ms duration, so we pause
' 250 ms between digits. Note: in the DTMF code as used by the phone
' system, zero is represented by ten (1010 binary) not 0. That's why
' the phone number 459-0623 is coded 4,5,9,10,6,2,3.

for digit = 0 to 6
  lookup digit,(4,5,9,10,6,2,3),pins      ' Write current digit to pins.
  high CS_p                               ' Done with write.
  pause 250                               ' Wait to dial next digit.
next digit
 end
```

406). The voice activation was fast enough that even the first tone got through. This means that you wouldn't need an additional pin to switch between transmit and receive.

This is an application that a lot of Stamp users have been clamoring for. I remember in particular that grape growers need to gather and evaluate "micro-climate" data regarding temperature and humidity among their pampered vines, and would kill for a wireless way to obtain it. Here it is: Cheers. (And I prefer red, if you please, a Cabernet Sauvignon or Merlot.)

Return of the Counterfeit

Many of you have called my order line to purchase BASIC Stamps. It's a natural assumption: I'm cheerleading for a great product — I've got to *carry* that product, right?

Unfortunately, I don't. However, the manufacturer (Parallax) makes PBASIC chips available to those who want to build their own controllers based on Stamp technology. I showed how to do just that in my "Counterfeit Stamp" article last spring *(Nuts & Volts*, May '94).

In response to many requests, I'm making the Counterfeit available again as a complete kit for $29.00. The design incorporates features I have found handy in developing applications you've seen here: heavy-duty (100+ mA) voltage regulator; socket for pull-up/pull-down resistors; ground and +5V connections paired with every I/O pin; and turbo options for running the Counterfeit at 8 or 16 MHz — two to four times standard speed. The board is compact, but easy to assemble; see the photo (Figure 4).

I have also put together a Counterfeit Development System for $69.00. This includes everything required to program Counterfeits (or BS1 Stamps, for that matter), including your first Counterfeit kit. See the Sources listing for further information. NV

Sources

For more information on the BASIC Stamp, contact:

Parallax Inc.
3805 Atherton Road #102
Rocklin, CA 95765
Phone (916) 624-8333
Fax (916) 624-8003
BBS (916) 624-7101
E-Mail info@parallaxinc.com

The CM8880 is available from electronics distributors who carry **California Micro Devices**' product line (CMD phone, **602-961-6000**), or from Scott Edwards Electronics *(see listing below)*.

The DTMF box (part no. 5824-EN, $4.95), LCD Serial Backpack (7074-SE, $29.00), and a variety of LCD displays are available from:

Marlin P. Jones and Associates
P.O. Box 12685
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Phone (407) 848-8236
Fax (407) 844-8764

Scott Edwards Electronics:
Questions, suggestions, or requests for future Stamp Applications to:

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Sierra Vista, AZ 85635
Phone (520) 459-4802
Fax (520) 459-0623
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Internet: 72037,2612@compuserve.com

Scott also offers the following Stamp-related kit goodies: The CM8880 is $10.00; an App Kit containing one CM8880, the Stamp programs shown here (plus PIC assembly language versions) on disk, and complete documentation is $22.00.

The Counterfeit controller, a kit alternative to the BASIC Stamp, is $29.00. Double- and quad-speed options are $2.00 and $4.00, respectively. The Counterfeit Development System, required to program Counterfeits (also for programming original BASIC Stamps, like the BS1-IC) is $69.00 and includes 150-page manual, downloading cable kit, Parallax software, and one Counterfeit controller kit.

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TECH FORUM

Continued from page 135

schematic by swapping module assemblies between monitors.

Jan Zaluda
Mountain View, CA

ANSWER TO #79511 - JULY 1995

PIC Microcontroller Guru and monthly *Nuts & Volts* contributer, Scott Edwards, provided the basis for a solution to your question of interfacing eight thermocouples to a Basic Stamp microcontroller. In his July '95 "Stamp Applications" column, Scott discussed how an inexpensive, 4051 multiplexer could be used to read eight "pots." While thermocouples provide a voltage output related to temperature, thermistors provide a precise resistance change with temperature. Thermistors are essentially variable pots thus their resistance change can be fed directly into the Stamp microcontroller to provide inexpensive, simple, yet accurate temperature monitoring. Based on my experience, I would recommend using thermistors rather than thermocouples. The data can be stored in the EEPROM or displayed on Scott's LCD backpack. We have written a program in Visual Basic that permits us to obtain temperature data and present it in a wide variety of tabular and graphical formats.

We used such a system of multiplexed thermocouples and thermistors years ago to evaluate the disc brake system on several Gran Prix race cars. The multiplexed temperature sensors provided a simple way to obtain disc brake pad and rotor temperatures and correlate them with brake fad. Monitoring with such simple, inexpensive devices confirmed our need to use vented rotors to optimize heat dissipation and insure effective braking during demanding race conditions. In part, this thermocouple monitoring effort contributed to a first place finish at LeMans. Hopefully, your application will be as rewarding!

J. Valencia
Mission Viejo, CA

ANSWER TO #89513 - August 1995

The Ramsey Electronics scrambler/descrambler kit #SS-70 you've built is an interesting unit. Ramsey provided me with one several months ago for use in a future article. Based on my experience with the device, let's see if we can explain the trouble you are having properly descrambling the audio from one of your cordless phones.

The first thing to understand is that the Ramsey kit uses the MX118 full-duplex frequency inversion scrambler chip from MX Comm, Inc. This chip uses a standard frequency inversion scheme to literally turn the audio upside down. Low frequency content becomes high frequency and vise versa. The chip outputs what amounts to a mirror image of the spectral content within the range of frequencies handled by the chip, and this is where your problem occurs.

A key factor in frequency inversion scrambling is known as the "hinge point" and relates to the frequency upon which the inversion is centered. The "robotic" sound you mention is the result of mis-matched inversion hinge points between the phone scrambler and the MX118 IC in the Ramsey kit. Such symptoms can also result in sounds similar to listening to a mistuned single-sideband transmission, in which vocal frequencies are pitched up either too high or low.

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TECH FORUM

the MX118 will demonstrate why it might be difficult to effectively alter the inversion frequency. A 4.433619 MHz crystal is used as a timing reference by the chip to generate a 3.3 KHz audio frequency carrier. The carrier frequency minus the voice frequency energy equals the scrambled frequency (or descrambled frequency in this case).

Normally, one could just adjust the carrier frequency of the descrambler until it matched the carrier frequency of the scrambler to make the audio sound normal. With the MX118 chip, you'd have to replace the crystal used for a timing reference to alter the carrier frequency, but you'd be altering several other parameters, as well. The chip also uses the clock signals to set the frequency of the 10th order low-pass filter on the input of the device at 3.1 KHz, and the 14th order band-pass filter on the output (from 300-3000 Hz).

The problem is that all these internal functions are based on the single crystal. If one had a clock generator, it could be coupled to pin 16 of the chip and the frequency varied to test different results. The problems you might encounter would involve the values of the audio filters changing, as well. The worst scenario would be the band-pass filter not properly tracking the injected carrier frequency and allowing it to pass along with the desired audio.

Damien Thorn
Stockton, CA

ANSWER 1 TO #89511 - AUG. 1995

Here's the straight scoop on Mac vs. IBM-compatible PCs: The future is the PC. While PC and Mac software prices are comparable, 90% of the software available is for the PC. An equivalent Mac is more expensive than a PC, but if you are able to qualify for Apple's Education Discount the price playing field is level.

If you decide Mac, you must buy one based on the PowerPC chip — a PowerMac. Apple's new operating System 8.0 (aka Copeland) may not support the old 68040-based systems. Also important is the presence of PCI (Peripheral Component Interconnect) slots. Apple is phasing out its older NuBus slots in favor of PCI slots. These slots allow you to buy expansion cards from mainstream hardware vendors. Look for features similar to the ones listed in the PC section below.

If you decide PC, an ideal system is a Pentium 75 with the following features: 8 megabytes of RAM, a hard drive in the 750 megabyte to 1 gigabyte range, a quad-speed CD-ROM, a 16-bit sound card, a PCI graphics card able to display at least 256 colors in 800 by 600 mode, 2-4 PCI slots, a Plug-n-Play Flash BIOS, and Windows 95 pre-installed. Steer towards systems that include an 'application suite' such as Microsoft Office or Lotus SmartSuite. Try for a one to three year warranty. Also, look for the label "MPC 3" that will be appearing soon. This will ensure that your new computer complies with the "Multimedia PC — Version 3" standard and is adequate for today's demanding applications and games.

As for your second question: For hard drive recovery, the Norton Utilities from Symantec should get you started.

J.Q. LaVielle

ANSWER 2 TO #89511 - AUG. 1995

Comparing Apple to IBM is like asking which religion is better; but I'll put my two cents in. I am an engineer who has been an Apple Macintosh owner since 1985. I can't imagine using any other system on a regular basis, even though I have both a Mac and an IBM on my desk at work. The Macintosh OS is still the yardstick by which other OSs are measured. (The biggest compliment you can give to Windows '95 is that it is more Mac-like than ever!) Macintoshes are substantially easier to configure and maintain than MS-DOS or Windows machines. If your students are looking to buy computers, the Mac is a good choice because of Apple's traditionally strong presence in the educational market. As far as software goes, there are very few program catagories that are available on PCs that are not available on the Mac. In the rare case where I need to run PC software at home, I run it on SoftWindows, an emulator which runs on the Mac. If you enjoy spending time flipping DIP switches and calling tech support, then a PC is a great machine, and will give you something to do with your time. If you want to get some work done, or surf the Net, or play a game, get a Macintosh.

Robert Zusman
E-Mail: rzusman@amug.org

Events CALENDAR

Continued from page 51

land, off I-275 @ Exit 54. **HOURS:** 8am-5pm. **ADMISSION:** Adv: $6, Door: $8, under 12 free. **TALK-IN:** 145.19. **FEATURES:** C - CB - DP - EX - F - FM - FP - F/R - H. **CONTACT:** John WA8STX, 513-563-7373, VE exams: 513-574-1653.

SEPTEMBER 22

OH - CLEVELAND — Computerama USA. **SPONSOR:** OMM Productions. **LOCATION:** Brook Park Armory, 6225 Engle Rd. **ADMISSION:** $5. **DEALER INFO:** Tables: $40. **CONTACT:** Computerama USA, POB 173, Bryn Mawr PA 19010-0173; 610-527-5903. E-Mail: 72172,3545@compuserve.com.

SEPTEMBER 23

OH - CINCINNATI — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Cincinnati Gardens. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

SEPTEMBER 23-24

IL - GRAYSLAKE — Radio Expo '95. **SPONSOR:** Chicago FM Club. **LOCATION:** Lake County Fairgrounds. **HOURS:** 8am-4pm. **ADMISSION:** Adv $5, Door $6, good both days, under 12 free. **TALK-IN:** 146.16/76 (PL 107.2). **FEATURES:** C - EX - F - FM - FP - F/R - H. **CONTACT:** Radio Expo, 312-262-6773. Chicago FM Club, POB 1532, Evanston IL 60204.

SEPTEMBER 24

IL - ORLAND PARK — The Orland Park Computer Show. **LOCATION:** Orland Park Civic Center, 147th St & LaGrange Rd (Rte 45). **HOURS:** 9:30am-3pm. **ADMISSION:** Adults $5 - $1 off with copy of this ad, 8-12 yrs $2, under 8 free. **FEATURES:** A - C - CB - DP - FP - F/R - All indoors. **CONTACT:** 24-hour Hotline 708-974-3123.

MI - SOUTHGATE — Computer Trade Show. **LOCATION:** Southgate Civic Center, 14700 Dix-Toledo Rd, between Northline & Eureka. **HOURS:** 10am-3pm. **ADMISSION:** Adults $4; Seniors & students w/ID $3; under 12 free w/adult. **FEATURES:** C - DP. **CONTACT:** Computers & You, 313-283-1754.

MO - COTTLEVILLE — Swapfest. **SPONSOR:** St. Peters ARC. **LOCATION:** St. Charles County Community College Campus, 4601 Mid Rivers Mall Dr, take I-70 or MO Rte 94. **HOURS:** 7am-1pm. **ADMISSION:** $2. **TALK-IN:** 145.41 & 442.275. **FEATURES:** EX - FM - F/R - H. **DEALER INFO:** Flea Market Space $3. **CONTACT:** Jay Underdown W0OGS, 58 Judy Dr, St Charles MO 63301.

OH - CLEVELAND — ARRL Hamfest. **SPONSOR:** Hamfest Assn of Cleveland. **CONTACT:** Glenn Williams AF8C, 513 Kenilworth Rd, Bay Village OH 44140-2476. 216-835-4897.

SEPTEMBER 29-30-OCTOBER 1

KS - WICHITA — ARRL State Convention. **CONTACT:** Len Warren N0QHZ, 6233 Millsboro St, Wichita KS 67219-1637. 316-744-1930.

SEPTEMBER 30

IN - PERU — North Central Indiana Hamfest. **SPONSOR:** Miami County & Cass County ARCs. **LOCATION:** Miami County Fairgrounds, on County Rd 200 North (CRZOON). **HOURS:** 8am-? **ADMISSION:** $5, ARRL Member $4, under 12 free. **TALK-IN:** 147.345 K9ZEV, 147.180 W9VMW. **FEATURES:** DP - H - T. **DEALER INFO:** 8' Indoor Table: $5, Tailgate Space: Free w/admission. **CONTACT:** North Central Indiana Hamfest, % CCARC, POB 1092, Logansport IN 46947.

IN - TERRE HAUTE — Wabash Valley Computer Fair. **LOCATION:** Vigo County Fairgrounds, 1 mi S of I-70 on US 41. **HOURS:** 10am-4pm. **ADMISSION:** $4. **FEATURES:** C - DP - E - FP - F/R. **DEALER INFO:** 8' table: $30. **CONTACT:** David Martin, 812-442-0110. WVCF, POB 165, Seelyville IN 47878-0615.

MI - LIVONIA — Computer Trade Show. **LOCATION:** Livonia Elks Lodge Hall, 31117 Plymouth Rd, 1 block E of Merriman. **HOURS:** 10am-3pm. **ADMISSION:** Adults $4; Seniors & students w/ID $3; under 12 free w/adult. **FEATURES:** C - DP. **CONTACT:** Computers & You, 313-283-1754.

MI - WESTLAND — Great Lakes Computer Expo & Sale. **SPONSOR:** Progressive Computer Productions. **LOCATION:** Wayne-Ford Civic League, 1645 Wayne Rd, 1 blk S of Ford Rd. **HOURS:** 10am-4pm. **ADMISSION:** Adults $4, Seniors/Students $3, under 12 free w/adult. **FEATURES:** C - DP - FP - F/R - S. **DEALER INFO:** Covered 8' table $35 ea. **CONTACT:** Progressive Computer Productions, 23814 Michigan Ave, Ste 237, Dearborn MI 48124. 313-425-9276.

OH - DAYTON — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Montgomery County Fairgrounds. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

OK - ALTUS — ARRL Hamfest. **SPONSOR:** Altus Area ARA. **CONTACT:** Charles W Barker KB5YWP, 101 Terrace, Hobart, OK 73651. 405-726-3623.

SEPTEMBER 30-OCTOBER 1

AR - FORT SMITH — ARRL Hamfest. **SPONSOR:** Fort Smith Area ARC. **CONTACT:** Jerry Richards, AB5SE, 4115 MacArthur Dr, Fort Smith, AR 72904. 501-783-0542.

OCTOBER 1

IN - HUNTINGTON — ARRL Hamfest. **SPONSOR:** Huntington County ARS. **CONTACT:** Ray Tackett KC9DZ, POB 284, Huntington, IN 46750. 219-786-0029.

MI - GRAND RAPIDS — Computer Trade Show. **LOCATION:** Holiday Inn Crown Plaza, 5700 28th St SE, E of I-96 Exit 43B. **HOURS:** 10am-4pm. **ADMISSION:** Adults $4; Seniors & students w/ID $3; under 12 free w/adult. **FEATURES:** C - DP. **CONTACT:** Computers & You, 313-283-1754.

MI - PORT HURON — ARRL Hamfest. **SPONSOR:** American Red Cross AR Service. **CONTACT:** Darryl Smith KA8UKO, 2817 16th Ave, Port Huron MI 48060. 810-987-3818.

MI - TROY — Computer Show. **LOCATION:** American Polish Cultural Center, 2975 E Maple Rd, NW corner of Dequindre Rd. **HOURS:** 10am-3pm. **ADMISSION:** Adults $4, students & seniors w/ID $3, under 12 free. **FEATURES:** C - DP. **CONTACT:** International Computer Trade Shows, 810-858-2416.

OH - ASHLAND — North Central Ohio Hamfest. **SPONSOR:** Ashland Area ARC. **LOCATION:** Ashland County Fairgrounds. **HOURS:** 8am-3pm. **ADMISSION:** Adv $3, Door $4, under 15 free. **TALK-IN:** 147.15+. **FEATURES:** DP - FM - H. **DEALER INFO:** Indoor tables: $7, Flea Market Space $3. **CONTACT:** Wally Green W3YXS, 3 East Liberty St., Ashland OH 44805. 419-281-3903.

OH - COLUMBUS — Computer Show & Sale.

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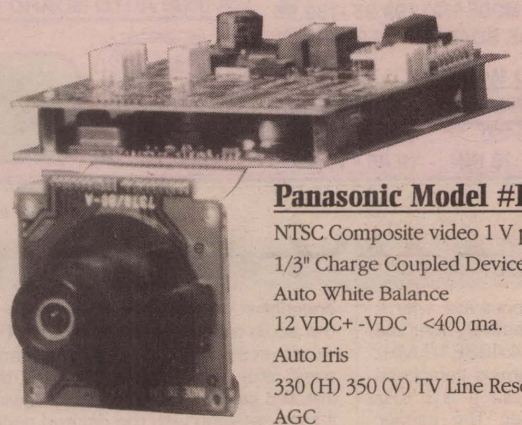

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Events CALENDAR

SPONSOR: MarketPro. **LOCATION:** Ohio Expositions Center. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

OH - LIMA — ARRL Hamfest. **SPONSOR:** Northwest Ohio ARC. **CONTACT:** Greg Schwark N8WBD, 600 Sunset Dr, Spencerville OH 45887. 419-647-6321.

OCTOBER 7

IN - INDIANAPOLIS — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Indianapolis State Fairgrounds. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

IN - INDIANAPOLIS — Indianapolis Computer Fair. **LOCATION:** Indianapolis Events Center, 3655 E Raymond @ Sherman, 5 mi E of downtown Indianapolis. **HOURS:** 10am-3pm. **ADMISSION:** $4, under 12 free. **FEATURES:** C - DP. **CONTACT:** Ben Yanto, AGI Computer Fairs.*

ND - GRAND FORKS — Hamfest/Computer Fair. **SPONSOR:** FORX ARC. **LOCATION:** University Lutheran Church, 2122 University Ave. **HOURS:** 7am-2pm. **ADMISSION:** $5. **TALK-IN:** 146.34/.94 WA0JXT. **FEATURES:** B - C - DP - EX - F - H. **DEALER INFO:** Flea Market Tables: Adv. $1, Door $5. **CONTACT:** Jeff Sorell N0PPW: 701-594-5013.

TX - BELTON — Ham Expo '95. **SPONSOR:** Temple ARC. **LOCATION:** Bell County Expo Center. **HOURS:** 7am-? **ADMISSION:** Free. **TALK-IN:** 146.82. **FEATURES:** AC - EX - H - T. **DEALER INFO:** Display Hall tables: $10, Indoor tailgate arena: $10. **CONTACT:** Temple ARC, 2014 S 53rd, Temple, TX 76504. Mike WA5EQQ: 817-773-3590.

OCTOBER 7-8

MI - DEARBORN — Vintage Radio Auction. **SPONSOR:** Estes Auctions. **LOCATION:** Henry Ford Museum, 20900 Oakwood Blvd. **HOURS:** Sat: 10am - 5pm, Sun: 10am?, preview Fri: 3pm-6pm, Sat & Sun: 8am-10am. **CONTACT:** Estes Auctions: 216-769-4992, 216-769-3987. Henry Ford Museum, 313-271-1620.

TX - EL PASO — 8th Annual International Hamfiesta. **SPONSOR:** Various Area ARCs. **LOCATION:** National Guard Armory. **HOURS:** Sat: 8am-5pm, Sun: 8am-2pm. **ADMISSION:** Adv $5, Door $6. **CONTACT:** Interntl Hamfiesta, POB 10496, El Paso TX 79995. Clay Emert K5TRW: 915-859-5502.

OCTOBER 8

IN - BEDFORD — Hoosier Hills Hamfest '95. **SPONSOR:** Hoosier Hills Ham Club. **LOCATION:** Lawrence County 4-H Fairgrounds, 4 mi SW of Bedford on US Hwy 50. **HOURS:** 6am-3pm. **ADMISSION:** $6. **TALK-IN:** 146.730. **FEATURES:** C - CB - DP - E - EX - F/R - H - RV-H. **CONTACT:** Larry Foster WB9DNB, 812-275-3688.

IN - SOUTHBEND — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** St. Joseph's Fairgrounds. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

MI - ANN ARBOR — Colossal Computer Sale. **SPONSOR:** Jewish Community Center. **LOCATION:** Washtenaw Community College, Morris Lawrence Bldg. **HOURS:** 9:30am-4pm. **CONTACT:** 313-971-0990.

MI - MADISON HEIGHTS — Computer Trade Show. **LOCATION:** UF&CW Hall, 876 Horace Brown Dr, 1 blk E of I-75, 1 blk S of 13 Mile Road. **HOURS:** 10am-4pm. **ADMISSION:** Adults $4; Seniors & students w/ID $3; under 12 free w/adult. **FEATURES:** C - DP. **CONTACT:** Computers & You, 313-283-1754.

OH - SPRINGFIELD — Hamfest & Computer Show. **SPONSOR:** Springfield Independent Radio Assn. **LOCATION:** Clark County Fairgrounds. **HOURS:** 8am-3pm. **ADMISSION:** Adv $4, Door $5, under 12 free. **TALK-IN:** 145.45. **FEATURES:** C - FP - F/R - H. **DEALER INFO:** Tables: Adv. $10, door $12. Set-up Sat. 6pm. **CONTACT:** Sales: 513-323-6680 days, General: 513-964-8618. SIRA, POB 523, Springfield OH 45501.

OCTOBER 14

MI - ALPENA — Hamfest & Computer Fair. **SPONSOR:** TBARC. **LOCATION:** Hinks Elementary School. **HOURS:** 8am-3pm. **ADMISSION:** Adv $3, Door: $4, under 12 free. **TALK-IN:** 146.76. **FEATURES:** C - DP - E - EX - FP - F/R - H. **DEALER INFO:** Tables: Adv. $5, Door $6. **CONTACT:** TBARC, POB 764, Alpena MI 49707-0764. Bill N8YKG, 517-354-8867.

MI - TAYLOR — Computer Trade Show. **LOCATION:** Democratic Club of Taylor, 23400 Wick Rd, 4 blks E of Telegraph. **HOURS:** 10am-3pm. **ADMISSION:** Adults $4; Seniors & students w/ID $3; under 12 free w/adult. **FEATURES:** C - DP. **CONTACT:** Computers & You, 313-283-1754.

OH - TOLEDO — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Seagate Convention Centre. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

OCTOBER 15

IL - CENTRALIA — 6TH Annual Hamfest. **SPONSOR:** Centralia Wireless Assn & Kaskaskia College REACH Club. **LOCATION:** Kaskaskia College, 27210 College Rd. **HOURS:** 8am-3pm. **ADMISSION:** $2, under 12 free. **TALK-IN:** 147.27/87, 443.2/8.2. **FEATURES:** C - DP - EX - FM - FP - F/R - H - RV-S - T. **DEALER INFO:** Tailgating: free. Flea market tables: 8' $8, 6' $6. Set-up 7am. **CONTACT:** Bud King WA9U, Daisy King AA9EK, 776, Bethel Rd, Sandoval IL 62882. 618-532-6606.

IL - ORLAND PARK — The Orland Park Computer Show. **LOCATION:** Orland Park Civic Center, 147th St & LaGrange Rd (Rte 45). **HOURS:** 9:30am-3pm. **ADMISSION:** Adults $5 - $1 off with copy of this ad, 8-12 yrs $2, under 8 free. **FEATURES:** A - C - CB - DP - FP - F/R - All indoors. **CONTACT:** 24-hour Hotline 708-974-3123.

IN - FT. WAYNE — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Allen County Fairgrounds. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

MI - FLINT — Computer Show. **LOCATION:** Holiday Inn Gateway Center, 5353 Gateway Center, I-75 N to I-475 (exit 111), 1 mi to Hill Rd (exit 2), turn left, go approx 3 mi. **HOURS:** 10am-4pm. **ADMISSION:** Adults $4, students & seniors w/ID $3, under 12 free. **FEATURES:** C - DP. **CONTACT:** International Computer Trade Shows, 810-858-2416.

MI - KALAMAZOO — 13th Annual Hamfest. **SPONSOR:** Kalamazoo ARC & SW Michigan ART. **LOCATION:** Kalamazoo County Fairgrounds. **HOURS:** 8am-? **ADMISSION:** Adv $3, Door $4. **TALK-IN:** 147.040 repeater. **FEATURES:** DP - FP - F/R - H - T. **DEALER INFO:** Tables: $1.50/ft, electrical hook-up $5. Trunk sales: $5/space, set-up 6am. **CONTACT:** Kalamazoo Hamfest, 616-657-4482 or Gary Hazelton KB8PL, 75075 M-40, Lawton MI 49065.

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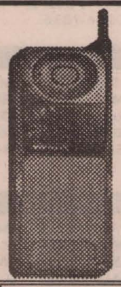

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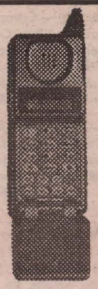

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Events CALENDAR

OH - AKRON — Computer Trade Show. **SPONSOR:** Peter Trapp Shows. **LOCATION:** Tadmore Shrine Temple. **HOURS:** 10am-3pm. **ADMISSION:** $6, $1 off w/this ad or coupon, under 12 free. **FEATURES:** AC - C - FP - F/R. **CONTACT:** Peter Trapp Shows, 607-369-2796.

OCTOBER 21

IN - NOBLESVILLE — Indianapolis Computer Fair. **LOCATION:** Hamilton County 4-H Grounds, off Pleasant St. **HOURS:** 10am-3pm. **ADMISSION:** $4, under 12 free. **FEATURES:** C - DP. **CONTACT:** Ben Yanto, AGI Computer Fairs.*

MI - JACKSON — Computer Trade Show. **LOCATION:** Jackson Catholic Middle School, 915 Cooper St, Approx 1 mi S of I-94. **HOURS:** 10am-3pm. **ADMISSION:** Adults $4; Seniors & students w/ID $3; under 12 free w/adult. **FEATURES:** C - DP. **CONTACT:** Computers & You, 313-283-1754.

MI - SAUGATUCK — Westshore Hamfest & Computer Expo. **SPONSOR:** Holland ARC. **LOCATION:** Holland Christian High School. **HOURS:** 8am-1pm. **ADMISSION:** $4, under 12 free. **TALK-IN:** 147.060+ w/94.8 PL. **FEATURES:** C - DP - EX - F/R - H. **DEALER INFO:** 8' table: $8, 5' table: $6. 616-857-1343. **CONTACT:** Barb Siebelink, 6418 Otis Rd, Saugatuck MI 49453.

MI - WESTLAND — Great Lakes Computer Expo & Sale. **SPONSOR:** Progressive Computer Productions. **LOCATION:** Wayne-Ford Civic League, 1645 Wayne Rd, 1 blk S of Ford Rd. **HOURS:** 10am-4pm. **ADMISSION:** Adults $4, Seniors/Students $3, under 12 free w/adult. **FEATURES:** C - DP - FP - F/R - S. **DEALER INFO:** Covered 8' table $35 ea. **CONTACT:** Progressive Computer Productions, 23814 Michigan Ave., Ste 237, Dearborn MI 48124. 313-425-9276.

OCTOBER 22

CO - GOLDEN — RMRL Hamfest & ARRL State Convention. **SPONSOR:** Rocky Mountain Radio League. **LOCATION:** Jefferson County Fairgrounds, 15200 W. 6th Ave. **HOURS:** 8am-2pm. **ADMISSION:** $4. **TALK-IN:** 144.62/145.22. **FEATURES:** DP - EX - F - F/R - H. **DEALER INFO:** Tables: $10. **CONTACT:** Joe Dickinson WT0C, 303-771-9577.

IL - PALATINE — Computer Central. **LOCATION:** Harper College, building M on W side of campus, at Algonquin and Roselle Roads. **HOURS:** 9:30am-3pm. **ADMISSION:** Adults $6, 8-12 $2, under 8 free. $1 off reg. adult admission w/this ad. **FEATURES:** AC - C - FP. **CONTACT:** Computer Central, Jay B. Robinson, 708-940-7547.

MI - DEARBORN — Computer Trade Show. **LOCATION:** Dearborn Civic Center, 15801 Michigan Ave, corner of Greenfield. **HOURS:** 10am-4pm. **ADMISSION:** Adults $4; Seniors & students w/ID $3; under 12 free w/adult. **FEATURES:** C - DP. **CONTACT:** Computers & You, 313-283-1754.

MI - FLINT — Five Star Computer Shows, **SPONSOR:** Five Star Productions. **LOCATION:** Flint Holiday Inn, Gateway Centre, US-23 at Hill Rd Exit 2 mi S of I-69. **HOURS:** 10am-4pm. **ADMISSION:** $4. **FEATURES:** C - DP - FP. **CONTACT:** Five Star Productions, 810-239-3640.

MI - SOUTHGATE — Computer Show. **LOCATION:** Southgate Civic Center Annex, 14700 Reaume Rd, Dix-Toledo to Reaume Rd. **HOURS:** 10am-3pm. **ADMISSION:** Adults $4, students & seniors w/ID $3, under 12 free. **FEATURES:** C - DP. **CONTACT:** International Computer Trade Shows, 810-858-2416.

MI - WARREN — USECA Swap. **SPONSOR:** Utica Shelby Communications Assn. **LOCATION:** Our Lady of Redemption Conf. Center, 425 Cole, just NE of Van Dyke & 12 Mile. **HOURS:** 8am-2pm. **ADMISSION:** $4, under 11 free. **TALK-IN:** 147.18+ (100 Hz tone), 147.42 simplex. **FEATURES:** C - E - EX - FP - F/R - H. **DEALER INFO:** Tables: $15. **CONTACT:** Kevin Everett N8QVX, 810-772-8082, 21947 Birchwood, Eastpoint MI 48021.

OCTOBER 27-28-29

OK - KINGSTON — ARRL Hamfest. **SPONSOR:** Texoma Hamarama Association. **CONTACT:** Charles Bilbay, KI5CG, Rte. 2, Box 301, Bokchito OK 74726. 405-924-0687.

OCTOBER 28

IL - EVANSTON — Chicago TI International World Faire. **SPONSOR:** Chicago TI99/4a User Group. **LOCATION:** Evanston Public Library, 1730 Orrington. **HOURS:** 9am-4pm. **ADMISSION:** $2, group-members: free. **CONTACT:** Hal Shanafield, TI User Group, POB 7009, Evanston IL 60204-7009 or 708-864-8644.

MN - ST. PAUL — Hamfest Minnesota & Computer Expo. **SPONSOR:** Twin Cities FM Club. **LOCATION:** St. Paul Civic Center, Main Arena, Kellogg & West 7th Street. **HOURS:** 8am-4pm. **ADMISSION:** Adv $5.50, Door $7. **TALK-IN:** 146.16/76. **FEATURES:** C - CB - DP - EX - FM - F/R - H - S. **DEALER INFO:** Flea Market Table: $20, set-up Fri, 6pm-10pm, Sat 7am-8am. **CONTACT:** PO Box 5598, Hopkins MN 55343, or call, 612-535-0637.

MO - ST. LOUISE — ARRL Hamfest. **SPONSOR:** Gateway to Ham Radio Club & St. Louise ARC. **CONTACT:** Dennis McCarthy, AA0A, 5022 Lansdowne Ave, St. Louise MO 63109. 314-351-3568.

OCTOBER 29

IA - DES MOINES — ARRL Hamfest. **SPONSOR:** Tikva Tracers ARC. **CONTACT:** Randal Lees, M0LMS, 1575 NW 78th St, Clive IA 50325-1255. 515-279-4241.

IL - GLEN ELLYN — Computer Central. **LOCATION:** College of DuPage, Park Blvd & College Rd. **HOURS:** 9:30am-3pm. **ADMISSION:** Adults $6, 8-12 $2, under 8 free. $1 off reg. adult admission w/this ad. **FEATURES:** AC - C - FP. **CONTACT:** Computer Central, Jay B. Robinson, 708-940-7547.

IN - LEBANON — Hamfest. **SPONSOR:** Boone & Clinton County ARCs. **LOCATION:** Boone County 4-H Fairgrounds, Warm & Dry Community Bldg. on I-65, 17 mi N of Indianapolis. **HOURS:** 8am-4pm. **ADMISSION:** $3. **TALK-IN:** 147.105/443.150. **FEATURES:** CB - EX - FM - FP - F/R - T. **DEALER INFO:** Table space: $5, set-up 6am. **CONTACT:** Michael Ottinger NX9Q, 317-482-1866, 809 E Walnut St, Lebanon IN 46052.

OH - MARION — 21st Annual Hamfiesta & Computer Show. **SPONSOR:** Marion ARC. **LOCATION:** Marion County Fairgrounds. **HOURS:** 8am-3pm. **ADMISSION:** Adv $4, Door $5. **TALK-IN:** 147.90/30. **FEATURES:** C - DP - FP - F/R - H. **DEALER INFO:** Tables: $10. **CONTACT:** Karen Eckard N8JDH, 6583 South St, Meeker OH 43302, 614-499-3565. Betty Krist N8UDT, 132 N Seffner Ave, Marion OH 43302, 614-387-3533 eves.

NOVEMBER 4

IL - GODFREY — ARRL Hamfest. **SPONSOR:** Lewis & Clark Radio Club. **CONTACT:** Harold Elmore KC9GL, 5203 Dixon Dr, Godfrey IL 62035. 618-466-1909.

NOVEMBER 4-5

OH - CINCINNATI — Computer Fair. **SPONSOR:** Trade Show Productions. **LOCATION:** Cincinnati Gardens, 2250 Seymour Rd. **HOURS:** Sat: 10am-5pm; Sun: 10am-3pm. **ADMISSION:** $5, good both days. **FEATURES:** C - CB - FM - S. **DEALER INFO:** 513-263-3378. **CONTACT:** Trade Show Productions, Mark Hanslip, 143 Schloss Ln, Dayton OH 45418.

TX - ODESSA — ARRL Hamfest. **SPONSOR:** West Texas ARC. **CONTACT:** Robert Jordan N5RKN, 1521 E 13th St, Odessa TX 79761. 915-335-7980.

NOVEMBER 5

MI - FLINT — Computer Show. **LOCATION:** Holiday Inn Gateway Center, 5353 Gateway Center, I-75 N to I-475 (Exit 111), 1 mi to Hill Rd (Exit 2), turn left, go approx 3 mi. **HOURS:** 10am-4pm. **ADMISSION:** Adults $4, students & seniors w/ID $3, under 12 free. **FEATURES:** C - DP - . **CONTACT:** International Computer Trade Shows, 810-858-2416.

MI - LATHRUP — 1995 Swap & Shop. **SPONSOR:** Oak Park ARC & Spirit of 76 ARC. **LOCATION:** Southfield-Lathrup High School, 19301 W 12 Mile Rd. **HOURS:** 8am-? **ADMISSION:** $5. **TALK-IN:** 146.76-. **FEATURES:** DP - EX. **DEALER INFO:** Tables: $15 (adv only). **CONTACT:** Swap Hotline, 810-559-2442, VE exams: Jeff N8WRY, 810-642-3608.

OH - MASSILLON — ARRL Hamfest. **SPONSOR:** Massillon ARC. **CONTACT:** Jack Cale N8FEB, 6021 Longbrook St SW, Massillon OH 44646. 216-477-8261.

WI - KAUKAUNA — Hamfest. **SPONSOR:** Fox Cities ARC. **LOCATION:** Starlite Club, Corner of 55 & JJ. **HOURS:** 8am-? **ADMISSION:** $4. **TALK-IN:** 146.76, PL-100.0. **DEALER INFO:** Tables: $6. **CONTACT:** FCARC, 2410 E. Newberry Ct, Appleton WI 54915. Dan Vanevenhoven: 414-739-5101.

EASTERN REGION

SEPTEMBER 2-3

NC - SHELBY — 39th Hamfest. **SPONSOR:** Shelby ARC. **LOCATION:** Cleveland County Fairgrounds. **TALK-IN:** 146.28/88. **FEATURES:** CB - FM - T. **CONTACT:** Barbara Elliott, POB 191, Fallstone NC 28042. 704-538-7919 after 1pm.

NJ - CHERRY HILL — PC Dealer Showcase. **LOCATION:** Cherry Hill Mall, Rte 38. **HOURS:** Sat: 10am-9:30pm, Sun: 12pm-5pm. **ADMISSION:** Free. **FEATURES:** AC - C - FP. **DEALER INFO:** Tables $95 table/day. **CONTACT:** Starware 610-584-8770.

SEPTEMBER 6-7-8-9

NY - ROCHESTER — 34th Historical Radio Conference. **SPONSOR:** Antique Wireless Assn. **LOCATION:** Thruway Marriott Hotel. **FEATURES:** B- FM - S. **CONTACT:** AWA, Box E, Breesport, NY 14816. 716-359-1800.

SEPTEMBER 9

MA - WILMINGTON — Computer Show. **LOCATION:** Shriner's, N of Boston at I-93 Exit #39, right at bottom of ramp, follow signs to hall. **HOURS:** 10am-4pm. **FEATURES:** C. **DEALER INFO:** 500+ tables. **CONTACT:** KGP Computer Show.*

NY - BALLSTON SPA — 10th Saratoga RACES Hamfest. **LOCATION:** Fairgrounds. **HOURS:** 7am-? **ADMISSION:** $4. **TALK-IN:** 147.24/147.84 147.00/146.40. **FEATURES:** C. **DEALER INFO:** Tables $5, Tailgaters - admission only. **CONTACT:** Lenny N2KKP, 518-885-4933.

PA - BETHLEHEM — Computer Trade Show. **SPONSOR:** Peter Trapp Shows. **LOCATION:** Stabler Arena. **HOURS:** 10am-3pm. **ADMISSION:** $6, $1 off w/this ad or coupon, under 12 free. **FEATURES:** C - FP - F/R. **CONTACT:** Peter Trapp Shows, 607-369-2796.

PA - ERIE — ARRL Hamfest. **SPONSOR:** Radio Association of Erie. **CONTACT:** Tom McClain N3HPR, 3954 Solar Dr, Erie PA 16506. 814-833-1640.

PA - UNIONTOWN — 46th Annual Gabfest. **SPONSOR:** Uniontown ARC. **LOCATION:** Clubhouse grounds, Old Pittsburgh Rd., Off Rte 51 and the 119 by-pass. **HOURS:** 8am-? **ADMISSION:** 1-$3; 2-$5; 5-$10. **TALK-IN:** 147.045+, 147.255+. **FEATURES:** DP - FM - FP - F/R - H. **DEALER INFO:** Contact Carl WA3HQK, 304-594-3779. **CONTACT:** Uniontown, ARC, 465 Old Pittsburgh Rd, Uniontown PA 15401.

SEPTEMBER 9-10

AL - BESSEMER — Computer Show. **LOCATION:** Bessemer Civic Center, 1130 Ninth Ave, SW, exit 108 at I-20/I-59. **HOURS:** Sat: 9am-5pm, Sun: 10am-4pm. **ADMISSION:** $5 both days, $4 Sun. only. **FEATURES:** AC - C - DP - FP. **DEALER INFO:** 8-ft tables $35. **CONTACT:** Computer Show, POB 295, Riverdale GA 30274. 800-746-9001.

NY - STONY BROOK — MarketPro Computer Show & Sale. **LOCATION:** Stony Brook University. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

VA - SPRINGFIELD — PC Dealer Showcase. **LOCATION:** Springfield Mall, I-95 & 495. **HOURS:** Sat: 10am-9:30pm, Sun: 12pm-5pm. **ADMISSION:** Free. **FEATURES:** AC - C - FP. **DEALER INFO:** Tables $95 table/day. **CONTACT:** Starware 610-584-8770.

SEPTEMBER 10

KY - LOUISVILLE — Computer Fair South. **SPONSOR:** MEKA Enterprises, Inc. **LOCATION:** Executive West Hotel, I-65 & 264 Freedom Way at the Fairgrounds. **HOURS:** 10am-3pm. **ADMISSION:** $4.. **DEALER INFO:** Vendor tables $45. **CONTACT:** Meka Enterprises, 812-825-2889.

MD - GAITHESBURG — FAR Fest '95. **SPONSOR:** Foundation for Amateur Radio. **LOCATION:** Montgomery County Fairgrounds, exit 11 off I-270. **HOURS:** 6am-? **ADMISSION:** $5, under 12 free. **TALK-IN:** 146.955- 443.400+ and 146.52. **FEATURES:** C - CB - E - EX - H - T. **DEALER INFO:** 10' tailgate space: $10 + admission, Mary Morris 703-971-3905. **CONTACT:** Al Brown, 301-490-3188.

NH - PORTSMOUTH — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Frank Jones Center, Exit 5 off I-96 to Rte 1 Bypass South (behind U-Haul). **HOURS:** 10am-3:30pm. **ADMISSION:** $7, under 14 free w/adult. **FEATURES:** C. **DEALER INFO:** Set-up 8am. **CONTACT:** Northern Computer Shows.*

NY - BREWSTER — Pearlfest '95. **SPONSOR:** Putnam Emergency and Amateur Radio League. **LOCATION:** JFK Elementary School, Foggintown Rd, follow signs from Exit 19, Rte 84. **HOURS:** 9am-2pm. **ADMISSION:** $5, ladies & under 12 free. **TALK-IN:** 145.130 MHz, down 600. **FEATURES:** C - DP - E - EX - FM - FP - F/R - H - T. **DEALER INFO:** Tables: adv $10, door $12, tailgating $7. **CONTACT:** Shirley Dahlgren N2SKP, 914-736-3558, POB 677, Verplanck NY 10596.

PA - BUTLER — Hamfest. **SPONSOR:** Butler County ARA. **LOCATION:** Butler Farm Show Grounds. **HOURS:** 8am-3pm. **ADMISSION:** $5, under 12 free. **DEALER INFO:** 8' indoor table $10, outdoor flea market space $1. **CONTACT:** Hamfest Chairman, POB 1787, Butler PA 16001.

VA - ANNANDALE — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Northern Virginia Community College. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

SEPTEMBER 16

MD - HUNT VALLEY — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Marriott's Hunt Valley Inn. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

NJ - WAYNE — Computer Show. **LOCATION:** William Paterson College, Recreation Center,near I-80, Rte 23 & Rte 46. **HOURS:** 10am-4pm. **FEATURES:** C. **DEALER INFO:** 400 tables. **CONTACT:** KGP Computer Show.*

NY - HAMBURG — Western New York Section Convention. **CONTACT:** Harold Smith K2HC, 300 White Spruce Blvd, Rochester NY 14623. 716-424-7184.

NY - POUGHKEEPSIE — MarketPro Computer Show & Sale. **LOCATION:** Mid-Hudson Civic Center. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

NY - SYRACUSE — Computer Trade Show. **SPONSOR:** Peter Trapp Shows. **LOCATION:** New York State Fairgrounds. **HOURS:** 10am-4pm. **ADMISSION:** $6, $1 off w/this ad or coupon, under 12 free. **FEATURES:** C - FP - F/R. **CONTACT:** Peter Trapp Shows, 607-369-2796.

PA - NEWTOWN — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Bucks County Community College. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

SC - ANDERSON — Hamfest & Computer Show. **SPONSOR:** Anderson ARC. **LOCATION:** New Civic Center, 4 mi off I-85. **HOURS:** 9am-2pm. **ADMISSION:** Adv $4, Door $5. **TALK-IN:** 146.79MHz repeater, 146.97MHz. **FEATURES:** AC - C - EX - F/R - H - RV-S. **DEALER INFO:** Tables, $10. Outside flea free with paid admission. **CONTACT:** Anderson ARC, POB 1525, Anderson SC 29622-1525. FAX 803-225-0567. Rip Merrell W4FX, 803-225-0028.

VA - SOUTH BOSTON — Fallfest. **SPONSOR:** Piedmont ARC. **LOCATION:** Halifax County Senior High School. **HOURS:** 9am-3pm. **ADMISSION:** Adv $4, Door $5. **TALK-IN:** 147.06-. **FEATURES:** EX - T. **DEALER INFO:** Indoor tables $8-$12, outside tailgating $3 per. **CONTACT:** Kathy Hendricks AC4LB or PARC, 2031 Robert Hester Rd, Hurdle Mills NC 27541.

VT - RANDOLPH — 7th Annual Fall Foliage Hamfest & Computer Fair. **SPONSOR:** Central Vermont ARC. **LOCATION:** Vermont Technical College, Judd Gymnasium. **HOURS:** 9am-3pm. **ADMISSION:** $4. **TALK-IN:** 147.09/.69 146.625/.025. **FEATURES:** DP - EX - F - F/R. **DEALER INFO:** Tables: Adv $6, Door $8. Tailgating $4. **CONTACT:** Barry Driscol N1NPU, RR1 Box 3165, Barre VT 05641, 802-479-1408. Tom Girardi WA1YNU, 802-244-7836.

SEPTEMBER 16-17

NJ - LAWRENCEVILLE — PC Dealer Showcase. **LOCATION:** Quakerbridge Mall, Rte 1. **HOURS:** Sat: 10am-9:30pm, Sun: 12pm-5pm. **ADMISSION:** Free. **FEATURES:** AC - C - FP. **DEALER INFO:** Tables $95 table/day. **CONTACT:** Starware 610-584-8770.

SEPTEMBER 17

CT - NEWTON — Western CT Hamfest. **SPONSOR:** Candlewood ARC. **LOCATION:** Edmond Town Hall, Rte 6-exit 10 on I-84. **HOURS:** 9am-2pm. **ADMISSION:** $4, under 12 free. **TALK-IN:** 147.12/.72. **FEATURES:** C - CB - DP - E - FM - F/R - H - T. **DEALER INFO:** Tables: $10, Tailgating: $6 (each includes one admission). Set-up 7am. **CONTACT:** Ken Weith KD1DD, POB 3441, Danbury CT 06813-3441. 203-743-9181.

DE - NEWARK — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** University of Delaware (Bob Carpenter Center). **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Show.*

FL - BOCA RATON — Narisaam Computer Show. **SPONSOR:** Narisaam, Inc. **LOCATION:** Embassy Suites Hotel, 661 Northwest 53rd St. **HOURS:** 10am-4pm. **ADMISSION:** $5, $4 w/ad, under 12 free. **FEATURES:** AC - C - FP. **CONTACT:** Narisaam.*

MA - CAMBRIDGE — Tailgate Electronics, Computer & Amateur Radio Flea Market. **SPONSOR:** MIT Radio Society and Harvard Wireless Club. **LOCATION:** Albany & Main Sts. **HOURS:** 9am-2pm. **ADMISSION:** $2. **TALK-IN:** 146.52, 449.725/444.725 - PL 2A - W1XM/R. **FEATURES:** C - FP - H - T. **DEALER INFO:** Tailgate room for 600 sellers. $10 per space at gate, $8 adv includes 1 admission. Set-up 7am. For info call 617-253-3776. Mail advance reservations before the 5th. **CONTACT:** W1GSL, POB 397082 MIT BR, Cambridge MA 02139-7082.

MA - PITTSFIELD — Hamfest. **SPONSOR:** Northern Berkshire ARC. **LOCATION:** Taconic High School, Valentine Rd. **HOURS:** 8am-2pm. **ADMISSION:** $2. **TALK-IN:** 146.91. **FEATURES:** CB - EX - FM - H - T. **DEALER INFO:** Vendors: Adv $5, Door $7. **CONTACT:** Chuck Lowery NZ1Z, 413-447-8377.

MD - BALTIMORE — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** BWI Marriott. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro

Computer Shows.*

NH - NASHUA — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Stanislaus Hall, 1/4 mile E of Rte 3 (Everett Turnpike), Exit 6, follow show signs. **HOURS:** 10am-3:30pm. **ADMISSION:** $7, under 14 free w/adult. **FEATURES:** C. **DEALER INFO:** Set-up 8am. **CONTACT:** Northern Computer Shows.*

NJ - PENNSAUKEN — 47th Annual Hamfest & Computer Show. **SPONSOR:** South Jersey Radio Assn. **LOCATION:** Pennsauken High School parking lot. **HOURS:** 8am-3pm. **ADMISSION:** Adv: $4, Door: $5. **TALK-IN:** 145.290-600. **FEATURES:** C - CB - DP - EX - FP - F/R - H - S - T. **DEALER INFO:** Tailgate space: $5 + admission. **CONTACT:** Paul E. Hayden KF2YX, 519 N Elmwood Rd, Marlton NJ 08053, 609-596-7749.

NY - SUFFERN — MarketPro Computer Show & Sale. **LOCATION:** Rockland Community College. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

SEPTEMBER 22-23-24

FL - MELBOURNE — Computer Software & Electronic Show. **SPONSOR:** Arflin Promotions. **LOCATION:** Melbourne Auditorium, 625 E. Hibiscus Bl. **HOURS:** Fri: 6-9pm, Sat: 10am-9pm, Sun: 12-6pm. **CONTACT:** Bill Arflin: 407-777-9692, Arflin Promotions, 290 Park Ave., Satellite Beach FL 32937.

SEPTEMBER 23

AL - Anniston — Hamfest. **SPONSOR:** AAERC. **LOCATION:** City Meeting Center, 1700 Noble St. **ADMISSION:** $5. **TALK-IN:** 147.040/146.780. **FEATURES:** DP - EX - H. **DEALER INFO:** Tabels: $5. **CONTACT:** Harold Romine 205-435-4833, Norris Landry 205-236-4588.

NJ - PENNSAUKEN — Computer Show. **LOCATION:** South Jersey Expo Center, off NJ Tpke Exit #4 on Rte 73. **HOURS:** 10am-4pm. **FEATURES:** C. **DEALER INFO:** 500+ tables. **CONTACT:** KGP Computer Show.*

PA - MONROEVILLE — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Pittsburgh Expo Mart. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

PA - YORK — Computer Trade Show. **SPONSOR:** Peter Trapp Shows. **LOCATION:** York County Fairgrounds. **HOURS:** 10am-3pm. **ADMISSION:** $6, $1 off w/this ad or coupon, under 12 free. **FEATURES:** C - FP - F/R. **CONTACT:** Peter Trapp Shows, 607-369-2796.

RI - SMITHFIELD — MarketPro Computer Show & Sale. **LOCATION:** Bryant College. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

VA - MANASSAS — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Manassas Fairgrounds. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

SEPTEMBER 23-24

GA - ATLANTA — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Cobb County Civic Center. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

NC - CHARLOTTE — Charlotte Area Computer Show. **LOCATION:** Metrolina Expo Center, 7100 N Statesville Rd I-77 N to Exit #16A (first exit N of the I-85 & I-77 intersection). **HOURS:** Sat: 9am-5pm, Sun: 10am-4pm. **ADMISSION:** $5 both days, $4 Sun. only. **FEATURES:** AC - C - DP - FP - F/R. **DEALER INFO:** 8' tables $40. **CONTACT:** Computer Show, POB 295, Riverdale GA 30274. 770-907-6225.

PA - YORK — 40th Annual Hamfest & Computer Show. **LOCATION:** York Interstate Fairgrounds. **HOURS:** 8am-? **ADMISSION:** $5. **TALK-IN:** 146.97. **FEATURES:** B - C - CB - DP - E - EX - FM - FP - F/R - H - S - T. **CONTACT:** York Hamfest, POB 351, Dover PA 17315. 717-751-9675.

VA - VIRGINIA BEACH — Hamfest/Computer Fair & ARRL Virginia State Convention. **SPONSOR:** Tidewater Radio Conventions. **LOCATION:** Pavilion Convention Center. **HOURS:** Sat 9am-5pm/Sun 9am-3pm. **ADMISSION:** $6, good both days, under 12 free. **TALK-IN:** 146.97. **FEATURES:** B - C - CB - F - FM - FP - H - T. **DEALER INFO:** 10' x 10' booth space $150, set-up Friday after 2pm. **CONTACT:** Lewis B Steingold W4BLO, 804-486-3800, FAX 804-486-0757.

SEPTEMBER 24

CT - WATERBURY — MarketPro Computer Show & Sale. **LOCATION:** Sheraton Inn Waterbury. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

FL - NEW PORT RICHEY — 5th Annual Pasco County Hamfest & Computer Show. **SPONSOR:** Suncoast ARC. **LOCATION:** New Port Richey Recreation Center. **HOURS:** 9am-3:30pm. **ADMISSION:** $5, under 12 free. **TALK-IN:** 145.35 147.15. **FEATURES:** AC - C - DP - H. **DEALER INFO:** Tables, $15. **CONTACT:** Ron N9EE, 813-376-6575, or Suncoast ARC, POB 1992, New Port Richey FL 34656.

KY - FT. MITCHELL — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Drawbridge Estate. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

MA - FRAMINGHAM — Fall Flea Market. **SPONSOR:** Framingham ARA. **LOCATION:** Framingham High School, A St, 1.3 mi N of Rtes 9 & 126 junction. **HOURS:** 9am/early bird; 10am/general. **ADMISSION:** $5/early bird; $2/general. **FEATURES:** C - DP - E - EX - FM - FP - F/R - H - T. **DEALER INFO:** Tables: adv $10, door $14, set-up 8am, tailgating: $10 per space. **CONTACT:** Lew Nyman K1AZE, 508-879-7456; FARA, POB 3005, Framingham MA 01701.

MA - TAUNTON — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Taunton Holiday Inn, Exit 9 off I-495, between Rte 24 & I-95. **HOURS:** 10am-3:30pm. **ADMISSION:** $7, under 14 free w/adult. **FEATURES:** C. **DEALER INFO:** Set-up 8am. **CONTACT:** Northern Computer Shows.*

MD - GAITHERSBURG — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Montgomery County Fairgrounds. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

NY - YONKERS — Giant Electronic Flea Market. **SPONSOR:** Metro 70cm Network. **LOCATION:** Lincoln High School, Kneeland Ave. **HOURS:** 9am-3pm. **ADMISSION:** $5, under 12 free. **TALK-IN:** 440.425 MHZ PL 156.7, 223.760 MHZ PL 67.0 **FEATURES:** DP - EX - F/M - FP - F/R. **DEALER INFO:** Vendors please call 914-969-1053. **CONTACT:** Otto Supliski WB2SLQ, 914-969-1053.

PA - ALLENTOWN — Computer Trade Show. **SPONSOR:** Peter Trapp Shows. **LOCATION:** Holiday Inn & Convention Center, Lehigh Valley. **HOURS:** 10am-3pm. **ADMISSION:** $6, $1 off w/this ad or coupon, under 12 free. **FEATURES:** AC - C - FP - F/R. **CONTACT:** Peter Trapp Shows, 607-369-2796.

PA - LANCASTER — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Lancaster Host Resort. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

SEPTEMBER 30

FL - FORT LAUDERDALE — Narisaam Computer Show. **SPONSOR:** Narisaam, Inc. **LOCATION:** Holiday Inn West, 5100 N State Road 7. **HOURS:** 9:30am-3:30pm. **ADMISSION:** $5, $4 w/ad, under 12 free. **FEATURES:** AC - C - FP. **CONTACT:** Narisaam.*

MA - FITCHBURG — MarketPro Computer Show & Sale. **LOCATION:** Royal Plaza Trade Center. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

NY - HORSEHEADS — Elmira International Hamfest-Computerfest. **SPONSOR:** Southern Tier ARA. **LOCATION:** Chemung County Fairgrounds. **HOURS:** 6am-3pm. **ADMISSION:** Adv $4, Door $5, Flea Market: free. **TALK-IN:** 147.96/36, 444.20. **FEATURES:** C - CB - DP - EX - FM - FP - F/R - H - RV-H - RV-S. **DEALER INFO:** Jay: 607-733-0761. **CONTACT:** Elmira Hamfest Dave Lewis, 465 Cr13, Van Etten NY 14889. 607-589-7495. FCC Testing: Bill 607-962-1134.

SEPTEMBER 30-OCTOBER 1

PA - KING OF PRUSSIA — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Valley Forge Convention Center. **HOURS:** 10am-4pm. **ADMISSION:** $6.50, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

OCTOBER 1

FL - WEST PALM BEACH — Narisaam Computer Show. **SPONSOR:** Narisaam, Inc. **LOCATION:** Palm Beach Airport Hilton, 150 Australian Ave. **HOURS:** 10am-4pm. **ADMISSION:** $5, $4 w/ad, under 12 free. **FEATURES:** AC - C - FP. **CONTACT:** Narisaam.*

MA - ROCKLAND — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Sons of Italy, Rtes 123 & 139; Rte 3, Exit 14 to Rockland Center. **HOURS:** 10am-3:30pm. **ADMISSION:** $7, under 14 free w/adult. **FEATURES:** C. **DEALER INFO:** Set-up 8am. **CONTACT:** Northern Computer Shows.*

NY - HEMPSTEAD — Computer Show. **LOCATION:** Hofstra University Field House, use Meadowbrook Parkway Exit M-4 to Hempstead Tpke, 1 mile past Coliseum. **HOURS:** 10am-3pm. **FEATURES:** C. **DEALER INFO:** 500+ tables. **CONTACT:** KGP Computer Show.*

NY - QUEENS — Semi-Annual Hamfest. **SPONSOR:** Hall of Science ARC. **LOCATION:** Hall of Science, 47-01 111 St, Flushing Meadow Park. **HOURS:** 9am-3pm. **ADMISSION:** $5, under 12 free. **TALK-IN:** 444.200 Repeat PL 136.5. **FEATURES:** C - CB - DP - FP - F/R - H. **DEALER INFO:** Sellers $10 per space, (includes 1 admission). **CONTACT:** Arnie Schiffman WB2YXB 718-343-0172 eves. Charlie Becker WA2JUJ 516-694-3955 eves.

PA - WARRINGTON — Hamarama. **SPONSOR:** Mt. Airy VHF Radio Club. **LOCATION:** Buck County Drive-In. **HOURS:** 7am-? **ADMISSION:** $5. **TALK-IN:** 146.52 Simplex. **FEATURES:** F/R - H. **DEALER INFO:** Sellers: Admission + $8 per space. **CONTACT:** Box 451, Montgomeryville PA 18936.

OCTOBER 7

FL - TAMPA — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Florida State Fairgrounds. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

NY - TROY — MarketPro Computer Show & Sale. **LOCATION:** Troy Armory. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

SC - FORT MILL — Rock Hill Hamfest & Computer Fair. **SPONSOR:** York County ARS. **LOCATION:** Knights Stadium, I-77, exit 88. **HOURS:** 6am-? **ADMISSION:** Adv $5, door $6. **TALK-IN:** 147.03-600. **FEATURES:** C - CB - DP - EX - F/R - H - T. **DEALER INFO:** YCARS Hamfest, 2129 Squire Rd., Rock Hill SC 29730. **CONTACT:** George Trunk AB4BG, 803-327-4344.

VA - VIRGINIA BEACH — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Virginia Beach Pavillion. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

OCTOBER 7-8

GA - NORCROSS — Atlanta Computer Show. **LOCATION:** North Atlanta Trade Center, 1700 Jeurgens Court, I-85 N to Exit 38 & turn right to Oakbrook Parkway, turn right to Jeurgens Court. **HOURS:** Sat: 9am-5pm, Sun: 10am-4pm. **ADMISSION:** $5 both days, $4 Sun. only. **FEATURES:** AC - C - DP - FP - F/R. **DEALER INFO:** 8' tables $45. **CONTACT:** Computer Show, POB 295, Riverdale GA 30274. 770-907-6225.

MS - BILOXI — ARRL Delta Division Convention. **CONTACT:** Donna Alexander, KA5OER, 22 Yorkshire Pkwy, Gulfport MS 39503. 601-896-4984.

OCTOBER 8

CT - DURHAM — Nutmeg Hamfest, Computer Show & State Convention. **SPONSOR:** Meriden, Middlesex & Shoreline ARCs. **LOCATION:** Fairgrounds, on Rte 17. **HOURS:** 9am-3pm. **ADMISSION:** $5, under 12 free. **TALK-IN:** 145.29. **FEATURES:** C - CB - EX - F - FM - FP - F/R - H - T. **DEALER INFO:** Inside table: $25, tailgate space: $20, both include admission, set-up Sat @ 4 pm. Dan Murphy KA1SZP, 203-349-1304 eves, 162 Tri-Mountain Rd, Durham CT 06422. **CONTACT:** Bill Wawrzeniak W1KKF, 203-269-8252 eves. VE exams: Joel Curneal N1JEO, 203-235-6932.

FL - ST. PETERSBURG — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** St. Petersburg Coliseum. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

NH - MANCHESTER — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Center of NH, Expo Complex at Holiday Inn, I-293 Exit 5 or 6. **HOURS:** 10am-3:30pm. **ADMISSION:** $7, under 14 free w/adult. **FEATURES:** C - FP. **DEALER INFO:** Set-up 8am. **CONTACT:** Northern Computer Shows.*

NJ - LINCROFT — Shore Area Hamfest & ARRL State Convention. **LOCATION:** Brookdale Community College, Garden State Pkwy exit 109, West on Rte 520. **HOURS:** 8am-? **ADMISSION:** Adv $5 w/2 stubs, Door: $6 w/1 stub, under 12 free. **TALK-IN:** 145.485/-6. **FEATURES:** AC - C - CB - DP - EX - F - FP - F/R - H - T. **DEALER INFO:** 8' indoor table $25, outdoor space $10, set-up 6am. **CONTACT:** Al Allen K2LG, Shore Area Hamfest, POB 635, Eatontown NJ 07724, 908-495-3246.

NY - WHITE PLAINS — MarketPro Computer Show & Sale. **LOCATION:** Westchester County Center. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

VA - RICHMOND — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** The Showplace. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

OCTOBER 9

MA - FALL RIVER — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** White's of Westport Columbus Day, Exit 9 E or Exit 10 W off I-195. **HOURS:** 10am-3:30pm. **ADMISSION:** $7, under 14 free w/adult. **FEATURES:** C. **DEALER INFO:** Set-up 8am. **CONTACT:** Northern Computer Shows.*

OCTOBER 13-14-15

GA - ATLANTA — Expo '95. **SPONSOR:** Grove Communications. **LOCATION:** Airport Hilton. **FEATURES:** B - F - S. **CONTACT:** Grove Enterprises, POB 30 S Hwy 64, Brasstown NC 28902. 800-438-8155.

OCTOBER 14

GA - AUGUSTA — 47th Annual Hamfest & Computer Show. **SPONSOR:** ARC of Augusta. **LOCATION:** Evans Middle School, @ Washington Rd & Belair Rd. **HOURS:** 9am-4pm. **ADMISSION:** $5. **TALK-IN:** 145.49-. **FEATURES:** EX - F - RV-S. **DEALER INFO:** Indoor tables: $10 + admission, outdoor sales: one free space w/admission, adl space $5. Set-up Fri 6pm-9pm, Sat 6am-9am. **CONTACT:** Richard KR4XN, 706-860-3828, Ed KM4QQ, 706-798-1918, Rhonda KE4DIM, 706-560-9600 or ARCA, POB 3072, Augusta GA 30914.

OCTOBER 14-15

KY - LOUISVILLE — Greater Louisville Hamfest & State Convention. **LOCATION:** Kentucky Fair & Exposition Center. **ADMISSION:** $5. **DEALER INFO:** Bill Rufner W9CBQ, 812-948-0037. **CONTACT:** Herbert Rowe, W4WQD 812-294-4905. Greater Louisville Hamfest, POB 34444-E, Louisville, KY 40232-4444.

MA - MARLBOROUGH — Computer Show. **LOCATION:** Royal Plaza Trade Center, take MA Tpke to I-495 N, go 4 miles, use Exit #24-B, 1/2 mile on right. **HOURS:** Sat:10am-4pm, Sun:10am-3pm. **FEATURES:** C. **DEALER INFO:** 500+ tables. **CONTACT:** KGP Computer Show.*

TN - MEMPHIS — ARRL Hamfest. **SPONSOR:** Mid-South ARA. **CONTACT:** Mary Moore, AC4GF, 5140 Woods Landing Cove, Memphis, TN 38125. 901-758-0661.

VA - ANNANDALE — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Northern Virginia Community College. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

OCTOBER 15

KY - LOUISVILLE — Computer Fair South. **SPONSOR:** MEKA Enterprises, Inc. **LOCATION:** Executive West Hotel, I-65 & 264 Freedom Way at the Fairgrounds. **HOURS:** 10am-3pm. **CONTACT:** William Ibarra, Meka Enterprises, 2656 E. 2nd St., Bloomington IN 47401. 812-333-4484, FAX: 812-333-4650.

MA - CAMBRIDGE — Tailgate Electronics, Computer & Amateur Radio Flea Market. **SPONSOR:** MIT Radio Society and Harvard Wireless Club. **LOCATION:** Albany & Main Sts. **HOURS:** 9am-2pm rain or shine. **ADMISSION:** $2. **TALK-IN:** 146.52, 449.725/444.725 - PL 2A - W1XM/R. **FEATURES:** C - FP - H - T. **DEALER INFO:** Tailgate room for 600 sellers. $10 per space at gate, $8 adv includes 1 admission. Set-up 7am. For info call 617-253-3776. Mail advance reservations before the 5th. **CONTACT:** W1GSL, POB 397082 MIT BR., Cambridge MA 02139-7082.

MD - COLUMBIA — CARA Hamfest. **SPONSOR:** Columbia ARA. **LOCATION:** Howard County Fairgrounds. **HOURS:** 8am-3:30pm. **ADMISSION:** $5, children free. **TALK-IN:** 146.52 Simplex, 147.135/735 Rptr 222.32/92 Rptr. **FEATURES:** C - E - EX - F/R - H - T. **DEALER INFO:** Tables $20, tailgate space: $10, call 410-992-8209. **CONTACT:** CARA Hamfest Committee, POB 911, Columbia MD 21044.

NJ - FAIRFIELD — MarketPro Computer Show & Sale. **LOCATION:** Radisson Hotel. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

PA - WILKES BARRE — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Genetti's Best Western. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

OCTOBER 20-21

FL - STARKE — Hamfest & Computer Show. **SPONSOR:** Bradford Area ARC. **LOCATION:** Bradford County Fairgrounds, on US-301. **HOURS:** Fri: 4pm-9pm; Sat: 8am-4pm. **ADMISSION:** Families: $3. **TALK-IN:** 145.15, 146.52, 146.82. **FEATURES:** C - DP - H. **DEALER INFO:** Tables: $5, tailgating $4. **CONTACT:** Dan Phillips K4RVD, 8214 Carl Brook Rd., Keystone Hts FL 32656. 904-475-2695.

OCTOBER 21

NH - SALEM — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Rockingham Park Race Track, I-93 Exit 1, next to

175 store Mall. **HOURS:** 10am-3:30pm. **ADMISSION:** $7, under 14 free w/adult. **FEATURES:** C. **DEALER INFO:** Set-up 8am. **CONTACT:** Northern Computer Shows.*

NY - BUFFALO — MarketPro Computer Show & Sale. **LOCATION:** Buffalo State College. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

PA - SENECA — Ham Radio Auction & Flea Market. **SPONSOR:** Fort Venango Mike & Key Club. **LOCATION:** Christian Life Bldg, Rte 257 between Rte 3 & Rte 62. **HOURS:** 8am-? **ADMISSION:** $3, under 12 free. **TALK-IN:** 147.12+, 145.23-, 145.19-, 444.125+. **FEATURES:** DP - FM - F/R - H. **DEALER INFO:** Tables: $5, Mary Housholder N3QCR, 814-437-2036. **CONTACT:** Fort Venango Mike & Key Club, RD1, Box 591, Cranberry PA 16319.

SC - SUMTER — 9th Annual Hamfest & Computer Show. **SPONSOR:** Sumter ARA. **LOCATION:** Sumter County Exhibition Center, 700 W. Liberty St.. **HOURS:** 8am-4pm. **ADMISSION:** $5. **TALK-IN:** 147.015. **FEATURES:** C - DP - EX - F - FM - F/R - H - T. **DEALER INFO:** Tables/tailgate space: $6, set-up Fri: 4pm-9pm & Sat: 6am. **CONTACT:** Mike Dunlap KC4HUT, 803-481-4611 or Tommy Dubose KB4CIH, 803-469-5093.

TN - GRAY — Tri-Cities Hamfest. **SPONSOR:** Kingsport, Bristol & Johnson City ARCs. **LOCATION:** Appalachian Fair Grounds, off I-181. **ADMISSION:** $5. **FEATURES:** FM - RV-H. **CONTACT:** POB 3682 CRS, Johnson City TN 37602.

OCTOBER 21-22

AL - HUNTSVILLE — Huntsville Area Computer Show. **LOCATION:** Von Braun Civic Center, 700 Monroe Street, Exit 19-C off I-565. **HOURS:** Sat: 9am-5pm, Sun: 10am-4pm. **ADMISSION:** $5 both days, $4 Sun. only. **FEATURES:** AC - C - DP - FP - F/R. **DEALER INFO:** 8' tables $45. **CONTACT:** Computer Show, POB 295, Riverdale GA 30274. 770-907-6225.

FL - WEST PALM BEACH — Hamfest & Computer Show. **SPONSOR:** Palm Beach Repeater Assn. **LOCATION:** South Florida Fairgrounds, Southern Blvd. **HOURS:** Sat: 9am-5pm, Sun: 9am-3pm. **ADMISSION:** Door $5, good both days. **TALK-IN:** 147.165/147.765. **FEATURES:** AC - C - EX - FM - H - RV-H. **DEALER INFO:** Flea Tables: $20 + admission, set-up Fri: 2pm-8pm Vi Kiekenapp KC4LCF: 407-585-9074. **CONTACT:** PBRA Hamfest, POB 461, Lake Worth, FL 33460.

KY - LOUISVILLE — Computer Fair. **SPONSOR:** Trade Show Productions. **LOCATION:** Kentucky Fair & Expo Center. **HOURS:** Sat: 10-5, Sun: 10-3. **ADMISSION:** $5, good both days. **FEATURES:** C - CB - FM - S. **DEALER INFO:** Commercial booth: $200, Flea Market space: $30. **CONTACT:** Trade Show Productions/Mark Hanslip, 143 Schloss Ln, Dayton, OH 45418. 513-263-3378.

OCTOBER 22

ME - PORTLAND — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Verrillo's Conv. Ctr at Howard Johnson Motor Lodge, I-95 Exit 8. **HOURS:** 10am-3:30pm. **ADMISSION:** $7, under 14 free w/adult. **FEATURES:** C. **DEALER INFO:** Set-up 8am. **CONTACT:** Northern Computer Shows.*

NY - ROCHESTER — MarketPro Computer Show & Sale. **LOCATION:** The Dome Center. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

NY - SYRACUSE — Computer Trade Show. **SPONSOR:** Peter Trapp Shows. **LOCATION:** NY State Fairgrounds. **HOURS:** 10am-4pm. **ADMISSION:** $6, $1 off w/this ad or coupon, under 12 free. **FEATURES:** C - FP - F/R. **CONTACT:** Peter Trapp Shows, 607-369-2796.

PA - GREENSBURG — Hamfest. **SPONSOR:** Foothills ARC. **LOCATION:** Greensburg Hose Company #1, off Rte 66, N of Greensburg. **HOURS:** 8am-2pm. **ADMISSION:** $2. **TALK-IN:** 147.18+. **FEATURES:** FM - T. **DEALER INFO:** Inside tables: $10, tailgating $3. **CONTACT:** Al Compton N3LQX, 412-512-3727. Foothills ARC, 555 Agnew Rd, Greensburg PA 15601-9701.

PA - LEBANON — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Lebanon Valley Expo Center. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

PA - SELLERSVILLE — Hamfest. **SPONSOR:** RH Hill ARC. **LOCATION:** Sellersville Fire House, Rte 152, 5 mi S of Quakertown. **ADMISSION:** $5. **TALK-IN:** 145.31. **FEATURES:** EX. **DEALER INFO:** Indoor space w/table: $18, outdoor space only: $6. **CONTACT:** Linda Erdman: 215-679-5764 or POB 29, Colmar, PA 18915.

OCTOBER 28

CT - WATERFORD — Ham Radio Auction. **SPONSOR:** Tri City ARC. **LOCATION:** Senior Citizens Center, Waterford Municipal Complex. **HOURS:** 10am-? **ADMISSION:** Free. **TALK-IN:** 146.37/.97. **FEATURES:** F/R. **DEALER INFO:** Set-up 9am. **CONTACT:** Bob KA1BB: 203-739-8016.

FL - PORT ST. LUCIE — Hamfest '95. **SPONSOR:** Port St. Lucie ARA. **LOCATION:** Port St. Lucie Yacht Club, 500 Prima Vista Blvd. **HOURS:** 8am-3pm. **ADMISSION:** $2. **TALK-IN:** 146.955, 146.520. **FEATURES:** DP - F/R - H - T. **DEALER INFO:** Inside tables: $10, tailgate space: $5. **CONTACT:** Bill Perciasepe, 407-879-4020, Roy Cox, 407-340-4319.

GA - ATLANTA — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Lakewood Fairgrounds. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

MA - PLYMOUTH — Amateur Radio Flea Market. **SPONSOR:** Mayflower ARC. **LOCATION:** Plymouth Memorial Hall Bldg, Court St (Rte 3A). **HOURS:** 9am-3pm. **ADMISSION:** $2, under 12 free. **FEATURES:** H. **DEALER INFO:** Tables: Adv $12, Door $14. **CONTACT:** Mayflower ARC, POB 766, Plymouth MA 02362. Jon WS1K, 508-746-0162, Jim NM1F, 508-747-2224.

MA - WEST SPRINGFIELD — MarketPro Computer Show & Sale. **LOCATION:** Eastern States Exposition. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

PA - BETHLEHEM — Computer Trade Show. **SPONSOR:** Peter Trapp Shows. **LOCATION:** Stabler Arena. **HOURS:** 10am-3pm. **ADMISSION:** $6, $1 off w/this ad or coupon, under 12 free. **FEATURES:** C - FP - F/R. **CONTACT:** Peter Trapp Shows, 607-369-2796.

OCTOBER 28-29

MD - GAITHERSBURG — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Montgomery County Fairgrounds. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

NJ - HACKENSACK — Computer Show. **LOCATION:** Fairleigh Dickinson University, Rothman Athletic Center, Rte 4 to Hackensack Ave South, left at first light (Temple Ave). **HOURS:** 10am-4pm. **FEATURES:** C. **DEALER INFO:** 500+ tables. **CONTACT:** KGP Computer Show.*

PA - MONROEVILLE — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Pittsburgh Expo Mart. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

OCTOBER 29

GA - ATLANTA — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Cobb County Civic Center. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

MA - SOUTHWICK — Amateur Radio Fleamarket & Electronics Show. **SPONSOR:** Hampden County Radio Assn. **LOCATION:** Southwick Recreational Center, Powder Mill Rd, off Rte 57. **HOURS:** 9am-? **ADMISSION:** $3. **TALK-IN:** 146.52, 446.00. **FEATURES:** DP - EX. **DEALER INFO:** Tables $15, tailgating $6 per car, set-up 6am. **CONTACT:** Barry Mason N1IJK, 413-747-7010, John Walker N1QXV, 413-572-4592 or Hamfest Committee, 36 Kenwood Ter., Springfield MA 01108-1716. VE Exams: York Phillips, 413-566-3010.

MD - WESTMINSTER — Mason-Dixon Computer & Hamfest. **SPONSOR:** Carroll County & Penn-Mar ARCs. **LOCATION:** Carroll County Ag Center. **HOURS:** 8am-? **ADMISSION:** $5, under 12 free. **TALK-IN:** 145.410. **FEATURES:** C - EX - F - F/R - H - S - T. **DEALER INFO:** Tailgate space: $5, setup 6am. 8ft inside tables: Adv $15, Door $20. **CONTACT:** Larry Martin N3DGK, 410-374-4544. Mason-Dixon Computer & Hamfest, POB 763, Hanover PA 17331.

NY - LINDENHURST — Long Island Hamfest & Computer Show. **SPONSOR:** Suffolk County ARC & Great South Bay ARC. **LOCATION:** Knights of Columbus Hall, 400 S. Broadway. **HOURS:** 9am-4pm. **ADMISSION:** $5. **TALK-IN:** 146.685, PL 4Z 136.5. **FEATURES:** C - F/R - H. **CONTACT:** Andy Feldman WB2FXN, 516-928-3868, Walt Wenzel KA2RGI, 516-957-0218.

NY - POUGHKEEPSIE — MarketPro Computer Show & Sale. **LOCATION:** Mid-Hudson Civic Center. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

PA - NEWTON — Ham & Computer Tradefest. **SPONSOR:** Penn Wireless Assn. **LOCATION:** Bucks County Comm. College, next to Tyler State Park on Swamp Rd.. **HOURS:** 8am-4pm. **ADMISSION:** $5, XYL's & under 12 free. **TALK-IN:** 146.520-PL131.8, 145.250- PL131.8, simplex 146.520. **FEATURES:** C - EX - H. **FEATURES:** Indoor space: $12, outdoor $10. **CONTACT:** Steve: 215-752-1202.

NOVEMBER 4

AL - MOBILE — ARRL Hamfest. **SPONSOR:** Mobile ARC. **CONTACT:** Richard Ireland KD4TTD, 10341 Hwy 188, Grand Bay AL 36541. 334-824-2749.

FL - EUSTIS — Lake County Hamfest & Electronic Expo. **SPONSOR:** Lake ARA. **LOCATION:** Lake County Fairgrounds, @ Ste Rte 44 & Cnty Rd 452. **HOURS:** 9am-5pm. **ADMISSION:** Adv $4, Door $5, under 13 free. **TALK-IN:** 147.255, 442.900. **FEATURES:** DP - E - EX - FP - F/R - H - T. **DEALER INFO:** Tables: $15 (includes one admission), tailgaters: $5 + admission. **CONTACT:** LARA, % Tim Morrison, POB 881, Tavares FL 32778. Tony Summelin: 904-787-1449.

FL - FORT LAUDERDALE — Narisaam Computer Show. **SPONSOR:** Narisaam, Inc. **LOCATION:** Holiday Inn West, 5100 N State Rd. 7. **HOURS:** 9:30am-3:30pm. **ADMISSION:** $5, $4 w/ad, under 12 free. **FEATURES:** AC - C - FP. **CONTACT:** Narisaam.*

FL - WEST PALM BEACH — Free Flea. **SPONSOR:** West Palm Beach ARC. **LOCATION:** John Prince Park in Lake Worth at Mound Circle Picnic Area. **HOURS:** 8am-2pm. **ADMISSION:** Free. **TALK-IN:** 147.135+, 146.670-. **FEATURES:** FP - F/R - H - T. **DEALER INFO:** Sellers: free. **CONTACT:** Marvin Kaskawits KD2CK, 407-683-2930.

FOREIGN

SEPTEMBER 8-9-10

CANADA - MANITOBA, AUSTIN — Hamfest. **SPONSOR:** Manitoba Amateur Radio Museum. **LOCATION:** Manitoba Agricultural Museum, 1-1/2 mi South of Hwy 1 on Hwy 34. **HOURS:** Fri 6pm-9pm; Sat 9am-midnight; Sun 9am-3pm. **ADMISSION:** $5. **FEATURES:** CB-DP-FM-F/R-H. **DEALER INFO:** Tables & tailgaters $5. **CONTACT:** Dave Snydal VE4XN or MARM, 25 Queens Crescent, Brandon Manitoba Canada R7B 1G1.

SEPTEMBER 9

CANADA - ONTARIO, LINDSAY — 3rd Annual Amateur Radio & Computer Flea Market. **SPONSOR:** Victoria-Haliburton ARA. **LOCATION:** Lindsay Fairgrounds, across from K-Mart, next to the hospital. **HOURS:** 9am-2pm. **ADMISSION:** $5. **TALK-IN:** VELNZ-147.195+ and 52. **FEATURES:** DP - F/R. **DEALER INFO:** Commercial table $10, 2 table min. Non-commercial tables $10, no min. Tailgating $5 + admission. **CONTACT:** Victoria - Haliburton ARA, Box 835, Lindsay Ontario Canada K9V 5N3 OR Drew VE3AAU, 705-786-3503 res., Lisa VA3AAU, 705-324-7586 wk.

EVENTS CALENDAR Month at a Glance

SEPTEMBER 1995

SEPTEMBER 1-2-3
CA - Long Beach - HAMCOM 95-Southwest Div Convention

SEPTEMBER 2
CA - Antioch - MarketPro Computer Show*
CA - Santee - Ham, Computer & Electronics Swap Meet
IN - Indianapolis - Hoosier Hamfest & Computer Show
OH - Toledo - MarketPro Computer Show*

SEPTEMBER 2-3
NC - Shelby - 39th Annual Hamfest
NJ - Cherry Hill - PC Dealer Showcase

SEPTEMBER 3
CA - Livermore - Livermore ARC Swap Meet
CA - Santa Rosa - MarketPro Computer Show*
IN - Fort Wayne - MarketPro Computer Show*

SEPTEMBER 6-7-8-9
NY - Rochester - 34th Historical Radio Conference

SEPTEMBER 8-9-10
CANADA - Manitoba - Austin - Hamfest
TX - Arlington - Digital Communications Conference

SEPTEMBER 9
CANADA - Ontario - Lindsay - Radio/Computer Flea Market
CA - Fontana - Amateur Radio & Electronics Swap Meet
CA - Fresno - MarketPro Computer Show*
CA - Reseda - Computer Marketplace
IL - Rolling Meadows - ARRL W9DXCC Convention
IL - Wheaton - MarketPro Computer Show*
IN - Fort Wayne - Summit City Computer Show & Hamfest
IN - Indianapolis - AGI Computer Fair*
IN - Laporte - Hamfest
MA - Wilmington - KGP Computer Show*
MI - Taylor - Computers & You Computer Show
NY - Ballston Spa - 10th Saratoga RACES Hamfest
PA - Bethlehem - Computer Show & Sale
PA - Erie - ARRL Hamfest
PA - Uniontown - 46th Annual Gabfest

SEPTEMBER 9-10
Al - Bessemer - Computer Show
CA - Ventura - MarketPro Computer Show*
NY - Stony Brook - MarketPro Computer Show*
VA - Springfield - PC Dealer Showcase

SEPTEMBER 10
CA - Buena Park - Computer Marketplace
CA - Sacramento - MarketPro Computer Show*
IA - Dubuque - Hamfest/Radiofest/Computer Expo
IL - Harrisburg - Hamfest
IL - Joliet - Hamfest '95
IL - Palatine - MarketPro Computer Show*
KY - Louisville - Computer Fair South
MD - Gaithersburg - F.A.R. Fest '95
MI - Flint - Computers & You Computer Show
MI - Waterford - Computer Show
MO - Monett - Hamfest & Picnic
NH - Portsmouth - Northern Computer Show*
NY - Brewster - Pearlfest '95
PA - Butler - Hamfest
VA - Annandale - MarketPro Computer Show*

SEPTEMBER 15-16-17
IL - Peoria - Superfest '95

SEPTEMBER 16
AZ - North Scottsdale - Family Amateur Radio Event
CA - Palm Springs - MarketPro Computer Show*
CA - Santa Barbara - Computer Marketplace
CA - Santee - Ham, Computer & Electronics Swap Meet
MD - Hunt Valley - MarketPro Computer Show*
MI - Hudsonville - Super Swap '95
MI - Taylor - Computer Show
NM - Santa Fe - Hamfest
NJ - Wayne - KGP Computer Show*
NY - Hamburg - Western NY Section Convention/Hamfest
NY - Poughkeepsie - MarketPro Computer Show*
NY - Syracuse - Computer Show & Sale
OH - Cleveland - MarketPro Computer Show*
PA - Newton - MarketPro Computer Show*
SC - Anderson - Hamfest & Computer Show
VA - South Boston - Fallfest
VT - Randolph - Fall Foliage Hamfest & Computer Show

SEPTEMBER 16-17
CA - San Diego - MarketPro Computer Show*
NJ - Lawrenceville - PC Dealer Showcase
OR - Portland - Ham Fair

SEPTEMBER 17
AZ - Phoenix - Computer & Electronic Swapmeet
CA - Stockton - MarketPro Computer Show*
CT - Newton - Western CT Hamfest
DE - Newark - MarketPro Computer Show*
FL - Boca Raton - Narisaam Computer Show*
IL - Glen Ellyn - Computer Central
IN - South Bend - Camera & Computer Swap Meet
MA - Cambridge - MIT Flea Market
MA - Pittsfield - Hamfest
MD - Baltimore - MarketPro Computer Show*
MI - Flint - Five Star Computer Show
MI - Madison Heights - Computers & You Computer Show
MI - Mt. Clemens - 23rd Annual Swap & Shop
NH - Nashau - Northern Computer Show*
NJ - Pennsuaken - 47th Annual Hamfest & Computer Show
NV - Carson City - Swap Meet
NY - Suffern - MarketPro Computer Show*
NY - Woodbury - ARRL Hamfest
OH - Akron - MarketPro Computer Show*
OH - Cincinnati - Hamfest

SEPTEMBER 22
OH - Cleveland - Computerama USA

SEPTEMBER 22-23-24
FL - Melbourne - Computer Software & Electronic Show
OR - Milton-Freewater - ARRL Hamfest

SEPTEMBER 23
AL - Anniston - Hamfest
NJ - Pennsuaken - KGP Computer Show*
OH - Cincinnati - MarketPro Computer Show*
OR - Bend - Northwest VHF/UHF Conference
PA - Monroeville - MarketPro Computer Show*
PA - York - Computer Show & Sale
RI - Smithfield - MarketPro Computer Show*
VA - Manassas - MarketPro Computer Show*

SEPTEMBER 23-24
CA - Vallejo - MarketPro Computer Show*
GA - Atlanta - MarketPro Computer Show*
IL - Grayslake - Radio Expo '95
NC - Charlotte - Charlotte Area Computer Show
PA - York - 40th Annual Hamfest & Computer Show
VA - Virginia Beach - State Convention/Hamfest

SEPTEMBER 24
CA - Oxnard - MarketPro Computer Show*
CA - Santa Ana - ACP's Computer Show
CT - Waterbury - MarketPro Computer Show*
FL - New Port Richey - Hamfest and Computer Show
IL - Orland Park - Orland Park Computer Show
KY - Ft. Mitchell - MarketPro Computer Show*
MA - Framingham - Fall Flea Market
MA - Taunton - Northern Computer Show*
MD - Gaithersburg - MarketPro Computer Show*
MI - Southgate - Computers & You Computer Show
MO - Cottleville - Swapfest
NY - Yonkers - Electronic Flea Market
OH - Cleveland - ARRL Hamfest
PA - Allentown - Computer Show & Sale
PA - Lancaster - MarketPro Computer Show*

SEPTEMBER 26-27-28-29
CA - San Francisco - Seybold Expo '95

SEPTEMBER 30
CA - Reseda - MarketPro Computer Show*
FL - Fort Lauderdale - Narisaam Computer Show*
IN - Peru - North Central Indiana Hamfest

Events CALENDAR

IN - Terre Haute - Wabash Valley Computer Fair
MA - Fitchburg - MarketPro Computer Show*
MI - Livonia - Computers & You Computer Show
MI - Westland - Great Lakes Computer Expo & Sale
NY - Horseheads - Elmira Interntl Hamfest/Computerfest
OH - Dayton - MarketPro Computer Show*
OK - Altus - ARRL Hamfest

SEPTEMBER 30-OCTOBER 1
AR - Ft. Smith - ARRL Hamfest
CA - San Diego - MarketPro Computer Show*
KS - Wichita - ARRL State Convention
PA - King of Prussia - MarketPro Computer Show*

OCTOBER 1995

OCTOBER 1
CA - Buena Park - Computer Marketplace
CA - Livermore - Swap Meet
FL - West Palm Beach - Narisaam Computer Show*
IN - Huntington - ARRL Hamfest
MA - Rockland - Northern Computer Show*
MI - Port Huron - ARRL Hamfest
MI - Troy - Computer Show
NY - Hempstead - KGP Computer Show*
NY - Queens - Semi Annual Hamfest
OH - Ashland - North Central Ohio Hamfest
OH - Columbus - MarketPro Computer Show*
OH - Lima - ARRL Hamfest
PA - Warrington - Hamarama

OCTOBER 7
AZ - Bullhead City - Fallfest
CA - Santee - Ham, Computer & Electronic Swap Meet
FL - Tampa - MarketPro Computer Show*
ID - Nampa - Hamfest & Computer Fair
IN - Indianapolis - AGI Computer Fair*
IN - Indianapolis - MarketPro Computer Show*
ND - Grand Forks - Hamfest/Computer Fair
NY - Troy - MarketPro Computer Show*
SC - Fort Mill - Rock Hill Hamfest & Computer Fair
TX - Belton - Ham Expo '95
VA - Virginia Beach - MarketPro Computer Show*

OCTOBER 7-8
CA - Pomona - Computer Marketplace
CA - Sacramento - MarketPro Computer Show*
CT - Durham - ARRL State Convention
GA - Norcross - Atlanta Area Computer Show
MI - Dearborn - Henry Ford Museum Vintage Radio Auction
MS - Biloxi - ARRL Delta Division Convention
TX - El Paso - 8th Annual International Hamfiesta

OCTOBER 8
CA - Fresno - MarketPro Computer Show*
CT - Durham - Nutmeg Hamfest/Computer Show/State Conv
FL - St Petersburg - MarketPro Computer Show*
IN - Bedford - Hoosier Hamfest '95
IN - Southbend - MarketPro Computer Show*
MI - Ann Arbor - Colossal Computer Sale
NH - Manchester - Northern Computer Show*
NJ - Lincroft - Shore Area Hamfest/ARRL State Convention
NY - White Plains - MarketPro Computer Show*
OH - Springfield - Hamfest & Computer Show
VA - Richmond - MarketPro Computer Show*

OCTOBER 9
MA - Fall River - Columbus Day Northern Computer Show*

OCTOBER 13-14-15
GA - Atlanta - Expo '95

OCTOBER 14
CA - Santa Barbara - Computer Marketplace
GA - Augusta - Hamfest
MI - Alpena - Hamfest & Computer Fair
OH - Toledo - MarketPro Computer Show*

OCTOBER 14-15
CA - Oxnard - MarketPro Computer Show*
CA - Vallejo - MarketPro Computer Show*
KY - Louisville - Hamfest/State Convention
MA - Marlborough - KGP Computer Show*
TN - Memphis - ARRL Hamfest
VA - Annandale - MarketPro Computer Show*

OCTOBER 15
IL - Centralia - 6th Annual Hamfest
IL - Orland Park - Orland Park Computer Show
IN - Ft Wayne - MarketPro Computer Show*
KY - Louisville - Computer Fair South
MA - Cambridge - MIT Flea Market
MD - Columbia - CARA Hamfest
MI - Flint - Computer Show
MI - Kalamazoo - 13th Annual Hamfest
NJ - Fairfield - MarketPro Computer Show*
OH - Akron - Computer Show & Sale
PA - Wilkes Barre - MarketPro Computer Show*

OCTOBER 20-21
FL - Starke - Hamfest & Computer Show

OCTOBER 20-21-22
CA - Concord - Pacific Division Convention

OCTOBER 21
CA - Santee - Ham, Computer & Electronic Swap Meet
IN - Noblesville - AGI Computer Fair*
MI - Saugatuck - Westshore Hamfest & Computer Expo
MI - Westland - Great Lakes Computer Expo & Sale
NH - Salem - Northern Computer Show*
NY - Buffalo - MarketPro Computer Show*
OH - Marion - 21st Hamfiesta & Computer Show
OR - Medford - Swap Meet
OR - Rickreal - Swap-toberfest & ARES/RACES Convention
PA - Seneca - Ham Radio Auction & Flea Market
SC - Sumter - 9th Annual Hamfest & Computer Show
TN - Gray - Tri-Cities Hamfest

OCTOBER 21-22
AL - Huntsville - Huntsville Area Computer Show
CA - Del Mar - MarketPro Computer Show*
FL - West Palm Beach - Hamfest & Computer Show
KY - Louisville - Computer Fair

OCTOBER 22
CA - Stockton - MarketPro Computer Show*
CO - Golden - RMRL Hamfest & ARRL State Convention
ME - Portland - Northern Computer Show*
MI - Flint - Five Star Productions Computer Show
MI - Southgate - Computer Show
MI - Warren - USECA Swap
NY - Rochester - MarketPro Computer Show*
NY - Syracuse - Computer Show & Sale
PA - Greensburg - Hamfest
PA - Lebanon - MarketPro Computer Show*
PA - Sellersville - Hamfest

OCTOBER 27-28-29
OK - Kingston - Texoma Hamarama

OCTOBER 28
CT - Waterford - Ham Radio Auction
FL - Port St. Lucie - Hamfest '95
GA - Atlanta - MarketPro Computer Show*
IL - Evanston - Chicago TI Int'l World Faire
MA - Plymouth - Amateur Radio Flea Market
MA - West Springfield - MarketPro Computer Show*
MN - St. Paul - Hamfest Minnesota & Computer Expo
MO - St. Louis - ARRL Hamfest
PA - Bethlehem - Computer Show & Sale

OCTOBER 28-29
CA - Pomona - Computer Marketplace
MD - Gaithersburg - MarketPro Computer Show*
NJ - Hackensack - KGP Computer Show*
PA - Monroeville - MarketPro Computer Show*

OCTOBER 29
GA - Atlanta - MarketPro Computer Show*
IA - Des Moines - ARRL Hamfest
IL - Glen Ellyn - Computer Central
IN - Lebanon - Hamfest
MA - Southwick - Amateur Radio/Electronics Fleamarket
MD - Westminster - Mason-Dixon Computer & Hamfest
NY - Lindenhurst - Long Island Hamfest & Computer Show
NY - Poughkeepsie - MarketPro Computer Show*
OH - Marion - 21st Annual Hamfiesta & Computer Show
PA - Newton - Ham & Computer Tradefest

NOVEMBER 1995

NOVEMBER 4
CA - Reseda - Computer Marketplace
CA - Santee - Ham, Computer & Electronic Swap Meet
FL - Eustis - Lake County Hamfest/Electronics Expo
FL - Fort Lauderdale - Narisaam Computer Show*
FL - West Palm Beach - Free Flea
NC - Sanford - CCARS Fall Festival
PA - York - Computer Show & Sale

NOVEMBER 4-5
GA - Stone Mountain - Hamfest '95 & Computer Expo
OH - Cincinnati - Computer Fair
PA - Ft. Washington - KGP Computer Show*

NOVEMBER 5
CA - Buena Park - Computer Marketplace
CA - Livermore - Swap Meet
FL - West Palm Beach - Narisaam Computer Show*
MI - Flint - Computer Show
MI - Lathrup - 1995 Swap & Shop
WI - Kaukauna - Hamfest

NOVEMBER 11
AL - Montgomery - 18th Annual Hamfest & Computer Show
CA - Fontana - Amateur Radio & Electronics Swap Meet
FL - Titusville - 1995 Hamfest
IN - Indianapolis - AGI Computer Fair*
LA - Monroe - Hamfest
NY - Syracuse - Computer Show & Sale
PA - Hershey - Hamfest
SC - Myrtle Beach - Beachfest '95

NOVEMBER 11-12
NC - Durham - Durham Area Computer Show
NJ - Edison - KGP Computer Show*

NOVEMBER 12
MO - Carthage - Hamfest

NOVEMBER 17-18
MS - Ocean Springs - Ham/Swapfest 1995

NOVEMBER 18
CA - Santee - Ham, Computer & Electronic Swap Meet
MI - Westland - Great Lakes Computer Expo & Sale
PA - Scranton - Computer Show & Sale

NOVEMBER 18-19
CA - Pomona - Computer Marketplace
FL - Tampa - Suncoast Radio/Computer & ARRL State Conv.
IN - Ft Wayne - Hamfest/Computer Expo & ARRL State Conv
MA - Wilmington - KGP Computer Show*
TN - Nashville - Nashville Area Computer Show

NOVEMBER 19
AZ - Phoenix - Computer & Electronic Swapmeet
IL - Orland Park - Orland Park Computer Show
MI - Flint - Five Star Productions Computer Show
MI - Madison Heights - Computer Show
NY - Binghampton - Computer Show & Sale
OH - Akron - Computer Show & Sale

November 24-25-26
GA - Atlanta - Atlanta Area Computer Show

NOVEMBER 25
IN - Evansville - 3rd Annual Winter Hamfest
IN - Indianapolis - AGI Computer Fair*
PA - Harrisburg - Computer Show & Sale

NOVEMBER 25-26
NJ - Pennsauken - KGP Computer Show*

NOVEMBER 26
CA - Santa Ana - ACP's Computer Show
KY - Louisville - Computer Fair South
*See Computer Show Promoter Info Box

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TYPE or PRINT your **ELECTRONICALLY RELATED** ad copy **CLEARLY (not all caps)** on the form provided or on a separate piece of paper. 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 photo 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). Enclose your name, address, and *Nuts & Volts* account number from your mailing label (if available) for identification purposes. Include full payment – **CLASSIFIEDS ARE RUN ON A PRE-PAID BASIS ONLY** – and mail your completed order to: **NUTS & VOLTS MAGAZINE**, 430 Princeland Court, Corona, CA 91719.

RATE PER WORD

The ad rate for **current PAID subscribers** is **30¢** per word. All others pay **60¢** per word. These rates apply to the first 150 words of your ad. From 151-200 words, the rate per word doubles to 60¢ and $1.20 respectively. We do not accept ads over 200 words. There is a **$4.50 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 (e.g., Ohio = OH). A phone number is one word. It will be most helpful if you would spell out words when submitting handwritten copy.

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 or reduce line art, or **$8.00** for halftone of photographs. To **BOX** your ad, include an additional **$25.00** for copy-only ads, or **$50.00** for ads with artwork or photos.

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You may fax in ad copy or changes before the closing date (5:00pm on the 10th) at 909-371-3052 using MasterCard or Visa. Be sure to include the credit card expiration date, the name that appears on the card, a daytime phone number, and your *Nuts & Volts* account number. Ads faxed in without credit card information will not be listed as received until payment is received in full. Due to the large number of ads received, **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 (10th of the month) will appear in the following month's issue. For example, ads received by May 10th will run in June. Ads postmarked through the 10th, but received after the closing date, will be placed in the next available issue. No cancellations or changes after the 10th. 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. The magazine is mailed on or before the 1st of the month. 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 30¢ 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 copy.

CHOOSING A CLASSIFICATION

Select the appropriate classification for your ad(s) to appear in and mark it in the space provided below. If no classification is indicated, the ad(s) will be placed in the Misc. Section or wherever we deem most suitable. Available classifications to choose from are:

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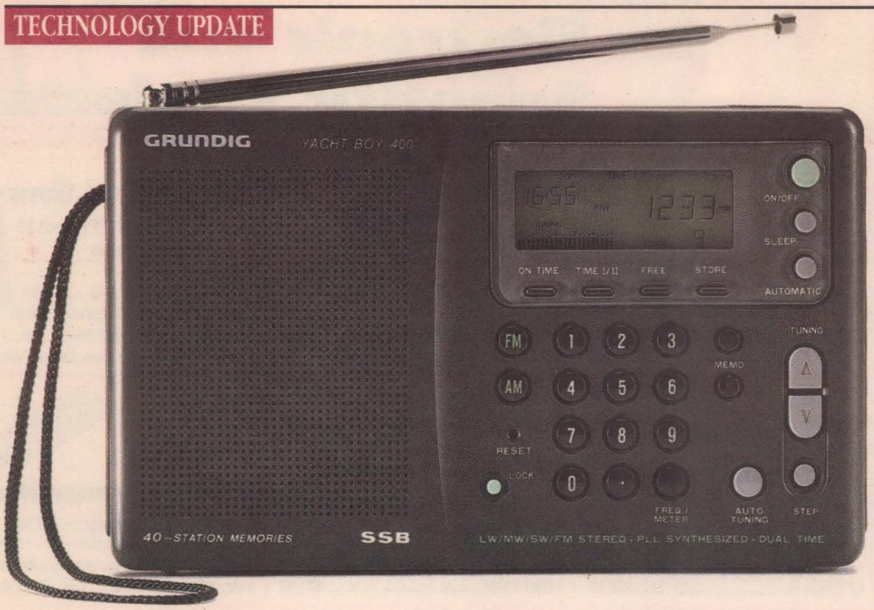

It's 7 p.m. in your Chicago hotel room and you're catching up on the news from Radio Moscow

Whether you're home or travelling the globe, get up-to-the-minute news, weather, sports or music from all over the world.

by Matthew Ziehl

Keeping in touch with the news isn't easy. You can read the paper, but to get the latest news you have to wait until the next morning for the latest edition. TV news broadcasts are only truly up-to-date if they are live, otherwise the same information soon becomes "old news." The last way you'd keep yourself informed is the radio. The only way you can hear the news is between music or on a good AM station—if you can find one and tune it in.

Radio revolution. Now the new Grundig Yacht Boy 400 AM/FM/shortwave radio will change the way you think about radio. The Grundig world travel radio keeps the most current news and financial information coming in from all over the world. It broadcasts directly to you whether you're in Paris, Texas or Paris, France.

The Yacht Boy 400 is portable and small enough to fit into a jacket pocket or a purse and weighs only two pounds. You can take it with you absolutely anywhere. It operates on three AA batteries, but also has a port for an external power source.

Broadcasts from around the world. The Yacht Boy 400 is truly a technological innovation. To receive broadcasts from around the world, the Yacht Boy 400 covers *all* shortwave bands (1.6-30 MHz) without gaps. To listen to your local radio station, simply switch to AM or FM tuning. Tune in signals using the dial or the built-in keypad. Plus its 40 randomly programmable presets allow for quick access to favorite stations.

Clock radio. The Yacht Boy 400 radio can be programmed to automatically turn on or sound an alarm by using the *auto on* feature. If you want to catch an early program or just wake up for work, simply set the alarm. Other features include *sleep* and *snooze* and dual alarm modes: radio and beeper. With the multi-function Liquid Crystal Display (LCD) you can easily check the time in the dark.

Use it all day long. Imagine your typical day. It's 5 a.m. and you are awakened by the radio on your Yacht Boy. While you're getting ready in the bathroom you tune in to BBC London and listen to all the latest events before work. After your morning meetings you pick up some amateur radio. In the afternoon you have some time to catch a few minutes of the soccer game between Spain and Italy. On the way home you flip on the news again, but this time it's Radio Beijing. After dinner you tune in to an exotic music special coming directly to you from West Africa. Finally, before bed you set the Yacht Boy alarm.

Risk-free home trial. The Grundig Yacht Boy 400 is backed by Comtrad's exclusive risk-free home trial. Try it. If you're not completely satisfied, return it within 30 days for a full "No Questions Asked" refund. The Yacht Boy 400 is also backed by a one-year manufacturer's warranty. Most orders processed within 72 hours.

> "*World Radio & TV Handbook* calls Yacht Boy 400 "the best value portable radio on the world market."

Special limited-time offer. If you order the Grundig Yacht Boy now you will receive it at the factory-direct price of only $199. In addition, you'll receive FREE: a carrying case, telescoping antenna and advanced external compact reel antenna, three AA batteries and the *Grundig Shortwave Listening Guide*. Call today to take advantage of this limited-time offer.

Grundig Yacht Boy 400 . . . . . **$199** $12 S&H

Please mention promotional code **763-NV-5817.**

For fastest service call toll-free 24 hours a day

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To order by mail, send check or money order for the total amount including S&H (VA residents add 4.5% sales tax.) Or charge it to your credit card by enclosing your account number and expiration date.

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2820 Waterford Lake Drive, Suite 106
Midlothian, Virginia 23113

TOP FIVE REASONS TO REPLACE YOUR RADIO WITH THE YACHT BOY 400

1 Legendary Sound Quality. Grundig is famous throughout the world for its sound quality. The Yacht Boy 400 has a built-in telescoping antenna and an external reel antenna.

2 40 Programmable Presets. Forty programmable memory presets allow for quick access to favorite stations. Plus PLL-synthesized tuning delivers solid frequency stability.

3 Ultra-wide Range. Continuous shortwave from 1.6 to 30 MHz (with no tuning gaps) covers all existing shortwave bands plus FM-stereo, AM and longwave. Shorter amateur, aeronautical and maritime two-wave communications can be heard.

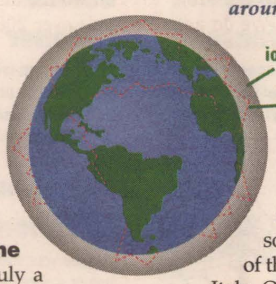
4 Programmable Sleep Timer. LCD simultaneously shows time, frequency, band, automatic turn-on and sleep timer. Sleep timer is programmable in 15-60-minute increments. It features dual alarm and dual clocks which show time in 24 hour format.

5 World News. Listen to news broadcasts, including the BBC, live from around the world without commercial interruption.

HOW DOES SHORTWAVE RADIO WORK?

Shortwave signals depend on factors such as the sun, the ionosphere and even the earth itself to broadcast around the world. The ionosphere is a cloud-like layer surrounding the earth consisting of ions and electrons. The process by which these radio waves travel is called radio wave deflection and ionospheric propagation. In simple terms, radio waves travel the earth by bouncing around. Once transmitted from earth, the radio waves travel up, bounce off the ionosphere back down to earth and up again. This process repeats several times. Because this takes place at low angles, radio waves travel great distances with every bounce taken.

Many of the major countries use shortwave radio to transmit broadcasts for worldwide listening. There are international broadcasts that are specifically intended to be heard by North American audiences.



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EJK1KM-N Easy to Assemble Kit $24.50

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XFM1K-N $39.50

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Listen to calls over any FM radio
• Tunable 70 - 130 MHz
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• Only transmits during phone use
XFT300K-N.....$29.50

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Rebroadcast VCR, Tape Recorders, Stereo to any TV or FM Radio
• Eliminates Wires & Cables
• Wide Band Operation • 70-130 MHz
RWM3K-N.....$24.50

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For Homing & Tracking up to 3 Mi
• Works with any FM radio • 70 - 130 Mhz
• Use for Hunt Games, Vehicles, Animals, etc. HOD1K-N.....$24.50

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• Sub Mini Design
• Universal Battery/12VDC/115VAC oper.
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Aim at room window and listen to sounds from within using reflected light. *Caution - Not for Illegal Use!* Includes ready-to-use 5mw laser and long range laser receiver kit. # LWB3K-N $149.50

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Projects charged ions that induce shocks in people and objects without any connection! Great science project as well as a high tech party prank!
IOG30N Ready to Use $99.50
Higher Powered Lab Version:
IOG7K-N Kit $99.50
IOG70-N Ready to Use $149.50

ALL NEW! Powerful Home Security Telecom - Infinity Transmitter

Access on premises, ongoing phone calls, phone break-in capabiltiy, control of electrical functions such as lights, alarms etc. *Caution - Check Legality in Your State!*
TELECOM2K-N Kit, w/PC board ..... $149.50 TELECOM20-N Ready to Use $199.50

Voice Changer Telephone

Disguise your voice! Sound like a gruff old man or a sweet young girl. • Variable Disguise Control • 10 number memory • Redial/Hold/Flash • Tone or Pulse • Wall or Desk Mount. # VD10-N $99.50
CAUTION: Phone harrassment is Illegal!

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Neat little device will light a 40W fluorescent lamp without contact, yet is smaller than a pack of cigarettes. Many interesting applications. 12VDC or 115VAC.
BTC2-N Kit $29.95

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Visual display of plasma pyrotechnics. 3" arc travels 30" from top to bottom. Unique solid state 12KV transformer, safety shutdown. Req's wood enclosure and readily availble hardware.
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....Pulsed Shocker, ignitor, etc. Electronic Module Kit. PSHK1K-N Kit $29.50

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Neat device - Make hand and shock balls, shock wands, electrify objects, charge capacitors. Great payback for those wise guys! SHK1K-N EZ Assembly Kit $24.50

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Puts subjects under control using highly effective electronic stimuli. Intended for entertainment- Must be used with caution. Includes valuable text book reference and plans. EH2-N Plans and Text Book.. .$19.50

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Detects the presence of living bodies, warm and hot spots, insulation leaks, etc. Use for security, law enforcement, R&D, etc. Dual mode operation.
BHTIK-N Kit $99.50

NEON License Frames

NEON NUMBER LICENSE FRAME

Easy to install, high brightness units. Available in purple, green, or pink. Specify color when ordering. *While They Last!*
LIC-N (specify color) $19.50

Extended Play Tel. Taping System

Automatically records both sides of a call. CAUTION: check local laws for alerting beeper requirements. Ready to use with X4 recorder. TAP40X-N $84.50

Plasma Neon Fire Saber

Active energy field produces the Star Wars effect, visible length of plasma field controlled by grip contact. Choose your color: Photon Blue, Neon Red, Phasor Green or StarFire Purple. FS2K-N $49.50

1000 Ft++ Spud Cannon

NOT A TOY.
Uses electronic or piezo ignition. CAUTION REQUIRED!
POT1-N Plans (Dangerous Product) $10.00

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In addition to the speed and performance computer control offers, the OptoScan535 can also be used with the revolutionary Scout™. The Scout Reaction Tune™ feature allows the Scout to simultaneously tune the Pro-2035 through the CI-V port the OptoScan535 modification provides.

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BASIC STAMP® MODULES

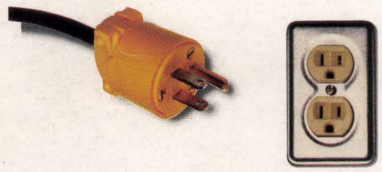
Stamp II has many useful new instructions

BASIC Stamps are perfect for many applications, from controlling model trains to monitoring factory sensors. They have 8 or 16 I/O lines, which can be used for a variety of digital and analog purposes. And to keep life simple, they're programmed in BASIC. Our special "PBASIC" language includes familiar instructions, such as GOTO, FOR...NEXT, and IF...THEN, as well as instructions for serial I/O, button debounce, DTMF tone generation, etc.

The BASIC Stamp Programming Package contains everything you need to program Stamps using your PC. The package includes our editor software, programming cables, manuals, application notes, and free technical support. The package is available for $99; Stamps and carrier boards must be purchased separately.

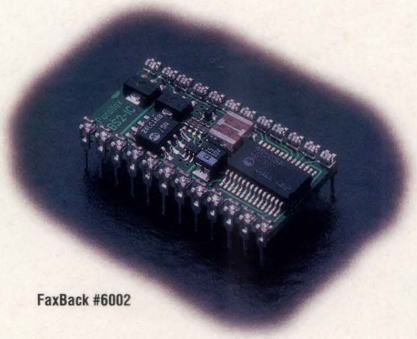
DTMFOUT *

Generates DTMF tones with just one I/O pin, two capacitors, and a speaker. Another related instruction, **FREQOUT**, generates one or two tones simultaneously. Each tone is programmable in 1-Hz increments from 0-Hz to 32767-Hz.



XOUT *

Generates standard X-10 powerline control signals using two I/O pins and an inexpensive TTL-to-AC convertor module. Signals are received by small modules that control lights and appliances. Receiver modules are available from Parallax, Radio Shack, and other convenient sources.



FaxBack #6002

COUNT *

Counts cycles on an I/O pin. Makes tachometer and other count/time programs simple.

BASIC Stamp II Module (BS2-IC)

16 general-purpose I/O lines
2048-byte program space (600 instructions)
20-MHz clock (38400 baud serial, etc.)
$49, $69 with optional carrier board

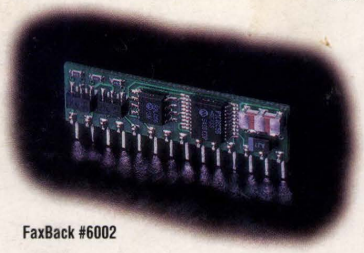
** Only available on the Stamp II.*

SHIFTOUT *

Uses two I/O pins to control common serial-to-parallel shift registers. Can be used as a means of controlling many devices without using too many of the Stamp's I/O pins.

74HC595

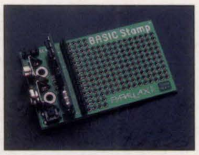
OUT1	1	16	VCC
OUT2	2	15	OUT0
OUT3	3	14	SERIN
OUT4	4	13	$\overline{OE}$
OUT5	5	12	RCLK
OUT6	6	11	SCLK
OUT7	7	10	$\overline{SCLR}$
GND	8	9	OUT7'



FaxBack #6002

BASIC Stamp I Module (BS1-IC)

8 general-purpose I/O lines
256-byte program space (100 instr.)
4-MHz clock (2400 baud serial, etc.)
$34, $49 with optional carrier board



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