NUTS & VOLTS
MAGAZINE

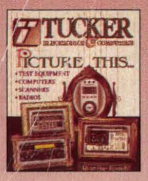
$3.00
VOL. 15 NO. 8
AUGUST 1994

Exploring Electronics And Technology For The Hobbyist And Professional

Put an end to boring lighting with the LFX Programmable Controller – an inexpensive, easy-to-program Lighting Effects Generator.

- **Covert Vehicle Surveillance Systems – Part 1**
- **Inverters and Chargers Combine Forces**

. . . plus more



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PRE-OWNED QUALITY

Fluke 8022B $99

Digital Multimeter

The 8022B is a pocket-size digital multimeter that is ideally suited for applications in the field, lab, shop or home. Offers all standard DMM measurement functions including AC & DC Volts, AC and DC current and resistance. Features a high contrast 3 1/2-digit LCD display that can be easily read from across the room! Each range has full auto-polarity operation, overrange indication, and effective protection from overloads and transients. Long term calibration stability- 2 years. Easy calibration- few adjustments. DCV: 200 mV to 1000 V f.s.; ACV: 200 mV to 750 V f.s. (45 Hz to 450 Hz); AC & DC current: 2 mA to 2000 mA f.s.; Resistance: 200 Ω to 20 MΩ f.s.

HP 10833 A,B,C,D

HP-IB Interconnection Cables

10833A $35
10833B $35
10833C $30
10833D $35

We recently purchased a quantity of HP-IB cables and we're passing the savings to you! These are quality HP cables and feature a connector block at both ends. Each HP-IB cable has a plug on one side and a matching receptacle on the other, allowing several cables to be connected in parallel.

Cable length: 10833A, 1 meter (3.3 ft.); 10833B, 2 meters, (6.6 feet); 10833C, 4 meters, (13.2 feet); 10833D, 0.5 meters (1.6 feet).

PRE-OWNED QUALITY

HP 1741A

Storage Oscilloscope

$995

FACTORY NEW CRT

What a deal on a dual channel storage oscilloscope with a NEW CRT! That's right, for a limited time we're offering our HP 1741A with a brand-new $2000 Storage CRT. You won't find a better price on an excellent dual channel storage oscilloscope. The ease-of-use and reliability has continued to make this scope a highly desired instrument covering a wide range of applications. Sensitivity of 5 mV/div to 20 V/div and 200 cm/μS variable persistence & stored writing speed allow for outstanding signal viewing. Sweep rates of 50 nS/div to 2 S/div are available. Other features include: minimum blind time and auto intensity circuitry, third channel trigger view and selectable input impedance. This is the right scope at the right price and with a new $2000 CRT...how can you go wrong?

HP 204C $249

Oscillator

The HP 204C is a small, lightweight capacitive-tuned oscillator. AC line or rechargeable battery operation makes this instrument ideal for both field and laboratory use. The HP 204C provides frequency from 5 Hz to 1.2 MHz in 6 overlapping ranges with a flatness of ±0.5% (from 100 Hz to 300 kHz). Delivers an output voltage of >2.5 V rms (10 mW or +10 dBm) into 600 Ω. Includes Sync Output >100 mV rms into <100 pF over entire range.

PRE-OWNED QUALITY

PRE-OWNED QUALITY

HP 4260A $395

Universal Bridge

The HP 4260A is a simple bridge to operate. Set the function knob for the parameter to be measured, adjust range switch for on-scale indication, and obtain a null with CAL control. There are no interacting controls to adjust or re-adjust, or any fake nulls. A unique electronic auto balance circuit solves all these problems. Components with low Q or high D are as easy to measure as those without loss. Five bridge circuits are incorporated in the 4260A, each is composed of stable, high-quality components for good accuracy and linearity. An internal 1 kHz signal drives the bridge.

- Capacitance range: 1000 pF to 1000 μF
- Inductance range: 100 μH to 1000 H
- Resistance range: 10 Ω to 10 MΩ
- Internal oscillator: 1 kHz.

Logimetrics 920-S101

Signal Generator

$395

PRE-OWNED QUALITY

The 920-S101 is a general purpose solid-state instrument, used for generating accurate CW, amplitude modulated, or frequency modulated signals over the 11 MHz to 80 MHz frequency range. The frequency range is covered in three over-lapping ranges. This unit is easy-to-use and the front-panel is logically designed so that quick setups are possible even with inexperienced users. Output frequency is displayed by a direct digital readout. The 920-S101 provides a continuous real-time calibration of the output frequency throughout the operating range of the generator. Internal 1 kHz or external (50 Hz to 1 kHz) signal may be used for AM modulation. In the FM mode of operation the RF signal may be modulated by an internal 1 kHz signal or by an external 50 Hz to 10 kHz signal with a deviation or 0 to 10 kHz, or 0 to 20 kHz (selected via the front panel). Calibrated output signal in 10 dB steps from -110 dBm to +10 dBm. Both Amplitude and Modulation are displayed using large, easy-to-read meters.

PRE-OWNED QUALITY

Military ZM16B $49

Resistance Decade

The Military ZM16B offers nine full decades with steps ranging from 0.1 to 10 MΩ (±2%) and high current handling capabilities. The wide range of the ZM16B makes this an excellent substitution box. Also very well suited for loading power supplies with less than 2 A output. Built rugged to meet military specifications, includes steel case with protective lid for storage and transportation.

PRE-OWNED QUALITY

HP 5245L 5253B/2590B

Frequency Counter System with Converter

$449

DC to 15 GHz

The HP 5245L/5253B Frequency Counter System has been the industry standard for many years and we're making it even more dynamic by including the 2590B Frequency Converter. With the 2590B performing as a transfer oscillator and a transfer oscillator synchronizer, you'll be able to make CW frequency measurements inherently equal to the accuracy of the external time base used, even on rapidly drifting signals. While covering the frequency range from DC to 15 GHz, you'll find this system to be very versatile and easy-to-use. Input voltage range of 50 mV to 1 V rms. Measures period, multiple period, average, ratio and multiple ratio with measurements read directly from an 8-digit display. The timebase has a short-term accuracy of 2 parts in 10-10. The mainframe will also accept a wide variety of other plug-ins (sold separately).

PRE-OWNED QUALITY

Visual Instrumentation Institute 1203

TV Test Pattern Generator

$149

With the VII 1203 you'll save hundreds of dollars over comparable units! Designed for the alignment and performance analysis of closed-circuit and studio television equipment. The 1203 develops complete video signals that will generate the display of precise patterns reliable and easily. The nominal output levels are 1.0 V video (including blanking pedestal), plus 0.4 V sync. Output may be adjusted readily to supply a 1.0 V composite signal of 0.786 V in conjunction with a 0.214 V sync level. Front panel selection permits operation with a non-composite output (no sync) if desired. Functions include: Flat Field, Frame, V Stripe, H Stripe, Window, Gray Scale, Black Reference, V Bars, H Bars, Bars, Dots, Dot Grating, Centering, and Resolution.

PRE-OWNED QUALITY

NEW LOW PRICE

HP 8640B/003

AM/FM Signal Generator

$1995

Covering the highly utilized frequency range of 0.5 to 512 MHz, the 8640B is a solid-state generator designed to provide years of dependable service. Offers calibrated power output from +19 to -145 dBm for most any application. Extremely low noise beyond the 10 kHz offsets, at a 20 kHz offset from the carrier, CB phase noise is < -130 dBc. Frequency stability is <0.05 ppm/hr in the locked mode while accuracy is quite high using the 6 1/2-digit readout. AM/FM modulation is calibrated and metered. Includes option 003 reverse power protection up to 50 W, eliminates instrument damage due to accidental transmitter keying.

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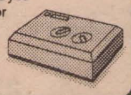
Give your Mac Vision!

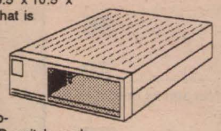
With MacVision (and a video camera) your Macintosh will be able to see the outside world! Capture video stills from any composite video source (camera, VCR, video disk) and you can commit a B & W image to a disk file for editing with your paint program. New in the box unit with cables and power supply. Works with Mac II, SE or Plus, System 4.1+



HSC# 80150 $39.95

The case for external drives...

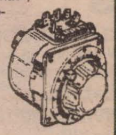
You could make a case against having external drives if your computer case has enough bays, but if it doesn't, don't make a case, buy this one! It is a 9.5" x 10.5" x 2.25" beige plastic case that is perfect for CD or hard disk drives. It features a fan-cooled 40W power supply, two external SCSI 50-pin connectors (for daisy chain installation) and internal ribbon cable, SCSI device ID switch, and audio cable for Sony-type (4-pin) CD ROM drives. All you need is an IEC power cord (not included) and a drive that needs a home! Incredible break-through price, hurry!



HSC# 14783 $39.95

NeatBitz...

A. Variable Autoformer -- commonly called a "Variac", although that name is a General Radio trademark, and these "Powerstats" are made by Superior Electric. 5A rating, variable 0-140VAC output. Used, open frame (i.e. not in a case) with large knob, dial plate. Very handy to have, no test bench should be without one! HSC# 14752 $37.50



B. Ultrasonic Transducer Emitter/Receiver set -- the kind that are so handy for sonic ranging, intrusion detection or control projects. Identical .63" dia. housings have 40 KHz transducers made by Murata/Erie. Receiver is rated at -68dB min. sensitivity, transmitter is rated at 110dB min. sound level. Sold as a set. Specification diagram included. HSC#14682 $3.95

C. Camera flash unit -- (not shown) consists of a 2" x 2" printed circuit board of irregular shape that has a 1" long strobe tube with lens and reflectormounted on one side, and circutry mounted on the other. Add 1.5 VDC (an AA cell will do), and a momentary switch, and "flash" you're in business! HSC# 14702 $3.95

D. HPIB Cable -- genuine Hewlett Packard (#92220R) HPIB/GPIB interface cable, 1 foot long. Has dual stackable 24-cond. connector at each end (one is right angle). Fully shielded, rugged metal hoods. HSC# 14803 $12.50

E. Auto Cigarette Lighter Plug w/Coiled Cord -- perfect for radar detectors, handy-talkies, CD players, etc. Coiled cord is 8 ft. long, with a set of adaptors for most types of input jacks, good for 2A @ 12VDC. Compare at $9.95 at the Shack! HSC# 14747 $2.95

Macintosh Scanners

Don't re-type that document into your Mac...don't try to paint the Mona Lisa with your mouse...just say "Scan it!" with these handy scanners by Animas!

A. 256 Gray Scale Hand Scanner -- SCSI interface, 100 to 400 dpi, eight-bit (256 shades of gray), 4.134 inch scan path. Image enhancement software with customizable tool & filters palette, edge detection, etc. New in box with adaptors, cables, manual & software. Requires Mac SE/30 or II family, 8-bit video card, 2 MB RAM. 90-day warranty. HSC# 14808 $79.95

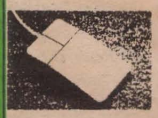
B. "Speed Reader" B&W Hand Scanner -- SCSI interface, 100 to 400 dpi, dithered or Black & White modes, 4.134 inch scan path. Handy for scanning halftones. line-art, etc. "MacSee" software is a simple B&W paint program for editing your images. New in box with adaptors, cables, manual & software. Use with your own OCR software (sorry, we don't have any) for text recognition. Requires Mac Classic, SE, LC, SE/30 or II family, 1 MB RAM. 90-day warranty. HSC# 14809 $49.95

It's More than a Game...It's History!

They should make more computer games like this one..."Their Finest Hour -- The Battle of Britain" by Lucasfilm Games. It is a historically accurate depiction of the air battles that convulsed England during the summer of 1940, and you can relive WW II history by flying a Supermarine Spitfire or a Junkers "Stuka" divebomber (or one of six other fighters or medium/heavy bombers). You get a realistic-looking cockpit instrument panel on your screen, and your chosen craft's performance is based on the actual abilities of the planes. One of the best things about this game (leave it to Lucasfilm to excel in this area!) is the book that accompanies it. It starts off with a 45 page history of the war up to this crucial turning point, and is interspersed throughout with period photographs, campaign maps, profiles and quotes of important personalities, and discussions of strategies. There are even diary entries from British and German fliers that give first-hand accounts of what aerial combat was like in those desperate days. All that is left to experience the realism of battle is to climb into your "cockpit", grab the joystick and follow the mission plan you have built. You can even turn on a "cockpit camera" to record your battle for later viewing. This game was one of the most popular flight simulation games going a couple of years ago, now you can fly along with the aces, and if you are good enough, change history! What a way to painlessly absorb a history lesson, by living it! IBM/DOS, EGA/VGA, AdLib compatible. HSC#14694 $9.95

Huge Mouse Invasion!

Well, no, enormous rodents are not running around here just yet, but we do have a rather large number of mouse-type pointing devices that are looking for a good home next to your computer! Adopt one today! Eek-eek!

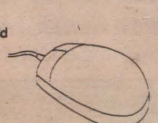


A. High-Quality Optical Mouse (shown at left) -- serial interface (9-pin "D-sub") two-button mouse by Mouse Systems, comes with 7" x 7.75" mousepad. No mechanical parts to wear out or get dirty...no balls to clean! New, with driver disk, OEM version (no book or box). HSC# 14719 $14.95

B. MacPRO mouse -- three-button Mac compatible mouseby Animas (shown at right). 350 DPI resolution, Apple ADB interface (4-pin Mini-DIN) for Mac II, IIc, IIci, IIfx, IIsi, LC, SE, Classic, or other Macintosh computer with ADB port. Programmable "cdev" allows full programmability for all three buttons. You even get a paint program called Colorframe (included on driver disk). New in box with manual, mouse-mat, 90 day warranty. HSC# 14718 $19.95

C. Generic Mouse (Super economy version) -- three-button mechanical mouse for 9-pin "D-sub" type serial interface. New OEM version (sorry, no book, software or fancy box), 100% Microsoft Compatible, should work with most mouse drivers. HSC#14673 $4.95

D. Fat Mouse -- For those of you with big hands and bold strokes! This serial-port two-button device is a larger-than-life mouse measuring 4" x 2.5" and 1.25" at the tallest point, and feels comfortably "fat" to the hand. 100% Microsoft Compatible, 200 cpi. opto-mechanical type mechanism. 90-day warranty. New, sorry, no box or software. HSC#14087 $7.95



Hard Disk Full? Put the Squeeze on your Data with SuperStor!

There are thousands of ironic stories in Software City, this is only one of them... Before Microsoft came out with DOS 6.0, there were dozens of thriving software companies writing all sorts of useful DOS utilities, including several varieties of Data Compression utilities. One company, Addstor, had a pair of products called SuperStor 2.0 and SuperStor PRO, which were finished, functioning, mature products. Giant Microsoft released DOS 6.0 with a data compression utility included, and Addstor saw their market evaporate. They eventually went under. The irony? DOS 6.0 had problems in the data compression utility, which required the birth of DOS 6.2...at the same time, a lawsuit by another utility provider against Microsoft was upheld, which we hear means that DOS 6.2's data compression utility may not be included anymore! Where does that leave Addstor? Still defunct, we're afraid, and no longer offering support, but we bought the remaining stock of their SuperStor and SuperStor PRO packages, and offer them at these amazing prices! We have had reports that Addstor's compression technology was more robust than some of the other companies' schemes.

addstor

A. SuperStor 2.0 will increase your disk capacity, defragment files, and make better use of your disk space. Need DOS 3.2 or later, not compatible with Zenith or Tandy DOS. HSC# 14674 $6.95

B. SuperStor PRO includes Windows-based JPEG/MPEG compression/expansion utilit .JPG, .BMP, .TIF, .TGA and .PCX graphics files (huge benefits, 20:1 compression typica Windows utilities, increased compression and speed over SuperStor 2.0, password protection Tune-up Analyzer, Integral Disk Cache, Compression Preview, automatic transparent data com pression, more! HSC# 14675 $14.95

-- Large quanitities of both types available, dealer inquiries invited! --

Sketch like a pro with HP SketchPro!

Well, the PenMates by Mouse systems featured in last month's ad are long gone. We are sorry if you wanted one but didn't get one, but maybe you will be interested in this item as an "upgrade"...the 7060A SketchPro by Hewlett Packard. It is a medium-format (11" x 11") digitizing tablet with up to 1219 lines per inch resolution, accurate to within .02" and can emulate Summagraphics Bit Pad 2 and Hitachi HDG1111B tablets, as well as a Microsoft Mouse. This allows the SketchPro to be used with most of the popular CAD and graphics programs, such as AutoCAD, Versa CAD and CADKEY. We are offering a brand-new-in-the-box tablet with pen-type pointing device, subtitute power supply and documentation for only $149.00 (list price was $599). A four-button "puck" type cursor is available directly from HP if you prefer that type of input device. We are offering a 90-day warranty on this high-quality U.S. product. If you missed the PenMates, don't miss this one!

HSC#14739 $149.00

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Call or write for current advertising rates.

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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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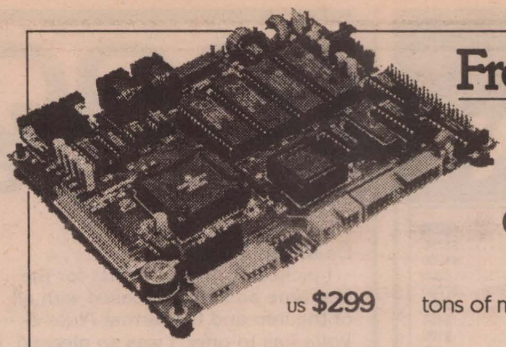

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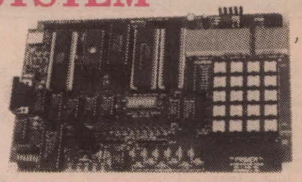

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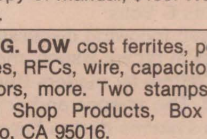

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reader FeedBack

Dear Nuts & Volts:

I picked up *Nuts & Volts* for the first time and I was pleased with all of the info and the format *Nuts & Volts* has to offer. I was so pleased, I put in for a two year subscription. Thanks and keep it coming.

Randi Owen
Tomah, WI

Dear Nuts & Volts:

I built the Voltage Meter, (April N&V), it works very well indeed! Using the 1/2V steps, 12 volt meter, it calibrated well, most steps are within .1 volt! I hand selected the 1KΩ resistors to match, and increased the LED dropping resistors (R 3, 5, 7, etc.) to 1KΩ to reduce brightness & current draw.

Paul R. Goemans
Madison, WI

Dear Nuts & Volts:

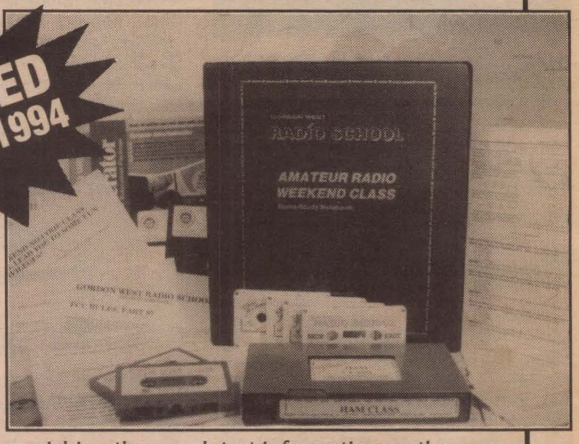
I've been following discussions on antennas in recent issues, most notably letters by readers Uhrig and Winslow. The science and art of antenna systems design have been explored in great depth by the amateur radio community for over 70 years. Antennas, feedlines and the applications thereof are well defined technologies; volumes of data and practical applications articles have been published over the years. In spite of availability of such lay language references, bar-stool discussions of antenna systems about both in print and in working situations. Without going into critical analysis of the discussion cited above, your readers should know that both gentlemen made incorrect assertions.

For persons interested in a working understanding of antenna system design, I recommend acquisition of any antenna books from the American Radio Relay League. Their flagship publication, *QST Magazine*, will be available on newsstands in the next few months; the magazine carries a list of ARRL publications available by mail order. ARRL publications can also be found in many libraries. Further, readers should know that articles in ARRL publications are screened by competent, technical staff. The materials presented are as close to "gospel" as you can get and still be in layman's language.

Robert L. Nuckolls, III
Wichita, KS

AMATEUR RADIO GENERAL UPDATE

REVISED July 1, 1994



The Amateur Radio General Class Element 3B question pool has been revised and will be valid for four years. Hams wishing the very latest information on the new questions should obtain the new study materials.

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COVERT VEHICLE SURVEILLANCE SYSTEMS Part 1

by Peter Lieg

Vehicle tracking systems, generically referred to as "bumper beepers," "bird dogs," or "auto bugs," are an important weapon in the arsenal of most law enforcement agencies, as well as many sophisticated private investigation firms.

Unfortunately, many popular TV detective shows and movies have given a false impression of the accuracy and utility of these units. Scenes of Simon and Simon driving around San Diego with a small box sporting a single short whip antenna and shouting "He turned left!" lead one to believe operation of a tracker system is virtually foolproof. In the real world, this is far from the case.

However, a high-quality device in the hands of an experienced operator can be very effective in tailing or locating a moving vehicle or object by means of zeroing in on a transmitter secreted on the target. The recent location of O.J. Simpson in a moving vehicle by means of tracking his cellular phone transmissions is a good example.

The key word here is "experienced." Even the least elaborate system will perform adequately in a totally open, free-space environment, but all kinds of gremlins pop up in a densely populated urban setting with its attendant reflected signals, interference, and signal attenuation. Practical problems also exist in the covert placement of the transmitter on the target vehicle as well as legal considerations, particularly if the evidence obtained is to be used in a court of law.

We intend to address these problems in a two-part series: first, covering the technical aspects and theory of operation of these units; and secondly, showing how they may best be implemented in the field with tips and techniques to increase their performance as well as a list of common mistakes to avoid.

Vehicle tracking systems are one element of a broader field known by the acronym RDF (for Radio Direction Finding). Much of the progress in this area was due to the efforts of the military during both world wars. Locating enemy ships and troop deployments by homing in on their communications transmissions provided an invaluable strategic and tactical advantage.

In many cases, this was accomplished by using two or more widely separated receivers equipped with narrow beam-width antennas. These antennas would output a greatly increased signal level when pointed directly at the transmitting source. By plotting the bearings of the two antennas, an intersect point could be obtained which represented the location of the sending unit. With high-gain, extremely narrow beam-width antennas, a very high degree of accuracy could be obtained.

Unfortunately, due to the large size of the receiving antennas, this was a fixed-location affair and the need became apparent for some form of portable or mobile receiving device, particularly when tracking a moving target. A single, high-gain, narrow beam-width antenna and a portable receiver could give a bearing indication, but any antenna small enough to be portable did not have sufficient resolution to narrow down the bearing indication to anything less than about 25 or 30 degrees. With only one signal to work with, the distance to the target was impossible to compute.

In addition, moving targets presented the problem of having to continually rotate the receive antenna to peak out the incoming signal, obviously a problem in a moving chase vehicle.

Finally, due to their large size, these antennas were impossible to conceal on the chase vehicle and any element of covert operation was lost.

The best solution, and the one most commonly employed in modern units, utilized some variation of the Doppler principle. Or, in a simpler form, phase shift in a signal received by two or more antennas simultaneously.

The Doppler effect is what you notice when listening to a train passing by. As the train approaches, you hear a steady tone which decreases to a lower note when the train is next to you and decreases even further as the train passes by and is receding. As it moves away, the speed of the train is subtracted from the speed and resultant frequency of the sound and the amount of decrease can be used to compute the speed of the train.

In its simplest form, a Doppler, or phase shift RDF unit, consists of a sensitive receiver tuned to the frequency of the transmitter on the target object and two antennas, generally short, omni-directional whips.

The receiver switches its input between the two antennas at a rapid rate. If the transmitter is on a line perpendicular to the line between the two antennas, each antenna receives a signal identical in amplitude, frequency, and phase since each is exactly the same distance from the transmitter. If, however, the antenna array is rotated off-axis from the signal vector from the transmitter so that one antenna is closer to the source than the other, there will be a difference in phase between the two signals due to the longer distance travelled by the wave hitting the more distant antenna. This difference can be computed to show the angle or bearing of the signal relative to the plane of the two antennas.

Typically, 1/4 wavelength whips are used, separated by 3/8 to 5/8 wavelength of the frequency of the signal transmitted.

For a transmitter operating in the 150-170 MHz business and public service band, this translates to antennas approximately 18-20 inches high separated by about two feet, a much easier array to camouflage on a covert chase vehicle.

In addition, no mechanical rotation or tweaking of the antennas is necessary, allowing permanent installations and one-man operation.

The limitation of two antenna systems is that they plot a bearing vector perpendicular to and through the axis of the receive antenna array and give no indication of whether the transmitter is ahead of you on that line or 180 degrees around, behind you on the same vector.

Using four antennas in a square array and commutating in a rotary manner solves this problem and gives a single bearing indication locating the sender unit's position relative to the receiving unit.

Even with relatively short whip antennas, accuracy on the order of ±5 degrees is readily obtainable and a good, sensitive signal-strength meter on the receiver can indicate distance from the object quite accurately.

The sending unit is generally a small, low-power transmitter slightly larger than a pack of cigarettes (batteries take up the bulk of the space), mounted in a water-proof case and equipped with a powerful magnet assembly to facilitate rapid placement on the target vehicle. Although certain situations occur where the device is installed on a vehicle owned or operated by the same parties doing the tracking (for instance, to keep track of the movement of one of their own cars or to track a vehicle or person involved in an undercover meeting with the bad guys) or when tracking inanimate objects such as packages or other equipment,

most cases involve covertly hiding the transmitter on a vehicle without the operator's knowledge. This necessitates a totally self-contained unit with its own built-in battery power supply.

Since the effective range from which the transmitted signal may be received and processed by the tracking receiver is directly proportional to the transmitting power of the sender, and since battery life is inversely related to power output, several compromises are usually made to increase battery longevity. Obviously, it's a real disappointment to be following a vehicle and to suddenly lose the signal because the batteries went dead. Transmitters are expensive and you can't replace the batteries if you can't find the car. More transmitters have been lost due to dead batteries than due to equipment failure, operator error, road hazards, and discovery of the transmitter by the suspect combined.

One method of increasing battery life is to send a train of short pulses instead of a steady carrier signal. Typically, a duty cycle of 1/4 second on, 3/4 second off will give an adequate signal for the receiving RDF to process and will decrease battery drain by 75%. It also makes it easier to identify the signal when tuning the receiver. Some units will work with a duty cycle as low as one-in-thirty but resolution generally suffers if this parameter is pushed to the extreme; one-in-four to one-in-ten seems to be the optimum range.

Another technique is to use a motion-sensor on the transmitter. Many times, the transmitter must be placed on the target vehicle well in advance of its expected departure. If the only opportunity to covertly install the transmitter is well in advance of its movement, precious battery energy is wasted transmitting from a stationary vehicle.

Many units have a standby mode when stationary, typically one pulse every ten seconds or so. This is too slow for the RDF to lock onto, but it can still be heard from the receiver and indicates the target vehicle has not moved yet. A motion or vibration sensor is built into the transmitter and switches it into the fast mode as soon as there is any activity of the target vehicle.

This method can greatly extend the operational life of the system and gives an immediate indication to the tracker of movement of the target. In addition, legal FCC licensing of the transmitters takes into account the power output of the device and pulsed signals are averaged out over the full duty cycle allowing a higher power unit to be rated at a lower effective radiated level.

Another method is to use a duplex system. The transmitter is equipped with its own internal receiver on another frequency and a signal from the chase vehicle is used to bring the transmitter out of standby and into the active mode. Standard telephone pagers or beepers can be inexpensively employed for this purpose. We'll show you how, later.

Probably the most serious problem with transmitter placement is the physical and electrical environment in which the transmitter has to operate. Electrical interference from the car's ignition and electrical system, extremes of heat and cold, vibration, shock, and rain and moisture can all affect the performance of the unit, but careful design and weatherproofing can minimize these effects.

A much more serious difficulty arises relative to the electrical characteristics of the transmitter placement. In order to prevent the transmitter from being spotted by the target vehicle operator, it is usually attached underneath the car, typically on the gas tank or in a fender well. The antenna, which is normally a short (approximately 18" for 150 MHz.), flexible wire is wound around and in & out of structural members to prevent it from hanging straight down and thereby being noticeable (as well as preventing the likelihood of snagging on a road obstruction and ripping the transmitter loose).

Unfortunately, this places the radiating element of the transmitter underneath and in close proximity to an extremely large mass of metal which seriously degrades its effectiveness.

In addition, the antenna wire often ends up in a horizontal orientation whereas the receiving antennas are usually mounted in a vertical plane. When the antennas are at right angles to each other, the signal captured by the receiving antenna(s) is greatly reduced. This is referred to as "polarization" and every effort should be made to keep as much of the transmitting antenna as possible in the same plane as the receiving antennas. Keeping the transmit antenna as far away as possible from large metal surfaces also helps maximize the effective radiated signal.

Another difficulty arises when using these systems in heavily populated urban areas. Any RDF unit will indicate the direction from which it senses the incoming wave. When there are a large number of high-rise buildings and other surfaces which reflect the transmitted signal, there will often be several wavefronts impacting the receive antenna array simultaneously.

Buildings, chain-link fences, and even trees can all cause reflected signals which can lead to erroneous indications on the RDF unit. This phenomenon is known as "multi-path reception" which is rather self-explanatory.

Most RDF units have a bearing indicator display comprised of a circle of LEDs or a liquid-crystal screen similar to a clock face. When the light at 12 o'clock is lit, it indicates the target vehicle is dead ahead, 9 o'clock indicates a signal from your immediate left, etc.

When multi-path signals are present, it is common for the display to suddenly jump to a reading at some totally different spot on the read-out and then jump back when the multi-path decreases. Essentially, there are "hot spots" of incident reflected signals. Fortunately, driving a few feet farther down the road usually gets you out of the multi-path area and signal indications return to normal.

Standard practice usually involves driving to a spot of high ground such as an overpass or the top floor of a parking ramp to get an initial bearing and repeating this process if the readings become confusing. The theory being, there are a lot less reflections when you're up in a clear space. Driving around down in the canyons formed by one high-rise after another can frustrate even the most patient observer.

Many units also have an audio output of the received signal and will give a pure sounding tone when the received wave is coming in direct, but will shift to a raspy, distorted tone when there are reflected signals being processed.

Experience is your best friend in these circumstances — we'll talk more about this when we get down to the practical nuts-and-bolts aspects of RDF.

Some final words about frequencies, licensing, and legality: RFD units have been used effectively on frequencies from down around 30 MHz all the way up to microwaves (above 1000 MHz). Although you get more distance per watt of transmitter power at lower frequencies (primarily due to better propagation and the ability of the signals to penetrate obstacles and follow the ground contours better than higher frequencies) — which are more "line of sight" — the antennas on both ends must be much larger. This becomes a serious limiting factor for mobile use.

Tuned circuits in the transmitter are also physically larger and make for a bulkier package. On the other end of the spectrum, frequencies above 500 MHz or so allow the use of much smaller antenna arrays. However, the signals tend to radiate in a straight line, have less ability to penetrate intervening structures, and — due to the much shorter wavelength — give poorer resolution when decoded by the RDF unit.

As an example, a currently available unit has an angular resolution of ±5 degrees at 150 MHz, but this deteriorates to ±20 degrees at 450 MHz. This is still a fairly useful indicator, however, and the much smaller antennas on the chase vehicle are desirable in some instances. Practical experience dictates using either the 150-170 MHz band or the 450 MHz business bands. (Many law enforcement agencies are licensed for tactical communications channels between 160-170 MHz.)

Commercial equipment and antennas are readilly available on these frequencies and individuals may easily obtain FCC licenses on these bands. It should go without saying that you should obtain a license for the frequency (-ies) you wish to employ and use only FCC type-approved transmitters.

A call to the nearest FCC field office, listed in most phone directories, will walk you through the licensing procedure.

This generally involves several steps: listening to activity on and around the frequency (-ies) you wish to use to determine whether there are other operators on that frequency; sending a list of those frequencies to an agency such as NABER who will do a frequency co-ordination search to verify the availability of these channels in your area; and finally applying to the FCC for a license on that frequency.

The procedure takes several weeks, but assures you a clear channel for your use. In addition, once you are legally licensed in a given band, there are numerous "itinerant frequencies" set aside for tracker and beacon use on which you may legally broadcast. Sole occupancy of these frequencies is not guaranteed, but it widens the list of channels available to you. **NV**

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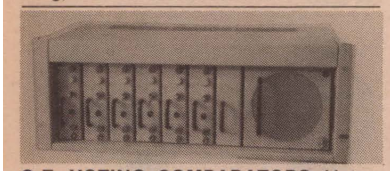

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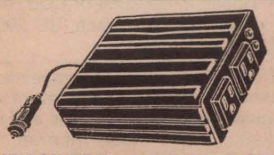

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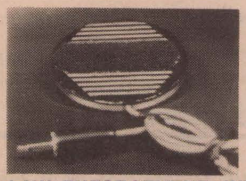

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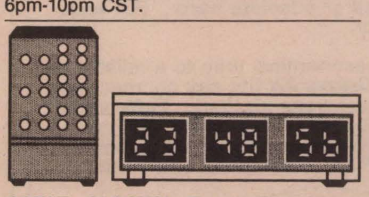

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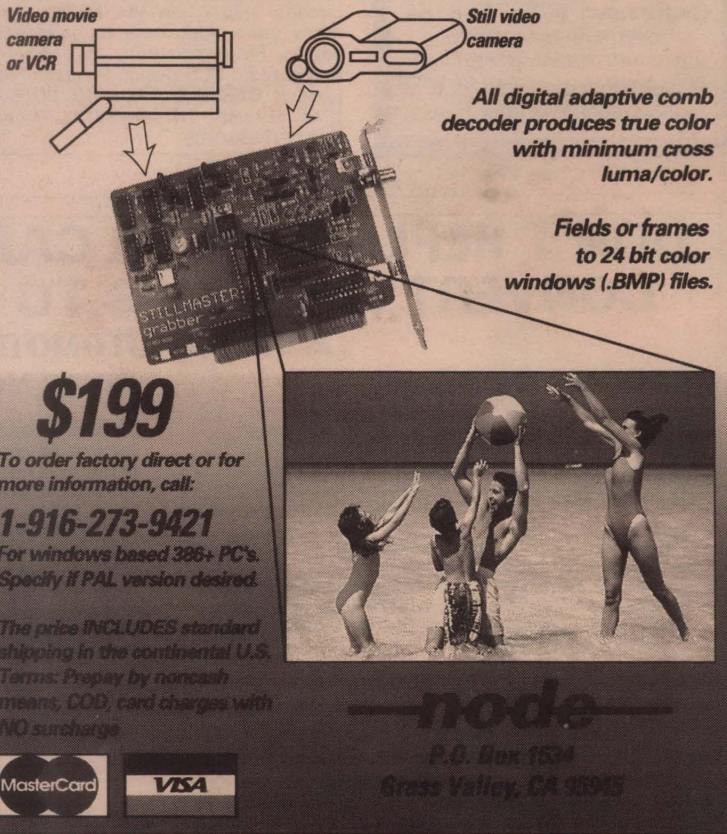

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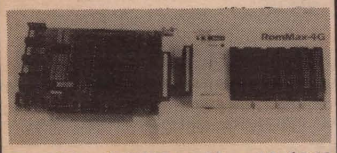

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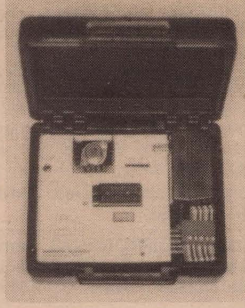

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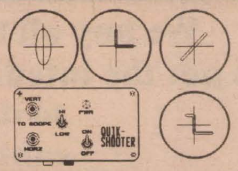

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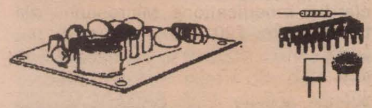

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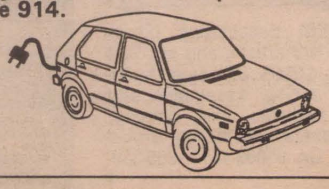

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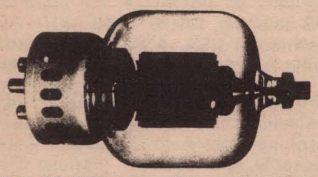

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AN/GRC-142C Radio Teletype sets shelters incomplete sets, fit on pick-up truck beds, many available. Call or write Dave Martin WA6TYJ, 805-239-1932, 4820 Deer Creek Way, Paso Robles, CA 93446.

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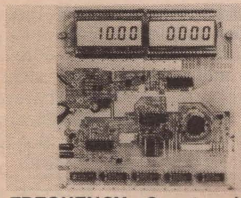

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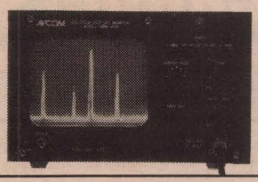

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List price $649.95/**CE price $339.95/SPECIAL**
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Frequency Coverage: 25.0000 - 549.9950, 760.0000 - 823.9950, 849.0125 - 868.9950, 894.0125 - 1,300.0000 MHz.

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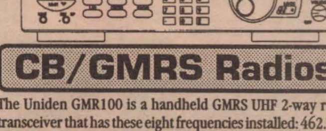

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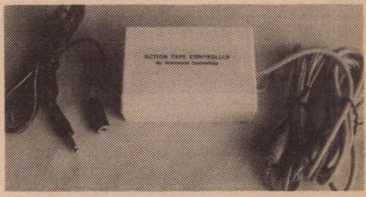

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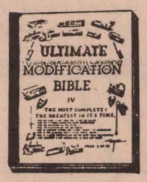

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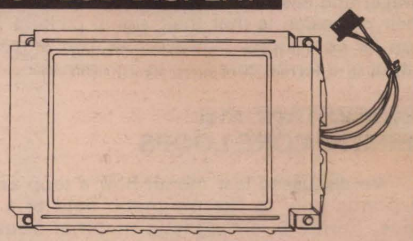

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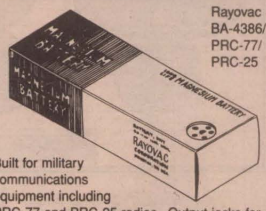

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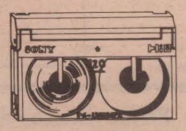

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OPEN CHANNEL

by Harry Helms

FERRITE CORE LOOPS FOR THE AM BAND

Last month, we discussed the theory behind loop receiving antennas for medium wave frequencies and detailed the construction of an air core loop. If you built the loop, you no doubt have been impressed by its performance and also appalled by its size and unwieldiness! However, there is an alternative: ferrite core loops. Ferrite core loops are smaller and easier to construct than air core loops. Their downside is that their signal pick-up is less than air core loops. However, we can amplify the output of a ferrite core loop to compensate.

UNDERSTANDING FERRITE CORE LOOPS

We discussed last month how a loop antenna responds only to the magnetic field of a radio wave. Ferrite is a magnetic material frequently used in inductors to help contain the magnetic field produced by current flowing through an inductor. If we substitute ferrite for air as the core material for a loop antenna, the ferrite will "capture" a surprising amount of the magnetic field of a signal in a small space, making compact loops practical. As mentioned last time, most radios with a built-in AM band antenna use a "loopstick" or "ferrite bar" antenna, which are ferrite core loops. In contrast to air core loops, ferrite core loops are really simple; they're just a length of wire wound around a ferrite rod! Figure 1 shows a basic schematic diagram for a ferrite core loop.

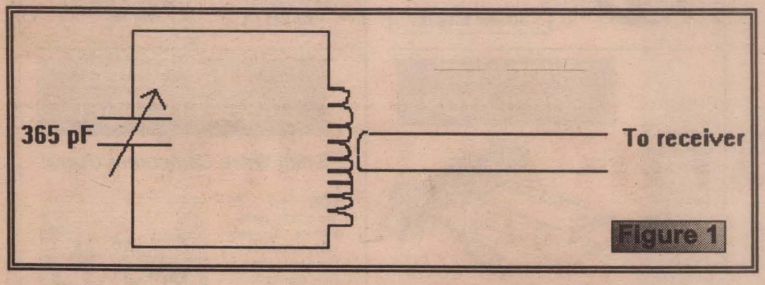

Figure 1

Ferrite rods come in a wide range of diameters and lengths. Most ferrite core loops are built from rods measuring 7.5 to 15 inches in length with a diameter of about half an inch being common. The most important element is the rod permeability. For best results, the rod should have a permeability of at least 125. The larger the rod, or the more rods used, the greater the amount of signal that will be intercepted by the loop.

The small size of a ferrite core loop might make you wonder why anyone would bother with an air core loop. One advantage of the air core loop is much greater signal pick-up. While a ferrite core loop can do a respectable job, an air core loop (like the one described last month) will deliver a far stronger signal to your receiver than a one foot long ferrite core loop will.

Another problem is nulling. While a ferrite core loop also has nulling abilities, an air core loop will deliver deeper and "sharper" (that is, narrower) nulls than a ferrite core loop. A final problem is that the tuning of a ferrite core loop can be influenced by "hand capacitance." If you bring your hand or other part of your body near some ferrite core loops — such as when tuning or rotating it — the loop can be seriously detuned.

However, ferrite core loops do have some advantages over air core loops other than size. For one thing, ferrite core loops are easier to build than air core loops. For another, ferrite core loops can be used with receivers, have internal loopstick antennas for AM, and no external antenna connections, like most portable receivers.

BUILDING A FERRITE CORE LOOP

Ferrite rods come in a variety of lengths, diameters, and prices. (Price, by the way, is not always a good indicator of quality!) If you're interested in building a single rod loop, almost any ferrite rod with a permeability of at least 125 will do fine. If you're interested in building a loop using multiple rods, however, you need to select rods that are very close in length and diameter and are also relatively straight. You can combine ferrite rods side by side (as in a bundle) or even end to end if the ends are flat. Ordinary Epoxy glue can be used to join the rods together; allow the resulting bundle to harden overnight before actually constructing the loop. Figure 2 shows end views of how three or four rods can be bundled together. The more rods you can use, or the larger (in diameter and/or length) the rods, the greater the signal pick-up. However, there is a point of diminishing returns where the additional signal pick-up by adding more rods is not noticeable. In most cases, this point is around 8 or 10 rods.

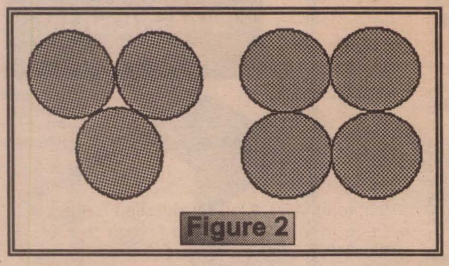
Figure 2

For winding the loop turns, litz wire is preferred. However, #24 magnet wire can be used although signal pick-up will be less. As with air core loops, the support structure must be of wood, plastic, or some other nonferrous material. PVC pipe is very popular since it protects the ferrite rod(s) and windings; select a length of PVC tubing that is slightly greater in diameter than the combined rods and windings. However, you can use any nonferrous base if you glue the windings in place or otherwise take steps to secure the winding. The only other components you'll need are a 365 pF variable capacitor, a piece of nonferrous material — or better yet, a plastic box — for mounting the capacitor, and a tuning knob for the capacitor.

The loop windings should be made over the center two-thirds of the rod or rod bundle, as shown in Figure 3. The spacing between the turns will vary. If you're using a single ferrite rod, you can closely space the windings, such as a turn every 1/8-inch (for best results, make sure the windings don't touch). With multiple rod antennas, space the turns at wider intervals, such as every 1/4-inch.

Before winding the loop, you must decide whether you want to use the loop with a receiver that has connectors for an external antenna or with a receiver that doesn't. If the latter, wind the length of the ferrite, as shown in Figure 3, and leave plenty of wire at both ends so you can connect the 365 pF variable capacitor. If you want to use the loop with a receiver having external antenna connector, skip a couple of turns in the middle of the loop for a link winding as described in last month's column.

The tuning capacitor should be at least a couple of inches away from the ferrite rod(s). Proper placement of the capacitor may take a little experimentation, as you want to avoid "detuning" the loop through hand capacitance when using the variable capacitor. A shaft extension for the tuning capacitor may be needed.

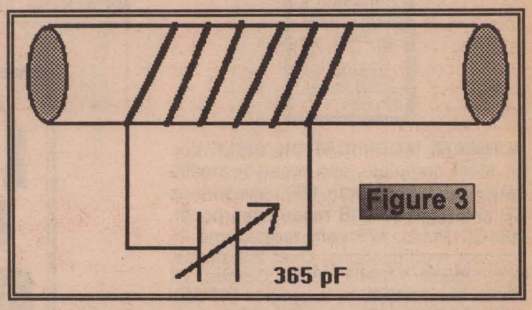

Figure 3

To use the loop with a radio without an external antenna connector, find the approximate location of the internal loopstick within the radio and place your ferrite core loop as close as possible to the loopstick. Don't try to install your ferrite loop inside the radio or use your radio with its cover removed; the ferrite core loop with work fine so long as it's within three or four inches of the internal loopstick. The ferrite loop will be inductively coupled to the internal loopstick, and the ferrite loop will essentially "control" the internal loopstick. As you tune the variable capacitor, stations on the frequency the ferrite loop is tuned to will abruptly increase in strength. When the signal strength is at maximum, the loop is tuned to the same frequency as the radio and the directional characteristics of the ferrite loop will come into play. By rotating or otherwise repositioning the ferrite loop, you can null out unwanted stations and other interference.

One construction possibility — if you use the loop in this way — is to mount the ferrite rod(s) inside a section of PVC tubing and install the tuning capacitor at one end of the tube. This would make it easier to place the loop adjacent to the radio's internal loopstick. Depending on the radio, it may be possible to mount such a PVC tube containing the ferrite loop on the outside of the radio.

If the ferrite loop is used with a receiver having external antenna connection, wind a couple of turns of wire around the space left for the link winding. Attach both ends of the winding to a terminal strip on the side of the ferrite rod(s) opposite the tuning capacitor. Connect a length of coaxial cable or 300 ohm twinlead and run it to your receiver, as described in last month's column. You need to allow some way for the loop to be rotated, such as installing the loop on a "Lazy Susan" plastic turntable or similar arrangement.

While ferrite loops are used mainly for medium wave reception, there have been some experiments in using them on shortwave by connecting both ends of the winding to a broadband antenna tuner (such as that used by hams for antenna matching) and then amplifying the output. The main advantage of ferrite loops at shortwave is their ability to null out local noise sources. **NV**

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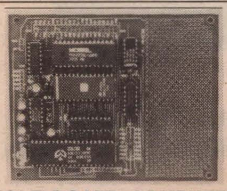

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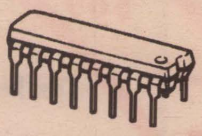

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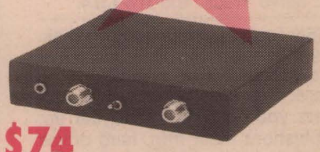

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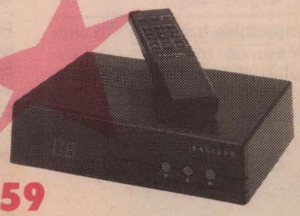

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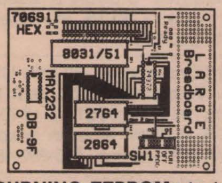

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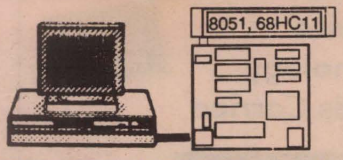

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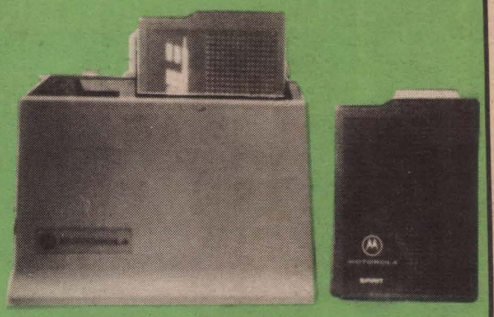

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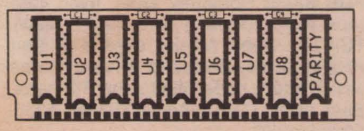

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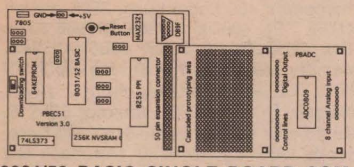

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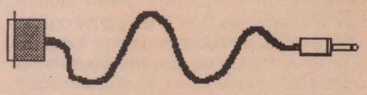

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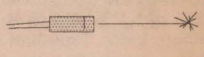

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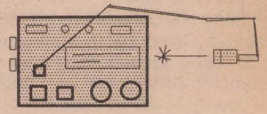

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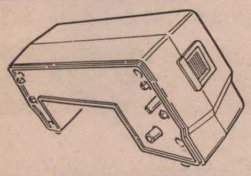

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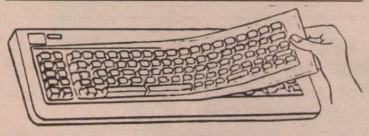

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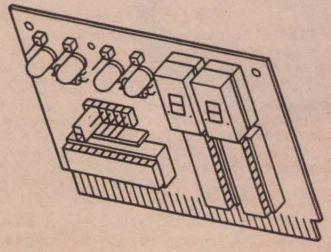

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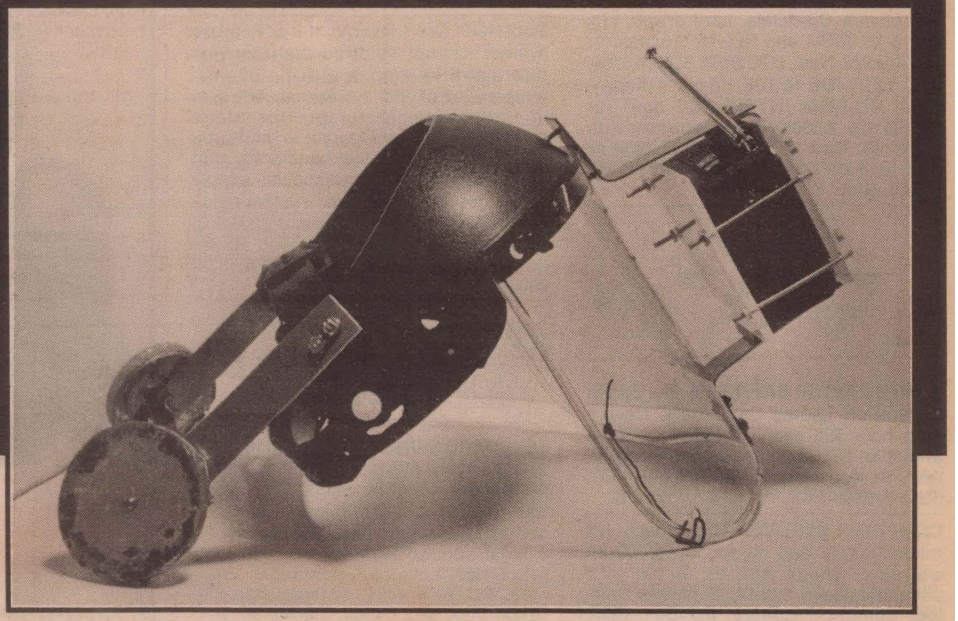
Building a Head-Mounted Visual Display for the VR Environment — Part 2

Construction of the HMD

by John Iovine



The Head-Mounted Visual Display is a challenging project. Unfortunately, we must build it first to procedure the simpler projects and to enjoy the exploration of Virtual Reality.

Choosing an LCD Display

We will use an LCD TV for our display screen. You may use either a black & white or color. To simplify construction, we must choose an LCD TV we can use in the HMD without taking it apart or doing any modifications. The LCD TV should have inputs for an external antenna, power, video, and an earphone (headphones) jack. The screen should be directly viewable, not reflected in a mirror assembly.

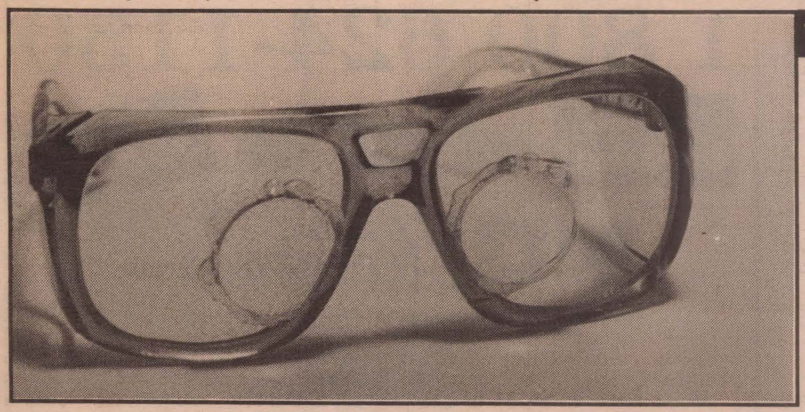
The external antenna jack is needed when we want to use the HMD untethered by wires. In a future telepresence robot (T-bot) project, we will build a simple Video Transmitter. The transmitter sends the video images from a video camera mounted on the robot to Channel 3. *(Note: Depending upon your location in the country, the transmitter can be tuned to transmit on TV Channels 3 or 4.)* The external antenna is needed to receive the pictures.

The Video-In input on the LCD TV is used in conjunction with the VGA-NTSC converter (discussed later). A cable connects the TV to the converter. This is useful when entering VR programs running on the PC. However, it's possible to connect the Video-Out from the VGA-NTSC converter to the video transmitter and use the HMD untethered.

The earphone jack can be used for headphones. The video transmitter is capable of transmitting sound along with the video image.

The TV controls — volume, brightness, tuning, etc. — should be on the sides or top of the TV enclosure. This isn't mandatory, but it makes working with those controls easier.

For the prototype, I chose a Radio Shack LCD color TV part number 16-165. This TV is identical to Casio TV-7500. The TV has a diagonal screen of 3.3". Several LCD TVs meet these requirements. Strive for the largest LCD screen in the smallest enclosure.



1

HMD Optics

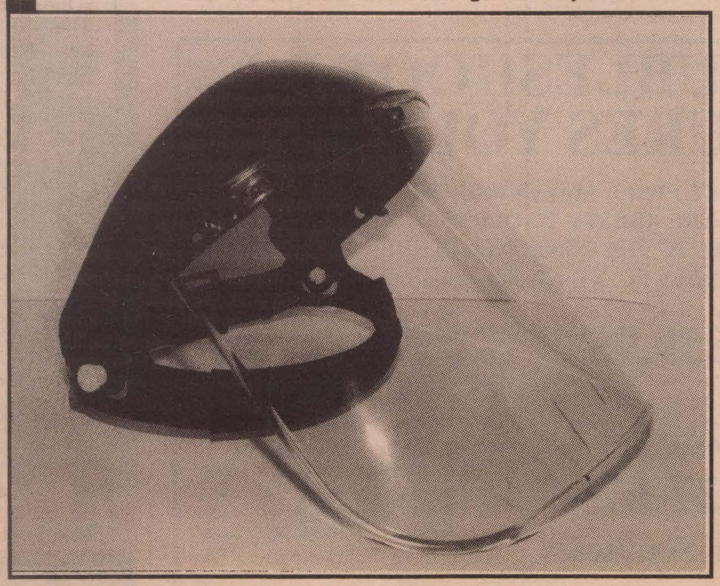
The LCD display in the HMD is too close for the eyes to focus on directly. Therefore, we use a simple optical system, the purpose of which provides the user an image they can focus on.

The optics we are using are two plano convex lenses available from Edmund Scientific or Images Company (see parts list). The diameter of each is about 25 mm (1 inch) with a focal length of 170 mm (7 inches). To place the lens in front of the eyes we use standard eye protection glasses (see Figure 1). These glasses are available from Images Company. The lenses are mounted on the outside of the glasses (flat side toward the glass), using a small dab of Epoxy cement.

To align the lenses for gluing, follow this procedure: Cut a piece of paper the same size as the LCD TV screen with type written text on it. Yesterday's newspaper will provide ample resources for this step. Mount the text on a piece of cardboard the can stand up vertically. Purchase a marking pencil or marker than can write on the plastic glasses. Put on the glasses. Position the lenses in front of your eyes on top of the glasses using one hand to hold each. Position your head and lens so that you can easily read the newspaper text with both eyes open. Hold one lens in position on the glasses and remove the other. With your free hand pick up the marker and mark the position of the lens on the glasses. Try to mark the entire circumference. Repeat for the other side.

When you are finished, you should have two circles drawn on the glasses marking the proper placement of the lenses. Recheck the placement before proceeding by placing them in the inscribed circles. Can you still read the newspaper text easily with both eyes open? If you answer yes, proceed to glue the lens in position. If you answer no, clean the glasses and repeat the alignment procedure.

Glue the lens in position. Since there is no stress placed on it a small amount of Epoxy or hot glue on the circumference will be sufficient.



2

HMD Ergonomic Factors

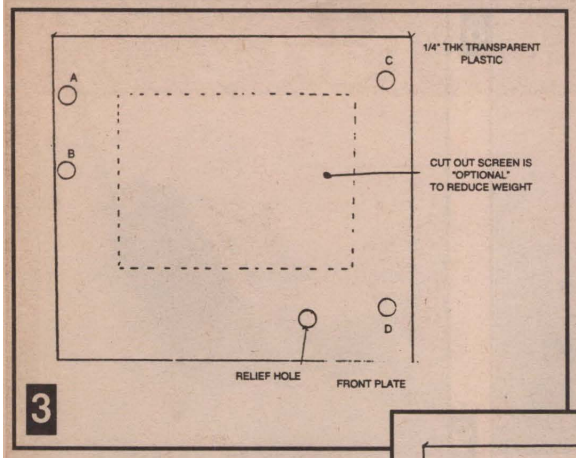
Wearing an HMD impacts on your comfort and restricts extended use. It becomes important to make the HMD as comfortable as possible to wear. A few factors we should consider are:

Adjustability

Adjustability is an important consideration. Consider how uncomfortable wearing shoes that don't fit properly is; you won't wear them for long. The first adjustment is head size. Our HMD unit is adjustable for head size. The second factor is the interpupillary distance (IPD) of the lens system. The IPD of our system is optimized for the user. Even so, the IPD is robust because we are using a single LCD screen. Stereo optical systems require finer IPD adjustments. However, if this system is to be applied in an arcade environment, the IPD should be made somewhat adjustable.

Weight & Balance

Balance is a more important factor than weight. An unbal-



anced HMD is uncomfortable to wear after a short time. We will make the HMD as light as possible, but more important, balance it with counter weights to place the center of gravity on the user's head.

Donning and doffing (accessibility)

Getting in and out of an HMD becomes more important in an arcade system. We use a standard face shield as our HMD shell.

Hygiene

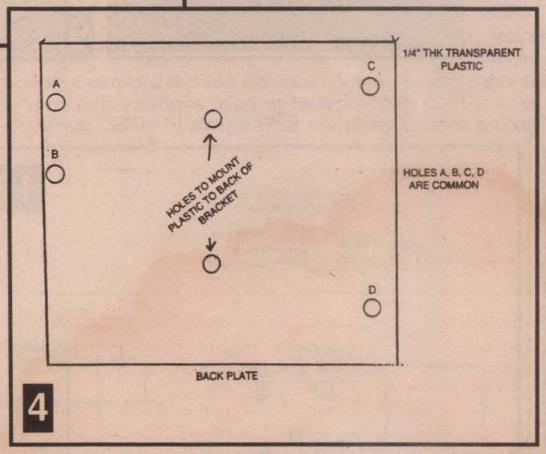
In an arcade environment where HMDs are shared, you must consider the hygiene of the equipment. Cleaning the HMD with disinfectant between users will prevent the transmitting of most diseases.

HMD Shell

We can use a standard face shield as the HMD shell (see Figure 2). The face shield has adjustable head straps that can be sized to each individual's head. The front face plate made of transparent plastic is used to mount the LCD TV.

Use your marker again to outline the housing of the LCD TV on the front plastic. Remove the TV and the paper from the front plastic piece.

Buy an AC adaptor for the TV set. Using an AC adaptor will eliminate the batteries for the LCD TV set in the HMD. Batteries add a lot of weight and must be changed when worn out.



These are two no no's for use in an HMD.

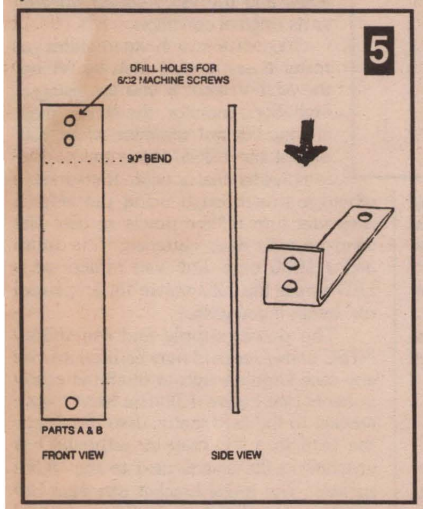
The LCD must be held at a minimum distance to be viewed. To gauge this distance accurately, here is what you do: First, put on the glasses with the close-up lens made previously. Next, put on the face shield. Get a standard 12" ruler and place one end against the face shield, on the bottom of the TV outline, so that the ruler sticks out in front of the shield. Turn on the LCD TV and place it on top of the ruler. Slide the TV back and forth on the ruler and find the closest distance you can easily focus on. Add 1/2" or so distance to this measure. Write this number down. This is the distance that the front (NOT back) LCD TV screen must be placed at to view the LCD screen. We will use this measurement when making the "U" support bracket a little later.

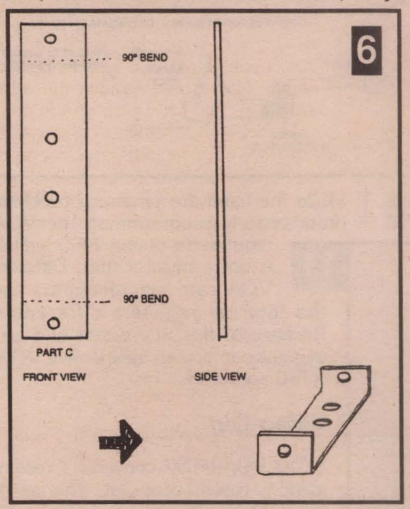
The LCD TV is mounted (sandwiched) between two plastic plates, see Figures 3 and 4. The size of the plastic plates are 4" x 4.5" x 1/4" thick. If I were to do these parts over again, I would use 1/8" thick plastic. The hole placement for the screws are aligned so that the screws do not block any of the TV controls. If you are using the same LCD TV as I have in my prototype, you can use these figures as a template.

Before drilling the holes, tape both plates together to insure accurate alignment of the holes. After the holes are drilled, separate the plates. On one plate that will become the back plate, drill an additional two holes as shown in Figure 4 for mounting the assembly to the U bracket.

Before mounting the TV set, we must make a U bracket that holds the TV assembly to the face shield. I used three 1" x 5 1/4" x 1/16 thick steel plates to fashion the U. It's a good idea to drill the holes you need in the steel plates before bending them. The length of parts A and B will be determined by the distance the LCD TV must be held away from the front of the face shield. When sizing up the length, add 3/8" to the back of the LCD TV to compensate for the foam and plastic back plate. Soft steel plates may be purchased at a local hardware store or from Images Company.

Figure 5 details parts A and B, which are the legs of the U bracket. Make parts A and B identical. Drill two holes on one end and one hole on the other. Next, place one end of the steel plate in a vise, and bend using the flat of your palm.





Part C is illustrated in Figure 6. Begin by drilling the holes as shown. The two center holes are for holding the back plate of the TV mounting assembly. Use the back plastic plate as a guide for drilling the two center holes to insure the holes line up accurately. Then bend both ends as shown in the drawing.

The pieces of steel are held together using #6/32 machine screws with nuts and a lock washer (see Figure 7) to form the U shape. Mount the back plastic plate to the steel U. Figure 8 is a photograph of the U bracket. Notice the foam strips that soften the assembly of the LCD TV.

Place the U assembly on the face shield. Line up the outline of the TV with the back plate. Mark and drill the four holes that will secure the assembly to the face shield.

Line the back plate with strips of soft foam, then place the LCD TV on the back plate. Cut and place additional foam on the front of the LCD TV. Try to place strips of foam around the screen without blocking the screen. Place the front plate of plastic on the front on the LCD TV. Use #6-32 machine screws and nuts to secure the front plate to the back plate (see Figure 9). Make the nuts snug, but do not over tighten as this may damage the LCD TV.

Now secure the U assembly to the face shield, as shown in Figure 10, using the four holes marked and drilled previously. If you put on the HMD after the TV is mounted, you will notice that the face shield droops forward onto your face and threatens to fall off. This is because the HMD is unbalanced.

Balancing Weight

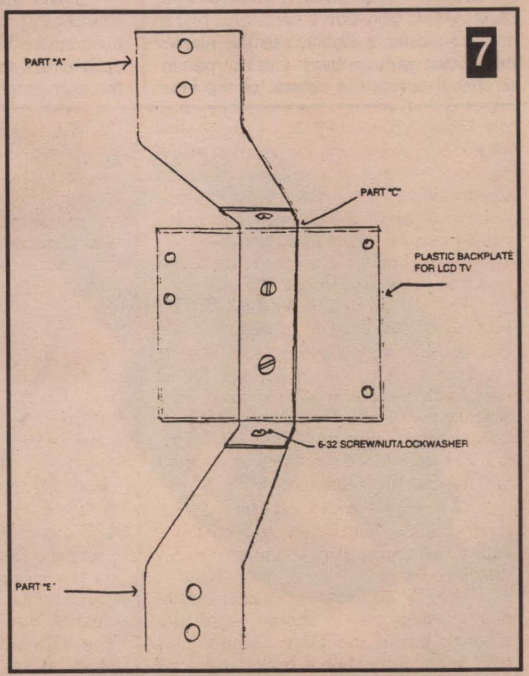
To balance the HMD so it doesn't fall forward, you must add weight to the back. In the prototype, balancing weight is positioned at the back of the HMD. It's important that the balancing weight be connected to the front visor that supports the weight of the transparent face shield, LCD TV, and U bracket (see Figure 11). This places the center of gravity right in line with the user's head.

If, for instance, the balancing weight were connected to the head straps, it would do nothing for balancing the HMD.

Steel plates (the same type used to make the U) are used to make a larger U shape that connects to the sides of the visor and around the back of the user's head. Position the counterbalancing weights on the back of this structure. The amount of weight to use should be about equal to the weight of the LCD assembly. In my case, this worked out to about two pounds.

Making the Weights

You can make the weights from just about anything: lead, solder, shot. I made counterbalancing weights from easy-to-melt electrical solder. If you wish to do this also, obtain solder without a rosin core. The solder can be melted in



The first step is adjusting the face shield to your head. Next, place the text paper used to align the lens on the glasses on front of the face shield. Look in a mirror and align the paper so that it's at a comfortable eye level centered, directly in front of your eyes. Mark the papers' position with your marker. Next, tape the paper in place.

Remove the face shield from your head. Place your LCD TV on the front of the face shield. Align the TV so that the paper covers the LCD screen perfectly.

an old pot, on a kitchen burner under a low flame. Only melt enough solder to make one weight at a time.

For a mold, I used an old drinking glass. Whatever you use, make sure you have two identical molds.

After the solder is completely melted, carefully pour it into an old glass. Allow the solder to cool slowly. *Do not quench the glass in water to speed cooling, this will cause the glass to crack.* When the solder has completely cooled, break the glass and remove the molded solder.

Use the same procedure to make the second weight.

The solder weights are very easy to drill. Drill a center hole in each weight. Use the hole to attach the weights with machine screws and nuts.

Covering

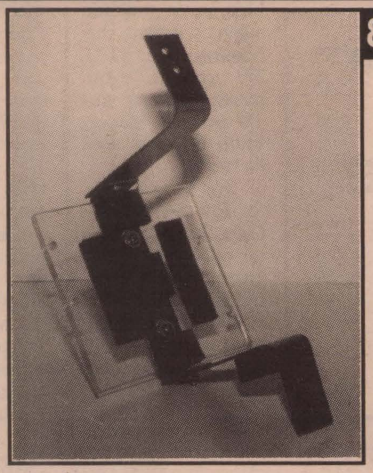
Once the HMD is complete, you may want to cover the front face shield with black opaque plastic to block all visual input except what is given on the LCD TV. If you don't have any black opaque plastic available, use the plastic from black garbage bags. Cut the plastic so that it covers the outside of the face shield and tape it into place. Make sure before you tape the plastic that the TV is set up for HMD operation. First, the LCD TV set should be turned on. All wires for the AC adaptor, remote antenna, and VCR adaptor should be brought out. If the set is manually tuned, set station to Channel 3.

Remember the LCD TV is turned on and off using the power from the remote AC adaptor.

VGA to NTSC Converter

Most VR programs require the computer to have a VGA video card. In order to use an LCD TV (and hence the HMD) with these standard VR programs, we need a VGA to NTSC converter. The VGA output from the video card cannot be used directly to drive a LCD TV. Televisions require a standard composite video signal called NTSC.

There are inexpensive solutions to this problem. Inexpensive VGA to NTSC converters modify the VGA registers through programming to output a RGB signal. From this point, it becomes a simple matter to build hardware that converts the RGB signals to NTSC output.



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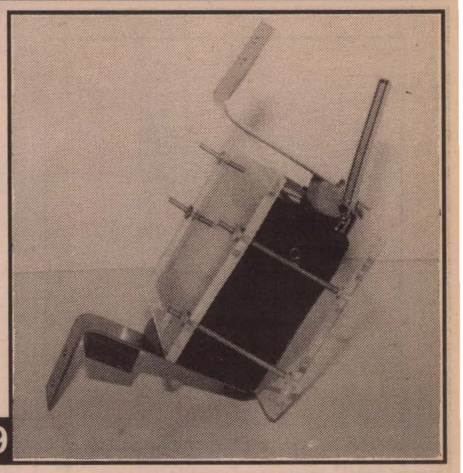

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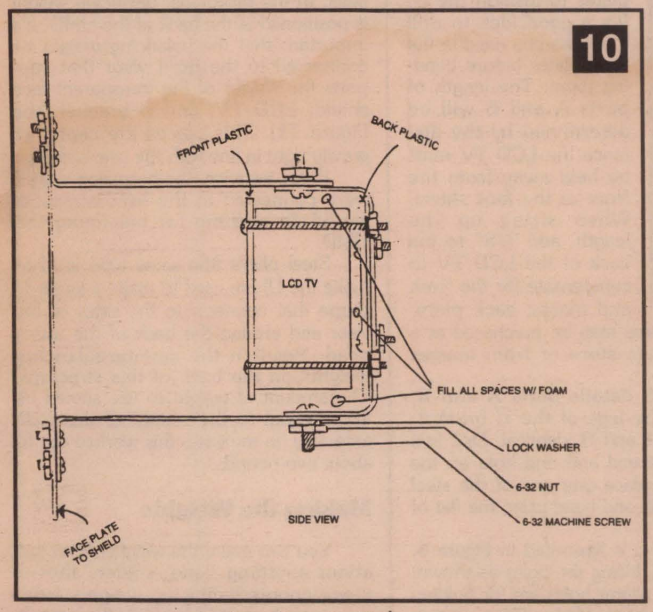

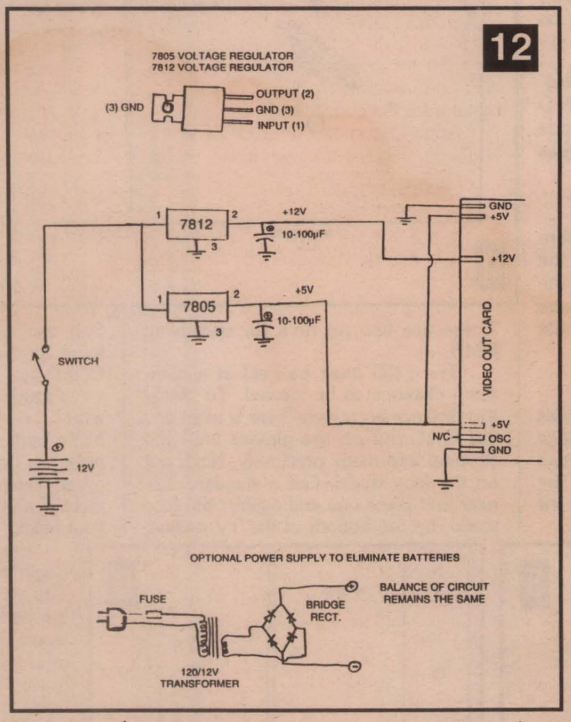

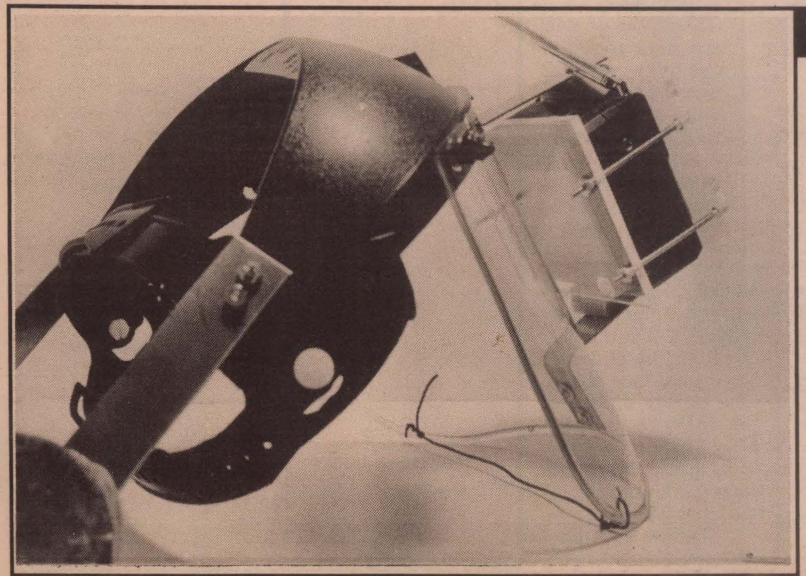

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While the hardware poses no problem, unfortunately programming the VGA registers to output RGB signals is not a trivial matter. Different VGA card manufacturers use the internal registers differently. Because of this, it's easier and less expensive to buy an inexpensive VGA-NTSC converter.

Video-Out

The VGA-NTSC converter I recommend is called Video-Out. The unit is an eight-bit PC card supplied with cabling and software. The unit DOES NOT have to be installed into a PC to work. By supplying the proper power to the card, we can enclose the board to create a stand-alone external unit. The VGA-NTSC is compatible with a large variety of VGA cards.

Figure 12 is a schematic of the power supply board for the converter card. I used a 12 volt battery supply for the unit. You may substitute a 120 VAC/12 VAC transformer with rectifier and filter capacitor for the battery supply, if you wish. Solder the wires from the power supply directly to the converter card.

After the power connections are made to the card, the unit should be tested before enclosing it in a plastic case. Set up the cables as described in the manual that comes with the converter card. There is an RCA type plug on the card that can be directly connected to the Video-In on any TV set. Run the Video-Out program.

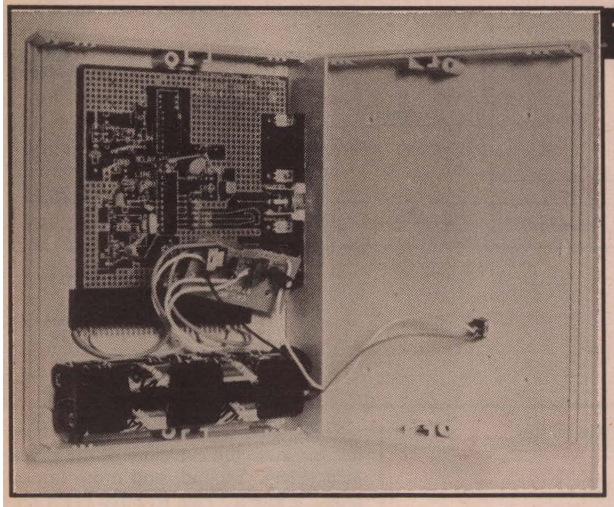
The Video-Out program is a Terminate and Stay Resident (TSR) type program. Once the program is run, it allocates a small portion of RAM for itself in the computer's memory and waits for a Hot-Key combination. The Hot-Key is the ALT and V keys pressed simultaneously. By pressing the ALT-V keys, the converter outputs an NTSC signal. The screen on your standard VGA monitor may appear scrambled, but the video on the TV set will be fine. Hit the ALT-V keys again and the video system reverts to its original condition.

You may switch video states as many times as you wish by hitting the ALT-V keys. If you are using a Multi-Sync monitor, the screen may change but not scramble when you output the NTSC video to the TV — consider that a perk. Remember, when you're through using the NTSC converter turn off the power or you will wind up with dead batteries. You could add a 1000 ohm 1/4 watt resistor and LED across the 12V power for a "power on" lamp, if you wish.

The power supply and the VGA-NTSC converter card may be mounted in any case large enough to fit all the components (see Figure 13). The front metal bracket to the card that is used to mount the card in a PC may be removed by unscrewing the inserts next to the VGA sockets. The metal bracket can then be used as a template to mark the enclosure to cut out holes for the VGA sockets and RCA plug. When the card is fitted into the enclosure, the inserts can be screwed back into the card through the side of the enclosure where the sockets come through to secure the card.

Memory

As stated, the Video-Out program is a TSR-type program and being so might cause problems with some VR programs. I checked out the Video-Out program



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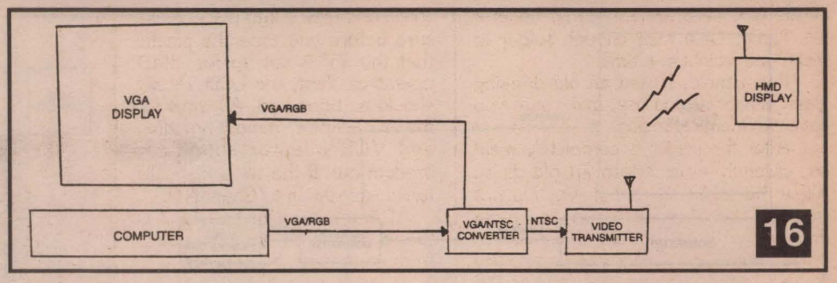
VGA display connection from the computer to the VGA monitor. Figure 15 illustrates inline placement of the VGA-NTSC converter. After the VGA cables have been connected according to the Video-Out manual, connect the RCA-type plug from the VGA-NTSC converter to the Video-In on the LCD TV in the HMD. Power up the VGA-NTSC converter. Run the Video-Out program on the computer. Hit the Hot-Key combination to output the NTSC signal from the converter.



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with the two VR programs, *VR Studio* and *VREAM*, and it works fine with both of them. However, be prepared to allocate memory in case you run into difficulties.

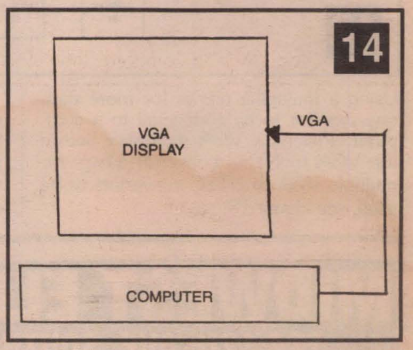
Try Out

Figure 14 illustrates the standard AC adaptor. Put the glasses with the close-up lens on. Next, put on the HMD. With the HMD in place you should be able to focus on the LCD TV easily.

The screen image from the computer should now be displayed on the LCD screen in the HMD. This is just a test to make sure all the equipment is functioning.

Wireless (Untethered) HMD System

As mentioned earlier, we will be building a video transmitter as part of a future project. The video transmitter is kept as a modular component, meaning it may be easily disconnected from the T-Bot system and used elsewhere. By placing the Video-Out of the VGA to NTSC converter to the Video-In on the transmitter, the HMD may receive the video display from the computer without a cable (untethered), note Figure 16.



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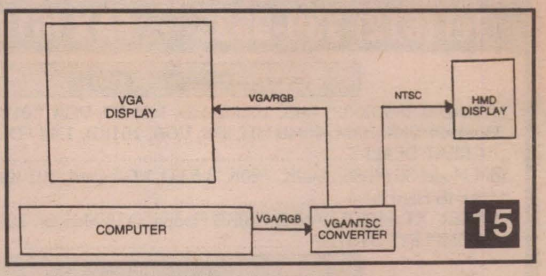

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Simple Multi-Viewer VR System

The video transmitter may be used as the base for a multi-viewer VR system (see Figure 17). A multi-viewer system does not mean multi-user. Although many people can enter the same VR environment, only one person commands the interface into the VR environment. The multi-viewer system allows the operator to take other people along for the ride.

This multi-viewer system assumes that the other HMDs involved are capable of receiving the broadcasted TV signal as the HMD we built is capable of. This may not be the case. Many commercial HMDs can accept a cabled NTSC signal and for that there is another possibility.

VGA Multiplier/Multi-viewer

A VGA multiplier takes a VGA signal and provides multiple VGA outputs.

HMD NOTES

One Screen Stereographic Tricks

A trick can be employed that generates stereoscopic images using a single screen. The screen flashes the right stereoscopic image to the right eye for 1/60 of a second, then flashes the left stereoscopic image to the left eye for 1/60 of a second. The user wears LCD shutter glasses that open and close each eye frame in synchronization with the screen.

In Development

At the University of Washington, the Human Interface Technology Lab is developing the Virtual Retinal Laser Scanner. This experimental system uses a very low power laser to paint an image on the retina of the eye. This system allows a high resolution and high refresh rate. The experimental system exists only as a proof of concept in the lab and is years away from common application.

Future Watch

While it's impossible to accurately predict the future, I would like to offer a few thoughts on the subject. Future displays, for computers as well as VR applications, will become miniaturized to the point where they can be placed upon the eye much like today's contact lens.

Direct input into the visual cortex of the brain is also a possibility. This may sound like science fiction, but it is not. The purpose of this original research is an attempt to restore sight to the blind. Over the past few decades, experiments were carried out that stimulated the vision centers of the brain. This stimulation allowed the blind to see glowing phosphenes.

What's a phosphene? Well, to a sighted individual, the best description I can offer is the after image left from a flash bulb. That glob of light that took a while to disappear is a phosphene. Of course, the phosphenes generated by electrical stimulation are much smaller and pixel-like.

It is interesting to note that the generated phosphenes were immediately recognized as visual information from research patients that had been blind from birth.

In 1955, J.D. Shaw received patent No. 2,721,316 for a system that electrically stimulated the occipital lobe of blind people to inform them of ambient light levels.

In 1968, G. Brindley and W. Lewin developed the first neural prosthesis to stimulate the occipital lobe.

In 1977, another visual prosthesis — the Dobelle — used a matrix of 64 electrodes controlled by a computer. The computer generated geometric patterns that were recognized by the patients. Information gathered showed that there isn't a one-to-one correspondence between electrode placement in the occipital lobe area and phosphenes generated.

New research by Dr. Eugene de Juan, Dr. Mark Humayun, and Dr. Roy Propst begins by stimulating the optical nerve behind the eye using tiny sub-millimeter wire. The team, working out of Duke University's Eye Center in Durham N.C., perform the operation on blind patients. The hope of this research is to graft light-sensitive chips to the human retina to restore vision. The light-sensitive chips are essential artificial photo-receptive neuron replacements. Experiments show that the photoreceptor cells can be placed less than a millimeter apart. This close spacing means that high resolution images can be made available.

In the future, people may have artificial retinas grafted on top of their natural retinas not to cure blindness but to enhance their vision into the infrared and ultraviolet light bands. In addition, computer link-up to the artificial retinas could supply text and graphic information that is usually supplied by standard monitors.

The application to virtual reality is direct; the artificial retina may provide the creme de la creme of virtual reality interfaces.

For those of us who wish to reap the benefits of this technology but are not interested in having grafted synthetic retinas, it will be possible to have nano-photo-multipliers (enhanced vision) and graphic devices implanted in contact lens.

Parts List

Face Shield	$ 24.95
Steel Plates (1" x 5" x 1/16 thick)	$ 1.50 each
Plano convex lens 25mm dia x 170 mm FL	$ 12.00 each
Plain Glasses	$ 5.00
Video-Out VGA-NTSC converter	$ 99.95
6"x6"x 1/4" thick transparent plastic	$ 4.00 each

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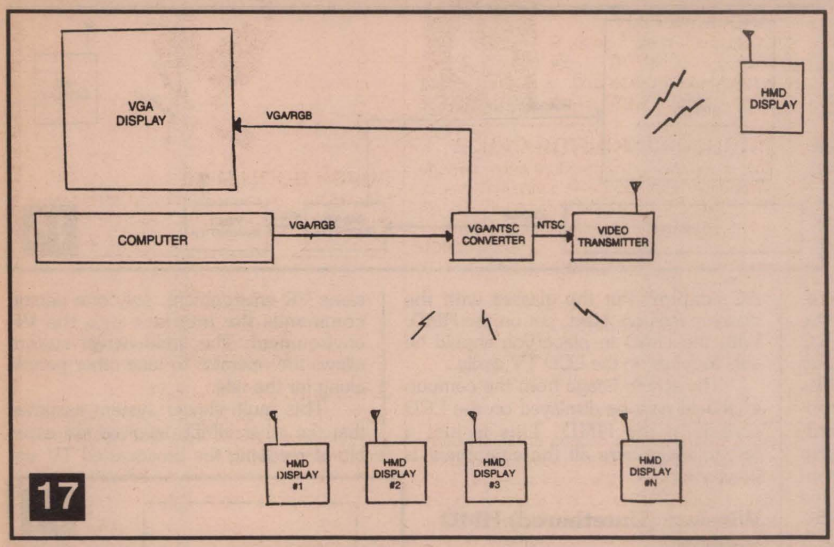
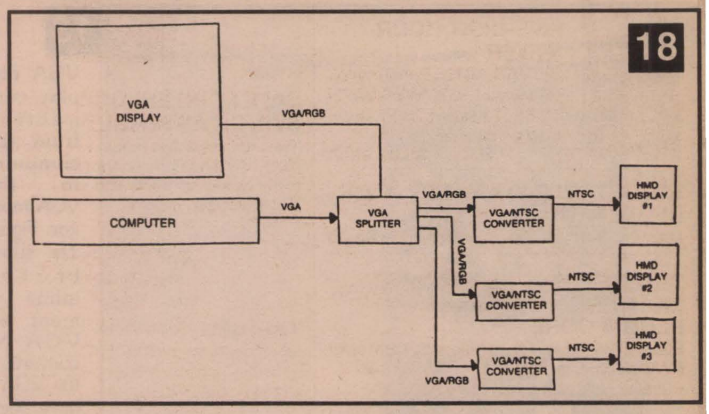


Using a multiplier allows for more than one monitor to be connected to a computer. Placing a VGA multiplier before the VGA to NTSC converter allows for multiple VGA to NTSC converters to be used, see Figure 18.

If the HMDs in use can accept VGA signals, you can eliminate the VGA to NTSC converters in Figure 18. One last multi-viewer possibility is to use a video multiplier circuit. Take the NTSC signal from the Video-Out and run it through a multiplier to the HMDs.



Storage

When I store the HMD, I place it upside down. This prevents the weight from flattening out the front plastic face shield. Also, you may want to secure a wire from each side of the plastic face shield in line with your chin. Align the wire so that it rests comfortably on your chin when you wear the HMD.

The wire serves two purposes: First, it helps keep the curvature of the plastic face shield. Second, and more importantly, it forms a chin rest that helps prevent the HMD from tilting or slipping forward during use.

Displacement of the HMD is so common place, the motion of lifting it back has been coined the "VR gesture."

GOOD LUCK AND GOOD VIEWING WITH YOUR HMD.
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ADJUSTABLE VOLTAGE REGULATOR
LM350K. 3-37VDC @ 3A. (94I019) **$3.25**

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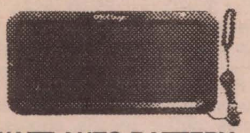
Standard cigarette lighter plug with 4 feet of 22 AWG zipcord. (94J020) **$1.75 each**
• Similar item with 8 feet of 18 AWG zipcord. (94J021) **$2.00 each**



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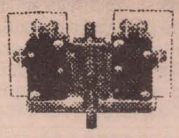

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Two micro switches mounted on one mounting plate. Switches have normally open and normally closed contacts and are actuated by a single plunger. (94B002) **$2.79 each**

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With 6mm coaxial plug. Originally for Canon typewriters. Canon P/N AD-6, new and in original box. (94E005) **$4.95 each**

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4.0V @ 5Ah. Size 3.5" x 3" x 2". Gates P/N 0809-0010/04V.
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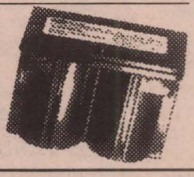

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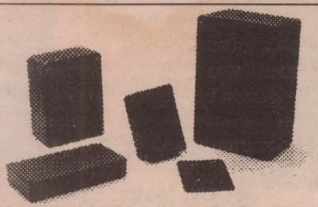

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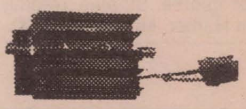

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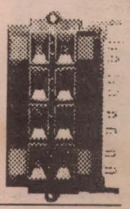

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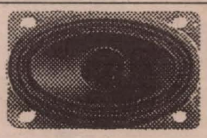

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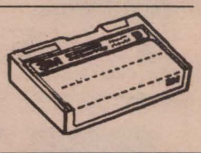

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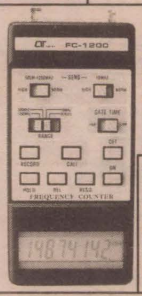

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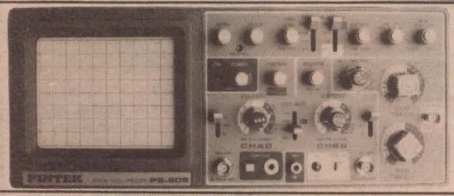

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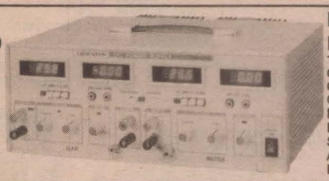

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0.5 % 50Hz - 500kHz
Output impedance: 600 ohm

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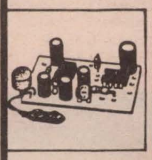

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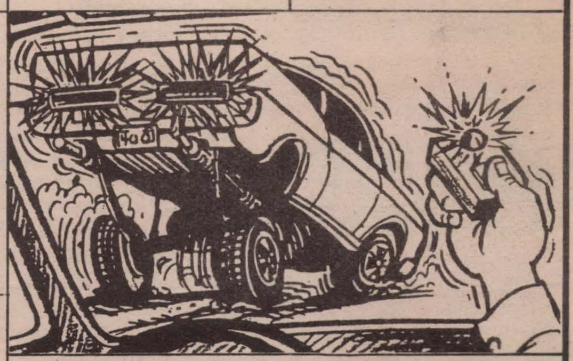

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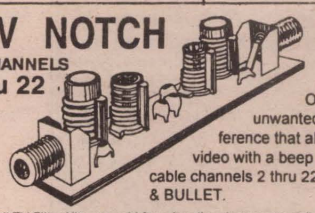

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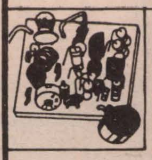

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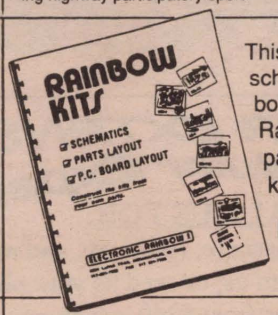

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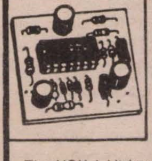

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Bi-Directional Parallel Ports

by Robert M. Harkey

The continuing interest in the two-way use of parallel ports on IBM compatible computers prompted me to take a closer look at some of the available input/output boards.

Several articles that I had read indicated that the output pins could, in some cases, be forced high or low and could be read by the computer. If this was true, there must be an input path tied directly to the output pins which the machine could read. Now, if there was only a way to disable or disconnect the output driver which is also connected to the data pins.

Most of the circuit boards that I examined contained discrete low power schottky ICs on the outputs of the parallel ports. Generally, the output driver was a 74LS374 which is an octal D-type flipflop with three-state outputs. A small value (27 ohm) series resistor connects the output D-type flipflop to the eight data pins of the DB25 output connector. Also, connected to each of the data pins is an input to a 74LS244 octal buffer, which also has three-state outputs. (See Figure 1.) So, the general idea of this circuit is that output data is transmitted from the computer bus through the 74LS374 to the output connector via small value resistors (which are used for short circuit protection). At the output connector, the computer monitors the actual output signals by routing the signal through the 74LS244 buffer back to the computer innards.

Further examination showed that the 74LS374's three-state control pin was the "not" output enable signal on pin 1 and that this pin was tied directly to ground. So, the circuit isn't actually using the three-state capability of the 74LS374 — but I could!

I cut pin 1 very close to the circuit board. (I don't recommend trying to unsolder IC pins from computer boards unless it is absolutely necessary.) I then temporarily tied this pin to +5 volts (on pin 20 of the same IC), to put the chip in the high impedance output mode.

By connecting various combinations of the data pins on the output connector to +5 volts and ground, and using very simple GWBASIC commands, I was able to confirm that the port had been converted to an input port — without any forcing or complicated add-on circuitry.

Now to find a simple way to control pin 1 of the 74LS374. Remembering that the parallel ports are normally comprised of three addresses, I devised a simple method to control the data pins of the port. See Figure 2 for the details.

An NPN transistor (2N3904) is used as a switch to either pull the output enable pin (pin 1) to ground to use the parallel port in the normal output mode, or to allow the enable pin to be pulled high to put the port in an input state.

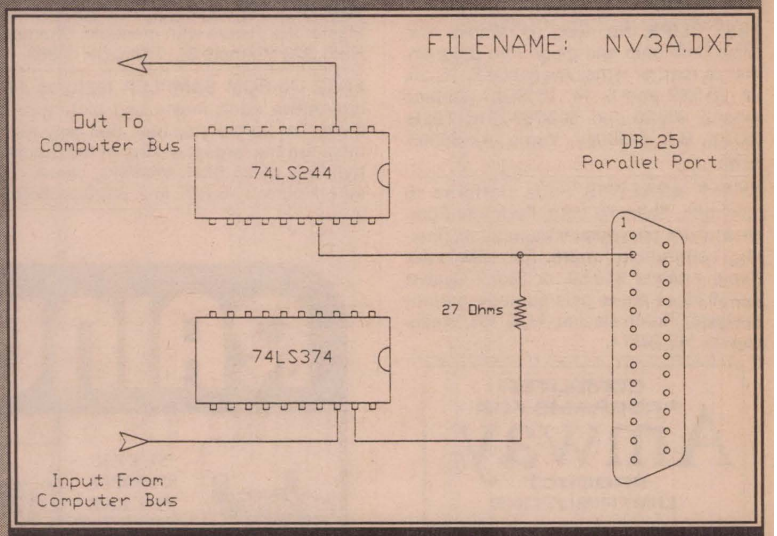

FIGURE 1 — Typical connections for a single data line.

To insure foolproof operation, a small switch was placed on the parallel port board (or anyplace you want) to "lock" the driver IC in its "output" mode.

In the normal (closed) position of the switch, pin 1 of the 74LS374 is tied directly to ground through the switch. In the "input" mode, pin 1 is controlled by the 2N3904 which, in turn, is turned on/off by the "not" strobe pin of the control port.

As an example, assume your parallel port is LPT-1 at address 278H. The control port is then at address 27AH and it is this address that we use to control pin 1 of the 74LS374. By placing the switch in the open position (input mode) and sending an OUT &H27A,0 while in GWBASIC, we pull the base of the 2N3904 near to ground and the collector (and the output enable pin) is allowed to go high. This puts the 74LS374 in its tri-state output mode.

If we then route an external eight bit signal onto pins 2 through 9 of the DB25 connector, we can read the digital word by using an INP command. In GWBASIC, send the command A$ = INP(&H278): PRINT A$. The value of the input digital word will be printed on your screen. Works great!

When you have finished using the port for input/output and want to again use it as a conventional printer port, put the switch in its closed or "normal" position. This will lock the 74LS374 into its output mode and any signals on the control port will have no affect on the 74LS374.

So get yourself a parallel port plug-in board (they're dirt cheap now) which has 74LS374's and 74LS244's as outlined above and have at it. You'll truly have a "bi-directional" parallel port which is very useful for computer control and monitoring. **NV**

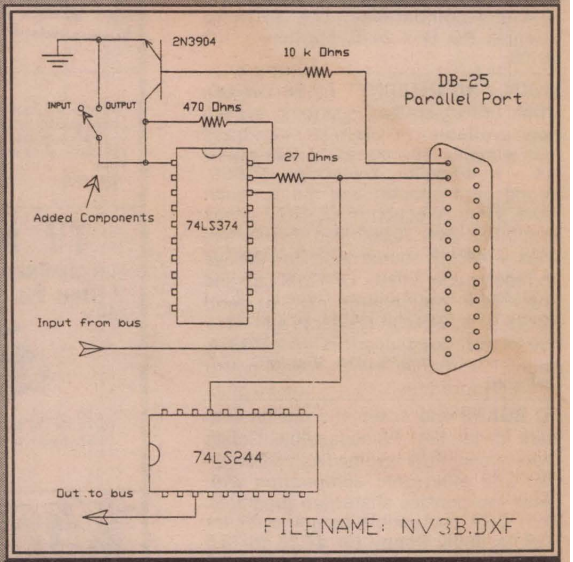

FIGURE 2 — Modified parallel port.

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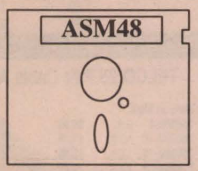

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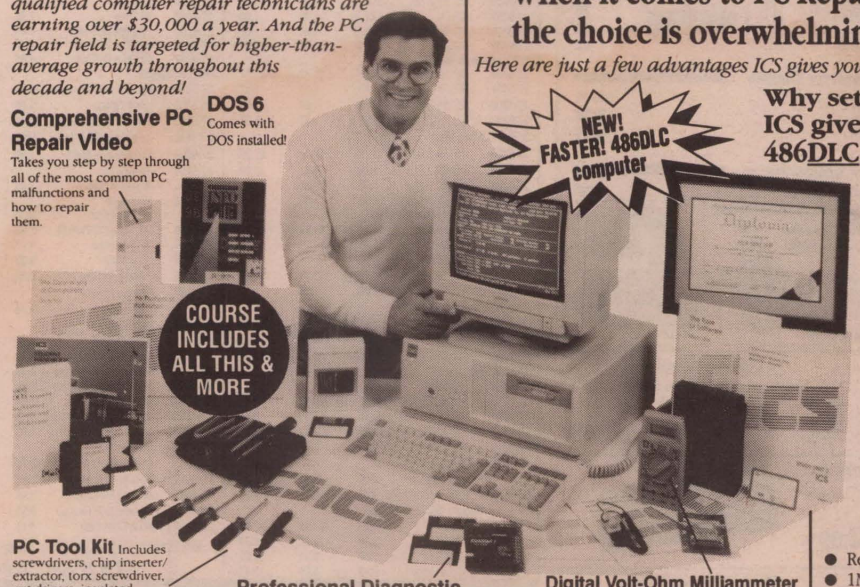

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LCS-8634MI	16-bit Ethernet Adapter (BNC,SGL Chip)	$46
LCS-8634TBA	16-bit Ethernet Adapter (AUI,BNC,TP)	57
LCS-8834P-T	Ethernet Pocket LAN Adapter (BNC or AUI)	110
LCO-8834P-T	Ethernet Pocket LAN Adapter (Twisted Pair Connectors)	113

BOCA Ethernet Adapters

BEN1P1	Ethernet Adapter for PCI-Bus (RJ-45 & BNC)	$83
BEN100	10Base-T Twisted Pair Ethernet Adapter	56
BEN300	10Base-T Combo Ethernet Adapter	73
BEN1V1	High Speed 10Base-T VL-Bus Ethernet Adapter	73

BOCA Ethernet Hubs

BEN220	16-Port Ethernet 10Base-T Hub	$264

Longshine Ethernet Transceivers

LCS-883T1	AMP Connector Piercing Type	$112
LCS-883T2	Transceiver for N-Type Connector	79
LCS-883T3	Transceiver for BNC Connector	62
LCS-883T-T	Transceiver 10Base-T(AUI to RJ-45)	42

Ethernet Transceiver Cables

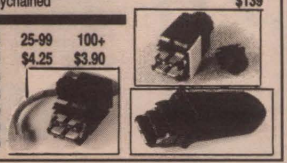
TXC-1M	15 Pin Male to Female, 1 Meter	$19.39
TXC-2M	15 Pin Male to Female, 2 Meters	22.69
TXC-4M	15 Pin Male to Female, 4 Meters	29.59

BOCA 10Base-T Concentrator

BEN-210	Up to 8 Nodes, RG-45, can be daisychained	$139

Token Ring

Part #	Descripton	1-24	25-99	100+
D-4C	4-Pin Data Connector	$5.50	$4.25	$3.90
RS-DT	Reset Tool for MAU-DT	$36		
RS-RJ	Reset Tool for MAU-RJ	$43		
TR8	4-PIN Data Cable 8 ft.	$15.99		
TR10	4-PIN Data Cable 10 ft.	18.99		
TR30	4-PIN Data Cable 30 ft.	28.99		



BNC Cables for Ethernet

(Male to Male)

58BC-10	RG-58	10 ft.	$4.59	$3.82	$2.86	$2.30
58BC-25	RG-58	25 ft	6.79	5.66	4.24	3.40
58BC-50	RG-58	50 ft	8.89	7.41	5.56	4.45

Octopus Cables

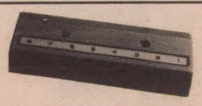
50 pin female telco connector to modular plugs

4W-12L	12 legs, 4 Wire Plugs	
6W-8L	8 legs, 6 Wire Plugs	
8W-6L	6 legs, 8 Wire Plugs	$16.69

Harmonicas

Modular female jacks to 50 pin male telco connectors

4W-12P	12 Four Wire Modular Ports	
6W-8P	8 Six Wire Modular Ports	
8W-6P	6 Eight Wire Modular Ports	$14.89



Punch Down Blocks

Part#	Description	Each
66M1	Block without Telco Connector	$8.89
66M2-1	Block with One Telco Connector	22.29
66M2-2	Block with Two Telco Connectors	32.29
66PDT	Punch Down Tool	$13.99
66BC	Bridging Clips	

1-99 /$.06 100-499/$.048 500+/$.035

Cross Connect Wire

#24 AWG Solid Copper Conductors in Pairs used for interconnecting Punch Down Blocks.

Part#	Description	Each
CCW1P100	1 Pair on 100 foot Spool	$3.99
CCW1P1000	1 Pair on 1000 foot Spool	19.99
CCW2P100	2 Pair on 100 Foot Spool	4.99
CCW2P1000	2 Pair on 1000 Foot Spool	29.99

Modular Plugs

Part#	Description	1-99	100-999	1000+
MP-4M	For Handset Plugs 4x4	$.20	$.15	$.11
MP-4	RJ-11 Plugs 4x6	.20	.15	.11
MP-6	RJ-12 Plugs 6x6	.25	.18	.14
MP-8	8 pin RJ-45 Plug 8x8	.30	.22	.17
MP-10	10 x 10 Pin Modular plug	.58	.46	.40
MP-4S	4 pin for 24 AWG Solid Wire	.24	.18	.14
MP-6S	6 pin for 24 AWG Solid Wire	.29	.22	.18
MP-8S	8 pin for 24 AWG Solid Wire	.35	.26	.21

Modular Wall Plates

Part#	Description	Each	25-99	100+
MWP6-1	6 conductor 1 jack	$1.83	$1.46	$1.22
MWP6-2	6 conductor 2 jacks	2.75	2.20	1.83
MWP8-1	8 conductor 1 jack	1.85	1.48	1.23
MWP8-2	8 conductor 2 jacks	3.45	2.76	2.30

Modular Wire

Part#	Description	Per Ft.	100 Ft.	1000 Ft.
MW-4	4 conductor	$.08	$.04	$.033
MW-10	10 conductor	.20	.17	.13
MW-6	6 conductor	.14	.07	.054
MW-8	8 conductor	.17	.08	.067
60-3011	Cutter and Stripper for Modular Wire			$6.95

Modular Crimping Tools

MCT-04M	Crimps Handset Plugs	$12.95
MCT-06	Crimps MP-4 & MP-6 Plugs	12.95
MCT-08	Crimps MP-8 Plugs	12.95
MCT-10	Crimps MP-10 Plugs	29.95
60-3008	Crimps DEC modular plugs	69.95
60-3016	Crimps MP-4, MP-6, and MP-8	34.95

Modular Surface Mount Jacks

Part#	Description	Each	25-99	100+
SM-6	Screw Terminal 6 Conductor Jack	$1.83	$1.46	$1.22
SM-8	Screw Terminal 8 Conductor Jack	3.08	2.46	2.05
SM-4IDC	4 Conductor 110 IDC type	3.87	2.90	2.32
SM-6IDC	6 Conductor 110 IDC type	4.30	3.23	2.58
SM-8IDC	8 Conductor 110 IDC type	4.80	3.60	2.88

Modular "T" Connectors

MTC-6C	6 Conductor, 1 Male to 2 Female	$1.73	$1.38	$1.15
MTC-8C	8 Conductor, 1 Male to 2 Female	2.43	1.94	1.62

Modular Cord Couplers

CC-6C	6 Conductor	$1.50	$1.20	$1.00
CC-8C	8 Conductor	2.00	1.60	1.33
CC-10C	10 Conductor	2.95	2.75	2.50

Baluns - Coaxial Eliminators for Arcnet

Part#	Description	Each	25-99	100+
BLO1	BNC to RJ-11 and Screw Terminal	$5.83	$4.38	$3.50
BLO1A	BNC to RJ-45	7.50	5.63	4.50
BLO1RJ	BNC to RJ-11	1.99	1.75	1.50
BLO2	Female Chasis Mount to RJ-11	7.50	5.63	4.50
BLO2A	Female Chasis Mount to RJ-45	7.50	5.63	4.50
BLO5	Twinax to RJ-11	9.00	8.18	7.50
BLO7	BNC-TNC Wang Applications	28.00	25.45	20.00
BLO7A	Cable set for BL-07	5.95	5.50	5.00

Bulk Coaxial Cable

Part#	Description	100-999'	1000'
RG-58U	50 Ohm Ethernet	$0.09	$0.061
PRG-58U	50 Ohm Ethernet (Plenum)	0.33	0.219
RG-62U	93 Ohm Arcnet	0.11	0.073
PRG-62U	93 Ohm Arcnet (Plenum)	0.36	0.243

Modular Patch Panels

Modular Jacks to 50 Pin Telco Connectors 19" Rack Mountable

PP424	4 wire RJ-11 24 port	$69.39
PP624	6 wire RJ-12 24 port	87.99
PP824	8 wire RJ-45 24 port	96.99
PP448	4 wire RJ-11 48 port	121.69
PP648	6 wire RJ-12 48 port	134.39
PP848	8 wire RJ-45 48 port	137.99

Modular Adapter Kits

6 = 6 PIN RJ-11 8 = 8 PIN RJ-45

Convert D-Sub to Modular Connections

Part#	Description	Each	25-99	100+
MA9M-6	9 pin D-Sub male to RJ-11	$3.00	$2.40	$1.90
MA9F-6	9 pin D-Sub female to RJ-11	3.00	2.40	1.90
MA25M-6	25 pin D-Sub male to RJ-11	3.00	2.40	1.90
MA25F-6	25 pin D-Sub female to RJ-11	3.00	2.40	1.90
MA9M-8	9 pin D-Sub male to RJ-45	3.50	2.80	2.40
MA9F-8	9 pin D-Sub female to RJ-45	3.50	2.80	2.40
MA25M-8	25 pin D-Sub male to RJ-45	3.50	2.80	2.40
MA25F-8	25 pin D-Sub female to RJ-45	3.50	2.80	2.40

One-Piece Modular Adapter Kits with Thumbscrews

Part#	Description	Each	25-99	100+
MA9M-6TS	9 pin D-Sub male to RJ-11	$1.99	$1.69	$1.39
MA9F-6TS	9 pin D-Sub female to RJ-11	1.99	1.69	1.39
MA25M-6TS	25 pin D-Sub male to RJ-11	1.99	1.69	1.39
MA25F-6TS	25 pin D-Sub female to RJ-11	1.99	1.69	1.39
MA9M-8TS	9 pin D-Sub male to RJ-45	1.99	1.69	1.39
MA9F-8TS	9 pin D-Sub female to RJ-45	1.99	1.69	1.39
MA25M-8TS	25 pin D-Sub male to RJ-45	1.99	1.69	1.39
MA25F-8TS	25 pin D-Sub female to RJ-45	1.99	1.69	1.39
MA25M-10TS	25 pin D-Sub male to 10 conductor	2.95	2.75	2.57

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BNC Connectors (Partial Listing)

Part #	Description	1-24	25-99	100+
Twist-On Male				
27-9050	RG 59 & 62	$1.17	$1.08	$1.00
27-9051	RG-58	1.17	1.08	1.00
27-9059	RG-58 Teflon	2.17	2.00	1.86
27-9206	RG-58 Thin Net	2.03	1.87	1.74
2 Piece Crimp Male				
27-9000	RG-59 & 62	$1.43	$1.32	$1.22
27-9001	RG-58	1.43	1.32	1.22
27-9204	RG-58 Teflon	1.95	1.80	1.67
27-9207	RG-58 Thin Net	1.95	1.80	1.67
3 Piece Crimp Male				
27-9100	RG-59 & 62	$1.28	$1.18	$1.09
27-9101	RG-58, 141	1.28	1.18	1.09
27-9205	RG-58 Teflon	1.73	1.59	1.48
27-9208	RG-58 Thin Net	1.95	1.80	1.67
6 Pc. Standard Solder Male				
27-9020	RG-59 & 62	$1.40	$1.27	$1.17
27-9021	RG-58	1.40	1.27	1.17
2 Piece Crimp Female				
27-9003	RG-59 & 62	$1.60	$1.45	$1.33
27-9014	RG-58	1.60	1.45	1.33
Twist-On Female				
27-9053	RG-59 & 62	$1.80	$1.64	$1.50
27-9031	RG-58	2.40	2.18	2.00
27-9230	RG-58 Teflon	2.40	2.22	2.06
Chassis Mounts				
27-8460	Bulkhead Recepticle 3/8"	$0.90	$0.82	$0.75
27-9248	RG-58 Crimp	3.15	2.91	2.70
27-9249	RG-59, 62 Crimp	3.15	2.91	2.70
27-8470	Feed thru - 1/2"	3.00	2.73	2.50
27-8469	Economy 8470 (Shorter)	2.50	2.31	2.14
27-8461	Isolated Bulkhead	2.55	2.35	2.19
Chassis Mounts 5/8" Twist-On				
27-8475	RG-58	$3.38	$3.12	$2.89
27-8476	RG-59,62	3.38	3.12	2.89
27-8477	RG-59,62 Teflon	3.60	3.32	3.09
27-9234	RG-58 Teflon	4.05	3.74	3.47
Impedence Terminators				
27-9007	75 Ohm	$2.25	$2.08	$1.93
27-9008	50 Ohm	2.25	2.08	1.93
27-9093	93 Ohm	2.25	2.08	1.93
27-9245	75 Ohm W/Chain	4.05	3.74	3.47
27-9246	50 Ohm W/Chain	4.05	3.74	3.47
27-9247	93 Ohm W/Chain	4.05	3.74	3.47
BNC Adaptors				
27-8250	Female to TNC Male	$3.08	$2.84	$2.64
25-7430	Inline Splice	1.40	1.27	1.17
27-8120	Female to UHF Male	2.40	2.22	2.06
27-8110	Female to RCA Male	1.88	1.73	1.61
27-8100	Female to F Male	1.88	1.73	1.61
27-8150	Female to Rt Angle Male	3.60	3.27	3.00
25-7365	Female to UHF Female	3.30	3.05	2.83
27-8140	"T" 1 Male 2 Female	2.93	2.70	2.51
27-8141	"T" 3 Female	4.73	4.36	4.05
27-8142	"T" 3 Male	6.30	5.82	5.40
29-3855	Female to SMA Male	8.25	7.62	7.07
29-4150	Female to Mini UHF Male	3.75	3.46	3.21
29-3835	Female to SMA Female	8.25	7.62	7.07
27-8130	Male to BNC Male	2.20	2.00	1.83
25-7420	Male to UHF Female	2.48	2.28	2.12
29-3850	Male to SMA Female	8.25	7.62	7.07
29-3830	Male to SMA Male	4.88	4.50	4.18
25-7510	Male to RCA Female	1.50	1.38	1.29
25-7500	Male to "F" Female	1.73	1.59	1.48
29-4155	Male to Mini UHF Female	3.75	3.46	3.21
26-8016	Female to N Male	5.55	5.12	4.76
26-8017	Male to N Female	5.55	5.12	4.76
26-8018	Female to N Female	5.55	5.12	4.76
27-9211	Male Dust Cap	4.13	3.81	3.54

We Stock BNC Crimping Tools & Coaxial Cable Stripping Tools

TELCO 25 Pair Cable Assemblies

Male to Male			Male to Female		
T50MM-5	5 ft.	$9.99	T50MF-5	5 ft.	$9.99
T50MM-10	10 ft.	11.49	T50MF-10	10 ft.	11.49
T50MM-15	15 ft.	12.89	T50MF-15	15 ft.	12.89
T50MM-25	25 ft.	15.79	T50MF-25	25 ft.	15.79
T50MM-50	50 ft.	22.99	T50MF-50	50 ft.	22.99
T50MM-75	75 ft.	31.39	T50MF-75	75 ft.	31.39
T50MM-100	100 ft.	37.69	T50MF-100	100 ft.	37.69
Female to Female					
T50FF-5	5 ft.	$9.99			
T50FF-10	10 ft.	11.49			
T50FF-15	15 ft.	12.89			
T50FF-25	25 ft.	15.79			
T50FF-50	50 ft.	22.99			
T50FF-75	75 ft.	31.39			
T50FF-100	100 ft.	37.69			

Token Ring DATA Cables

In 8, 10 and 30 ft.

TR8	4Pin Data Connector Cables 8 '	$15.99
TR10	4Pin Data Connector Cables 10 '	18.99
TR30	4Pin Data Connector Cables 30 '	28.99

Custom Cable Assemblies Available, Call for Quote!

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VOICE DATA CABLE - LEVEL 3, 4 & 5

Part #	Description	1-99'	100-999'	1000'
VDC3-2	Level 3, 2 Pair, Unshielded CL-2 PVC	$.06	$.04	$29
VDC3-2P	Level 3, 2 Pair, Unshielded CL-2P Plenum	.13	.11	71
VDC3-3	Level 3, 3 Pair, Unshielded CL-2 PVC	.07	.05	36
VDC3-3P	Level 3, 3 Pair, Unshielded CL-2P Plenum	.16	.12	83
VDC3-4	Level 3, 4 Pair, Unshielded CL-2 PVC	.08	.07	44
VDC3-4P	Level 3, 4 Pair, Unshielded CL-2P Plenum	.18	.14	94
VDC3-6	Level 3, 6 Pair, Unsheilded CL-2 PVC	.13	.10	67
VDC3-6P	Level 3, 6 Pair, Unshielded CL-2P Plenum	.26	.20	136
VDC4-4P	Level 4, 4 Pair, Unshielded CL-2P Plenum	.20	.17	150
VDC5-4	Level 5, 4 Pair, Unshielded CL-2 PVC	.12	.10	80
VDC5-4P	Level 5, 4 Pair, Unshielded CL-2P Plenum	.25	.20	180

10BASE-T LEVEL 5 PRODUCTS

10BASE-T Patch Cables

For use in 10Base-T 802.3 Applications.

Category 3 (10Mbps)

Part #	Description	1-9	10-24	25+
10BT3-3GY	3 ft GREY	$3.75	$3.50	$3.25
10BT3-6GY	6 ft GREY	4.25	4.00	3.75
10BT3-10GY	10 ft GREY	5.00	4.75	4.50
10BT3-25GY	25 ft GREY	7.25	6.75	6.00
10BT3-3BK	3 ft BLACK	3.75	3.50	3.25
10BT3-6BK	6 ft BLACK	4.25	4.00	3.75
10BT3-10BK	10 ft BLACK	5.00	4.75	4.50
10BT3-25BK	25 ft BLACK	7.25	6.75	6.00

Category 5 (100Mbps)

Part #	Description	1-9	10-24	25+
10BT5-3GY	3 ft GREY	$4.50	$4.25	$4.00
10BT5-6GY	6 ft GREY	6.00	5.75	5.50
10BT5-10GY	10 ft GREY	7.75	7.25	6.75
10BT5-25GY	25 ft GREY	11.25	11.00	10.25
10BT5-3BK	3 ft BLACK	4.50	4.25	4.00
10BT5-6BK	6 ft BLACK	6.00	5.75	5.50
10BT5-10BK	10 ft BLACK	7.75	7.25	6.75
10BT5-25BK	25 ft BLACK	11.25	11.00	10.25

19"Patch Panels With 110 Blocks

Part #	Description	1-4	5-9	10+
PP824-5	8 Wire, 24 Port	$99	$96	$89
PP848-5	8 Wire, 48 Port	209	194	181
PP896-5	8 Wire, 96 Port	399	372	347

19" Blank Panels

KP-16	16 Port	$23	$22	$20
KP-24	24 Port	25	23	22
KP-32	32 Port	29	27	25
KP-48	48 Port	35	32	29

Wall Plates For Inserts

Part #	Description	1-9	10-24	25-99
KWP-1W	1 Port, White	$1.49	$1.34	$1.22
KWP-2W	2 Port, White	1.49	1.34	1.22
KWP-3W	3 Port, White	1.49	1.34	1.22
KWP-4W	4 Port, White	1.49	1.34	1.22
KWP-6W	6 Port, White	1.49	1.34	1.22
KWP-1I	1 Port, Ivory	1.49	1.34	1.22
KWP-2I	2 Port, Ivory	1.49	1.34	1.22
KWP-3I	3 Port, Ivory	1.49	1.34	1.22
KWP-4I	4 Port, Ivory	1.49	1.34	1.22
KWP-6I	6 Port, Ivory	1.49	1.34	1.22

110 Type RJ45 Jack Inserts

KJ-110WH	White	$5.50	$5.00	$4.58
KJ-110IV	Ivory	5.50	5.00	4.58
KJ-110BK	Black	5.50	5.00	4.58
KJ-110RD	Red	5.50	5.00	4.58
KJ-110GR	Green	5.50	5.00	4.58
KJ-110YE	Yellow	5.50	5.00	4.58
KJ-110OR	Orange	5.50	5.00	4.58
KJ-110BL	Blue	5.50	5.00	4.58

Other Type Inserts

KP-IN	Blank Insert	$0.30	$0.25	$0.20
KP-BNC	BNC Feed through Insert	3.00	2.73	2.50
KP-ST	ST Insert	6.50	5.91	5.42

Wall Plate Mounting Boxes

MB-IV	Ivory	$2.50	$2.27	$2.08
MB-WH	White	2.50	2.27	2.08

AltexElectronics

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TERMS: For C.O.D. orders add $5 per package. Minimum $25. Cash or Cashiers Check only. For orders under $99 add $3 handling charge. Orders $99 or more no handling fee. All shipping is FOB San Antonio, Texas and will be added to your invoice. Texas residents add 7-3/4% sales tax. All returns require RMA# and must be returned in original condition. A 15% restocking fee will be assessed on merchandise returned in non-resaleable condition. No returns on books, video tapes, batteries, memory, cut cable or custom cable assemblies Prices subject to change without notice. We are not responsible for typographical errors.

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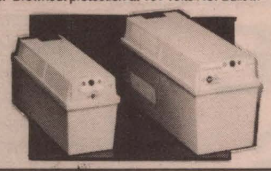
Standby Battery Backup Systems

These low priced units offer great protection from brownouts, blackouts, surges, spikes and line noise. Bigger batteries for longer battery life and backup times. Brownout protection at 101 volts AC. Built-in spike and RFI/EMI filtering. Phase synchronized 2 ms switching is so fast and smooth, your computer will never detect an interruption. $25,000 Ultimate Lifetime Insurance covers connected equipment for life; 2- Year Mfg Product Warranty.



BC-250	250 VA, 2 Outlets	$105
BC-400	400 VA, 2 Outlets	169
BC-500	500 VA, 2 Outlets	194

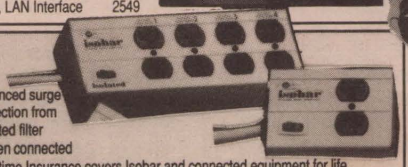
Standby Battery Backup Systems With Built-In LAN Interface

All the features of the BC Series plus a LAN interface to support the unattended shutdown of any network operating system. Features remote channel output for the server shutdown. Proper cabling is available for any LAN system (sold separately). UL Approved.

BC-400LAN	400VA, 4 Outlets, LAN Interface	$171
BC-500LAN	500VA, 4 Outlets, LAN Interface	199
BC-600LAN	600VA, 4 Outlets, LAN Interface	269
BC-750LAN	750VA, 4 Outlets, LAN Interface	309
BC-900LAN	900VA, 4 Outlets, LAN Interface	379
BC-1250LAN	1250VA, 4 Outlets, LAN Interface	529
BC-2000LAN	2000VA, 8 Outlets, LAN Interface	2549

Isobar Premium Surge Suppressors

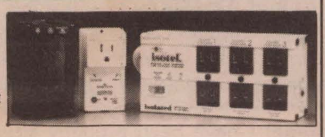
The world's best selling, most advanced surge suppressors offer outstanding protection from surges, spikes and line noise. Isolated filter banks eliminate interference between connected equipment. $10,000 Ultimate Lifetime Insurance covers Isobar and connected equipment for life.



IB2-0	2 Outlet (Direct Plug In)	$23	IB8	8 Outlet, 4 Filter Banks, 12' Cord	$61
IB2-6	2 Outlet with 6' Cord	39	IB-8RM	IB8 with Remote On/Off	69
IB4-4	4 Outlet, 2 Filter Banks, 6' Cord	43	EUROBAR	4 IEC-320 Outlets, 220VAC	52
IB4/220	4 Outlets, 6' Cord, 220VAC	49	IBR-12	12 Outlets, 19" Rack Mount, 12' Cord	89
IB6-6	6 Outlet, 3 Filter Banks, 6' Cord	51			

Modem/Fax Protectors

Protect your modems, telephone systems and fax machines from damag ing surges and spikes that can travel along your telephone lines. All units exceed telephone line standards and feature great Mfg product warranties.



ISOTELULT4	Isobar Ultra 4 Outlets, RJ11 Jacks, 6' Cord, $25K Ultimate Warranty	$55
ISOTELULT6	Isobar Ultra 6 Outlets, RJ11 Jacks, 6' Cord, $25K Ultimate Warranty	62
ISOTELULT8	Isobar Ultra 8 Outlets, RJ11 Jacks, 12' Cord, $25K Ultimate Warranty	74
ISOFAX	Protects 2 AC & 2 RJ45 lines, $10K Ultimate Warranty	36
TSB	3-Stage Modem/Fax Protector	38
MP	Economy Modem/Fax Protector	14
SMP-GS	1 AC Outlet with Modem/Fax Protection. Lifetime Guarantee	35

Economy Surge Suppressor Outlet Strip

Full protection for surges and spikes. Comes with four foot heavy duty line cord, reset circuit breaker, lighted rocker switch and 3 wire grounded outlets to get full protection from voltage surges, spikes and other damaging electrical disturbances. UL listed.

EOS-6 6 outlet **Each $6.99 10+ $6.50**

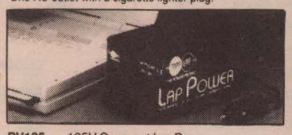
DC Power Supplies

Precision regulated and efficiently converts 120VAC to 13.8VDC.
Features
Crowbar over-voltage protection, current limiting electronic fold-back protection, solid state,
integrated circuit regulation, high quality filtering amd large heat sinks. (Fuse is chassis mounted)

PR-15	15A, ICS, 13lbs, For 50W Transmitter	$88.95
PR-25	25A, ICS, 19lbs, 75-100W Transmitter	129.95
PR-40	40A, ICS, 27lbs, 150- 200W Transmitter	169.95

LapPower DC to AC Power Inverter

About the size of a 35mm camera. Plugs into cigarette lighter plug recp. to provide 125W of continuous AC power. Lets you operate fax machines, laptop computers and other mobile office equipment anywhere you go. One AC outlet with a cigarette lighter plug.



PV125 125V Compact LapPower Power Inverter **$69**

Step-Up Step-Down Transformers

110 VAC to 220 VAC or 220 VAC to 110 VAC, comes with European adapter cable.

UDX-50	50 watt	$19
UDX-100	100 watt	$23
UDX-200	200 watt	$26
UDX-300	300 watt	$31
UDX-500	500 watt	$44
UDX-1000	1000 watt	$72
UDX-2000	2000 watt	$118

PROwatt Power Inverters

The PROwatt line of power inverters produce 115 VAC from 12VDC. They plug into any standard cigarette lighter plug recepticle.

PROWATT125	125 Watt Continous Output Power	$99	PROWATT800	800 Watt Continous Output Power	$359
PROWATT250	250 Watt Continous Output Power	$149	PROWATT1500	1500 Watt Continous Output Power	$650

Parallel Printer Cables
Standard DB-25 to Centronics. Fully shielded and have thumbscrews for easy installation.

Part#	Description	Each	10+
PPC301-6	DB25-36P 6 ft.	$2.99	$2.54
PPC301-6RA	DB25-36P 6 ft (Rt. angle)	4.99	4.24
PPC301-10	DB25-36P 10 ft.	3.99	3.51
PPC301-10RA	DB25-36P 10 ft. (Rt. angle)	5.99	5.09
PPC301-15	DB25-36P 15 ft.	4.99	4.24
PPC301-20	DB25-36P 20 ft.	5.99	5.39
PPC301-25	DB25-36P 25 ft.	6.99	5.94

IEEE-488 Cable Assemblies

Part#	Description	Each	10+
488-1	1 meter	$29.99	$26.99
488-2	2 meters	34.99	31.99
488-3	3 meters	36.99	33.99
488-4	4 meters	39.99	35.99

Apple Talk Accessories

Part#	Description	Each
APT-001	8 pin Mini-DIN, male to two, 3 pin Mini-DIN females	$21.99
TLT-001	8 pin Mini-DIN male to two, RJ-11 jacks	15.99
AC-14	3 pin Mini-DIN cable male to male, 6 ft.	5.99
AC-15	3 pin Mini-DIN cable male to male, 30 ft.	13.99
AC-19	4-Pin Mini-Din Extension 6 ft (MD4P-MD4S)	6.95

CABLES

DB-25 25 Line Cables
Cables are wired "all lines" straight through, fully shielded and have thumbscrews for easy installation.

Male to Male

Part#	Description	Each	10+
25MM-6	6 ft.	$3.99	$3.51
25MM-10	10 ft.	4.99	4.24
25MM-15	15 ft.	6.99	5.94
25MM-20	20 ft.	7.99	7.19
25MM-25	25 ft.	8.99	7.69
25MM-50	50 ft.	16.99	14.45
25MM-100	100 ft.	32.99	29.69

Male to Female

Part#	Description	Each	10+
25MF-6	6 ft.	$3.99	$3.51
25MF-10	10 ft.	4.99	4.24
25MF-15	15 ft.	6.99	5.94
25MF-20	20 ft.	7.99	7.19
25MF-25	25 ft.	8.99	7.69
25MF-50	50 ft.	16.99	14.45
25MF-100	100 ft.	32.99	29.69

Centronics 36 Pin Cable Assemblies
Cables are fully shielded and wired for standard parallel transmission.

Male to Male

Part#	Description	Each	10+
36MM-6	6 ft.	$3.99	$3.59
36MM-10	10 ft.	4.99	4.49
36MM-25	25 ft.	17.95	15.00

Male to Female

Part#	Description	Each	10+
36MF-6	6 ft.	$3.99	$3.59
36MF-10	10 ft.	4.99	4.49
36MF-25	25 ft.	17.95	15.00

Modem Cable Assemblies

Part#	Description	1-9	10+
ATM-1	AT to Modem 1 ft. (9S-25P)	$2.69	$1.90
ATM-6	AT to Modem 6 ft. (9S-25P)	3.29	2.60
ATM-10	AT to Modem 10 ft. (9S-25P)	3.99	3.49
25MF-6	PC to Modem 6 ft. (25S-25P)	3.99	3.44
25MF-10	PC to Modem 10 ft. (25S-25P)	4.99	4.39
XTM-10	PC/XT to Hayes Modem 10 ft.	3.59	3.23
XTM-6	Modem Cable to PC Hayes 6 ft.	2.59	2.33

Drive Cable Assemblies

Part#	Description	Each
DFC-XTS	Dual floppy cable (34S-34E-twist-34E)	$2.49
DFC-XTE	Dual floppy cable (34E-34E-twist-34E)	2.49
HDC-XT	Single hard drive cable set (20S-E & 34S-E)	2.59
2HDC-22	Dual hard drive cable set	5.99
DFCEX-XT	External dual floppy cable	6.79
YAD-4	Drive power "Y" cable 4 pin	1.99

Part#	Description	Each
A5-3	Regular 4 pin to mini 4 pin	$2.19
HD-IDE	40S-40S Single IDE Hard Drive Cable	1.49
2HD-IDE	Dual IDE Hard Drive Cable	2.99
DFC-U	Universal Cable Set (5 Connector)	2.95
DFC-COMBO	DFC-U & HD-IDE Cable Set	3.95
DFC-COMBO2	DFC-U & 2HD-IDE Cable Set	4.25

SCSI Cables

Part#	Description	Each
SCSI-HD	MAC+ to SCSI Drive	$6.69
SCSI-DC	Daisy Chain 6 ft.	7.99
SCSI-EC6	Extension Cable 6 ft.	9.99
SCSI-T	SCSI Terminator	13.99
SCSI-II	SCSI-II Adaptor Cable (50P Cent. to 50P Half Pitch)	29.95
SCSI-RC	SCSI Cable w/3 50 Pin Sckt. 2 ft.	4.95
SCSI-2HH	50P Half Pitch to 50P Half Pitch	34.95

Video Cables
15 pin high density to 5 BNC connectors R/G/B/H/V

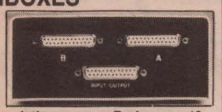
Part#	Desc	Each
15P-5BNC6	6 ft.	$29.59
15P-5BNC10	10 ft.	34.79
15P-5BNC15	15 ft.	39.99
15P-5BNC25	25 ft.	44.29
VMC-10	RCA to RCA Cable 6 ft.	2.50
9P-RCA	9-Pin Male RCA Plug 6 ft.	6.95

Adapters

Part#	Description	Each	10+
ATSCA	9 pin female to 25 pin male	$2.49	$2.24
PCSCA	9 pin male to 25 pin female	2.49	2.24
NMA-9	9 pin Null Modem M/F	2.99	2.69
NMA-25	25 pin Null Modem M/F	2.99	2.69
PS2-KA	PS2 Keyboard Adapter	2.89	2.60
PS2-MA	PS2 Monitor Adapter	4.29	3.86
PS2-SA	PS2 Serial Adapter	3.79	3.41

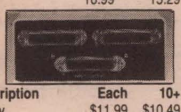
SWITCHBOXES

DB-25 25 Line Switchboxes



Part#	Description	Each	10+
AB25-2E	2 Way	9.99	$8.99
AB25-3E	3 Way	13.99	12.59
AB25-4E	4 Way	15.99	14.39
AB25-5E	5 Way	23.99	21.59
AB25-6	6 Way	49.95	44.00
AB25-XE	X-Over	16.99	15.29

Centronics 36 Line Switchboxes

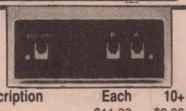


Part#	Description	Each	10+
AB36-2E	2 Way	$11.99	$10.49
AB36-3E	3 Way	15.99	14.49
AB36-4E	4 Way	22.99	19.99
AB36-XE	X-Over	19.99	17.99

DA-15 15 Line

Part#	Description	Each	10+
AB15-2E	2 Way	$14.95	$12.49
AB15-4E	4 Way	17.95	15.49

RJ-11 & RJ-45 Modular Switchboxes

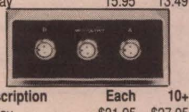


Part#	Description	Each	10+
ABRJ11-2E	2 Way	$11.99	$9.99
ABRJ11-4E	4 Way	13.99	11.99
ABRJ45-2E	2 Way	12.99	10.99
ABRJ45-4E	4 Way	17.99	15.99

BNC Switchboxes

Part#	Description	Each	10+
ABBN-2E	2 Way	$9.99	$8.99
ABBN-4E	4 Way	15.95	13.49

Twin-Axial Switchboxes



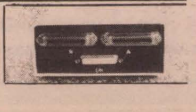
Part#	Description	Each	10+
ABTWX-2	2 Way	$31.95	$27.95
ABTWX-4	4 Way	38.95	36.95

IEEE-488 24 LINE

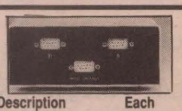
Part #	Description	Each	10+
AB24-2	2 Way	$39.95	$36.95
AB24-4	4 Way	49.95	46.95

Specialized Switchboxes

Part#	Description	Each	10+
AB5750-2	2 Way, 50-pin Telco type switchbox	$42.99	$39.99
AB50-2	2 Way 50-pin "D" sub type switchbox	$52.99	49.99

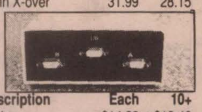


DE-9 9 Line Switchboxes



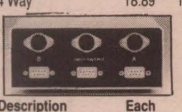
Part#	Description	Each	10+
AB09-2E	2 Way	$9.99	$8.49
AB09-4E	4 Way	14.99	13.49
AB09-X	9 Pin X-over	31.99	28.15

15 Pin High Density Switchboxes



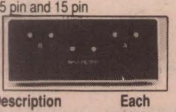
Part#	Description	Each	10+
ABHD15-2E	2 Way	$14.89	$13.40
ABHD15-4E	4 Way	18.89	17.00

Monitor-Keyboard



Part#	Description	Each	10+
ABMKB-2E	2 Way - 5 and 9 pin	$14.95	$13.45
ABMKB-4E	4 Way - 5 and 9 pin	29.99	26.99
ABVGKB-2E	2 Way VGA - 5 pin and 15 pin	17.99	16.19
ABVGKB-4E	4 Way VGA - 5 pin and 15 pin	24.99	22.49

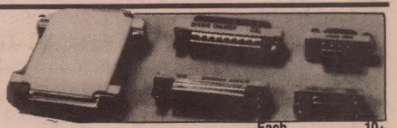
MINI DIN 8 Line Switchboxes



Part#	Description	Each	10+
ABMD8-2E	2 Way	$12.89	$10.89
ABMD8-4E	4 Way	15.89	13.89
ABMD8-X	X-Over	37.95	35.49

Gender Changers

These gender changers inexpensively mate "like to like" connectors. They are quick, easy to use, and are available in 9, 25 and 36-pin configurations.



Gender Changers - Ultrathin

Part#	Description	Each	10+
TGC-9M	9-pin male to male ultrathin	$2.69	$2.42
TGC-9F	9-pin female to female ultrathin	2.69	2.42
TGC-25M	25-pin male to male ultrathin	2.99	2.69
TGC-25F	25-pin female to female ultrathin	2.99	2.69

Gender Changers - Regular

Part#	Description	Each	10+
AGC-9M	9-pin male to male	$1.99	$1.79
AGC-9F	9-pin female to female	1.99	1.79
AGC-25M	25-pin male to male	1.99	1.79
AGC-25F	25-pin female to female	1.99	1.79
AGC-36M	36-pin male to male Centronics	4.99	4.24
AGC-36F	36-pin female to female Centronics	4.99	4.24

VISA MasterCard DISCOVER

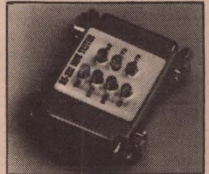
Non-Powered Parallel Line Extender

For computer (transmitter) to printer (receiver), you can safely transmit data up to 1600 ft. over 4Pair phone line without data loss. Compact, FCC Approved.

PLE100	DB25 Male to DB25 Male with 50' cable.	$49.00
PLE110	DB25 Male to 36 Pin Cent. Male w/50' cable.	49.00
IC-9V200	9V/200mA Power Adaptor extends to 2000'	6.25

RS-232 Testers

The RS-232 mini tester contains 7 dual state LED's that monitor pins 2, 3, 4, 5, 6, 8 & 20. Green is positive and red is negative. 25 pin male to female.



		Each	10+
MTT-25	7 LED mini tester	$8.95	$6.49

800-531-5369

Write in 55 on Reader Service Card.

INVERTERS AND CHARGERS

COMBINE FORCES

by Gordon West

It makes sense that the new breed of high tech power inverters and voltage-sensing battery chargers get combined into one nice, neat unit for mariners, RVers, or rural homeowners who may wish to balance the benefits of solar cells, generator, DC to AC, and AC to DC.

POWER INVERTERS

The power inverter changes 12 volts DC over to 110 volts AC silently, without the need to crank over a generator when you want to plug in that 16-cup coffee maker, or power up the squeezer to turn out some orange juice at 6:00 in the morning. If you are a boater or camper, your neighbors will appreciate your quiet approach in converting 12 volts DC over to 110 volts AC.

The auxiliary generator for boats, mobile homes, and cabins makes good sense when you may be running the air conditioning and your refrigeration system for the better part of a day. A continuous constant load is easily handled by a relatively small 3-4 kW generator set during the day. But running the generator just to power up a coffee maker, radial saw, or soldering iron may cause premature generator problems by constantly starting and stopping it for short periods of time. The generator doesn't have enough time to properly distribute internal lubrication, and the on-and-off-again cycle will dramatically shorten its mechanical life.

Power inverters that change 12 volts DC to 110 volts AC are now solid-state, and may or may not use big heavy transformers. Gone are the days of vibrators. "The ability of providing 120 volts AC power from a vehicle or boat battery is not new; DC motor generators were implemented during World War II. But only since the advent of new, high-efficiency, high-surge, solid-state inverters has the concept become practical and inexpensive," comments Warren Stokes, Senior Vice-President, Heart Interface Corporation (800-446-6160). "And now we combine two units into one that accomplishes both voltage inverting from 12 volts to 110 volts AC, and battery charging from 110 volts AC down to 12 volts DC. Whether the power is coming or going, it all happens automatically, silently, and efficiently in our combination inverter/charger systems," adds Stokes.

Changing 12 volts DC to 110 volts AC is accomplished by transistorized-switcher circuits which break up the 12 volts direct current into pulses controlled by field effect transistors that are then stepped up from 12 volts to 120 volts RMS, 60 Hz output. The transformer is necessary in the larger switcher power supplies to handle a wide variation of possible loads, including reactive-motor loads that sometimes draw as much as five times the average current when first switched into the circuit. While you can develop relatively small switcher inverters without any big transformer on the inside, they're not able to handle the 110 volt AC power requirements at 750 watts, 1000 watts, 2000 watts, or 2500 watts. For these "big power" outputs, expect a rather hefty 30 to 60 pound inverter to get the job done, including reverse battery charging when you can plug in, as well as the capability of a triple momentary overload when trying to kick over motor-type appliances.

The AC output from the inverter is a modified sinewave. If you looked at the output on an oscilloscope, it would not be a pure sinewave that is only found in some very expensive medical-type inverters. Oh yeah, you can get a pure sinewave, but it's going to cost you thousands of dollars. The modified sinewave should work all of your AC electronics – including your computer – just fine, and pricing for a 750 watt inverter starts below $500.00.

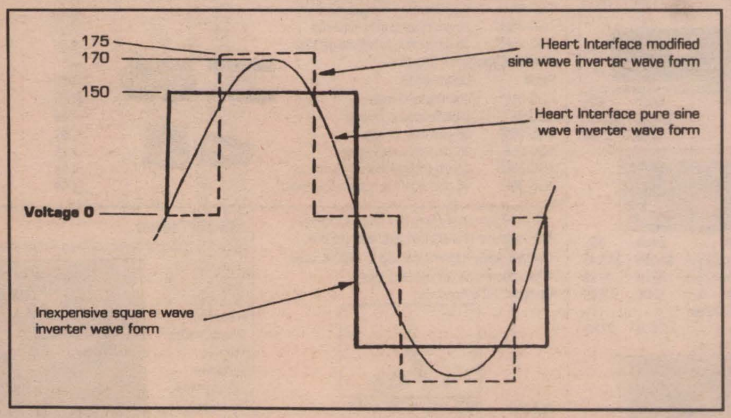
I have worked quite closely with the Heart inverters, and they continue

Inverter Output Waveform

A comparison of inverter output wave forms, or shapes, is essential for a good understanding of inverter function and of the differences between the various types available. It is necessary for proper application of inverters.

Wave form is compared to that of the pure sinewave, which is the wave form associated with commercial power sources. Scales allow comparison of output voltages. The typical, or averaging type of voltmeter can read the voltage from a generator or commercial utility, but a RMS type of meter is necessary to read inverter output. If inverter output is measured with an averaging meter it will read from 25 to 125 volts, and these voltages will vary and are dependent upon the inverter model and the percentage of rated load applied when the reading is taken.

The RMS voltage output of all wave forms shown in the diagram is 120 volts. This means that the average of the voltage "segments" contained within the waveform is 120 volts. RMS means "root mean square" and there is a mathematical equation used to calculate it. Refer to technical manuals for greater detail of this explanation if it is required.



One Electrical Cycle

The peak voltages shown in the Battery Cable Sizing Chart can be measured. The connected load "sees" only the RMS voltage. Modified sinewave inverters offer substantial performance advantages over squarewave units since the wave form closely approaches that of a sinewave, and the peak voltages are higher.

Battery Cable Sizing

Heart Interface inverters are shipped complete with factory- installed battery cables which have been properly sized to deliver full current requirements from the battery with minimal voltage drop. These cables are 36" in length.

If the distance between the Heart and batteries exceeds this standard cable length, then it is necessary to extend the cables to suit the installation requirements. This can be done, but it is mandatory to keep voltage drop to an absolute minimum for best performance. Voltage drop is wasted energy, which is unuseable. Always keep cables as short as possible.

Battery Cable Sizing Chart

Model	Distance From Heart To Battery 0-3'	6-9'	9-12'	12-15'	15-18'
HF12-600	#4	x	#2		x
HF12-1200	1/0			x	2/0
HF12-2000	2/0				x
HZ12-1500	1/0		x	2/0	x
HF24-1200	1/0				x
HF24-2500	1/0			x	2/0
HF32-1200	1/0				x
HF32-3000	1/0			x	2/0

Extension cables can be bolted together or quick-connected with special connectors. Make certain the connections are tight and protected against corrosion. Poor connections will result in high resistance with consequential voltage drop and power loss.

Either battery cable or welding cable can be used. Welding cable is more flexible, and installation may be easier.

to give noise-free power to audio amplifiers, computers, and any other type of electronics where input wave form and frequency tolerance is critical for the proper performance of the equipment.

But you should choose an inverter rated for what you plan to use it for most of the time. For instance, the new under $500.00 Heart "Freedom 7" pumps out 750 watts AC, and doubles as a three-stage, 25 amp battery charger and fully automatic 15 amp AC power source transfer switching. The inverter activates automatically when it senses the outside AC power is not available, and will then switch back to outside AC when outside power again becomes available. Here are some typical appliances that run nicely off of a 750 watt inverter:

- Stereos
- Floodlights
- Shavers
- Blenders/food processors
- Computers
- Small coffee makers
- Bug zappers
- Soldering equipment
- Test scopes
- Color televisions & VCRs

But 750 watts may not be enough for continuous operation of bigger home appliances. You will want a minimum of a 1000 watt inverter, or better yet, a 2000 watt inverter for the following AC appliances:

- Big microwave ovens
- Toasters & big coffee makers
- Hot plates
- Big vacuum cleaners
- Big power saws
- High-intensity floodlights
- Popcorn makers
- Hair dryers

Keep in mind that inverters draw more than one tenth of their AC output watts as amperes at 12 volts DC. For a 1500 watt microwave oven, you are going to suck more than 100 amps out of your 12 volt battery. But if you're only running a microwave oven for a couple of minutes, and you are working off of a 100 amp-hour, 12 volt battery, no problem. And if you are powering up a home video set-up, including some AC lights, you might draw 600 watts, and this conceivably could pull up to 50-60 amps at 12 volts DC when all the stuff is switched on. As you remove the AC loads, the inverter cycles down to an almost idle state, drawing less than 1 amp of current with little or nothing on the output. The modern inverter will also cycle down completely if it detects no load at all.

At 70 to 100 amps, your inverter must be powered by the same major-diameter cables that you would expect to feed a starter motor with. These cables are as large as your thumb, and Heart offers big league fuses which go right on the battery terminals to insure you don't have a catastrophic short-out.

BATTERY CHARGING

The modern inverter now contains a built-in charger to replenish those batteries when you are plugged back into AC. New switcher-smarter battery charging technology now does away with the old taper charger – the type that would slowly pull down the charging current as the battery would begin to develop a higher and higher terminal voltage. The new type of "smart charger" three-stage systems layer battery charging capacity into three stages:

1) Bulk charge constant current
2) Absorption charge constant voltage
3) Finish float charge with equalizing

When your 12 volt DC batteries are low, the charger first hits them with a high amperage bulk charge. This constant current charge continues until the charger senses that the battery has reached exactly 14.3 volts. The charger then switches to an acceptance charge mode where a variable current charge at a constant 14.3 volts is delivered until the battery will only accept 10 amps or less. It senses this by monitoring the voltage, and detecting how fast the terminal voltage begins to drop after the charge current is momentarily removed.

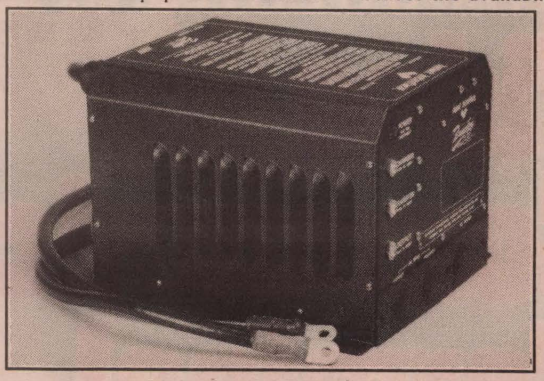
The charger then shifts into a float charge mode to maintain a constant voltage at 13.3 volts. You can also switch over to an equalizing cycle to condition a pair of batteries, too.

These smart chargers, built into premium voltage inverters, parallel the same type of technology we now see in the rechargeable alkaline systems and charge conditioners used on premium nickel cadmium systems. Microprocessor chips have been pre-programmed to sense exactly what's happening with the battery voltage, and kicking in just the right amount of charge for a specific period of time or a specific rise in voltage.

The new combination inverter/chargers continue to refine their output wave form to get as pure as possible to a sinewave. They have also dramatically reduced the amount of spurious emissions that are inherent with switcher types of power supplies and battery chargers. Through proper grounding, you won't even know that the inverter or charger is doing its thing. But as soon as you push the ON button to your vacuum cleaner or oscilloscope, 12 volts instantly becomes 110 volts AC – and as long as you remember to replenish your basic 12 volt DC source, you are all set for AC operation of equipment from a 12 volt DC source. **NV**

NEW FREEDOM 7 INVERTER/CHARGER

Heart Interface Corporation, the creator of modern inverter technology, is proud to announce an important new addition to its popular "FREEDOM" series of inverter/chargers, the "FREEDOM 7."



Heart's popular "Freedom" series inverter/chargers provide household 120 volt AC power from your auxiliary DC batteries, automatic battery charging, and automatic power source selection.

The FREEDOM 7 is a rugged, yet very practical 750 watt DC to AC inverter with a built-in three-stage 25 amp automatic battery charger and fully automatic 15 amp AC power source transfer switching.

The inverter provides clean and reliable 120 volt AC power from 12 volt battery systems . . . anywhere, anytime without the noise, vibration, fumes, or upkeep costs of a generator. In fact, unlike some generators, the power is clean enough to operate most sensitive electronic equipment like TVs and computers. The inverter activates automatically when it senses that outside AC power is not available and will switch back to outside AC when it becomes available again.

It is the perfect choice for small appliances and power tools. The FREEDOM 7 easily operates a full size TV and VCR, stereo, blender, ni-cad battery charger or even a compact microwave oven. For quick repairs this inverter can operate a power drill, orbital sander, soldering iron, or other tools.

To prevent unnecessary power drain, a special idle circuit reduces output and power consumption to less than .4 amp per hour when there is no AC load on the unit. The inverter will automatically shut off if battery voltage drops below 10.0 volts to prevent damage as a result of excessive discharging. Naturally, the inverter is fully protected against overloads and short circuits. Yet it is designed to allow momentary surges of extra power needed to start many electric motors without shutting the unit down.

The built-in 25 amp battery charger automatically activates as needed when it senses the availability of outside AC power. It charges in three stages to charge your batteries quickly and completely without ever overcharging. When the batteries are low, it starts with a maximum high current "bulk charge" to quickly charge the batteries. Then it switches to a variable current "acceptance charge" mode to thoroughly and completely charge the batteries without damaging them.

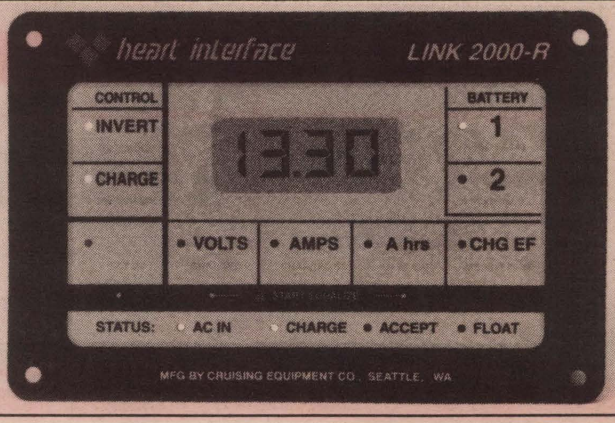
After the batteries reach a full charge, the "float charge" mode activates to provide long-term battery maintenance without overcharging and minimal electrolyte loss. In this mode, the charger will also act as an effective AC to DC converter for your DC lights and appliances while maintaining fully charged batteries.

The unit features user selectable settings for optimal charging of gel or wet cell batteries. The charger is also protected against overloads, overheating, and shorts by circuit breakers and a special electronic circuit.

An optional remote switch is available to provide on/off and reset capability from any convenient location. The remote switch is cabled with ordinary RJ-11 phone wire and connectors.

The FREEDOM 7 retails below $500.00. This will put high quality inverter/chargers within realistic reach of a much larger market and will likely contribute to an accelerated acceptance and proliferation of the technology.

The unit measures 12" x 9-3/4" x 7" and can be conveniently mounted horizontally or vertically. It is ruggedly built by Heart Interface in the U.S.A. using corrosion-resistant marine grade materials and includes a comprehensive owner's manual with easy-to-understand installation instructions. All units are tested at Heart's computer controlled automated test center before shipping and each has a 30 month factory warranty. Remotes, fuseholders, cable connectors, and other optional equipment are available from most Heart dealers.



For further information contact: Heart Interface Corporation (206) 872-7225 office (206) 872-3412 FAX 21440 68th Ave. So., Kent, WA 98032.

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#60 COMPUTER SOFTWARE *cont.*

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COMPUTER EQUIPMENT WANTED 70

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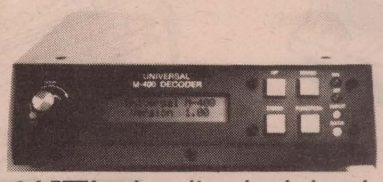

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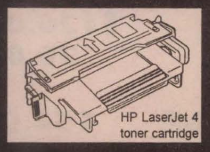

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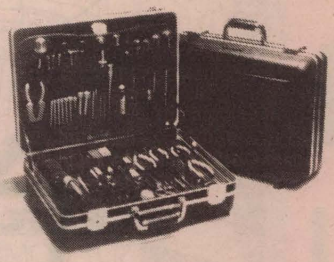

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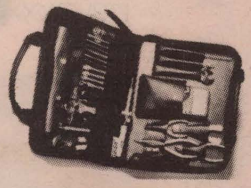

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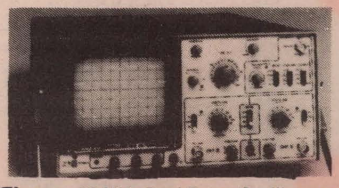

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TEST EQUIPMENT 80

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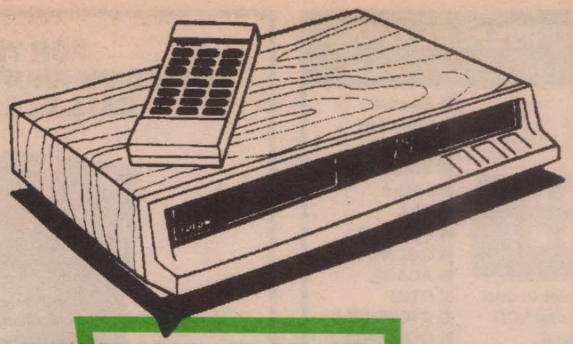

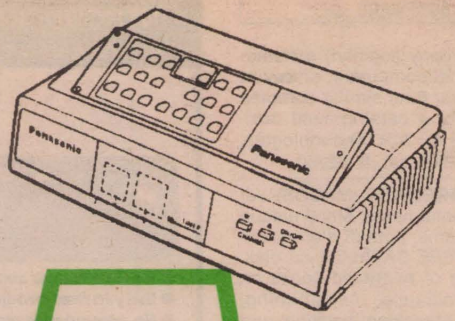

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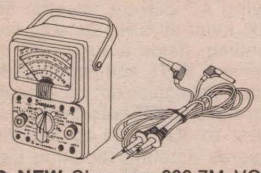

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PORTABLE SCOPES: Tek 2465A (400MHz) $3100. **Tek 2236** (100MHz) $725. **Tek 475** (200MHz) $595. **Tek 475A** (250MHz) $695. **Tek 466** (100MHz, storage) $850. **Tek 465** (100MHz) $425. All with BRIGHT CRTs, excellent condition. Tek probes available. **Pepper Systems,** 214-353-0257.

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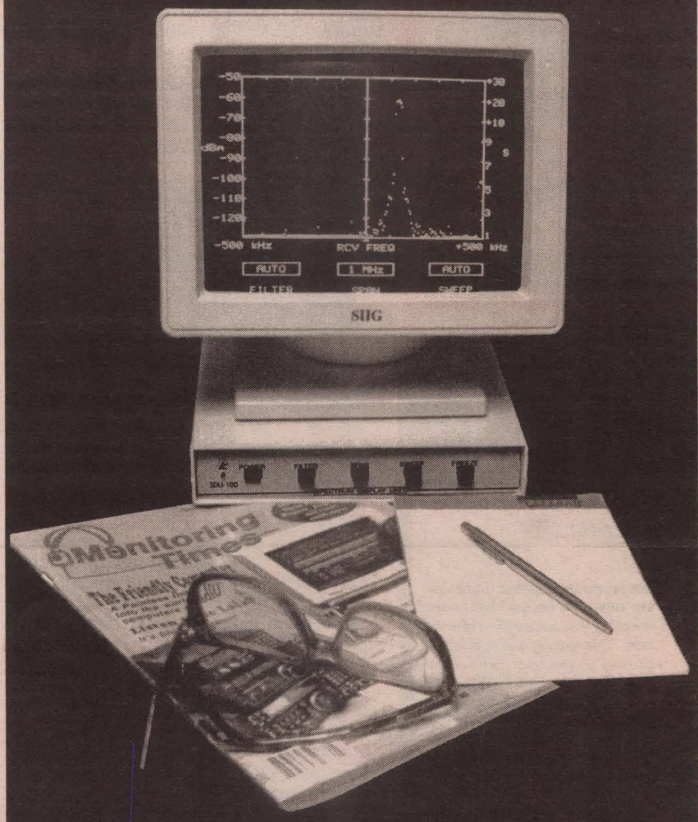
METERS: VALHALLA 2301 true RMS AC wattmeter: three 4-1/2 digit displays for AC volts, amps, watts (single phase) $695. **Tek DM 501A** 4-1/2 digit multimeter plug-in $250. **Tek DM 502A** auto-ranging multimeter plug-in $215. **HP 3455A** 6-1/2 digit multimeter $550. **HP 3456A** 6-1/2 digit multimeter $1100. **HP 3467A** printing 4-channel multimeter/recorder (monitors temperature too) $525. **Pepper Systems,** 214-353-0257.

SEE THE SIGNALS YOU COULD BE HEARING!



Put professional power in your radio monitoring with the surveillance technology the pros use! Now you can *see* hidden radio signals with Grove Enterprises' new SDU-100 Spectrum Display Unit.

The SDU-100 attaches to the IF output jack on the back of your receiver, and is shows you all the signals in a slice of the radio spectrum you select -- from 100 kHz up to 10 megahertz wide. Each signal appears as a "spike" on the display (the higher the spike, the stronger the signal).

Use Your Eyes to Spot Hidden Signals

Just the way surveillance countermeasures teams do, you'll be able to use both your ears and eyes in hunting new signals. With the power of spectrum display technology, you'll be able to track down elusive signals faster and more efficiently

While you can listen to only one signal at a time, the SDU-100 can show you a whole band of signals at once. So, if you are listening to a particular transmission and suddenly a new spike appears on the monitor, you'll know immediately that there's a new signal to be checked out. Without the power of the SDU-100, those momentary transmissions would go undetected.

The Grove SDU-100 Spectrum Display Unit, and a nine-inch video monitor** -- the same spectrum surveillance technology that the pros use -- costs just $599.95.

The Grove SDU-100 Spectrum Display Unit is now available for:

- **ICOM R7000, R7100, R9000**
- **Yaesu Ft1000, FRG-100**
- **Kenwood R5000***
- **Drake R8, TR-7***
- **JRC NRD-535-D***
- **Uniden BC890XLT***
- **Satellite receivers using 70.0 Hz IFs***

If you're serious about communications monitoring, the SDU-100 will put your signal hunting in overdrive!

Call 1-800-438-8155 to order the SDU-100 and nine-inch monitor.

Grove Enterprises, Inc.
300 South Hwy 64 West
Brasstown, NC 28902

* Requires receiver modification, available from the Grove service department
** Appearance of monitor may vary

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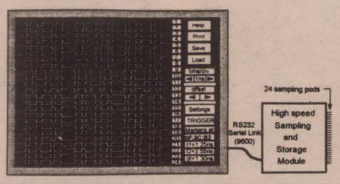
HEWLETT PACKARD 3430A digital voltmeter 100MV to 1000V $150 or BO. 408-373-8021, Gary.

PLOTTERS: COLORPRO HP 7440A 8-pen plotter $320. **HP 7550A** 8-pen plotter $650. Excellent condition, with warranty. **Pepper Systems,** 214-353-0257.



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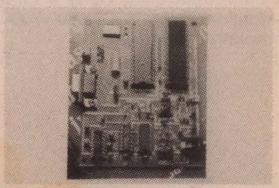
HP 8552B SPECTRUM analyzer-IF section $275, HP 3455A digital voltmeter $375, HP 435A power meter $225, HP 432A power meter $125, **HP 3575A GAIN PHASE METER $675,** HP 419A DC null voltmeter $75, HP 6131B digital voltage source $225, HP 3300A function generator $50, HP 5489 low pass filter $75, HP 8405A vector voltmeter $250, Tek data acquisition probe P6451 $45, GR 1396-B tone burst generator $125, Rockland 5100 programmable frequency synthesizer $250, **FLUKE 1953E COUNTER TIMER $275.** Future Systems, POB 5661, Buena Park, CA 90622-5661. 714-827-7345.

EIP351D COUNTER LED, oven TB, 18GHz $900, HP 204C $125, Boonton 42A no cable or head $100, Fluke 1900A $100, Fluke 510A AC reference std. $225. Corby Dawson, 805-736-0288.

TEST EQUIPMENT: We buy and sell late model HP, TEK, Fluke, Wavetek, GR, etc. All equipment we sell is calibrated and guaranteed to meet manufacturers specifications. **KANDEL ELECTRONICS,** Inc., PO Box 204, Oreland, PA 19075. **Toll Free 800-582-TEST (8378), 215-233-6100, FAX 215-886-7017.**

WANTED: WATKINS-Johnson 8617B. Late Racal VHF/UHF receivers, HP spectrum analyzers. 810-620-0853.



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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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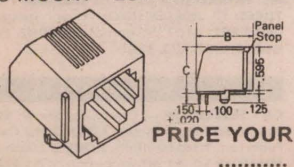

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Events CALENDAR

WESTERN REGION

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

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

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

All listing information should be sent to:

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EVENTS CALENDAR
430 Princeland Court
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FAX 909-371-3052

AUGUST 6

CA - SANTEE — Ham Radio, Computer & Electronics Swap Meet. **SPONSOR:** Amateur Radio Club of El Cajon. **LOCATION:** Santee Drive-in, 10990 N. Woodside. **OPENS:** Appx. 6:30am, rain or shine. **ADMISSION:** 50 cents. **TALK-IN:** 146.520. **FEATURES:** C - E - F - F/R - H. **DEALER INFO:** $6/vehicle. **CONTACT:** N6RGM Sonny 619-444-6532; WA6MHZ Pat 619-561-0052; ARCEC, Box 50, El Cajon CA 92020.

AUGUST 7

CA - LIVERMORE — East Bay Area Amateur Radio/Electronics/Computer Swap Meet **SPONSOR:** Livermore Amateur Radio Klub (LARK). **LOCATION:** Los Positas College, N of I-580 at Airway Blvd. exit. **HOURS:** 7am-12noon, rain or shine. **ADMISSION:** Free. **TALK-IN:** 147.045+ fr west, 145.350-(100Hz) fr east. **FEATURES:** E - H - FP - F/R. **DEALER INFO:** Setup after 6am only. $10 space fee. Covered spaces avail. If rain. **CONTACT:** Noel Anklam KC6QZK, 510-447-3857 eves or 510-783-2803 message days.

AUGUST 8-9-10-11-12-13

OR - PORTLAND — National Professional Electronics Convention. **LOCATION:** Red Lion Hotel at Lloyd Center. **FEATURES:** S. **CONTACT:** NPEC, 2708 W. Berry St., Ft. Worth TX 76109-2397. Phone: 817-921-9061, FAX: 817-921-3741.

AUGUST 13

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

CA - LOS ALTOS HILLS — Foothill College Amateur Radio Flea Market. **LOCATION:** Foothill College, Hwy 280, exit El Monte Rd West. Parking Lot A. **HOURS:** 6am-? **ADMISSION:** Free. Parking fee $2, bring quarters. **TALK-IN:** 145.270(-) or 224.360 (PL-100). **FEATURES:** E - EX - F/R - H. **DEALER INFO:** $10-$15. **CONTACT:** The Perham Foundation, 408-734-4453. Exam info: 408-255-9000 24/Hr.

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.*

NV - RENO — Reno Hamfest. **SPONSOR:** Sierra Nevada Amateur Radio Society. **LOCATION:** 10 mi. N of Reno on Hwy. 395 N. **ADMISSION:** $3. **TALK-IN:** 146.61-. **FEATURES:** DP - EX - FM - F/R. **DEALER INFO:** Tables $10. **CONTACT:** Robert Davis, KG7IY, 3775 Sleepy Hollow Dr., Reno NV 89502. 702-856-2826 home, 702-329-2833 office.

WA - TACOMA — Flea Market. **SPONSOR:** Radio Club of Tacoma. **LOCATION:** Charles Wright Academy, 7723 Chambers Creek Rd. W. **HOURS:** 9am-3pm. **ADMISSION:** $4, under 12 free. **TALK-IN:** 148.28. **FEATURES:** EX - FP - F/R. **DEALER INFO:** Commercial tables $40, non-commercial $15 and must pre-register. **CONTACT:** Alan Allen, N7EAY, 206-475-7413, POB 11188, Tacoma WA 98411.

AUGUST 14

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

AUGUST 20

CA - SANTEE — Ham Radio, Computer & Electronics Swap Meet. **SPONSOR:** Amateur Radio Club of El Cajon. **LOCATION:** Santee Drive-in, 10990 N. Woodside. **OPENS:** Appx. 6:30am, rain or shine. **ADMISSION:** 50 cents. **TALK-IN:** 146.520. **FEATURES:** C - E - F - F/R - H. **DEALER INFO:** $6/vehicle. **CONTACT:** N6RGM Sonny 619-444-6532; WA6MHZ Pat 619-561-0052; ARCEC, Box 50, El Cajon CA 92020.

WA - LONGVIEW — Ham Radio, Computer & Electronic Equipment Swap Meet. **SPONSOR:** Lower Columbia Amateur Radio Assn. **LOCATION:** Cowlitz County Fairgrounds. **HOURS:** 9am-3pm. **ADMISSION:** $3. **TALK-IN:** 147.26+. **FEATURES:** DP - FM - RV-H - T. **DEALER INFO:** Commercial tables $15; swap tables $12 before Aug. 6, $15 after; tailgate spaces $5. Setup Fri. 5-9pm & Sat. 6-8:45am. **CONTACT:** 206-425-6076, 206-425-9184, or 206-425-1866.

AUGUST 20-21

CA - NORTHRIDGE — Computer Show. **SPONSOR:** American Mega Shows. **LOCATION:** Cal. State Northridge, San Fernando Valley Hall. **HOURS:** 10am-5pm. **ADMISSION:** $6, $1 off w/coupon or ad. **FEATURES:** C. **CONTACT:** American Mega Shows, 818-961-3782.

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.*

AUGUST 21

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

AUGUST 26-27-28

CA - SAN DIEGO — ARRL Southwestern Division Convention. **LOCATION:** Town & Country Convention Center. **FEATURES:** CB. **CONTACT:** Sybil Allbright, W6GIC, 619-278-4284.

AUGUST 27

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

OR - HILLSBORO — Northwest Computer Show & Sale. **SPONSOR:** Access Marketing. **LOCATION:** Hillsboro Fairplex. **HOURS:** 9am-4pm. **ADMISSION:** $4, under 12 free. **FEATURES:** C - DP - FP - F/R. **CONTACT:** Access Marketing, 206-573-4301.

WA - TACOMA — MarketPro Computer Show & Sale. **LOCATION:** Tacoma Dome (tentative). **HOURS:** 10am-5pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

SEPTEMBER 3

CA - SANTEE — Ham Radio, Computer & Electronics Swap Meet. **SPONSOR:** Amateur Radio Club of El Cajon. **LOCATION:** Santee Drive-in, 10990 N. Woodside. **OPENS:** Appx. 6:30am, rain or shine. **ADMISSION:** 50 cents. **TALK-IN:** 146.520. **FEATURES:** C - E - F - F/R - H. **DEALER INFO:** $6/vehicle. **CONTACT:** N6RGM Sonny 619-444-6532; WA6MHZ Pat 619-561-0052; ARCEC, Box 50, El Cajon CA 92020.

SEPTEMBER 3-4

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

SEPTEMBER 4

CA - LIVERMORE — East Bay Area Amateur Radio/Electronics/Computer Swap Meet **SPONSOR:** Livermore Amateur Radio Klub (LARK). **LOCATION:** Los Positas College, N of I-580 at Airway Blvd. exit. **HOURS:** 7am-12noon, rain or shine. **ADMISSION:** Free. **TALK-IN:** 147.045+ fr west, 145.350-(100Hz) fr east. **FEATURES:** E - H - FP - F/R. **DEALER INFO:** Setup after 6am only. $10 space fee. Covered spaces avail. If rain. **CONTACT:** Noel Anklam KC6QZK, 510-447-3857 eves or 510-783-2803 message days.

SEPTEMBER 10

CA - LOS ALTOS HILLS — Foothill College Amateur Radio Flea Market. **LOCATION:** Foothill College, Hwy 280, exit El Monte Rd West. Parking Lot A. **HOURS:** 6am-? **ADMISSION:** Free. Parking fee $2, bring quarters. **TALK-IN:** 145.270(-) or 224.360 (PL-100). **FEATURES:** E - EX - F/R - H. **DEALER INFO:** $10-$15. **CONTACT:** The Perham Foundation, 408-734-4453. Exam info: 408-255-9000 24/Hr.

SEPTEMBER 10-11

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

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.*

SEPTEMBER 17

CA - SANTEE — Ham Radio, Computer & Electronics Swap Meet. **SPONSOR:** Amateur Radio Club of El Cajon. **LOCATION:** Santee Drive-in, 10990 N. Woodside. **OPENS:** Appx. 6:30am, rain or shine. **ADMISSION:** 50 cents. **TALK-IN:** 146.520. **FEATURES:** C - E - F - F/R - H. **DEALER INFO:** $6/vehicle. **CONTACT:** N6RGM Sonny 619-444-6532; WA6MHZ Pat 619-561-0052; ARCEC, Box 50, El Cajon CA 92020.

CA - SEBASTOPOL — 12th Annual Radio Flea Market. **SPONSOR:** Sonoma County Radio Amateurs, Inc. **LOCATION:** Holy Ghost Hall, 7960 Mill Station Rd., off Hwy. 116. **HOURS:** 7:30am-2pm. **ADMISSION:** Free. **TALK-IN:** 146.13/73. **FEATURES:** DP - FM - FP - F/R. **DEALER INFO:** Indoor & outdoor flea market spaces $10. Setup 6:30 am. **CONTACT:** SCRA, Box 116, Santa Rosa CA 95402.

SEPTEMBER 17-18

CA - WESTWOOD — Computer Show. **SPONSOR:** American Mega Shows. **LOCATION:** UCLA, Grand Ballroom. **HOURS:** 10am-5pm. **ADMISSION:** $6, $1 off w/coupon or ad. **FEATURES:** C. **CONTACT:** American Mega Shows, 818-961-3782.

SEPTEMBER 18

AZ - PHOENIX — Computer & Electronic Swap Meet. **SPONSOR:** Electronic Materials & Computers. **HOURS:** 8am-3pm. **ADMISSION:** Free. **FEATURES:** FP. **DEALER INFO:** Vendor spaces $10. **CONTACT:** 3102 W Thomas Rd. #902, Phoenix AZ 85017. 602-272-3200.

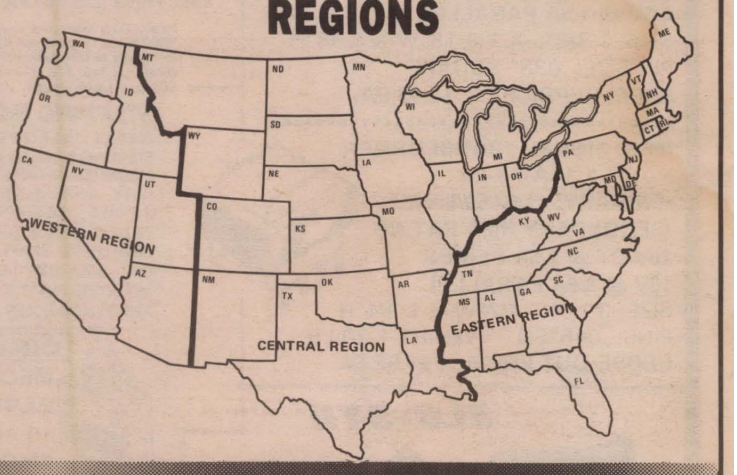
SEPTEMBER 24-25

CA - FULLERTON — Computer Show. **SPONSOR:** American Mega Shows. **LOCATION:** Cal. State Fullerton, Titan Pavilion. **HOURS:** 10am-5pm. **ADMISSION:** $6, $1 off w/coupon or ad. **FEATURES:** C. **CONTACT:** American Mega Shows, 818-961-3782.

SEPTEMBER 25

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.

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

CMA Computer Shows - 804-272-1570

KGP Computer Shows - 800-631-0062

MarketPro Computer Shows - 415-388-8893

NARISAAM Computer Shows - 404-565-9889
800-436-6707

Northern Computer Shows - 508-744-8440

Peter Trapp Shows - 607-369-2796

Robert Austin Computer Show & Sale
415-347-0100

UniCorp, Inc. - 305-731-4971

Events CALENDAR

OCTOBER 1

CA - SANTEE — Ham Radio, Computer & Electronics Swap Meet. **SPONSOR:** Amateur Radio Club of El Cajon. **LOCATION:** Santee Drive-in, 10990 N. Woodside. **OPENS:** Appx. 6:30am, rain or shine. **ADMISSION:** 50 cents. **TALK-IN:** 146.520. **FEATURES:** C - E - F - F/R - H. **DEALER INFO:** $6/vehicle. **CONTACT:** N6RGM Sonny 619-444-6532; WA6MHZ Pat 619-561-0052; ARCEC, Box 50, El Cajon CA 92020.

WA - BREMERTON — 3rd Annual Hamfest & Electronics Swap Meet. **SPONSOR:** North Kitsap ARC. **LOCATION:** Kitsap County Fairgrounds, President's Hall, NW corner of Fairgrounds Rd. at Nels Nelson. **HOURS:** 9am-4pm. **ADMISSION:** $4, under 12 free. **TALK-IN:** 145.31 (R). **FEATURES:** CB - DP - FM. **DEALER INFO:** Adv. tables $15, $20 after 9/1/94; Half-Tables adv. $10, $15 after 9/1/94. Commercial spaces $25. **CONTACT:** North Kitsap ARC, POB 2268, Silverdale WA 98383-2268.

OCTOBER 2

CA - LIVERMORE — East Bay Area Amateur Radio/Electronics/Computer Swap Meet **SPONSOR:** Livermore Amateur Radio Klub (LARK). **LOCATION:** Los Positas College, N of I-580 at Airway Blvd. exit. **HOURS:** 7am-12noon, rain or shine. **ADMISSION:** Free. **TALK-IN:** 147.045+ fr west, 145.350-(100Hz) fr east. **FEATURES:** E - H - FP - F/R. **DEALER INFO:** Setup after 6am only. $10 space fee. Covered spaces avail. if rain. **CONTACT:** Noel Anklam KC6QZK, 510-447-3857 eves or 510-783-2803 message days.

OCTOBER 8

OR - MEDFORD — Swap Meet. **SPONSOR:** Rogue Valley ARC. **LOCATION:** North Medford High School, 1900 Keeneway Dr. **HOURS:** 9am-4pm. **ADMISSION:** $5 adv., $6 door. **TALK-IN:** 147.160, 146.940. **FEATURES:** C - CB - DP - EX - FP - F/R - RV-S. **DEALER INFO:** Setup 7:30 am. **CONTACT:** RVARC, 1707 E. Main, Medford OR 97504.

OCTOBER 15

CA - SAN DIEGO — Computer Show. **SPONSOR:** American Mega Shows. **LOCATION:** Jack Murphy Stadium. **HOURS:** 10am-5pm. **ADMISSION:** $6, $1 off w/coupon or ad. **FEATURES:** C. **CONTACT:** American Mega Shows, 818-961-3782

CA - SANTEE — Ham Radio, Computer & Electronics Swap Meet. **SPONSOR:** Amateur Radio Club of El Cajon. **LOCATION:** Santee Drive-in, 10990 N. Woodside. **OPENS:** Appx. 6:30am, rain or shine. **ADMISSION:** 50 cents. **TALK-IN:** 146.520. **FEATURES:** C - E - F - F/R - H. **DEALER INFO:** $6/vehicle. **CONTACT:** N6RGM Sonny 619-444-6532; WA6MHZ Pat 619-561-0052; ARCEC, Box 50, El Cajon CA 92020.

OCTOBER 15-16

CA - SAN DIEGO — Computer Show. **SPONSOR:** American Mega Shows. **LOCATION:** Jack Murphy Stadium, Concourse area. **HOURS:** 10am-5pm. **ADMISSION:** $6, $1 off w/coupon or ad. **FEATURES:** C. **CONTACT:** American Mega Shows, 818-961-3782.

OCTOBER 22-23

CA - PASADENA — International Computer Shows & Sales. **SPONSOR:** R.G. Canning Attractions. **LOCATION:** Pasadena Center. **HOURS:** Sat: 1pm-7pm, Sun: 11am-5pm. **FEATURES:** C. **CONTACT:** R.G. Canning Attractions, POB 400, Maywood CA 90270 or call 213-587-5100 (Event Ext. 4), 909-628-4236 (Event Ext. 50).

CENTRAL REGION

AUGUST 3-4-5-6

IL - ELGIN — Radiofest 1994. **SPONSOR:** Antique Radio Club of Illinois. **LOCATION:** Holiday Inn Holidome & Convention Center, 345 River Rd. **FEATURES:** FM. **CONTACT:** Jeff Aulik, 1708 Parkview Ave., Rockford IL 61107. 815-399-1902 evenings or weekends.

AUGUST 5-6-7

IL - UTICA — 3905 Century Club Eyeball. **LOCATION:** Starved Rock State Park. **FEATURES:** F/R. **CONTACT:** Gene Marsh, N9OZI, 708-552-3024.

AUGUST 6

IL - CARLINVILLE — Hamfest. **SPONSOR:** Macoupin County ARC, Inc. **LOCATION:** Macoupin County Fairgrounds, 1/2 mi. N of Carlinville, on Rt. 4. **HOURS:** 8am-? **TALK-IN:** 146.82, 443.400, 103.5 PL. **FEATURES:** EX. **CONTACT:** 217-854-8261.

IN - GOSHEN — Hamfest. **SPONSOR:** Elkhart County Radio Assn. **HOURS:** 8am-3pm. **ADMISSION:** $4 adv., $5 door. **TALK-IN:** 145.43, 224.40, 443.325 (CTCSS 131.8). **FEATURES:** EX - F. **CONTACT:** Mike McCauley, KB9CNU, 11469 N. Executive Blvd., Syracuse IN 46567. 219-457-5944.

IN - INDIANAPOLIS — WA9SNT Hamfest. **LOCATION:** ITT Technical Institute, 9511 Angola Ct., across I-465 from the pyramids. **HOURS:** 8am-3pm. **ADMISSION:** $1 adv., $2 door. **TALK-IN:** 145.25-. **FEATURES:** CB - DP - FM - F/R. **DEALER INFO:** Setup 6am. Inside 5' table, electric furnished, $5 plus a door prize donation. **CONTACT:** Dave Johnston, K9HDQ. ITT Technical Institute, 317-875-8640.

IN - VALPARAISO — Porter County Hamfest & Computer Show. **SPONSOR:** Porter County Amateur Radio Club. **LOCATION:** Porter County Expo Center. **HOURS:** 8am-? **ADMISSION:** $4 adv., $5 door, under 12 free. **TALK-IN:** 146.775/-6kc 131.8 PL, 146.520 simplex. **FEATURES:** DP - EX - FP - F/R - T. **DEALER INFO:** Indoor tables $8, w/electricity $13. Setup 6am. **CONTACT:** Rich, N9QLQ, 219-762-8701 or send SASE to: PCARC Hamfest, POB 1782, Valparaiso IN 46384-1782.

MI - ROSEVILLE — International Canadian/American Mega-Fest Show. **SPONSOR:** E.S.P.S. Corp. **LOCATION:** Days Inn Hotel, 31960 Little Mack. I-94 to Gratiot, go to Masonic, make right, 1/4 mile on right. **HOURS:** 10am-4pm. **ADMISSION:** $4. **FEATURES:** C - CB - H. **DEALER INFO:** Setup 8am-9:45am. **CONTACT:** John or Sabrina, Bus: 313-884-7690/FAX

MO - SPRINGFIELD — Hamfest. **SPONSOR:** SMARC. **LOCATION:** University Plaza Trade Center. **HOURS:** 8am-? **ADMISSION:** $5. **TALK-IN:** 146.91, 444.4. **DEALER INFO:** Tables $5. **CONTACT:** Jimmie Jeffries, K0ICB, 417-869-6581 or 417-833-4111, E-Mail via CompuServe 70423,142.

OH - CLEVELAND — Computer Trade Show. **SPONSOR:** Peter Trapp Shows. **LOCATION:** Holiday Inn, Westlake. **HOURS:** 10am-3pm. **ADMISSION:** $5 w/ad or coupon $1 off, under 11 free. **FEATURES:** C - FM - FP - T. **CONTACT:** Peter Trapp Shows.*

OH - COLUMBUS — Hamfest. **SPONSOR:** Voice of Aladdin ARC. **LOCATION:** Aladdin Shrine Temple, 3850 Stelzer Rd., from I-270 exit Morse Rd., W on Morse to Stelzer Rd., turn S. **HOURS:** 8am-3pm. **ADMISSION:** $3 adv., $5 door. **TALK-IN:** 147.84/24. **FEATURES:** S. **CONTACT:** Jimmy Caines, KB8KME, 1056 Erickson Ave., Columbus OH 43227. 614-235-5606.

AUGUST 6-7

ID - IDAHO FALLS — WIMU Hamfest. **SPONSOR:** Eagle Rock Amateur Radio Club. **LOCATION:** Westbank Convention Center. **CONTACT:** WIMU Committee, Matt Hackman, N7VXU, 274 Colonial Way, Idaho Falls ID 83404. 208-523-5639.

AUGUST 7

IL - PEOTONE — 60th Annual Hamfest. **SPONSOR:** Hamfesters Radio Club, Inc. **LOCATION:** Will County Fairgrounds, I-57 to Peotone, Exit 327 East. **HOURS:** Exhibits: 8am-? Flea market: 6am-3pm. **ADMISSION:** $4 adv., $5 door, under 12 free. **TALK-IN:** 146.52 simplex. **FEATURES:** AC - C - CB - DP - FM - FP - F/R. **DEALER INFO:** No additional charge for flea market space. $10 fee for outside electricity. **CONTACT:** Hamfesters Radio Club, POB 42792, Chicago IL 60642 or call 708-535-AHAM.

IN - ANGOLA — Angola Hamfest. **SPONSOR:** Land of Lakes Amateur Radio Club. **LOCATION:** Steuben County 4-H Fairgrounds, corner of 200 W & 200 N. **HOURS:** 6am-2pm. **ADMISSION:** $3 adv., $4 gate. **TALK-IN:** 147.180, 145.090. **FEATURES:** DP - EX - FP - F/R - T. **DEALER INFO:** Indoor tables $6, trunk sales $2. Setup Sat. 3-10pm, Sun. 4-6am. **CONTACT:** Sharon Brown, WD9DSP, 905 W Parkway Dr., Pleasant Lake IN 46779. 219-475-5897.

MI - DEARBORN — Computer Trade Show. **LOCATION:** Adray Sports Arena, 14900 Ford Rd. (M-153), 1 blk E 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 - TAYLOR — International Canadian/American Mega-Fest Show. **SPONSOR:** E.S.P.S. Corp. **LOCATION:** Holiday Inn, 20777 Eureka Rd. I-75 to Eureka Rd. on E side of Fwy. **HOURS:** 10am-4pm. **ADMISSION:** $4. **FEATURES:** C - CB - H. **DEALER INFO:** Setup 8am-9:45am. **CONTACT:** John or Sabrina, Bus: 313-884-7690/FAX.

OH - AKRON — Computer Trade Show. **SPONSOR:** Peter Trapp Shows. **LOCATION:** Tadmor Temple. **HOURS:** 10am-3pm. **ADMISSION:** $5 w/ad or coupon $1 off, under 11 free. **FEATURES:** C - FM - FP - T. **CONTACT:** Peter Trapp Shows.*

OH - RANDOLPH — Hamfair '94. **SPONSOR:** Portage Amateur Radio Club. **LOCATION:** Portage County Fairgrounds, on St. Rt. 44, three miles S of I-76. **HOURS:** 8am-4pm. **ADMISSION:** $4 adv., $5 gate. **TALK-IN:** 145.39-600, 28.390, 223.500. **FEATURES:** DP - F - FM - FP. **DEALER INFO:** Indoor tables $8 ea., flea market spaces $3 ea. **CONTACT:** Joanne Solak, KJ3O, 216-274-8240.

WI - MARSHFIELD — 3rd Annual Picnic Potluck/Swapfest. **SPONSOR:** Marshfield ARS. **LOCATION:** Wildwood Pk. **HOURS:** 11am-? **TALK-IN:** 147.180. **CONTACT:** Guy A. Boucher, KB9GPJ, 107 W 3rd St., Marshfield WI 54449. 715-384-4323.

WV - MINERAL WELLS — Hamfest & Computer Show. **SPONSOR:** Mid Ohio Valley ARC & 3 Rivers PC Sig., Inc. Computer Club. **LOCATION:** Wood County 4-H Fairgrounds, near Parkersburg , WV-I-77 Exit 170. **HOURS:** 8am-3pm. **ADMISSION:** $4. **TALK-IN:** 146.745. **FEATURES:** C - DP - E - EX - FP - F/R - H - T. **DEALER INFO:** Inside tables $10, canopy tables $8, tailgating free. **CONTACT:** Mike Sewell, 614-678-8457.

AUGUST 13

IL - QUINCY — Ham Radio & Computer Swapfest. **SPONSOR:** Western Illinois ARC. **LOCATION:** Eagles Alps Lodge, 3737 N. 5th St., 1 mi. N of intersection US24 & N. 5th St. **HOURS:** 8am-2pm. **ADMISSION:** $2.50 adv., $3 door. **TALK-IN:** 146.63/03. **FEATURES:** DP - EX - FM - T. **DEALER INFO:** Tables $5, tailgating free. **CONTACT:** Rod Simon, N9MCX, c/o WIARC, POB 3132, Quincy IL 62305-3132. 217-223-8739. Testing: 217-224-8526.

IN - INDIANAPOLIS — Indianapolis Computer Fair. **LOCATION:** Quality Inn East, 3525 N Shadeland, near Pendleton Pike. **HOURS:** 10am-3pm. **ADMISSION:** $4, under 12 free. **FEATURES:** C - DP. **CONTACT:** Ben Yanto, AGI Computer Fairs.*

AUGUST 13-14

LA - BOSSIER CITY — Ark-La-Tex Hamfest. **SPONSOR:** Shreveport ARA. **LOCATION:** Bossier City Civic Center, Benton Rd. **HOURS:** Sat: 8:30am-4:30pm, Sun: 8:30am-1pm. **ADMISSION:** $3. **TALK-IN:** 147.03. **FEATURES:** B - CB - EX - F - FM - F/R. **CONTACT:** Alice B. Prudhomme, KG5ZZ, Rt. 1 Box 410, Mansfield LA 71052. Phone: 318-872-5988 after 6pm.

AUGUST 14

KY - LOUISVILLE — Computer Fair. **SPONSOR:** MEKA Enterprises, Inc. **LOCATION:** Executive West Hotel, I-65 & 264 Freedom Way at the Fairgrounds. **HOURS:** 10am-3pm. **ADMISSION:** $4. **DEALER INFO:** Tables: 1-3 $35 ea., 4 or more $30 ea. **CONTACT:** William Ibarra, Meka Enterprises, 2656 E. 2nd St., Bloomington IN 47401. 812-333-4484, FAX: 812-333-4650.

MI - GRAND RAPIDS — Computer Trade Show. **LOCATION:** Holiday Inn Crown Plaza, 5700 28th St. SE, at I-96 Exit #43A. **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 - COLUMBUS — Columbus Computer Fair. **LOCATION:** Days Inn North, 1212 E. Dublin-Granville Rd., just off I-71. **HOURS:** 10am-3pm. **ADMISSION:** $4, under 12 free. **FEATURES:** C - DP. **CONTACT:** Ben Yanto, AGI Computer Fairs.*

OH - PAULDING — 4th Annual Hamfest. **SPONSOR:** Paulding County Amateur Radio Group, Inc. **LOCATION:** Paulding County Fairgrounds, on Fairgrounds Rd. **HOURS:** 8am-? **ADMISSION:** $3, under 12 free. **TALK-IN:** 147.285+, 444.225+. **FEATURES:** DP - EX - F/R. **DEALER INFO:** 8' inside tables $10 includes 1 gate, outside space (20' x 30') $4 + gate. **CONTACT:** PCARG, Inc., KB8MAF, 14043 CR 111, Paulding OH 45879. 419-399-3641.

AUGUST 19-20-21

MN - BLOOMINGTON — 13th Annual Digital Communications Conference. **SPONSOR:** Twins-LAN Amateur Radio Club. **LOCATION:** Best Western Thunderbird Hotel & Convention Center, 2201 E 78th St., I-494 at the 24th Ave. exit. **ADMISSION:** $45 per person, includes admission to all conference activities, a luncheon buffet & copy of technical papers. Saturday evening buffet is additional $20 ea. **FEATURES:** F. **CONTACT:** Paul Ramey, WG0G, 16266 Finland Ave., Rosemount MN 55068. 612-432-1640.

AUGUST 20

NM - ALBUQUERQUE — Duke City Hamfest. **LOCATION:** New Mexico Army National Guard Armory, 600 Wyoming Blvd NE. **HOURS:** 7am-5pm. **ADMISSION:** Free. **TALK-IN:** 147.10+600, 147.15+600. **FEATURES:** DP - EX - F - F/R - T. **DEALER INFO:** Indoor tables $10 ea. before Aug. 11, $20 after. Setup 6pm Aug. 19. **CONTACT:** Send SASE to: POB 6552, Albuquerque NM 87197-6552 or call 505-821-2771.

OH - TOLEDO — Compvter Manial. **SPONSOR:** National Computer Exposition. **LOCATION:** Ramada Inn/Southwyck, 2340 S. Reynolds Rd., Ohio Tpk. 80/90 Exit 4. **HOURS:** 10am-4pm. **ADMISSION:** $5 w/ad, under 12 free. **FEATURES:** FP. **DEALER INFO:** Setup 8am-10am. Sellouts are common, early booking advised. **CONTACT:** Joe Bowen, 216-442-1776 or Ronald Nelson, FAX: 216-292-7746. National Expo's, Inc., 30799 Pinetree Rd. #230, Cleveland OH 44124.

AUGUST 21

IL - ORLAND PARK — The Orland Park Computer Show. **LOCATION:** Orland Park Civic Center, 147th St & LaGrange Rd (Rt. 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 - MADISON HEIGHTS — Computer Trade Show. **LOCATION:** UF & CW Hall, 876 Horace Brown Dr., 1 blk E of I-75, 3 blks 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 - CLEVELAND — Compvter Manial. **SPONSOR:** National Computer Exposition. **LOCATION:** Holiday Inn/Strongsville, 15471 Royalton Rd., at I-71 Exit 231A. **HOURS:** 10am-4pm. **ADMISSION:** $5 w/ad, under 12 free. **FEATURES:** FP. **DEALER INFO:** Setup 8am-10am. Sellouts are common, early booking advised. **CONTACT:** Joe Bowen, 216-442-1776 or Ronald Nelson, FAX: 216-292-7746. National Expo's, Inc., 30799 Pinetree Rd. #230, Cleveland OH 44124.

OH - MARYSVILLE — 18th Annual Marysville Hamfest & Computer Show. **SPONSOR:** Union County Amateur Radio Club. **LOCATION:** Union County Fairgrounds. **HOURS:** 6am-? **ADMISSION:** $4 adv., $5 door. 9 & under free. 6 admission tickets for $25. **FEATURES:** C - DP - FM - F/R. **DEALER INFO:** Inside tables w/electricity $15, outside 10x10 foot spaces are $5 ea. **CONTACT:** Gene Kirby, W8BJN, 13613 US 36, Marysville OH 43040. 513-644-0468 evenings.

OH - TOLEDO — Toledo Computer Festival. **SPONSOR:** Computer Support Services. **LOCATION:** Masonic Great Hall, 4645 Heatherdowns. **HOURS:** 10am-4pm. **ADMISSION:** $4 seniors, $3 students, under 12 free. **FEATURES:** DP - F/R. **DEALER INFO:** 8' tables draped & covered $40. Setup 7:30am-9:45am. **CONTACT:** Computer Support Services, POB 1350, Taylor MI 48180. 313-295-2237.

OH - WARREN — Warren Hamfest. **SPONSOR:** Warren Amateur Radio Assn. **LOCATION:** Trumbull Branch Campus of Kent State University, intersection of St. Rt. 5 Bypass & St. Rt. 45. **HOURS:** Flea Market: 6am-?, Dealer Displays: 8am-? **ADMISSION:** $4, under 12 free. **FEATURES:** AC - DP - EX - F - FM. **DEALER INFO:** 10' flea market space $3. **CONTACT:** Al VanSlyke, N8IKX, 216-889-3378.

AUGUST 27

IN - INDIANAPOLIS — Computer Show. **SPONSOR:** National Computer Fairs. **LOCATION:** Holiday Inn East, 6990 E. 21st St. **HOURS:** 10am-3pm. **ADMISSION:** $3. **FEATURES:** C - CB. **DEALER INFO:** Setup 8am-10am. Tables: 1-4/$25 ea., 5+/$20 ea. **CONTACT:** National Computer Fairs, POB 501403, Indianapolis IN 46250. 317-843-9201.

KS - CHANUTE — Hamfest. **SPONSOR:** Chanute Area ARC. **LOCATION:** National Guard Armory, South Santa Fe St. **HOURS:** 9am-2pm. **ADMISSION:** $5. **TALK-IN:** DP - EX - FM - F/R. **DEALER INFO:** Tables $5, setup 7am-9am. **CONTACT:** Paul (N0NBD) & Sarah (N0TKO) Smith, Rt. 1 Box 208, Humboldt KS 66748. 316-473-2873 evenings.

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:** 8' $30 ea, 12' $40 ea. **CONTACT:** Progressive Computer Productions, 23814 Michigan Ave., Ste 237, Dearborn MI 48124. 313-425-9276.

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WI - RHINELANDER — Northwoods Swapfest. **SPONSOR:** Northwoods ARC, ARES, Rhinelander & Tomahawk Repeater Associations. **LOCATION:** Sugar Camp Town Hall, 13 miles N of Rhinelander on Hwy 17. **HOURS:** 8am-2pm. **ADMISSION:** $2. **FEATURES:** EX - F/R. **CONTACT:** Mary Berger, NS9Q, 367 Lois St., Rhinelander WI 54501. 715-362-9296.

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OH - DAYTON — Computerfest '94. **SPONSOR:** Dayton Microcomputer Assn., Inc. **LOCATION:** Hara Complex, 1001 Shiloh Springs Rd. **HOURS:** Sat: 9am-6pm, Sun: 10am-4pm. **FEATURES:** C - CB - FM. **CONTACT:** 513-223-FEST.

Continued on page 80

#80 TEST EQUIPMENT *cont.*

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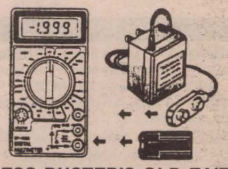

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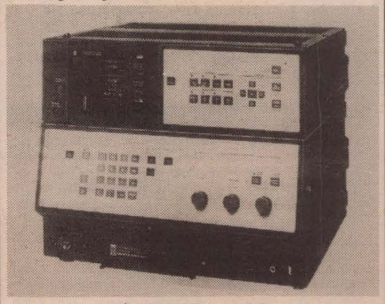

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What all these things have in common are light shows, electrical fireworks, chasers, marquees, colored bulbs, LEDs, and strobes. Although the lights are bright and the colors are dazzling, the animated patterns can be, well, boring. One second ON. One second OFF . . . Over and over . . .

Put an end to boring lighting with the programmable Lighting Effects Generator (LFX)!

Programmable Controller

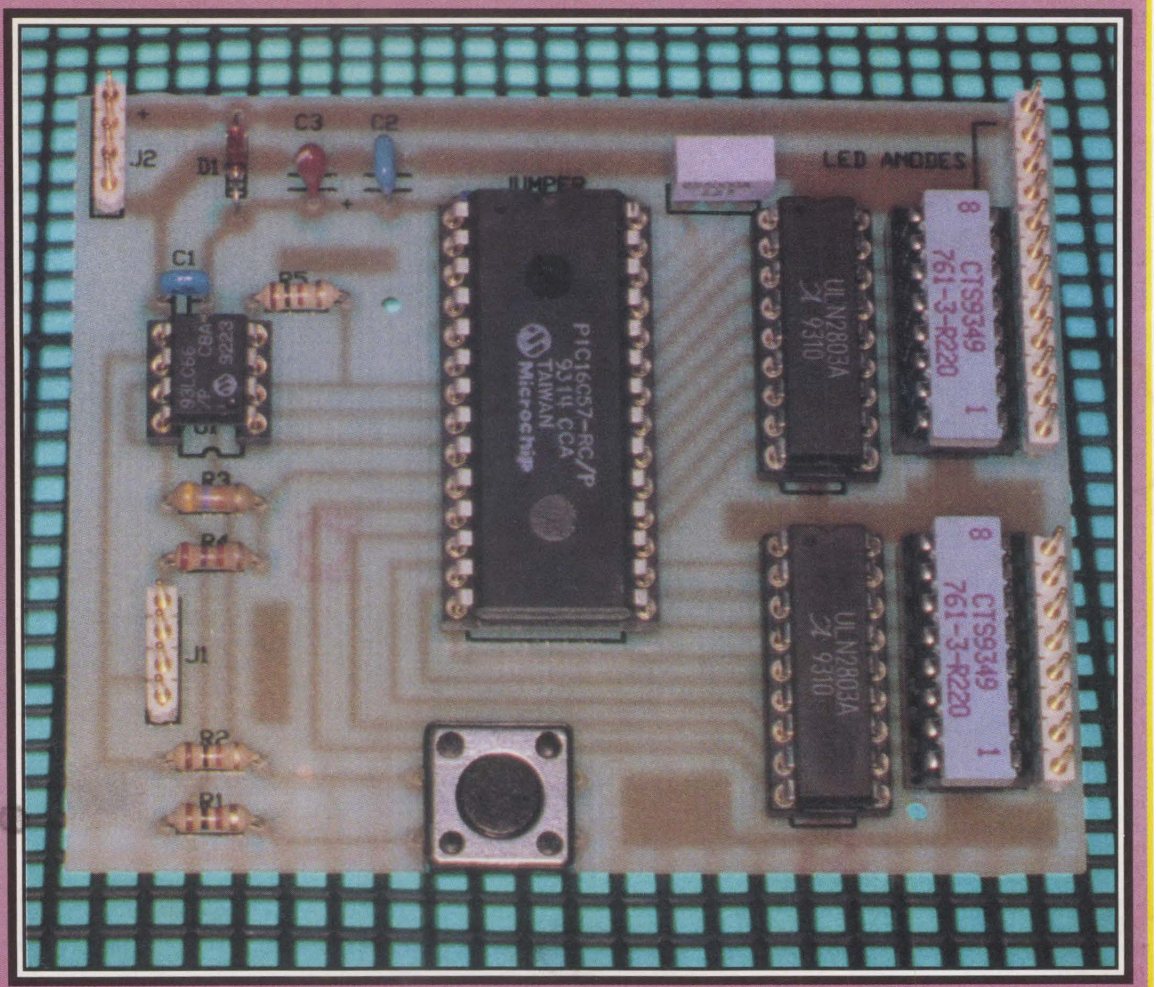
Runs 16 Channels of Lights in Animated Sequences up to 127 Steps Long

by Scott Edwards

This inexpensive project lets you command 16 half-amp drivers to directly power high-brightness LEDs in animated sequences up to 127 steps long. Add a bank of relays, and you're in the big time, controlling dozens or even hundreds of lights.

The LFX is easy to program. A temporary connection to your PC's serial port is all that's required. Easy-to-use software lets you specify which lights to turn on and when, with delays between steps from 1/1000th of a second to over a minute. Once programmed, the LFX is completely independent of your computer, and will store sequences in built-in memory for 10 years. Of course, you can change the program any time the creative urge hits you. The software includes example programs with names like YoYo, Hyper, Whip, and Whirl.

With these advanced features, you probably figure the LFX is going to be a nightmare to build, right? Take a look at Figures 1 and 2. The LFX circuit board is laid out with generous spacing between parts and traces, making it suitable for beginners and experienced builders alike. (Beginners must have the safety guidance of an experienced person if they elect to add relays for high-power control.)



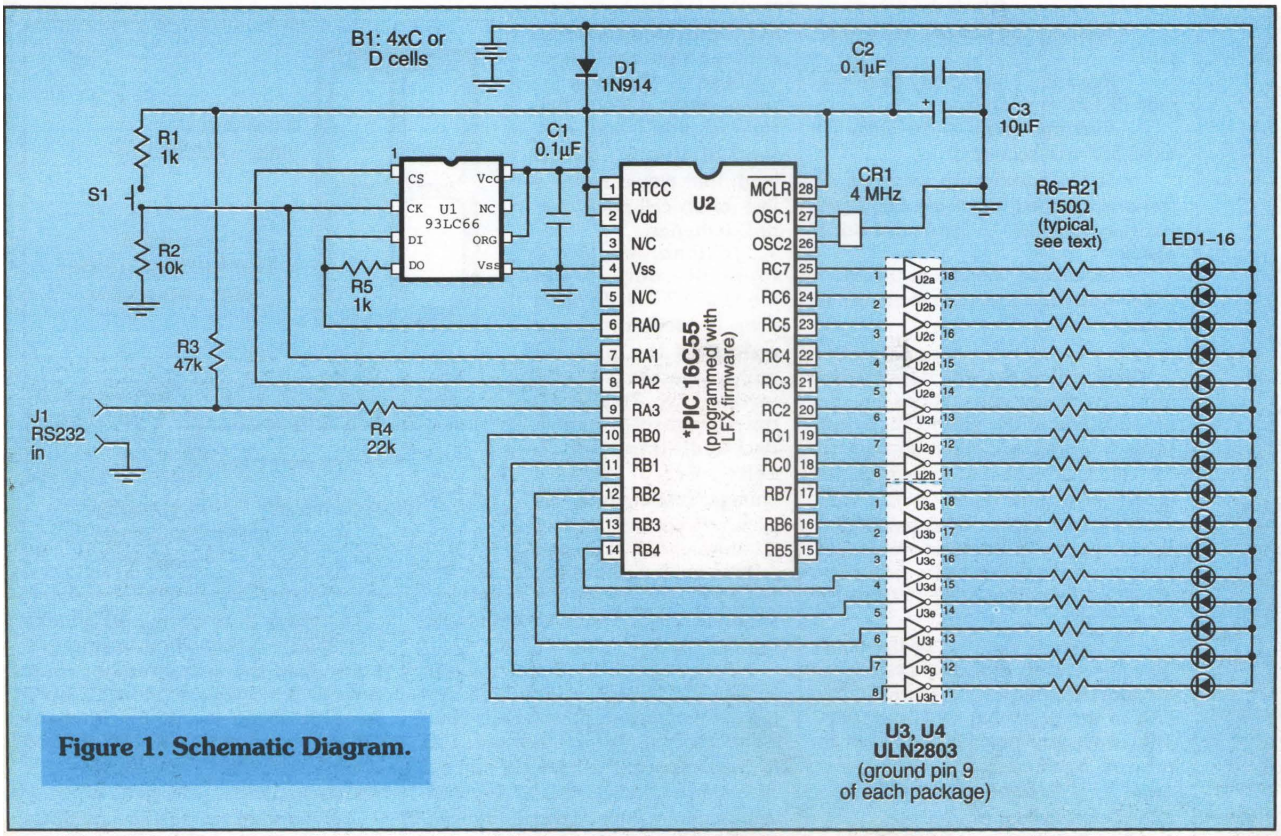


Figure 1. Schematic Diagram.

How it Works

LFX consists of a PIC 16C55 microcontroller, a 93LC66 serial EEPROM (electrically erasable programmable read-only memory), and a pair of ULN2803 eight-channel open-collector inverter/drivers.

The PIC is a microcontroller, which makes it a cheaper, dumber cousin of the microprocessors that run personal computers. Microcontrollers are the brains of "smart" appliances, timers, antilock brakes, security systems, and computer accessories like mice and trackballs. This model — the PIC 16C55 — has 24 bytes of RAM and 512 instructions of permanent ROM storage. I like to think of these devices as generic ICs and programming them as desktop manufacturing. If you're interested in the programming aspect of PIC development, contact the source in the parts list for information and tools. If you're not, just regard the PIC in Figure 1 as an "LFX controller IC" manufactured in a small Arizona town.

The PIC has two basic functions: downloading data from the PC into the EEPROM; and retrieving data from the EEPROM to run the light show.

Downloading occurs when the PIC senses an RS-232 connection at J1. As Figure 1 shows, pin RA3 of the PIC is connected to J1 through a 22K resistor. Another 47K resistor connects J1 to the positive supply rail. So when J1 is not connected, the PIC sees approximately +5 volts (a logical 1) at RA3.

When an RS-232 signal is connected to J1, it's a different story. RS-232 signals have two states: a negative voltage, representing a logical 1; and a positive voltage, representing 0. In its resting state, an RS-232 line outputs a steady 1 — the negative voltage. This pulls the level seen by RA3 to ground or below. So, when an active RS-232 line is connected to J1, the PIC sees a logical 0 at RA3.

This serial hookup makes it easy for the PIC to decide which mode to enter: 0 = RS-232 connected, so prepare to download data; 1 = RS-232 disconnected, so run the existing program.

Once in downloading mode, the PIC waits for serial data to arrive. This is signaled by a change in the state of RA3 from 0 to 1. Thereafter, data bits come in one at a time at precise intervals. Since the LFX's data rate is 1200 bits per second, bits arrive every 1/1200th of a second or 833 microseconds.

The PIC receives these serial bits, groups them into pairs of eight-bit bytes, then writes them to the 93LC66 serial EEPROM.

The 93LC66 is a versatile part. It can store 4,096 bits of data organized as either bytes or 16-bit words. In this application, the '66 is set up for word storage, because the LFX controls 16 lights at its outputs and generates 16-bit time delays.

The three remarkable features of the '66 are: (1) Once written, it retains data for 10 years without power; (2) It can be erased or rewritten at any time; and (3) It uses a fast three-wire interface to transfer data to and from the connected processor.

Typical applications for this type of serial EEPROM include storing speed-dial numbers in a smart phone, retaining number-of-pages data in a laser printer, and holding calibration data for sensors and machine tools.

EEPROMs have some limitations. They require a write/erase cycle a couple of milliseconds long. That's 10,000 times slower than most conventional memories. They also eventually wear out. After 10,000 to 1 million write/erase cycles, the cells that hold the charges representing stored data

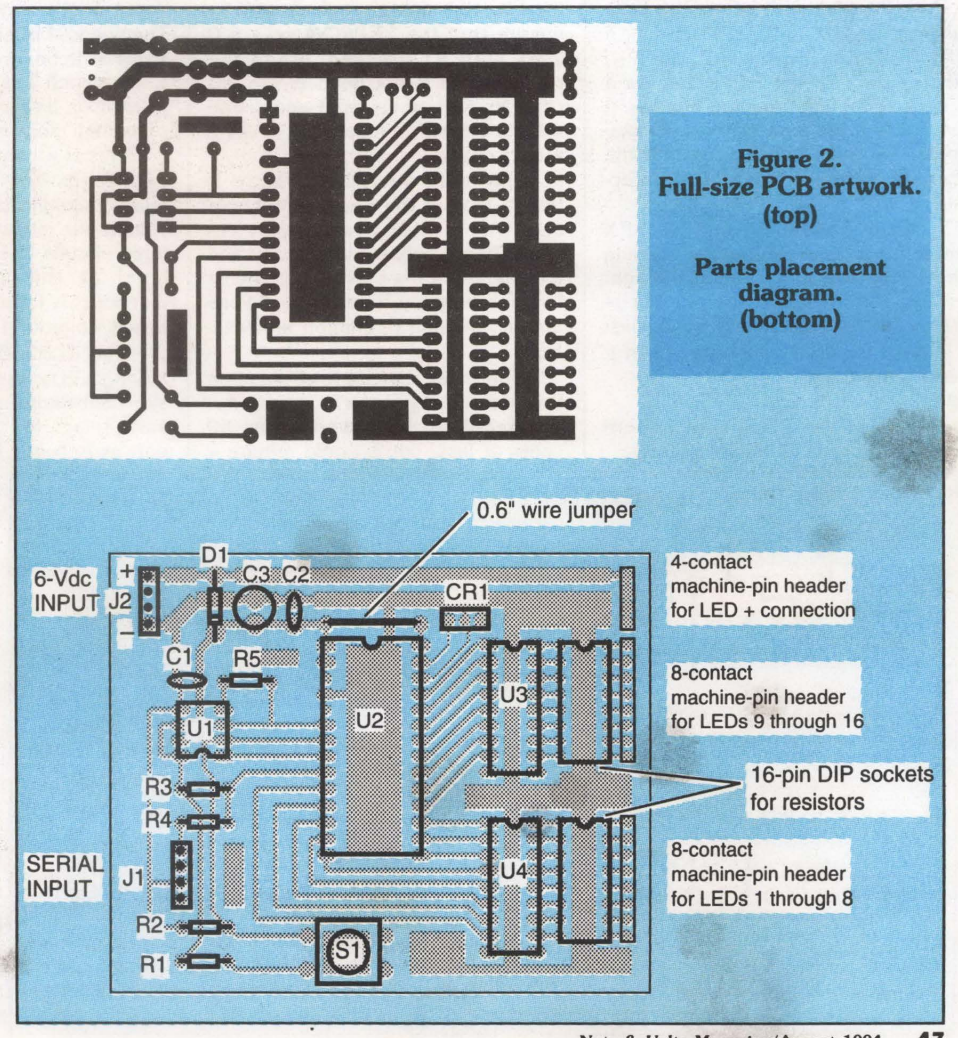


Figure 2. Full-size PCB artwork. (top)

Parts placement diagram. (bottom)

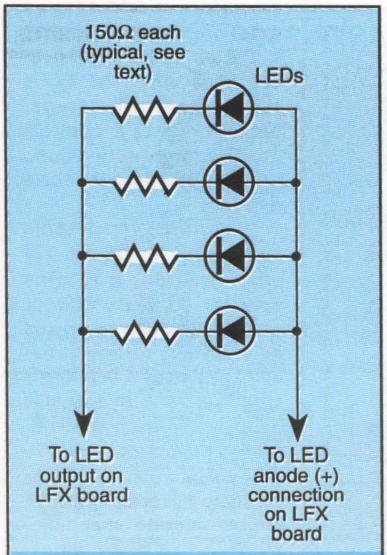


Figure 3. To connect more than one LED to one LFX output, use a separate series resistor for each LED to insure consistant brightness. Insert jumper wires in corresponding resistor locations (R6 - R21) on LFX board.

lose their ability to retain those charges. The EEPROM develops amnesia, and has to be scrapped.

Fortunately, reading data from the EEPROM doesn't contribute to its demise. So you can expect a lifetime of use from the LFX before the EEPROM gives up.

During a download, the PIC writes data to the EEPROM. As a check of the downloading process, it also writes the data to the LED outputs. You can actually see that the communication link is working properly.

After downloading, the LFX switches to its second mode, reading back the data and running the light show. The PIC reads the number of steps in the sequence from the last word of EEPROM memory. Then it enters this loop:

- Read the 16-bit light pattern from the current EEPROM address.
- Transfer the pattern to the output.
- Read the 16-bit delay from the next EEPROM address.
- Wait the length of the delay (1 to 65,535 milliseconds).
- If the maximum number of steps is reached, reset the EEPROM address counter to zero and do it again.
- Otherwise, increment the EEPROM address counter and do it again.

Notice that the PIC doesn't perform any fancy calculations on the data it finds in the EEPROM. It just takes the data and either sends it to the lights, or uses it to determine the length of a time delay. In the software section below, we'll see how a smart front-end program makes it possible to easily create complex lighting sequences based on this simple process.

Continuing our tour of the hardware: S1 and its associated resistors, R1 and R2, allow you to reset the LFX to the beginning of its program. That way, you don't have to turn it off and back on to download new data. This is handy for previewing and tweaking your programs.

The PIC line to which S1 is connected (RA1) is normally an output that drives the EEPROM clock input. Resistor R1 prevents the switch from interfering with these clock signals; the PIC can sink enough current to ensure that the EEPROM sees a 0 even with S1 pressed. When the clock output is not needed, the PIC changes RA1 to an input and examines its state. A 0 means S1 is up; 1 means down.

Moving to the right in Figure 1, take a look at the power supply circuit. Wait — what power supply circuit? There's only a battery pack and a diode. All of the LFX's components function properly from 5.5 to 4 volts or less, making regulation unnecessary.

The main advantage of skipping the voltage regulator is economy. The regulator itself would cost 50 cents or less, but it would require a substantial difference between input and output voltage — 2 volts or more. Since a 9-volt battery wouldn't last very long driving a 16-LED load, that would mean a five- or six-cell pack of C or D batteries.

Instead, we use a four-cell pack. The diode's 0.7 volt forward drop reduces the 6-volt output of the pack to approximately 5.3 volts for the LFX. This saves the purchase of one or two additional C or D cells every battery change. Elsewhere in the power circuit, capacitors C1 through C3 store and release energy to smooth out temporary dips in the supply voltage. That's all the regulation LFX needs.

Next stop on the hardware tour is CR1, the ceramic resonator. It sets the operating speed of the PIC's internal clock to 4 MHz ± 1 percent. This is good enough to ensure correct reception of RS-232 data and reasonably accurate time delays in the lighting sequences.

At the output end of the circuit are the ULN2803 drivers. Their proper name is "octal, high-voltage, high-current, Darlington transistor arrays." Yeah. That's why I call 'em drivers. They consist of eight Darlington-transistor switches in a single package. Each switch has a current limiting resistor on its input and a kickback-protection diode on its output.

This is a convenient way to connect loads like LEDs, bulbs, and relays requiring up to 500 mA at 50 volts to the relatively puny outputs of logic circuits like the PIC. A +5-volt level at the input causes the Darlington transistor to conduct heavily to ground, powering the load.

The ULN2803s are overkill for driving LEDs, but they allow expansion. Substitute mechanical or solid-state relays for the LEDs, and you can switch big AC loads with the LFX. Or, you can switch lots of LEDs. That's why there are no values listed in Figure 1 for resistors R6 through R21; they must be calculated on a case-by-case basis. Here's how:

Typical LEDs are very bright at 20 mA, and most have a forward voltage drop close to 2 volts. The switches of the ULN2803 have a voltage drop of 1 to 1.6 volts. We'll use 1 volt in our calculations. The total voltage drop of the LED and the ULN2803 = 3 volts. If our supply is 6 volts, then the series resistor must drop 6 - 3 = 3 volts at 20 mA. Ohm's law says divide voltage by current to get resistance: 3/0.02 = 150. So 150 ohms is a suitable value for the series resistors.

If you want to hook several LEDs in parallel to one of the outputs, calculate the series resistance for a single LED, then put that value resistor in series with each of the LEDs as shown in Figure 3. Why not use one resistor calculated for the total current draw of all the LEDs? Small variations in the LEDs' forward voltage drops will cause big variations in the LEDs' brightnesses. Individual series resistors allow each LED to find its own way. The result is consistent brightness.

The other advantage of individual resistors is that you don't have to use bulky power resistors. If you had a parallel string of LEDs drawing a total of 500 mA from one output, the series resistor would have to dissipate 0.5 amperes x 3 volts = 1.5 watts of power.

If you decide to connect relays to the outputs of the LFX, Figure 6 shows how. Note that if the supply voltage exceeds 6 volts, a voltage regulator is required to prevent damage to the LFX board.

For maximum flexibility in using your LFX, I strongly suggest that you use DIP sockets to mount resistors R6 through R21. That way, you can unplug the resistors and substitute jumpers if you later decide to connect relays. More on this in the construction notes. Right now, let's look at the LFX software.

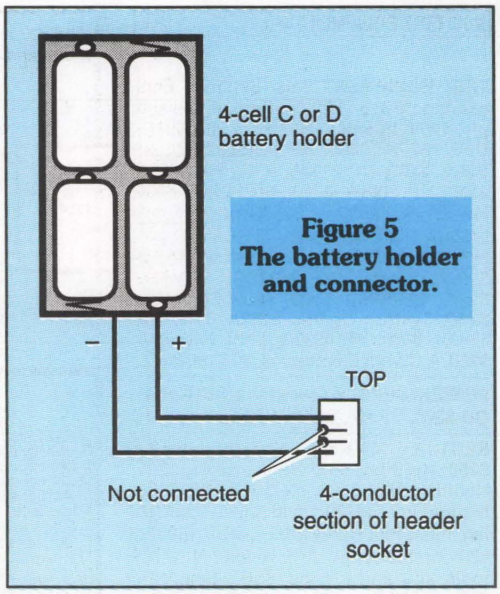


Figure 5 The battery holder and connector.

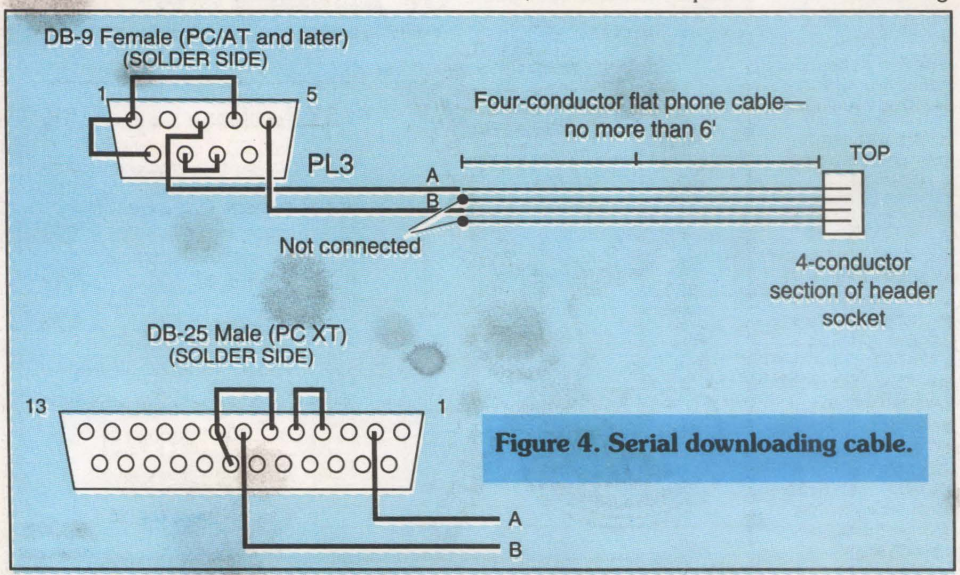


Figure 4. Serial downloading cable.

Software

To program the LFX, you type a file of instructions on your PC, then run it through the LFX data assembler, LFX.EXE. My first draft of the LFX software was easy to use, but a little tedious. You had two commands, OUTPUT and DELAY. The

Continued on page 140

TEST EQUIPMENT Sale: Behlman Engineering UPS10-11B6 uninterruptable supply; 120V 10 amp, $300; Sola 260050750; UPS 750VA, $300; HP 5245L, $250; HP 5246L $100; HP 5252A, $100; HP 5253A, $150; HP 5254A, $200; HP 5255A, $300; HP 5257A, $400; HP 5363B time interval probes, $150; HP 5328A, $200; HP 5303A, HP 5300A 500MHz counter, $200; HP 5261A, preamp, $100; HP 618C, $300; HP 628A, $250; HP 639C, $200; HP 428B, $250, Systron Donner 6152A, $150; HP 1743A, $400; HP 4260A, $300; HP 461A, $100. A-Comm Electronics, 303-290-8012.

POWER SUPPLY. Sorenson SCR-20-80-OU $395. DEXIS, 612-944-7670.

KEITHLEY 147 Nano voltmeter detector, $250; Keithley 601, electrometer, $200; Keithley 169, $100; Keithley 168, $150; MagnaFlux FM120, conductivity measuring inst, $150; Henry 2KD-2, $900; Mosley 680 chart recorder, $75; Nicolet NPC-764 logic ana and probes, $500; Scientific Atlanta 1750 receiver, $400; HP 302A wave ana, $200; Wayne Kerr, B801; R161, S161, $400; Weksler Instrument, 0811PU, 7 day vacuum chart recorder, $150; Wavetek 907 7-11 GHz sig gen, $700; Datachron 3170 clock code gen, $200; Varion 6130 X-Band Klystron, $50; Wavetek 157, $200; Photodyne 1950XR fiber optic attenuator; Scientific Atlanta 1691 wave guide fault locator 2.9-4 GHz, $200; Pacific Measurements 1009 dig power meter, $200; Bird 82A, 500W RF load, $200; Bird 81B, $100; DEC VR160DA color monitors new in box, $150 ea.; Boonton 230A, power amp, $250. A-Comm Electronics, 303-290-8012.

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PRINCETON 162 Box car averager, $200; Seismometers, Geotechnical 4681, $250; A6102 $250; Sonatest UFD-1, $150; HP X382A, $150; Noise/Com NC6101 noise gen 10Hz-20KHz 20 mw, $200; ESI 293 universal Z system, $250; Sorenson DCR-10A, $450. A-Comm Electronics, 303-290-8012.

TENSION/COMPRESSION tester Instron 2 ea. from $6,850. DEXIS, 612-944-7670.

STODDART NM10A URM6B, RF receiver 10-250 KHz complete with antennas, $500; HP 7046A, XYY plotter, $500; Krohnhite 3343 dual band pass filter, .01Hz-100KHz, $800; HP 3586B, $1,000; HP 653A osc. video test set, $200; HP 4815A, $900; HP 141T, $500; HP 8553B, $500; HP 8552B, $750; HP 8553L, $450; HP 8552A, $400. Send for Test Equipment Sales List. John Ayres, A-Comm Electronics, 7198 S. Quince Street, Englewood, CO 80112. 303-290-8012. FAX: 303-290-8133.

LOGIC ANALYZERS: HP 1630D logic analyzer (100MHz timing, 25MHz state) $1100. **HP 1631A** logic analyzer (100MHz timing, 25MHz state) with built-in 200 megasample/sec digitizing oscilloscope $1500. **Tek 308** data analyzer with pod $330. **Tek 318** data analyzer with pod $430. **HP 1615A** with pods $395. **Tek 7D01/DF1** logic analyzer plug-in, up to 100MHz, with pods $225. **Tek 7D02** logic analyzer plug-in, with PM 101 $225. **Pods** for HP 1600A $39 each. **Tek DAS 9129** color systems, up to 660MHz, low prices. Everything sold with warranty. **Pepper Systems,** 214-353-0257.

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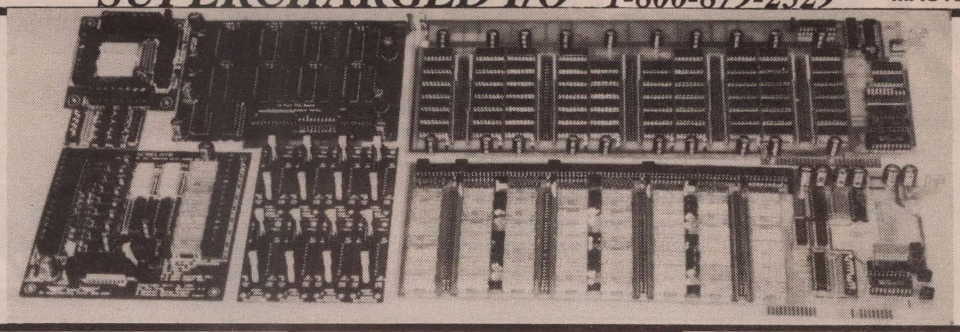

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- Directly drive many popular Solid State Relays.
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- Machine pin sockets make field repairs a snap.
- Silk screened, solder masked, & gold plated.
- See SCREWTERM, TERMRACK, SCRELAY8

SCRELAY64
64 Channel Relay Board

- 64 SPST 10VA 100 VDC 70 VAC 0.5 AMP relays.
- Use to drive solenoids, valves, relays, contactors.
- 16 Relays per 64 line gold plated header.
- 2 pins per relay line reduces resistance
- Independent A & B lines on all relays
- High density board reduces computer slots used.
- Sensitive relays minimize power consumption.
- Only 1.0 milliseconds to turn on/off relays.
- Long life relays (10,000,000 operations).
- Cards can share same space via extended I/O.
- Power on reset leaves relays open on power up.
- Uses 16 Byte wide ports. 8 Input + 8 Output.
- Full length PC AT form factor card for 8 bit slot.
- Input ports can read back state of any relay.
- Gold plated 64 line headers support 16 relays ea.
- Silk screened, solder masked, & gold plated.
- Includes manual and software.

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- Ideal to test cables, wire harnesess', PCBs
- Use for ATE, testing switch matrices & boxes.
- 240 Output paired with 240 Input channels.
- Use to stimulate any line
- Then monitoring all other lines for responses.
- Set port 0 to stimulate any 1 of 240 channels
- Set port 1 to monitor selected channel.
- Read port 0 to determine resopnse.
- Then scan 1 to 240 channels for response.
- Multiple boards may be used in system.
- Open collector outputs with 5.1K pullups.
- Every output paired with an input channel
- Uses only 4 ports in PC I/O space.
- Full size fuse protected PC/AT form factor card.
- Gold plated 50 line headers. 48 signal+pwr/gnd.
- Machine pin sockets make field repairs a snap.
- Silk screened, solder masked, & gold plated.

SCREWTERM
16 Channel Screw Terminal Board

- Directly interfaces to any port on SCPIO16.
- Supports 8 Input + 8 Output channels.
- LED Bargraph Displays monitor inputs & outputs.
- Screw terminals for all I/O, control & power lines.
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- Minimize your setup time.
- Reduce maintenance and repair costs.
- Saves many hours of building & wire wrapping.
- Shrouded Gold plated header with ejectors.
- Boards are Solder Masked & Silk Screened.
- I/O, Pwr, Gnd, Cntrl identified with legends.
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TERMRACK
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- Directly interfaces to SCPIO16
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- Supports 128 channels. 64 Input / 64 Output.
- 2 solder pads for ea. signal, control, & power line
- Provides simple interface to Solid State Relays.
- Easy interface to many other devices.
- Simple interface to wide range of sensors.
- Saves many hours of building & wire wrapping.
- Shrouded Gold plated headers with ejectors.
- Boards are Solder Masked & Silk Screened.
- I/O, Pwr, Gnd, Cntrl identified with legends.
- Large solder pads with plated through holes.
- Wide dual signal traces increase reliability.
- Plenty of well spaced mounting holes.

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SCRELAY8	8 optos + 8 rlys	129.00
TERMRACK	8 hdrs / 128 chnls	35.00
SCREWTERM	1 hdr / 16 chnls	29.00
SCRELAY64	64 Relays	495.00
	32 Relays	295.00
	16 Relays	195.00
Cable set	Four 4' cables	59.00
SCPROBE	240 Channels	489.00
	192 Channels	429.00
	144 Channels	369.00
	96 Channels	299.00
	48 Channels	199.00
Cable set	Five 4' cables	59.00
SCMIDI16	128 Channels	295.00
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IOTESTER	Leds&Switches	29.95
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- SPST 10VA 100VDC 70VAC 0.5Amp relays.
- Sensitive relays minimize power consumption.
- LED Bargraphs display input & output status.
- Opto inputs monitor AC/DC 0..32 volt lines.
- Independent A & B lines on all relays
- Power on reset leaves relays open on power up.
- Fuse protected power lines.
- Supports use of optional external power supply.
- I/O, Pwr, Gnd, Cntrl identified with legends.
- 5"x5" board with mounting holes & hardware.

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128 Line MIDI Digital I/O Board

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- Turn 64 digital devices on/off as music plays.
- Accept commands from up to 64 digital inputs.
- FREE I/O Tester board when you buy SCMIDIO
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- Programable MIDI Channel number 1 .. 16
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- On board computer converts inputs to Notes
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TEK FG501A 2MHz function generator $300. Tek PG122 o'scope probes brand new (sealed) $50 each. 415-244-9254.

TEKTRONIX PLUG-INS: TR 503 .1 to 1800 MHz tracking generator for Tek 492, 494, 496 $1400. **AA 501** distortion analyzer $1295. **AM 503** current probe amplifier with **A6302** probe, DC to 50MHz $890. **DM 502A** auto-ranging multimeter $215. **FG 504** audio to 40MHz function generator, lin/log sweep $725. **PG 507** 50MHz pulse generator (dual output) $245. **PG 508** 50MHz pulse generator (variable rise, fall times) $325. **PS 503A** power supply $250. **SW 503/1** 400MHz sweep generator $325. **DA 4084** distortion analyzer similar to AA 5001, with mainframe $1495. Excellent condition! With warranty; calibrated. Mainframes available. Many others available. **Pepper Systems,** 214-353-0257.

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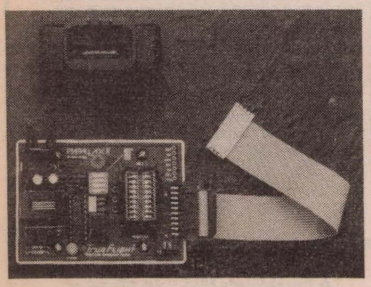
PROGRAMMER/DOWNLOADER FOR PIC16C71 AND PIC16C84



Parallax, Inc., now has TrueFlight available as a programmer and downloader as well.

TrueFlight is a programmer for the PIC16C71 and PIC16C84. However, by adding a ribbon cable and UV eraser, TrueFlight also becomes a downloader.

TrueFlight's 18-pin LIF socket can hold a '71 or an '84. The device's pins are duplicated on the end of an 18-pin cable, which can plug in place of a PIC in your target system. With the cable plugged into your target, you essentially have a PIC plugged into your target. Except for some variances at high frequencies, the operation of this remote PIC is the same as if one were actually plugged into your target.

When TrueFlight needs to program or read the PIC, it breaks the connection between the PIC and your target system, accesses the PIC, and then reconnects the PIC to your target. This is all done with a relay, so the operation is transparent.

Everything mentioned so far is fine, as long as you start with an erased PIC. What happens if the PIC isn't blank before programming? This is where the flash UV eraser comes in. The eraser fits snuggly over the LIF socket, completely covering the PIC. When TrueFlight attempts to program a part, it first checks to see if the part is erased. If it's not, TrueFlight turns on the eraser and periodically checks the PIC. When the PIC is erased, TrueFlight continues with the programming process. Of course, for the electrically-erasable '84, no UV cycle is necessary.

The typical cycle time to erase and program the '71 is about 65 seconds; cycle time for the '84 is only 9 seconds. Sixty-five seconds is a bit of a wait, but its effect on your work can be minimized by having TrueFlight erase while you do other things (such as edit your source code).

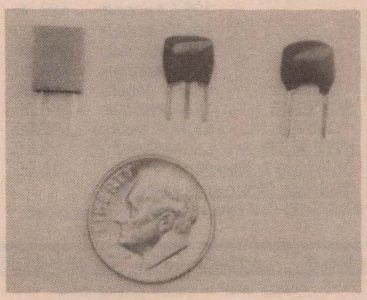
The last concern with TrueFlight is the cycle life of the PIC chips. The '84 has a typical life of 1,000 cycles. As for the '71, TrueFlight uses a special programming algorithm which extends its life to 2,500 cycles.

If your designs use either of these new PICs, TrueFlight can provide a simple and affordable solution for programming and in-circuit testing. The complete package, including all software and cables, is $299.00. To use TrueFlight, you'll also need a UV-erasable PIC16C71 and/or a PIC16C84.

For more details, call or write:

PARALLAX
3805 ATHERTON ROAD #102,
DEPT. NV
ROCKLIN, CA 95765
916-624-8333

CERAMIC RESONATORS WITH BUILT-IN CAPACITORS



Integrity Technology Corporation announces new ceramic resonators with built-in capacitors product line.

The ZTS ceramic resonators have a frequency range from 2.0 MHz to 12 MHz. Typical factory price is approximately $0.17 each at 10,000 pieces.

Typical built-in capacitance is achieved by using 30pF capacitors connected at the center pin for standard TTL circuits. Optional 100pF capacitors for CMOS circuits or other capacitance is available. Frequency tolerance is ±0.3% at ambient temperature. Operating temperature range is from -20°C to +80°C. Frequency tolerance due to aging is ±0.3% per year for 10 years.

The ceramic PZT resonators are produced with dielectric capacitors at the insulating pads connecting to the three output leads.

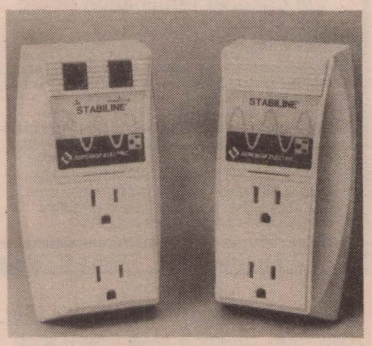
They have built-in load capacitors to save PCB spaces and eliminate the cost of two additional load capacitors to ground. These are compatible with industry three leads 0.1 inches spacing standards.

Typical ceramic resonator applications are battery powered remote controls, telephone tone dial DTMF circuit and silent alarm, security controllers, garage door openers, high temperature applicance micro-controllers, pocket transmitter for auto-alarm, personal notebook computer I/O and mouse device, electronic toys, music & sound synthesizers, and modems.

For more information, contact:

INTEGRITY TECHNOLOGY CORP.
1400 COLEMAN AVE., STE. E15,
DEPT. NV
SANTA CLARA, CA 95050-4358
408-262-8640
FAX: 408-262-1680

WALL-MOUNT VOLTAGE SUPPRESSORS/RFI FILTERS



Superior Electric is offering wall-mount transient voltage suppressors/RFI filters.

The STABILINE® Power Quality interfaces divert and attenuate all types of power disturbances before they reach the circuitry of sensitive home, business, and industrial electronic equipment. These simple, plug-in transient voltage suppressors/RFI filters provide an inexpensive solution for the damaging effects of voltage surges that can cause costly failure of electronic circuitry resulting in expensive repair or even replacement.

The unique, performance-proven, multi-stage suppression and filtration design of Models PQI-1115W and PQI-1115WD is state-of-the-art.

The hybrid design offers the lowest, best rated UL 1449 transient level suppression performance rating of 330 volts. It also allows bidirectional protection from source or load originated power disturbances.

Installation is quick and easy. The PQI unit is plugged into any convenient wall outlet and the power cord of the equipment to be protected is then plugged into the unit.

The PQI units are lightweight and packaged in compact, fire-rated ABS plastic housings with convenient NEMA 5-15P plug and plastic outlet locator pin assemblies. Model PQI-1115WD additionally has two RJ11 modular jacks with transient suppression and is supplied with a 6-foot telephone line cordset for use with fax machines, computers with modems, security systems, and similar applications.

For full information, contact:

SUPERIOR ELECTRIC
383 MIDDLE STREET, DEPT. NV
BRISTOL, CT 06010
203-585-4500
FAX: 203-582-3784

LOGICLAB EXPLORER VERSION 2.1

K.E. Ayres and Associates is now offering the updated version of LogicLab™ Explorer.

LogicLab Explorer is an affordable digital logic simulation system, designed with the student and hobbyist in mind, yet powerful enough to be used by the engineer or technician.

This software package runs under MS-DOS (DOS 5.0 or higher is recommended), on an IBM PC/AT (or compatible) computer, with at least 640K of RAM, and EGA or VGA display, and Microsoft (or compatible) mouse. Built-in hardcopy capabilities support virtually every type of printer in use today — from dot matrix to laser and inkjet printers.

It emulates the wire wrap process, which is familiar to those who have spent time at a real logic bench; and gives the user a very powerful digital logic prototyping environment. It does so by providing the simulated equivalent of the important elements of the logic bench: a well- stocked parts cabinet; a breadboarding facility; and a logic analyzer.

The most significant enhancements include: An expandable parts cabinet: Nearly every type of device — from ICs to pushbutton switches and signal sources — is implemented as a loadable device model. LogicLab's "parts cabinet" is constructed, at start up time, by searching through user-defined paths for device model files. Thus, the user can tailor the parts cabinet for specific projects.

User definable device models: LogicLab Version 2.1 comes bundled with the tools necessary to create models for new types of devices.

The tools include a compiler that translates source files, written in our own Device Model Description Language (DMDL), into loadable device models. Furthermore, we provide all of the source code for the parts that come in the standard parts cabinet.

Pop-up pin diagrams: While wiring or testing a circuit, the user can pop up a pin diagram window, for any device, simply by double

clicking on that device. In addition, when the user exits LogicLab, the entire session is saved so that, when restarted, the window layout will be just as it appeared before.

User definable wire routing: A circuit no longer has to look like the proverbial "rat's nest." Now, the user can route a wire anywhere on the board. A variable reference grid can be turned on or off; and we've even provided a user-selectable snap-to-grid capability. Both the color of the wire and breadboard can be specified. Furthermore, even after a wire is connected, the user can go back and change its routing using our convenient wire editor.

Enhanced printer support: LogicLab Explorer now supports virtually every type of printer ever made — either directly or through common emulation modes.

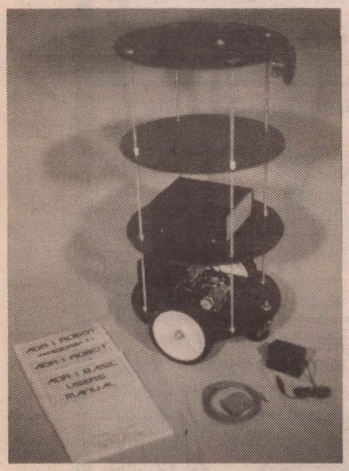
Installation is easy, thanks to LogicLab's automated install utility. It handles extracting the files from the single (3-1/2" high-density) distribution diskette, placing them into a directory specified by the user, and (optionally) modifying the PATH statement in the AUTOEXEC.BAT file.

LogicLab Explorer (Version 2.1) retails for $59.95.

For more information, contact:

K.E. AYERS AND ASSOCIATES, INC.
7825 LARCHWOOD ST., DEPT. NV
DUBLIN, OH 43017
614-792-2473

ROBOT KIT



Aclypse Corporation is now offering the ADR-1 Robot Kit for the hobbyist and eduational markets. The ADR-1 Robot is 27" tall, 14" in diameter and weighs approximately 16 lbs. This complete robot kit has an onboard computer system that features voice recognition capabilities, English speech output, power motor drive, and a battery with monitoring and recharge system.

It comes as a complete kit and sells for $299.00. No electronics or advanced computer experience is required to assemble and use the ADR-1 Robot. No special tools are required and it normally takes two to six hours to complete. Ease of assembly makes this kit ideal for classroom and lab environments.

The robot has its own operating system and a BASIC programming language is built-in to make it easy to instruct the robot what to do.

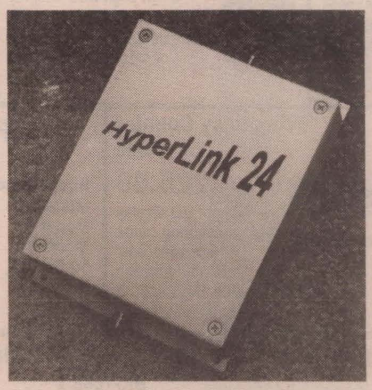
This can be programmed by users by connecting it to almost any computer or terminal over a serial cable. Program and data files can be sent back and forth between the robot and a personal computer.

The onboard computer is powered by a 16 Bit 8086 compatible CPU with 256K of RAM. Expansion cards can be connected to add memory, sensors, motors, and other new devices.

Further inquiries should be directed to:

ACLYPSE CORPORATION
ROUTE 2 BOX 213H, DEPT. NV
WORTHINGTON, IN 47471
812-875-2852

HYPERLINK FREQUENCY CONVERTERS



HyperLink Technologies, Inc., has introduced a line of bilateral frequency converters which allow existing 900 MHz spread spectrum equipment to operate in the higher 1.9 GHz PCS and 2.4 GHz ISM bands.

Several models are available, including single channel and multi-channel units. Multi-channel units allow the selection of several channels within the band, permitting several links to operate in close proximity to one another without interference.

The HyperLink converters consist of a frequency "upconverter," a "downconverter" and a high speed switching circuit, and can operate with just about any 900 MHz Part 15 wireless transceiver on the market, including high speed 900 MHz wireless network bridges.

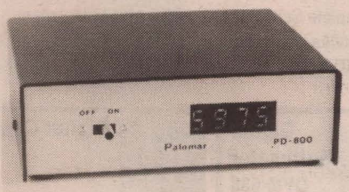
HyperLink's remote mounted design permits the use of low-cost cable and connectors since only the 900 MHz signals travel through the antenna cable. No additional wiring is necessary since the converters are powered through the feed cable. The units offer the additional function of a remote mounted final stage power amplifier as well as a low-noise receive amplifier, virtually eliminating the effects of feed cable attenuation.

The introductory price for the 2.4 GHz converter is $1,095 and includes a 20 inch parabolic reflector dish antenna.

For more information, contact:

HYPERLINK TECHNOLOGIES, INC.
6844 BRIDLEWOOD CT., DEPT. NV
BOCA RATON, FL 33433
407-368-0224
FAX: 407-368-6052

DIGITAL FREQUENCY READOUT



Palomar Engineers announces a new digital frequency readout for classic receivers. It works with Hallicrafters, Hammarlund, National, RCA, RME, and most other older radios.

Palomar's new PD-600 adds frequency readout accurate to 1 KHz on a four digit bright red display. No modification of the radio is needed;just wrap a wire around an oscillator lead. The readout is adjustable for any receiver intermediate frequency. Price is $199.95.

For further information, contact:

PALOMAR ENGINEERS
P.O. BOX 462222, DEPT. NV
ESCONDIDO, CA 92029
619-747-3343
FAX: 619-747-3346

MULTILINE RING GENERATOR FOR VOICE PROCESSING SYSTEMS

Northeast Innovations, Inc., announces the Model 5024 Multiline Ring Generator.

This compact device provides high voltage ringing for up to 24 remote, analog station devices. A built-in, per channel, tone detector, interprets a system provided Zip tone as a ring command for that channel and rings the connected device. The built-in, 24 VDC power supply, supplies up to 1 Amp of current. This provides a powerful source of loop current for many station devices. Installation is quick and easy.

Connectivity to the system is through a standard RJ-21X connector, and simple RJ-11 jacks connect station devices. These powerful, built-in features eliminate the need, space, and expense of both a break out box and a loop current power module.

An optional serial port is available to ring devices directly, without a system generated Zip tone, for even greater flexibility. Simple ASCII commands specify the number of rings desired and which channel to ring. This serial port may also be used for remote monitor or control applications.

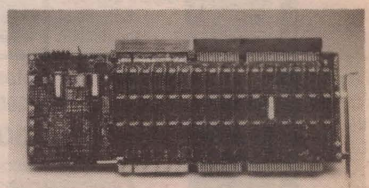
The 5024 is housed in a rugged aluminum case measuring 8 x 5.6 x 11 inches and weighs six pounds fully configured. The 5024 is powered by 117 VAC and is available in 8, 16, or 24 channel configurations.

Prices are $799.00 for 8 channels, $999.00 for 16 channels, and $1,399.00 for a full 24 channel configuration.

For more information, contact:

NORTHEAST INNOVATIONS
P.O. BOX 1330, DEPT. NV
CONCORD, NH 03302-1330
603-229-0500
FAX: 603-229-0434

SMART VL EXTENDER CARD SPEEDS UP VL BOARD TESTING



ICS Electronics Corporation has available a Smart Extender Card for testing and debugging printed circuit board assemblies for the PC VL bus.

Designated the VL-EXT, the extender card conforms to the VESA standard for VL-Bus cards. The VL-Bus, also known as the local bus, expands the standard ISA bus to 32-bits and operates at full CPU speeds, up to 66 MHz.

The VL-EXT Card contains all of the logic to connect power and the PC signals to the board-under-test without affecting the PC's operation. This allows a test board to be inserted into the PC while it is running, which eliminates the time lost in powering off and re-booting the computer between boards. The VL-EXT card continuously monitors all four power inputs and automatically turns off power to the test board if any load current exceeds a preset value.

The operation of the VL-EXT Card is controlled either by instructions from the user's test program or manually by on-card switches. To test a board, the user inserts the board into a connector at the top of the VL-EXT card. The test program can command the VL-EXT Card to apply power and signals to the board-under-test. The program may

Continued on page 143

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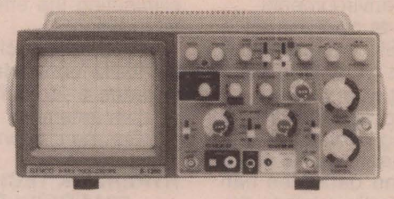

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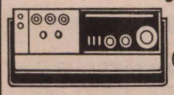

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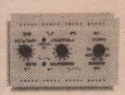
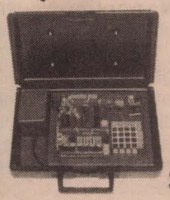


Learn to Build and Program Computers with this Kit



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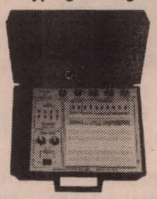

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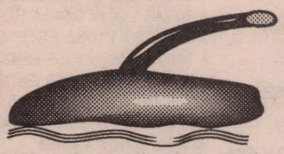

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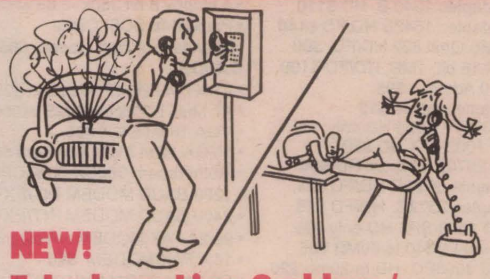

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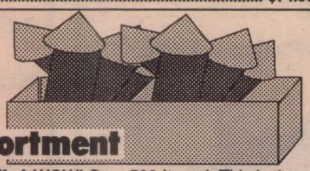

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High brightness red HeNe laser visible for miles. Produce your own light show! Projects a visible beam of red lite clearly visible in most circumstances. Can be used to intimidate by projection of a red dot on target subject. Also may be used to "listen in" using our laser window bounce method #LLIS1 below. *Easy to build module makes A working visible laser!*

LAS1KM Kit w/1mw Laser Tube, Class II. $69.50
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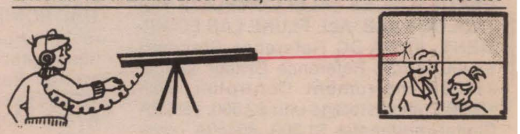

"Laser Bounce" Listener System

Allows you to hear sounds from an area via a lite beam reflected from a window or other similar objects. System uses our ready-to-use LATR1 Laser Terminator gun site as the transmitter. The receiver section is supplied as an easy-to-build kit, including our cushioned HS10 headsets. **LLIST2** Plans $20.00

LLIST1K Kit of Both Transmitter and Receiver $199.50
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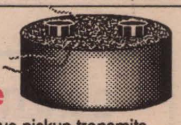

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SIERRA 425A DIGITAL carrier fault analyzer $1250. Dexis Corp., 612-944-7670.

DSP DEVELOPMENT Analog Devices EZ-kit complete with all software, books, $250. Alan, 813-627-3578.

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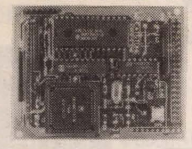

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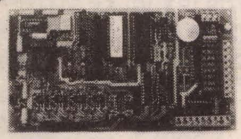

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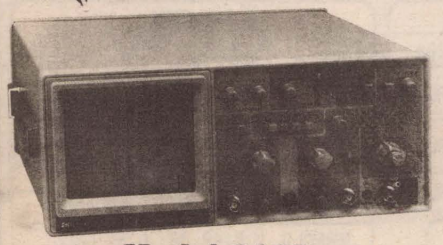

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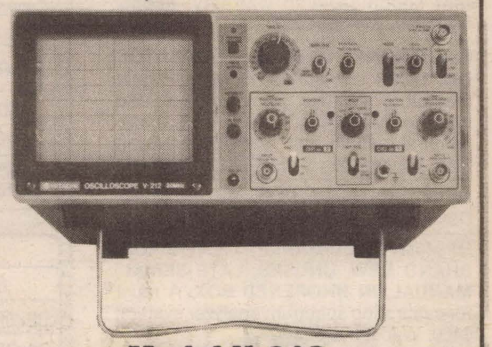

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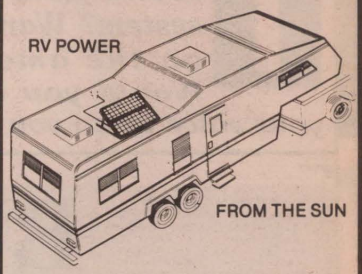

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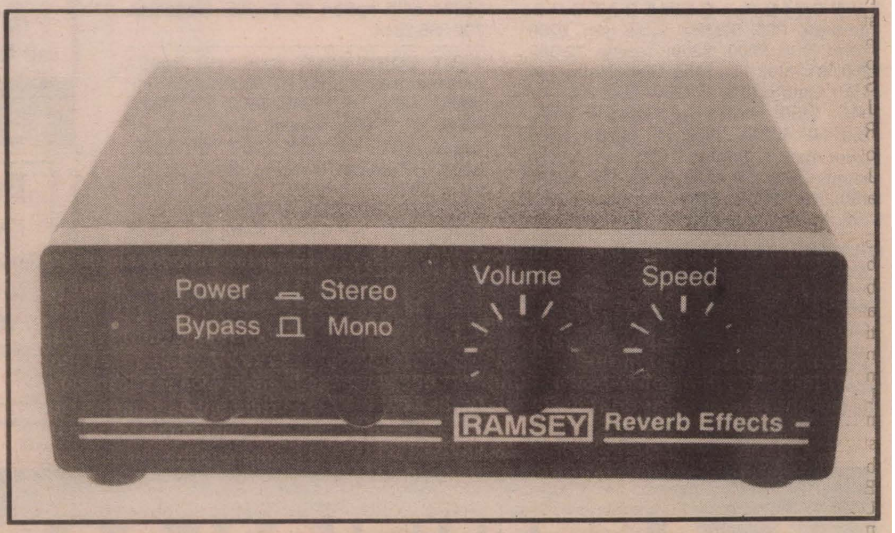
BUILD A SURROUND SOUND/REVERB PROCESSOR



by T.L. Petruzzellis

At one time or another you probably wished that you had surround sound or reverb effects! Surround sound can add amazing depth and realism to any stereo system or to a favorite action movie on your television or video game system.

The Surround Sound/Reverb project is actually two projects in one, since it can also be used to enhance the audio input to a public address system, or a CB or amateur radio station.

The Surround Sound processor can also add interesting special effects to your singing group or karaoke session, and perhaps you may think of other interesting applications for the Surround Sound project.

The low-cost Surround Sound/Reverb project provides complete control in adjusting decay time, volume, reverb duration, and delay times of up to 1/2 second and the project runs on a single 9-volt battery.

The Surround Sound/Reverb project is designed around a relatively new switched capacitor bucket brigade device (BBD). The integrated circuit functions just as the name implies with successive capacitors, or "bucket holders," which pass their charges from one to the next on every clock cycle.

When the BBD device is in operation, it causes a time delay from the input to the output, which is determined by the clock rate and the number of "bucket holders" in the BBD device. When the delayed sound is fed back into the input with some decrease in level, it produces a reverb effect similar to the echoing in a large room. This echo effect is similar to the old reverb springs which were used in old guitar amplifiers, except the BBD is fully controllable and immune to mechanical shock or movement.

The Surround Sound processor system diagram is shown in Figure 1. In the Surround Sound mode, the inputs and outputs are set for line level. The left and right outputs from your stereo's "tape out" is fed into J1 and J2 of the Surround Sound unit. The left and right inputs to the Surround Sound processor are allowed to go into two directions.

First, the inputs are sent directly to the outputs through R1 and R4. This allows the initial sound to be heard at the same instant it begins. The inputs are also added together in U1:A and are amplified or attenuated depending on the setting of R25, a 200K potentiometer.

The output of U1:A is then coupled directly to the input of U3, the bucket brigade device, an MN3007. The clock driver for the bucket brigade device is U2, an MN3101. As the clock rate of U2 is varied by R16, so is the delay time of the bucket brigade device. The delayed output of the BBD at U3 is then directed to U1:C, which forms a low-pass filter consisting of R5/C5, R6/C6, and R7/C7.

The low-pass filter serves to remove the clock feedthru from the BBD's output. The filter is set for the lowest clock frequency of 3 KHz, but it can be altered if a shorter delay is required. The output of the filter at U1:C is then sent to the left channel, while some of the output is fed back to the input which then allows the same sounds back through another cycle for the reverb effect.

The reverb effect is shown in Figure 2. The original signal is shown at "A," while the slightly delayed signal is depicted at "B," and finally the second recycle producing the reverb effect is shown at "C."

In the Surround Sound mode, the output of the low-pass filter is sent to U1:D, an inverting amplifier which produces a signal 180 degrees out of phase with the output of the lowpass filter. When this "out of phase" signal is sent to the right channel, this audio will cancel some of the audio from the left channel.

Since the audio that is cancelled is from the delayed output and not from the original sound, it produces an interesting effect of "widening" the placement of your speakers. Sometimes it even sounds as if the audio is coming right out of the walls! Switch S1 selects between the Surround Sound and the normal audio mode. In the normal mode, the output of the low-pass filter is sent directly to both the right and left channels.

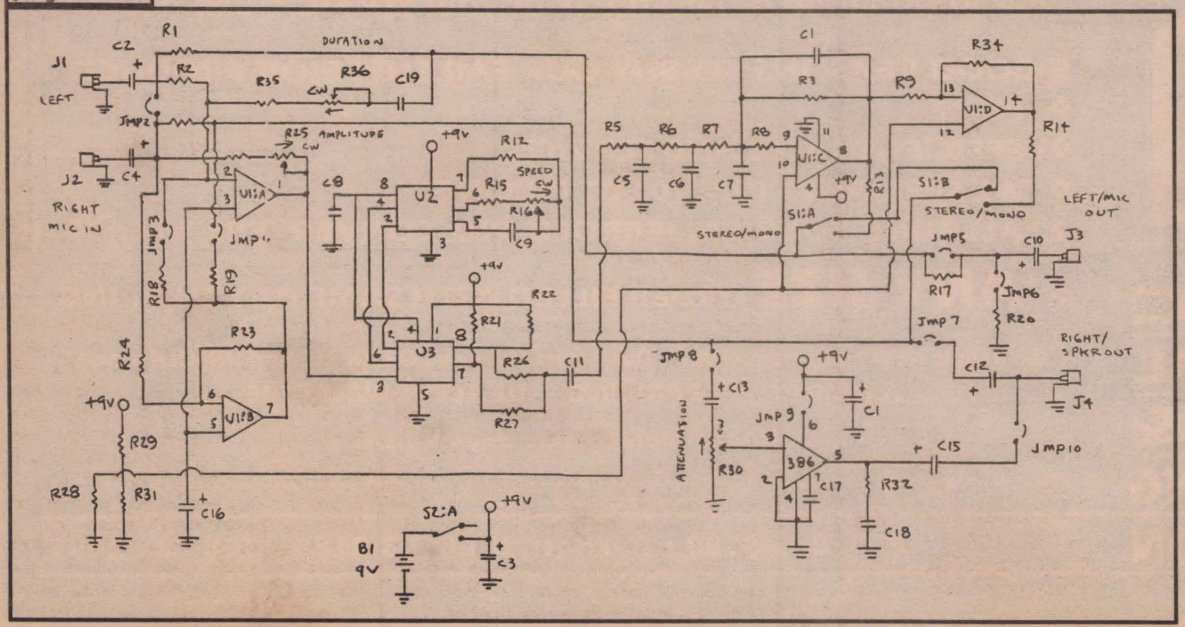
The Surround Sound configuration diagram in Figure 3 illustrates an example of how to connect your stereo system to the Surround Sound processor. The "tape outputs" from both the left and right channels are sent to the processor at jacks J1 and J2. The output of the Surround Sound processor at J3 and J4 is then directed to a "new" low power stereo amplifier which is used to drive the rear left and right speakers.

Take a second look at the schematic shown in Figure 1 and note that there are many jumpers shown in the circuit. These jumpers allow the kit to be configured for various applications as mentioned earlier.

When configuring the circuit as a Surround Sound processor for your stereo system, you will only need two jumpers, JMP5 and JMP7. All others are left out. In this configuration, the circuit can also be used to create a Surround Sound effect for a television with stereo outputs.

Install jumpers JMP5 and JMP7 and remove resistors R1 and R4. This will

Figure 1



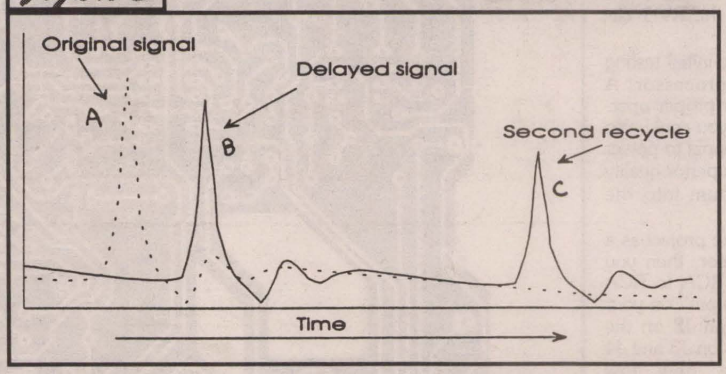
produce an enhanced effect of sounds bouncing off the back of a theater or auditorium. Resistors R1 and R4 prevent the original audio signal from arriving at the output, hence only the delayed signal is used.

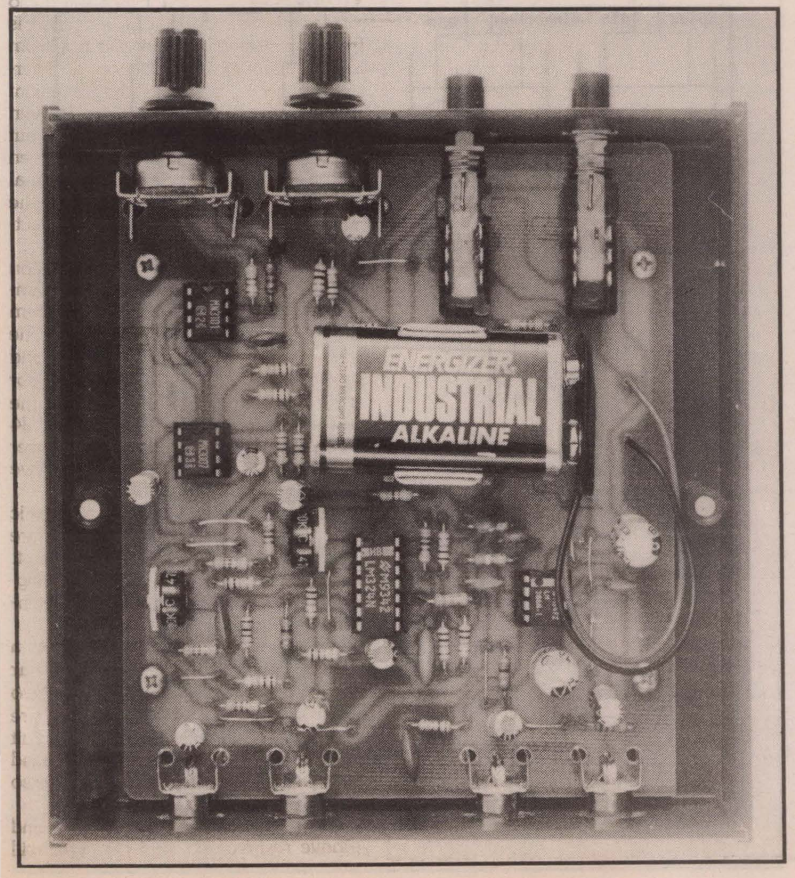
Other features of the Surround Sound processor include a stereo simulation mode as shown in Figure 4. In this mode, a mono source could be sent to either the left or right input of the processor, with jumpers JMP2, JMP5, and JMP7 placed in the circuit. In this configuration, a single mono source is provided to the input and stereo simulation is produced at the output of the Surround Sound processor at J3 and J4. Remember that the outputs at J3 and J4 are line outputs and must be further amplified in order to drive speakers.

If you wish to use the Surround Sound processor for vocal effects in your band or karaoke group to produce reverberation, or if you want to enhance the audio input to your CB or ham radio station, then you will be interested in this next configuration. You may have noticed that we have not yet discussed U1:B, which is used to pre-amplify a microphone input placed in jack J2. This stage is used to increase the mike level before it is sent to U1:A, and then to the BBD. Placement of jumper JMP3 allows U1:B to be fed into U1:A as shown, if a mike is used. Jumper JMP4 allows the pre-amplified microphone to be simultaneously directed to U4, the LM386 audio amplifier through jumper JMP8. The mike audio from U1:B is coupled through R30, an attenuation control which controls the input to the LM386 amplifier. Jumper J9 is used to feed power to the LM386. The output of U4 is then sent to JMP10, which connects the LM386 to the speaker jack at J4, if the amplified speaker feature is used.

Figure 5 illustrates a microphone and speaker connected to the Surround Sound/Reverb unit. In this configuration, you will need to install jumpers 3, 4, 6, 8, 9, and 10 while removing resistors R1, R2, R4, and R10. Now the right output at J4 will be a speaker output while the reverb effects will be at the line level output at J3. You can eliminate the audio amp U4 altogether and have the mike as a line output as well as the reverb effects at line level. If you desire to use the processor with your CB or amateur radio, then your microphone would be connected to J2, jumper JMP3 would be installed, as well as jumpers JMP5 and JMP7. The Surround Sound/Reverb processor, as you can see, is truly a versatile project.

Figure 2





The Surround Sound/Reverb processor we have been discussing is the Ramsey RV-1 kit. While we have provided all the essentials (including the circuit board layout) so that you can build the processor from scratch, it is often more fun, easier, and less stressful to have a complete set of parts in front of you when you begin a project.

Let's begin building the RV-1 Surround Sound processor. First you will need to refer to the parts layout diagram in Figure 6 and to the parts list in Table 1. Grab a 20-25 watt grounded soldering iron, a comfortable work space and chair, and we will begin. Open the parts bags and check the parts against the parts list to make sure you have everything. Locate the resistors, and note the resistor color code on the parts list. If you have any trouble identifing resistors, use an ohmmeter.

First, locate the resistors in the largest group, the 11 100K ohm values, and install them on the circuit board. Now attempt to locate the six 4.7K ohm resistors and install them. Be sure not to mistake these for the 47K or 470K ohm values. Next, locate the other resistors in groups of two and install them. Find all the remaining single value resistors, again being sure not to mistake the 10K and 100K values and the 33K and the 39K values. Lastly, install the 2 ohm resistor R32.

With all the resistors in place, we will move on to the capacitors. First, locate the nine 10uF electrolytic capacitors. Note that these capacitors are polarity sensitive and must be installed correctly for the circuit to function properly. Refer to the parts layout diagram before installing the 10uF electrolytics. Now locate and install the two 220uF electrolytic capacitors. Install the two .1uF capacitors marked (104), then locate and install the .01uF capacitors marked (103) or 10nF. Find the .005uF disc capacitors marked (502) or 5nF and install them. Finally, install the 470uF and 680pF discs.

The next step is to install the primary jumpers. Find some scrap resistor leads and install jumpers JMP12, located just above J2. Next, install jumper JMP13 to the right of R36, the duration control. Finally, install jumper JMP15 just above JMP13. These are the required jumpers for all configurations.

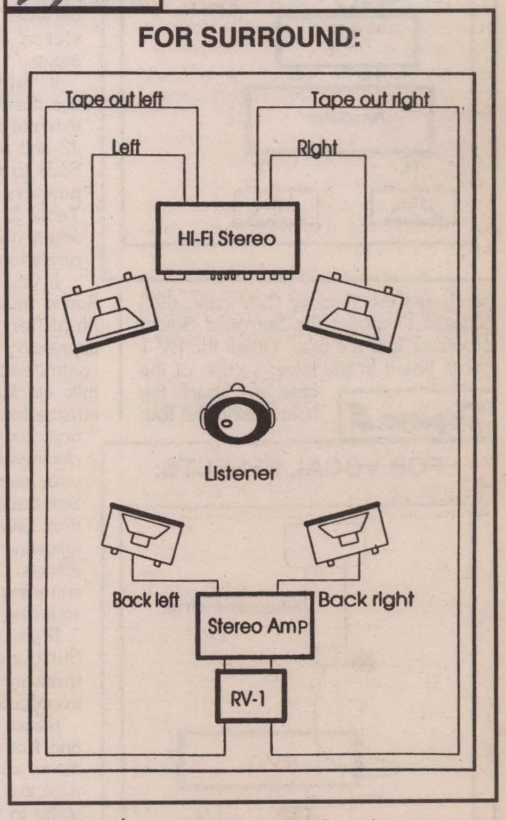
Locate the four potentiometers. First install R25, the 200K ohm potentiometer, just below the bottom left corner of the 9 volt battery. Now, locate and install R36, the duration control on the middle left edge of the PC board. Find R16 and R30 (the long shaft potentiometers) and install them on the top left corner of the board. Now, locate the two pushbutton switches S1 and S2 which will be mounted at the top left corner of the board next to R16 and R30. Lastly, mount the four RCA jacks J1 through J4 on the bottom of the circuit board. Once these jacks are in place, bend the tabs, and solder them to the board. This helps to secure the jacks to the PC board.

It's time now to install the integrated circuits. Place a piece of aluminum foil under the PC board and ground it with a small alligator clip to ground to prevent static transfer to the chips. Try to install all the ICs at one sitting to avoid static generation which could be transfered to the ICs. My personal choice is to install IC sockets before mounting the integrated circuits.

Locate the integrated circuits and observe the notch at the top of the chips, or the small indented circle near pin 1. Install U1 in the center of the PC board after referring to the PC layout diagram. Align the notch at the top of the IC upwards as shown. Next install U2, the clock driver, just below R16, observing the notch at the top of the IC. Then insert U3, the BBD device, just below U2.

Finally, install U4, the audio amplifier chip just above C15 in the lower right corner.

Figure 3



The Surround Sound processor is now almost completed except for the battery clip and battery holder. You can mount the battery holder in one of two ways. You could use a glue gun to tack the holder to the PC board, or you could fasten the holder by looping an uninsulated wire from the foil side of the PC board through the battery holder and then back through the PC board.

When using the wire method to secure the holder, solder one end of the wire to the foil side, place a small square of cardboard or foam under the holder,

and then tension the remaining wire lead as you solder it to the board.

Lastly, solder the battery clip to the circuit to the right edge of the PC board. The red battery clip lead is soldered to the point marked red on the board, and the black battery clip lead is soldered to the point marked black on the right middle edge of the PC board. Take a moment now to recheck polarity and positioning of the capacitors and ICs.

The Surround Sound processor is essentially completed, but before mounting it in its enclosure, you will need to decide which mode the processor will operate in. Refer now to Table 2, which illustrates the input and output jumper configurations for the project.

Once the mode has been determined, you can install the required jumpers for that particular mode. If you purchased the Ramsey CRV case, then proceed to mount the Surround Sound processor into the case. Orient the RV-1 circuit board in the lower section of the case and attach the board using the four small screws.

Figure 4

FOR STEREO SIMULATION:

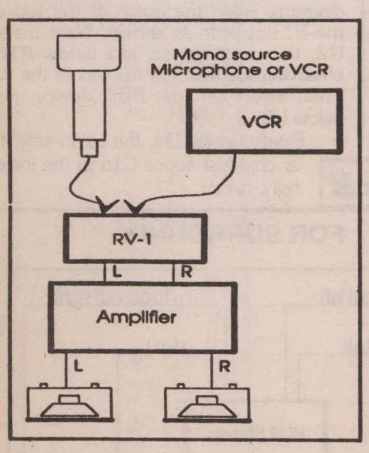
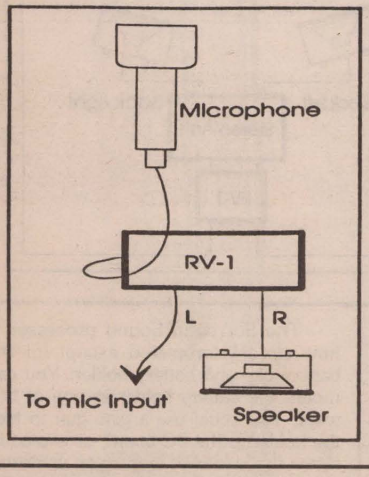


Figure 5

FOR VOCAL EFFECTS:



Next, locate the front and rear case ends and slide them into their respective sides on the bottom half of the case. Connect a good 9 volt alkaline battery and secure it to the PC board. Ensure that both pushbutton switches are in the outermost or off position.

Finally, attach the top case cover. It is keyed with a slot on one edge and a ridge on the other edge to match the bottom half of the case. Locate the two long screws which came with the case kit and use them to fasten the upper and lower case halves.

If you did not purchase the Ramsey case kit, then you will need to find a suitable enclosure 5-1/4 by 4-7/8 by 1-3/8 inches in which to mount the RV-1 circuit board.

Time now to begin the initial testing of the Surround Sound processor. A good battery is essential for proper operation of the project. While you could also use an AC to DC power supply to power the project, it must be of superior quality so it will not introduce hum into the audio system.

If you plan on using the project as a Surround Sound processor, then you will need to attach two RCA to RCA cables from the "tape output" on your stereo amplifier to J1 and J2 on the RV-1 board. The outputs on J3 and J4 are then directed to a "new" low power stereo amplifier which is used to drive the two rear channels.

If you want to use the RV-1 as a simple reverb unit with your CD or tape deck, with no additional rear channel amplifier, then insert the RV-1 between your CD player and your stereo amplifier tape or auxillary inputs.

If, on the other hand, you wish to use the RV-1 with a microphone and external speaker, then plug a mike into J2 and and a speaker into J4. Switch S1:B to the mono position and insert jumpers JMP2, 8, 9, 10. Refer to Table 2 and the schematic diagram when deciding the desired mode of operation.

If you have selected the Surround Sound mode, then turn on your stereo amplifier and turn on the RV-1 by depressing switch S2. Turn the duration control and the amplitude control to the fully clockwise position. Now turn the attenuation control fully clockwise (volume down) and the speed control fully clockwise for maximum delay. Turn up your stereo system. If you hear the Surround Sound or Reverb effects, then everything is operating fine. Try adjusting the controls for the desired effects. The effects can range from sounding like you're inside a tube to sounding like you're on the moon!

If you experience trouble with your Surround Sound processor project, there are a few logical places to search in order to troubleshoot the RV-1 unit.

Please check all your connections to and from the RV-1 board first, since many difficulties are caused from defective cabling. The RV-1 will pass audio to the output even with the RV-1 off. This will aid in checking cables, but also note that it is possible to have audio pass through the RV-1 with no reverb effects.

There are a number of things in the delay circuitry of the processor which can cause the unit not to function properly. If you experience this problem, then you may need to borrow a frequency counter or oscilloscope to verify the clock signals on pins 2 and 4 of U2. If no clock output is present, then check the voltage on pin 1 of U2 to ensure it is 8 to 9 volts. If voltage and the clock sig-

RV-1 Printed Circuit Board

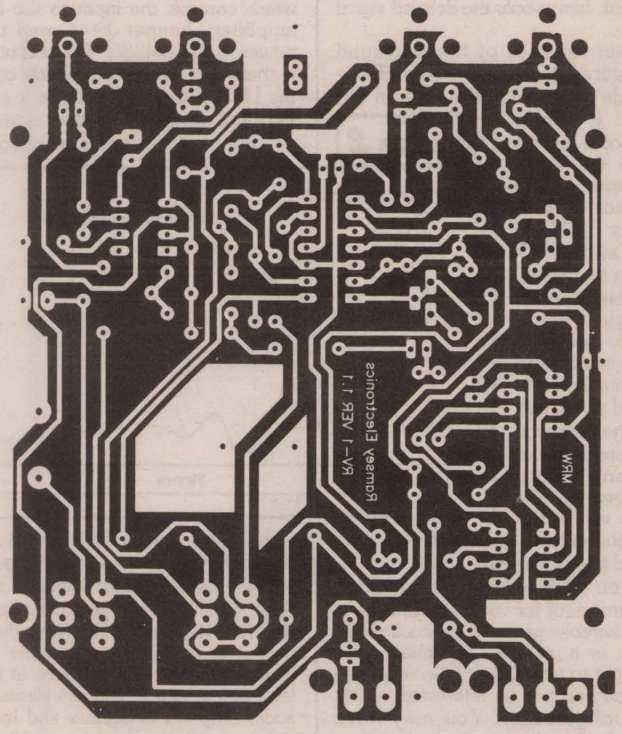
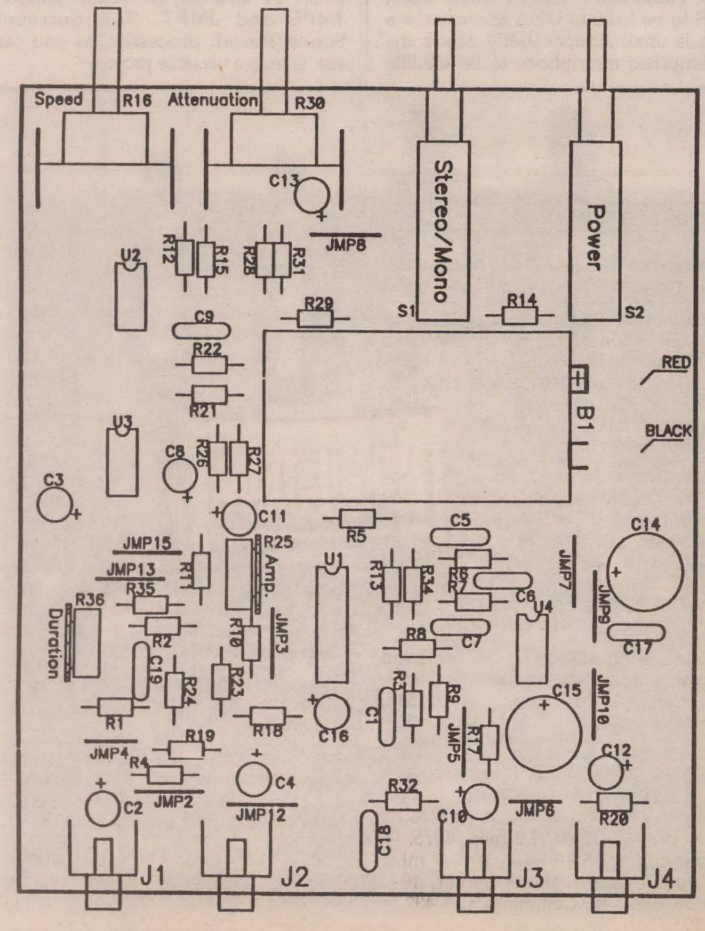


Figure 6 – RV-1 Parts Layout



nal are present, then check pins 3, 5, 10, and 12 of U1 for 3.5 to 4.5 volts. If not, check R29 and R31 and all the solder joints and capacitor orientations as well as the orientations of the ICs.

Trace the signal from the input to the output through each IC or stage of the processor. If you experience noise or feedback while using the microphone, then simply position the microphone away from the speaker if used.

Another common problem is a "motorboating" sound coming from the output. This is caused by a weak battery.

We hope you enjoyed your tour through the RV-1 Surround Sound processor. Even if you only have a single purpose for the Surround Sound processor in mind, you might try a little experimentation. You may even find that the RV-1 can serve you in other ways. You may like the RV-1 so much that you'll want to build a second one. Have fun! **NV**

TABLE 1 — PARTS LIST

SURROUND SOUND/ REVERB PROCESSOR

SEMICONDUCTORS
U1 — LM324 Quad op-amp - 14 pin IC
U2 — MN3101 Clock generator - 8 pin IC
U3 — MN30071024 Step Bucket Brigade Device - 8 pin IC
U4 — LM386 Audio amplifier

CAPACITORS
C7,C17 — .01uF 25VDC ceramic disc marked (103) or 10nF
C5,C6 — .005uF 25VDC ceramic disc marked (502)or 5nF
C18,C19 — .1uF 25VDC ceramic disc marked (104)
C1 — 470pF 25VDC ceramic disc marked (470)or (471)
C9 — 680pF 25VDC ceramic disc marked (680)or (681)
C2,C3,C4,C8 — 10uF 25VDC electrolytic
C10,C11,C12 — 10uF 25VDC electrolytic
C13,C16 — 10uF 25VDC electrolytic

RESISTORS
R32 — 2 ohm 1/4 watt (red-black-gold)
R24 — 1K ohm 1/4 watt (brown-black-red)
R15 — 2.2K ohm 1/4 watt (red-red-red)
R1,R4,R11 — 4.7K ohm 1/4 watt (yellow-violet-red)
R13,R14,R35 — 4.7K ohm 1/4 watt (yellow-violet-red)
R26,R27 — 5.6K ohm 1/4 watt (green-blue-red)
R20 — 10K ohm 1/4 watt (brown-black-orange)
R8 — 33K ohm 1/4 watt (orange-orange-orange)
R6,R7 — 39K ohm 1/4 watt (orange-white-orange)
R5,R12 — 47K ohm 1/4 watt (yellow-violet-orange)
R2,R3,R9 — 100K ohm 1/4 watt (brown-black-yellow)
R10,R18,R19 — 100K ohm 1/4 watt (brown-black-yellow)
R21,R22,R29 — 100K ohm 1/4 watt (brown-black-yellow)
R31,R34 — 100K ohm 1/4 watt (brown-black-yellow)
R17,R23 — 470K ohm 1/4 watt (yellow-violet-yellow)
R28 — 1 megohm 1/4 watt (brown-black-green)
R25,R36 — 200K ohm single turn PC mount potentiometers
R16 — 100K ohm long shaft potentiometer
R30 — 10K ohm long shaft potentiometer

MISCELLANEOUS
BC — battery clip
BH — battery holder
S1,S2 — DPDT pushbutton switches
J1,J2,J3,J4 — RCA jacks, PC board mount

REQUIRED, NOT SUPPLIED
9 volt alkaline battery
Microphone, speaker, audio cables

OPTIONAL
Ramsey CRV case or suitable enclosure

TABLE 2

JUMPER INSTALLATION AND CONFIGURATION

INPUT CONFIGURATION INPUT JUMPERS (JMP2,JMP3,JMP4)

A. SURROUND SOUND for HI-FI STEREO
* Install no jumpers or
* Install no jumpers and remove: R1 and R4 to add "enhanced rear channel effects"

B. STEREO SOUND FROM MONO SOURCE: such as VCR
* Install JMP2, all others out

C. MONO MICROPHONE SOURCE
* Install JMP3,JMP4, all others out
* Remove R1,R2,R4,R10

OUTPUT CONFIGURATION OUTPUT JUMPERS (JMP5,6,8,9,10)

A. BOTH OUTPUTS at LINE LEVEL OUTPUT
* Install JMP5 and JMP7, all others out

B. MICROPHONE LEVEL ON LEFT OUTPUT, LINE OUTPUT on RIGHT
* Install JMP6, all others out

C. SPEAKER OUPUT ON RIGHT, LINE OUTPUT on LEFT
* Install JMP8,JMP9,JMP10, all others out

D. SPEAKER OUTPUT on RIGHT, MICROPHONE on LEFT OUTPUT
* Install JMP6,JMP8,JMP9,JMP10, only JMP7 is out

*** The RV-1 SURROUND SOUND/REVERB PROCESSOR is available from:
RAMSEY ELECTRONICS, INC.
793 Canning Parkway
Victor, New York 14564
Phone: (716) 924-4560
Fax: (716) 924-4555

RV-1-TP Surround Sound/Reverb Kit	**$59.95**
RV-1-TP Surround Sound/Reverb wired	**$89.95**
CRV-TP Surround Sound/Reverb case	**$12.95**
RV-1PC-TP Surround Sound/Reverb PC board	**$ 9.82**

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New York State residents add appropriate sales tax.

#80 TEST EQUIPMENT *cont.*

FLUKE 335A DC voltage standard $1330. Dexis Corp., 612-944-7670.

AILTECH 124C Power osc, 200-2500 MHz, $400; HP 8616A signal gen 1.8-4.5 GHz, $650; Winslow ZM2B megger, $125; Low loss RF cable with TNC connectors, .35" dia, 54" lg; TNC male-TNC female 1.5dB insertion 11GHz, $20 ea., 50 available. A-Comm Electronics, 303-290-8012.

TEKTRONIX #465 oscilloscope includes two P6103 probes $700, heath #SO 4550 oscilloscope $75, Hickok #5002A oscilloscope $50, Variac #W20M 20 amp $250, Powerstat #116B 10 amp $95, Hypot #4045 $350; Amprobe temp/event recorder #LT8200R includes four probes chart paper $250. 518-747-2156 days.

GLOBAL SPECIALTIES Max-50 handheld frequency counter. Excellent condition with manual; $85. Decade capacitor; $15. Transistor tester kit; $13. Ross, 309-686-0211.

COATING THICKNESS. Used eddy current gauges with LCD readouts for nonconductive coating on metal. (1) Electromatic DAC-40/QE, 0-39.9 mils, $275. (3) Electromatic DFNE-8/Q4, 0-19.9 mils, $175 each. Call Richard Garber, 1930 Grande Rue Cir., Columbus, OH 43229. 614-891-7767.

TEST EQUIPMENT: Pulse Instruments PI-451A TTL-clocked pulse generator plug-in for Tek TM 500 series mainframe $175. **HP 59401A** bus system analyzer for GPIB $750. **Tek 149A** NTSC generator $675. **Tek 1105** portable battery-operated power supply, for 465, 475, etc. scopes, and TM 500 series mainframes $200. **Tek 390AD** dual-channel waveform digitizer $600. **HP 334A** distortion analyzer $395. **HP 3575A** gain-phase meter (dual display) $700. **HP 6227B** 0-25 V 0-2.0 A dual tracking lab power supply $475. **HP 6443B** 0-120 V 0-2.5 A power supply $475. **HP 8405A** vector voltmeter $425. **Kay** Digital Sona-Graph 7800 dual channel spectrograph, printer $750. **HP 8015A** 50MHz pulse generator $475. Also available: **HP 5004A, 5005A** signature analyzers, **Dranetz 606** and **BMI 4800** printing power line disturbance monitors. **Pepper Systems,** 214-353-0257.

PROGRAMMABLE WAVEFORM synthesizer, Wavetek 178 $2,250. DEXIS, 612-944-7670.

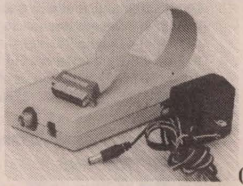
BUY AND SELL late model test equipment: HP, Fluke, Genrad, Tek and Wavetek. Call Dennis at **G P T E Surplus, 408-749-9805, FAX 408-749-9806.**

WANTED: TRUE TIME RECEIVERS, WWVN, satellite, etc. Other True Time equipment wanted also. Call Bill, 1-800-526-0388 or FAX: 1-800-788-5005.

OSCILLOSCOPES: TEK 7633A $300, 7603 $250, 7403 $200, 7A26 $125, 7B53A $125, OS-245P (Tek military) w/plug-ins $250. HP 184B/1801A/1821A (rack) $325, 181A/1801A/1821A $225, 180A/1801A/1820A $200. 602-732-2383.

PULSE GENERATOR SYSTEM, consisting of Hewlett Packard 8080A main frame, 8083A 300MHz output amplifier, 8092A 1GHz delay generator/frequency divider, new condition $875. Psitech Plus, 707-745-4804, FAX: 707-745-1060.

Digital Storage Oscilloscope For $169.95 ???



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Easy to Use

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Input: 10V to 50mV/Div. DC - 22kHz (-3dB)
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OSCILLOSCOPES & ACCESSORIES

TO 100 Mhz

TEK 2235 100 MHz Dual Trace Oscilloscope $1,000.00
TEK 5440 50 MHz 4-Trace Oscilloscope System, w/(2)5A48, 5B42 ..... $750.00
TEK 5A13N Differential Comparator $300.00
TEK 7603 100 MHz 3-slot Frame $250.00
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 R465B 100 MHz Dual Channel O'scope, rackmount $550.00
TEK SC502 15 MHz Dual Trace Oscilloscope plug-in, TM500 series $375.00

ABOVE 100 MHz

TEK 2465 300 MHz Quad Trace Oscilloscope $2,600.00
TEK 475 200 MHz Dual Channel O'scope $750.00
TEK 475A 250 MHz Dual Channel Oscilloscope $850.00
TEK 7704A 250 MHz 4-slot Frame $325.00
TEK 7844 400 MHz Dual Beam 4-slot Frame $750.00
TEK 7904 500 MHz 4-slot Frame $500.00
TEK 7904 500 MHz System, w/7A24,7A26,7B80,7B85 ..... $1,200.00
TEK 7A24 400 MHz Dual Trace Amplifier $450.00
TEK 7A26 200 MHz Dual Trace Amplifier $250.00
TEK 7A29-opt.04 1 GHz Amplifier, variable delay $1,150.00
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 7B87 400 MHz Time Base, with pretrigger acquire clock (7854) $250.00

STORAGE

TEK 5441 50 MHz 4-Trace Oscilloscope System, w/(2)5A48, 5B42 ..... $850.00
TEK 7854 400 MHz Waveform Processing frame, digital storage $1,500.00

DIGITAL

HP54100D 1 GHz Repetitive/40 MS/s Digital Oscilloscope $3,250.00

SAMPLING

TEK 7S11 Sampling Unit $450.00
TEK 7S14 1 GHz Dual Channel Sampling Unit $700.00
TEK 7T11 Sampling Sweep Unit $950.00
TEK S-4 14 GHz Sampling Head, for 7S11 or 7S12 ..... $750.00
TEK SD-14 3 GHz Dual Sampling Head, for 11801A, etc. $2,500.00
TEK SD-22 12.5 GHz Dual Sampling Head, for 11801A, etc. $2,500.00

PROBES

TEK 1101A Active Probe Power Supply $225.00
TEK A6902 Voltage Isolator, dual channel, 1.5 kV/chan., DC-15 MHz $650.00
TEK A6902B Voltage Isolator, dual channel, 500 V/chan., DC-20 MHz $950.00
TEK P6007-opt.01 100X 20 MHz 1.5kV Probe, 3.5 feet length (NEW/BOXED) $75.00
TEK P6046 100 MHz 1X/10X Differential FET Probe $750.00
TEK P6201 900 MHz FET Probe, 1X/10X/100X $400.00
TEK P6202 500 MHz 10X FET Probe $275.00
TEK P6231 1.5 GHz 10X FET Probe, for 11000 series $275.00

CALIBRATION

TEK SG503 Levelled Sine Wave Generator, 0.25-250 MHz,TM500 series $850.00
TEK TG501 Time Mark Generator, 1nS-5S, TM500 series $750.00

WAVEFORM GENERATORS

FUNCTION

HP3310A 5 MHz Function Generator $325.00
HP3310B 5 MHz Function Generator, monocycle & burst operation $425.00
HP3312A 13 MHz Function Generator; AM, FM, sweep capability $800.00
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 164 30 MHz Sweep/Function Generator $850.00

PULSE

COLBY PG-5000A 5 GHz 2-Channel Pulse Gen., requires external RF source $2,200.00
HP214B 10 MHz Pulse Generator, 50 V/50 Ohms, auto duty cycle $2,250.00
HP8015A-002 50 MHz Dual Output Pulse Generator, burst operation $700.00
HP8080A/81A/82A/83A 300 MHz Word Generator $900.00
HP8080A/91A/92A/2x93A 1 GHz Dual Charinel Pulse Generator $1,650.00
HP8080A/91A/92A/93A 1 GHz Single Channel Pulse Generator $1,400.00
HP8080A/91A/93A 1 GHz Clock Generator $900.00
HP8082A 250 MHz Pulse Generator $1,400.00
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

PROGRAMMABLE

HP8165A Programmable Signal Source, 1 mHz-50 MHz $2,600.00
STANFORD RESEARCH DG535 Digital Delay Generator, 4 channels, 5 pS res., GPIB $1,500.00
TEK AWG5105 Arbitrary Waveform Generator, 50 MS/s, 12 bits $3,000.00
TEK AWG5105-opt.02 Arbitrary Waveform Generator, dual channel option $4,250.00
TEK FG5010 20 MHz Programmable Function Generator, TM5000 series $1,200.00
TEK PFG5505 Programmable 12 MHz Pulse/Function Generator $1,275.00

VOLTAGE & CURRENT

VOLTMETERS

FLUKE 80E-10 High Voltage Divider, 1000X, 10 kV $250.00
FLUKE 8840A-059 5-1/2 Digit Programmable Multimeter $550.00
HP 3456A 6-1/2 digit Multimeter ****SUMMER*SALE*SPECIAL**** $700.00
HP 3468A-001 5-1/2 Digit Portable Voltmeter, battery option $350.00
KEITHLEY 155 Null Detector / Microvoltmeter $150.00
SOLARTRON 7150 5-1/2 / 6-1/2 digit Multimeter, GPIB $550.00
TEK DM501A 4-1/2 digit Multimeter, TM500 series $275.00
TEK DM511-opt.02 4-1/2 Digit DMM, w/P6602 Temp. Probe; TM500 (NEW/BOXED) $395.00

CALIBRATION

FLUKE 5200A AC Voltage Calibrator $2,000.00
HOLT 11 AC Thermal Converter Set, 0.5-1200 Volts $5,250.00

VOLTAGE SOURCES

HP6114A Precision Dual Range Power Supply, 20 V 2 A / 40 V 1 A $875.00
HP6115A Precision Dual Range Power Supply, 50V 0.8A / 100V 0.4A $875.00

CURRENT METERS & SOURCES

HP6177C DC Current Source, to 50V, 500mA $600.00
HP6186C DC Current Source, to 300V, 100mA $750.00
KEITHLEY 220 Programmable Current Source, 0.5 pA-101 mA, GPIB $2,000.00
KEITHLEY 225 Current Source, 1 nA-99.9 mA, 10-100 V compliance $450.00
KEITHLEY 227 Current Source, 1 uA-1 A, 10-300 V compliance $750.00
KEITHLEY 228 Prog. Voltage/Current Source, sink or source 100 Watts $2,250.00
KEITHLEY 261 Picoampere Source, 10 fA-10 mA $325.00
KEITHLEY 26220 Logarithmic Picoammeter, 1 pA-100 uA $500.00
KEITHLEY 414A Picoammeter, 0.1 nA-10 mA, analog scale $375.00
KEITHLEY 480/1788 5-1/2 digit Picoammeter, 1 nA-1 mA f.s., AC or batt.pwr $575.00
KEITHLEY 642 Electrometer $3,900.00
TEK CT-5 High Current Transformer for P6021/A6302, to 1000A $650.00
TEK P6022 Current Probe with passive termination, 935 Hz-120 MHz $300.00

IMPEDANCE & COMPONENT TEST

IMPEDANCE

HP4800A Vector Impedance Meter, 5 Hz-500 kHz $550.00

LCR

BOONTON 62AD 1 MHz Inductance Meter, 2-2000 uH $700.00
BOONTON 72B 1 MHz Capacitance Meter, 1-3000 pF $550.00
E.S.I. 296V 4-1/2 Digit LCR Bridge, 120 Hz & 1 kHz $850.00
HP4262A 3-1/2 digit LCR Meter, 120 Hz/1 kHz/10 kHz $1,600.00
HP4328A-001 Milliohmeter, 0.001-100 ohms f.s., battery option $1,350.00
HP4342A Q Meter, 22 kHz-70 MHz, Q=5-1000 ..... $2,250.00
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 $850.00
E.S.I. SR1050-10M Resistance Transfer Standard, 10 Megohms/step $3,600.00
FLUKE 5450A Programmable Resistance Standard, 2 & 4 wire $2,750.00
GR 1409-SERIES Standard Mica Capacitors, 0.05% accuracy $150.00
GR 1413 6-Decade Precision Capacitor, to 1.11110 uF, 1 pF res. $950.00
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-Z 6-Decade Resistor, to 11,111,100 ohms, 10 ohm res. $550.00
HP 16470B Stable Inductors, set of 4 ..... $500.00
LEEDS & NORTHRUP 4220-SERIES Milliohm Standards $650.00

HIPOT

ROD-L M500AV 5000 Volt AC HIPOT Tester $700.00

CURVE TRACERS

HUNTRON 1005B-1S Tracker $400.00
TEK 576 Curve Tracer, to 220W $2,350.00
TEK 577D1/177 Storage Curve Tracer, with standard test fixture $2,250.00
TEK 577D2/177 Curve Tracer, to 100W, with standard test fixture $1,750.00
TEK 7CT1N Curve Tracer, to 0.5W, 7000 series $500.00

TDR

MICROTEL 4530 Waveguide T.D.R.; 2, 4, 6, 11 GHz bands $4,000.00
TEK 1503B-opt.04 Time Domain Reflectometer, 2/10/100/100 nS PW, 0-50k ft $4,000.00

POWER SUPPLIES

SINGLE OUTPUT

GLASSMAN PS/EG-05R06 5kV CV/CL Power Supply, to 6mA $500.00
GLASSMAN PS/WH-30R15 30kV at 15mA CV/CC Power Supply $1,600.00
HP6002A-001 Programmable Power Supply, 0-50 V / 0-10 A / 200 Watts $875.00
HP6200B Dual Range Power Supply, 20 V at 1.5 A / 40 V at 0.75 A $250.00
HP6206B Dual Range Power Supply, 30 V at 1 A / 60 V at 0.5 A $250.00
HP6207B 160V at 200mA CV/CC Power Supply $300.00
HP6209B 320V at 100 mA CV/CC Power Supply $300.00
HP6260B-027 10V at 100A CV/CC Power Supply $675.00
HP6261B-027 20 V at 50 A CV/CC Power Supply $675.00
HP6263B 20V at 10A CV/CC Power Supply $400.00
HP6264B-011 20 V at 20 A CV/CC Power Supply, w/overvoltage crowbar $500.00
HP6266B 40V at 5A CV/CC Power Supply $400.00
HP6268B 40 V at 30 A CV/CC Power Supply $700.00
HP6282A 10V at 10A CV/CC Power Supply $300.00
HP6289A 40 V at 1.5 A CV/CC Power Supply $250.00
HP6296A 60V at 3A CV/CC Power Supply $400.00
HP6384A 4.0-5.5V at 8A CV/CL Power Supply $200.00
HP6438B 60V at 5A CV/CC Power Supply $375.00
HP6443B 120V at 2.5A CV/CC Power Supply $475.00
HP6448B 600 V at 1.5 A CV/CC Power Supply $800.00
KEPCO ATE-100-1M 100 V at 1 A CV/CC Power Supply $300.00
KEPCO JQE-36-15M 36 V at 15 A CV/CC Power Supply $375.00

MULTIPLE OUTPUT

HP6205C Dual Output Dual Range Supply, 0-20V 0.6A/ 0-40V 0.3A $375.00
HP6236A Triple Output Power Supply, fixed tracking ratio $450.00
HP6236B Triple Output Power Supply, variable tracking ratio $550.00
HP6253A Dual Output 20 V 3 A CV/CC Power Supply $500.00
HP6255A Dual Output 40 V 1.5 A CV/CC Power Supply $500.00
TEK PS5010 Programmable Triple Power Supply, TM5000 series $750.00
TEK PS503A Dual Power Supply, TM500 series $250.00

MISCELLANEOUS

ACME PS2L-1000 Programmable Load, to 75V / 150A/ 1000 Watts $450.00
BEHLMAN KBT-300D350 Programmable AC Source, 3 KVA, to 135V 30A/270V 15A $3,250.00
HP59501A HPIB Isolated DAC/Power Supply Programmer $175.00
HP6060A-020 Programmable 300 Watt Load, 0-60 A, 3-60 V autoranging $1,000.00
KEPCO BOP 100-1M Bipolar Op Amp/Power Supply, to 100 V, 1 A $500.00
KEPCO BOP 1000M Bipolar Op Amp/Power Supply, to 1000V, 40mA $600.00

TIME & FREQUENCY

UNIVERSAL COUNTERS

HP5314A 100 MHz/100 nS Universal Counter $225.00
HP5315A 100 MHz/100 nS Reciprocal Counter, high res. audio $550.00
HP5315A-001 100 MHz/100 nS Universal Counter, TCXO reference $650.00
HP5316A 100 MHz/100 nS Universal Counter, HPIB $750.00
HP5316A-001 100 MHz/100 nS Universal Counter, HPIB, TCXO reference $850.00
HP5316A-003 100 MHz/100 nS Universal Counter, HPIB, 1.0 GHz C-chan. $1,000.00
HP5334A-010 100 MHz Universal/Statistical Counter, OCXO ref. $1,200.00
HP5370B-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
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 DC503A 125 MHz Universal Counter/Timer, TM500 series $500.00
TEK DC509 135 MHz High Resolution Universal Counter/Timer, TM500 ..... $700.00
TEK TVC501 Time-Voltage Converter, TM500 series $700.00

FREQUENCY COUNTERS

EIP 351D 18 GHz Frequency Counter $950.00
HP5305B/5300B-001 1.3 GHz Counter Package w/TCXO ref., high res. audio $450.00
HP5340A 18 GHz Frequency Counter $1,400.00
HP 5340A-001,006 18 GHz Frequency Counter, OCXO, +39 dBm limiter $1,900.00
HP 5340A-001,011 18 GHz Frequency Counter, OCXO reference, HPIB $1,900.00
HP5345/5355/5356A-006 Pulsed/CW Frequency Counter, 1.5-18.0 GHz, 75 nS pulse $3,500.00
TEK 7D14 525 MHz Frequency Counter, 7000 series $175.00
TEK DC502 550 MHz Frequency Counter, TM500 series $400.00
TEK DC504 80 MHz Frequency Counter $125.00

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STANDARDS
AUSTRON 1210D-03 Portable Crystal Clock, 1/5/10 MHz, 100pps/1pps/1ppm $1,500.00
GR 1115C Crystal Frequency Standard, 0.1/1.0/5.0 MHz $1,600.00

AUDIO & BASEBAND

SPECTRUM ANALYZERS
HP3581A Wave Analyzer, 15 Hz-50 kHz $900.00
HP3586C Selective Level Meter, 50 Hz-32.5 MHz, 50 & 75 ohms $1,750.00
HP8556A LF Section, 20 Hz-300 kHz $500.00
TEK 5L4N Spectrum Analyzer,20 Hz-100 kHz, 10 Hz res., 5000-series $850.00
TEK 7L5-opt.25/7603 Spectrum Analyzer, 20 Hz-5 MHz, w/tracking gen.,display $2,250.00

DISTORTION ANALYZERS
HP333A Distortion Analyzer, 5 Hz-600 kHz, -60 dB, auto nulling $500.00
HP334A-001 Distortion Analyzer, 5 Hz-600 kHz, AM detector, VU $550.00
HP339A Distortion Analyzer, built-in low distortion osc. $2,400.00
TEK DA4084 Programmable Distortion Analyzer, 0.0025% THD, w/frame $1,750.00

RMS VOLTMETERS
FLUKE 8920A True RMS Voltmeter, 180 uV-700 V, 10 Hz-20 MHz $700.00
HP3400A RMS Voltmeter, 10 Hz-10 MHz $250.00

OSCILLATORS
HP204D Audio Oscillator, 5 Hz-1.2 MHz, 80 dB step atten. $200.00
HP3335A Synthesizer/Level Generator, 200 Hz-80 MHz $3,250.00
HP4204A Synthesizer, 10 Hz-1 MHz, 1 mV-30 V / 600 Ohms $350.00
ROCKLAND 5100 Synthesizer, 1 mHz-1.999999999 MHz $400.00
TEK SG505 Low Distortion Oscillator $800.00

FILTERS, MISCELLANEOUS
GR 1381 Random Noise Generator, 2 Hz-50 kHz $300.00
GR 1383 Random Noise Generator, 20 Hz-20 MHz $500.00
KROHN-HITE 3202R Dual HP/LP/BP/BR Filter, 20 Hz-2 MHz, 24 dB/octave $600.00
KROHN-HITE 3343 Dual Bandpass Filter, 0.01 Hz-100 kHz, 48 dB/octave $950.00
P.A.R. 189 Filter/Amplifier, 0.1 Hz-110 kHz, variable Q & gain $400.00
TEK AM502 Differential Amplifier, 0.1 Hz-1 MHz, TM500 series $575.00
WAVETEK/ROCKLAND 752A-002 Dual Low Pass Filter 1 Hz-100 kHz, 115 dB/octave, GPIB $1,100.00

RF & MICROWAVE

SPECTRUM ANALYZERS
HP11517A/18A/19A/20A Harmonic Mixer, 12.4-40.0 GHz, for 8555A, 8565A $700.00
HP11970K Harmonic Mixer, 18.0-26.5 GHz, for 8562, 8566, etc. $1,100.00
HP11971K Harmonic Mixer, 18.0-26.5 GHz, for 8569B $950.00
HP5371A Modulation Domain Analyzer, 125 mHz-500 MHz $5,900.00
HP8443A Tracking Generator, 0.1-110 MHz, LED display $700.00
HP8444A Tracking Generator, 0.1-1300 MHz, for 8554B $800.00
HP8444A-059 Tracking Generator, 0.5-1500 MHz, for 8554,8568,etc. $1,500.00
HP8552B IF Section $750.00
HP8553B RF Section, 1 kHz-110 MHz $500.00
HP8554B RF Section, 0.1-1250 MHz $800.00
HP8555A RF Section, 0.01-18 GHz $950.00
HP8555A/8552B/141T Spectrum Analyzer System, 10 MHz-18 GHz, 100 Hz res. $2,375.00
HP8558B/181TR Spectrum Analyzer, 0.1-1500 MHz, 1 kHz res., w/display $2,350.00
TEK 7L12/7613 Spectrum Analyzer, 0.1-1800 MHz, with storage display $2,000.00
TEK TR501 Tracking Generator, 0.1-1800 MHz, for 7L12, 7L13 ..... $700.00
TEK TR503 Tracking Generator, 0.1-1800 MHz, for 492/4/5/6 ..... $1,750.00

NETWORK ANALYZERS
HP11590B-001 Bias Network, 0.1-18.0 GHz, to 100V, 500mA, APC7 ..... $450.00
HP11665B Modulator, 0.15-18.0 GHz, for use with 8755/6/7 ..... $400.00
HP8405A Vector Voltmeter, 1-1000 MHz $700.00
HP8407A/8412A/8601A Network Analyzer, generator 100 kHz-110 MHz, with sweep $1,250.00
HP85020A Directional Bridge, 0.01-4.3 GHz, N(f), for 8755/6/7 ..... $750.00
HP85021A Directional Bridge, 0.01-18.0 GHz, APC7, for 8755/6/7 ..... $1,200.00
HP85050D APC7 Calibration Kit, for 8510 series $1,100.00
HP8743A-018 Reflection/Transmission ****SALE**** Test Set, 2-18 GHz $500.00
HP 8753B-006,010/85047A Network An., 300 kHz-6 GHz, Time Domain, S-Parameters $27,000.00
NARDA 7000A/7202/7206 Microwave Multimeter System: scalar analysis 0.1-18 GHz $1,950.00
WILTRON 640/G50/R50/T50 Scalar Network Analyzer, 1-1500 MHz, includes generator $1,950.00

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
COMSTRON FS-2000-4 Synthesizer, 10 MHz-4 GHz, 1 uS speed, -140 dBc noise $15,000.00
FLUKE 6060A Synthesized Signal Generator, 0.1-1050 MHz, 10 Hz res. $3,750.00
GIGATRONICS 875/86 Levelled Multiplier, 26.5-40.0 & 50.0-75.0 GHz outputs $8,000.00
HP11720A Pulse Modulator, 2-18 GHz, Tr<10nS, >80 dB $1,200.00
HP8403A-002 Modulator, 800-2400 MHz, 80 dB D/R, pulse 0.1-100 uS $500.00
HP85100V Frequency Mult., 10-15 GHz in / 50-75 GHz out >0 dBm $4,250.00
HP8640A Signal Generator, 0.5-512 MHz, AM, FM, analog readout $950.00
HP8654A Signal Generator, 10-520 MHz, calibrated AM, uncal. FM $650.00
HP8654B Signal Generator, 10-520 MHz, AM, FM $750.00
HP8656A Synthesized Signal Generator, 0.1-990 MHz, AM, FM, HPIB $3,500.00
HP86601A RF Plug-in, 10 kHz-110 MHz, for 8660 series $650.00
HP8660C/86602B/86633B Synthesized Signal Generator, 1-1300 MHz, AM, FM, HPIB $2,750.00
HP8660C/86603A-002/34A Synthesized Sig. Gen., 1-2600 MHz, phase mod. to 10 MHz $4,500.00
HP86631B Aux. Modulation Section, external AM/Pulse, for 8660 ..... $250.00
HP86632B AM/FM Modulation Section, for 8660 series $650.00
HP86633B AM/FM Modulation Section, for 8660 series $750.00
HP86634A Phase Modulation Section, for 8660 series $750.00
HP86635A FM/0M Modulation Section, for 8660 series $950.00
PRD/HARRIS 7838-11 Freq. Synthesizer, 0.1-80 MHz, 1 Hz res., +13 dBm $400.00
WAVETEK 3000 Synthesized Signal Gen., 1-520 MHz, 1 kHz res., AM, FM $550.00
WILTRON 6742A Synthesizer/Sweep Generator, 18.0-26.5 & 26.5-40.0 GHz $9,000.00

SWEEP GENERATORS
BOONTON/INTEGRA VTS-100 VCO Test Set, 2-18 GHz $1,750.00
EIP 928-opt.9201 Sweep Gen.,1.0-18.6 GHz, step atten., power sweep, GPIB $4,000.00
HP 8350B/83522A Programmable Sweep Osc., 10-2400 MHz, +13 dBm levelled $8,250.00
HP 8620C Sweep Oscillator Frame $550.00
HP 8620C-001 Sweep Oscillator Frame, BCD programmable $600.00
HP 8620C-011 Sweep Oscillator Frame, HPIB programmable $675.00
HP 86210A RF Plug-In, 3-350 MHz, +13 dBm levelled $450.00
HP 86222A RF Plug-In, 0.01-2.4 GHz, +13 dBm levelled $1,500.00
HP 86222A-002 RF Plug-in, 10-2400 MHz, 70 dB step attenuator $1,850.00
HP 86222B RF Plug-In, 10-2400 MHz, crystal markers 1, 10, 50 MHz $1,900.00
HP 86235A-001 RF Plug-in, 1.7-4.3 GHz, +16 dBm levelled $700.00
HP 86240A RF Plug-In, 2.0-8.4 GHz, +16 dBm levelled $1,000.00
HP 86241A 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 86250D-001 RF Plug-in, 8.0-12.4 GHz, +10 dBm levelled $500.00
HP 86290A RF Plug-In, 2.0-18.0 GHz, +7 dBm levelled $1,900.00
HP 86290B RF Plug-In, 2.0-18.6 GHz, +10 dBm levelled $2,250.00
WAVETEK 1067 Sweep Generator, 1-400 MHz, +10 dBm, 75 ohms $500.00
WAVETEK 2002A Sweep/Signal Generator, 1-2500 MHz $1,850.00
WILTRON 6617-OPT.03 Programmable Sweep Gen., 0.01-8.0 GHz, +10 dBm, GPIB $3,300.00
WILTRON 6647B Programmable Sweep Generator, 10 MHz-20 GHz $7,500.00

POWER METERS
BOONTON 42B/41-4B Analog Power Meter, with 1 MHz-12.4 GHz sensor $475.00
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 4240A Power Sensor, 0.01-18 GHz, -45 to +10 dBm, for 475/476 ..... $200.00
GENERAL MICROWAVE 478A/N436A Peak Power Meter, 0.75-18.0 GHz, -30 to +15 dBm, GPIB $1,650.00
HP432A/478A Power Meter, 0.01-10 GHz, -20 dBm to +10 dBm F.S. $375.00
HP432B/478A Digital Power Meter, 0.01-10 GHz, 10 uW-10 mW F.S. $450.00
HP435A/8481A Power Meter, 10 MHz-18 GHz, -30 to +20 dBm $1,000.00
HP435A/8482A Power Meter, 0.1-4200 MHz, -30 to +20 dBm $1,000.00
HP8900C/84811A Peak Power Meter, 100 MHz-18 GHz, 0 to +20 dBm $1,750.00
HPQ8486A Power Sensor, 33.0-50.0 GHz, WR22 waveguide $1,500.00
WAVETEK 1034A Portable Analog Power Meter, 1 MHz-18 GHz $375.00

RF MILLIVOLTMETERS
BOONTON 9200A-01 RF Millivoltmeter, 10 kHz-1.2 GHz, GPIB $950.00
RACAL 9303 TRMS Level Meter, 10 kHz-2 GHz, -77 to +23 dBm, GPIB $875.00

AMPLIFIERS, MISCELLANEOUS
AILTECH 7615 Noise Generator, 0.01-1.3 GHz, 15 dB ENR $350.00
AMPLIFIER RESEARCH 10L Amplifier, 40 dB, 150 kHz-300 MHz, 10 Watts $850.00
BOONTON 82AD FM/AM Modulation Meter, 10-1300 MHz $1,000.00
ENI 500LA Amplifier, 24 dB, 1.5-520 MHz, 300 mW $350.00
ENI 503L Amplifier, 40 dB, 2-510 MHz, 3 Watts $850.00
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
HP11715A Modulation Source $1,250.00
HP11975A Amplifier, 2-8 GHz, +6 to +16 dBm levelled output $1,200.00
HP346B-004 Noise Source, 15.2 dB ENR, 10 MHz-18 GHz, N(f) output $1,000.00
HP8447A Amplifier, 0.1-400 MHz, NF<7 dB, +6 dBm output $300.00
HP8447F-H64 Dual Amp., 9 kHz-50 MHz/ 28 dBG & 0.1-1300 MHz/ 25 dBG $1,100.00
MICROWAVE SEMI.CORP. MC5112 Noise Source, 25.5 dB ENR, 1.0-12.4 GHz, N(m), +28 VDC $325.00
PANASONIC VP-8125A AM/FM/Stereo Gen., 0.1-110 MHz, 0.1 Hz res.,0.05% dist. $850.00

COAXIAL & WAVEGUIDE

A.E.L. ASN113A Cavity Backed Spiral Antenna, 0.7-2.8 GHz, LHC, N(f) $175.00
A.E.L. H-1734 Double Ridge Horn, 0.5-6.0 GHz, 11 dB, 250 Watts, N(f) $500.00
ANZAC AM-109 Amplifier Module, 10 dB, 0.5-60 MHz, Po=+27 dBm, NF<7dB $75.00
FXR U175AF-20 WR28 Fixed Broadband 20 dB Attenuator, 26.5-40.0 GHz $135.00
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
HP11691D Directional Coupler, 22 dB, 2-18 GHz $500.00
HP11692D Dual Directional Coupler, 22 dB, 2-18 GHz $900.00
HP394A Variable Attenuator, 6-120 dB, 1-2 GHz, 200 Watts avg. $375.00
HP776D Dual Directional Coupler, 20 dB, 940-1900 MHz $250.00
HP778D-011 Dual Directional Coupler, 20 dB, 100-2000 MHz $400.00
HP779D Directional Coupler, 20 dB, 1.7-12.4 GHz $375.00
HP8473D PDB Diode Detector, 0.01-33.0 GHz, APC3.5(m) $300.00
HP8497K-004 Programmable Attenuator, 0-90 dB, DC-26.5 GHz, APC3.5 ..... $600.00
HPK532A WR42 Frequency Meter, 18.0-26.5 GHz $500.00
HPK752D WR42 Directional Coupler, 20 dB, 18.0-26.5 GHz $400.00
HPR532A WR28 Frequency Meter, 26.5-40.0 GHz $500.00
KAY 432D Step Attenuator, 0-101 dB, DC-1 GHz, BNC(f/f) $125.00
M/A-COM MA7700K-0104 Crystal Detector, 9.0-11.0 GHz, SMA(m/f) $35.00
MAURY 8045D Double Stub Sliding Tuner, 1.8-18.0 GHz, APC3.5(m/f) $350.00
MERRIMAC PDM-42-10GA Power Divider, 4-Way, 7.0-12.4 GHz, 6 Watts, SMA(f) $90.00
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 367NM 40 Watt Load, 2-18 GHz, N(m) $150.00
NARDA 4000-SERIES SMA Miniature Directional Couplers $75.00
NARDA 4202B-10 Directional Coupler, 10 dB, 1.0-12.4 GHz, SMA $225.00
NARDA 5070-SERIES Precision Reflectometer Couplers $300.00
NARDA 768-30 30 dB Attenuator, 20 Watts, DC-11 GHz, N(m/f) $125.00
NARDA 769-20 20 dB Attenuator, 150 Watts, DC-6 GHz, N(m/f) $250.00
OMNI-SPECTRA 2090-6210-00 Power Divider, 2-Way, 8.0-18.0 GHz, SMA(f) $100.00
TRGA526 WR28 Phase Shifter, 26.5-40.0 GHz, round flanges $200.00
TRGB510 WR22 Precision Attenuator, 0-50 dB, 33.0-50.0 GHz $700.00
TRGB551 WR22 Frequency Meter, 33.0-50.0 GHz $550.00
TRGW510 WR10 Precision Variable Attenuator, 0-50 dB, 75-110 GHz $1,000.00
WEINSCHEL 1515 Power Divider, DC-18 GHz, SMA(f/f/f) $125.00
WEINSCHEL 1579 Power Divider, ***NEW*** DC-26.5 GHz, APC3.5(f/f/f) $275.00
WEINSCHEL AF-144-45-11 Prog. Binary Step Atten., 0-45 dB, 3 dB/step, DC-18 GHz $450.00
WILTRON 3114 Variable Delay Line, 0-60 cm, DC-12 GHz,vernier readout $500.00

LOGIC

HP5004A Signature Analyzer $150.00
HP5005A Signature Multimeter $350.00
HP5005B Signature Multimeter, TTL/CMOS/ECL, HPIB $750.00
HP5006A Signature Multimeter, HPIB $675.00
HP8170A-002 Logic Pattern Generator, 2 MB/s, address driver option $1,400.00
TEK P6408/P6109 Word Recognizer Probe Set $225.00

COMMUNICATIONS

HP28687A LAN Wire Test Instrument, for 25 pair cable $750.00
HP3336B-001 Synthesizer/Level Generator, 10 Hz-21 MHz $650.00
HP59401A HPIB Bus Analyzer $700.00
HP83001A Microwave Repeater, 3.7-4.2 GHz CCR 25 channels, 1 Watt $750.00
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 521A PAL Vectorscope $1,500.00
WANDEL & GOLTERMANN RM-4 Radiolink Measuring Set, 70 ..... $1,750.00

MISCELLANEOUS

FLUKE 2190A/2300A/1120A 10-Chan. Scanning Thermometer, types J,K,T,R,C, GPIB $875.00
FLUKE 2190A/Y2003/Y2001 Temperature Calibration System $950.00
HP59307A HPIB VHF Switch $200.00
P.A.R. 5206 Two-Phase Lock-In Amplifier, 2 Hz-200 kHz $3,000.00
TEK J16/J6523 Photometer, with Spot Luminance Probe $900.00
TEK TM5003 5000-series 3-slot Programmable Power Module $400.00
TEK TM5006 5000-series 6-slot Programmable Power Module $600.00
TEK TM503 500-series 3-slot Power Module $175.00
TEK TM504 500-series 4-slot Power Module $175.00
TEK TM506 500-series 6-slot Power Module $250.00
TEK TM515 500-series 5-slot Traveller Power Module $275.00
TEK TSI8150 Test System Interface, w/(4) TSS40 scanner controllers $900.00

#80 TEST EQUIPMENT *cont.*

HEWLETT PACKARD, 1720A, 275MHz oscilloscope in operational condition, $485. Tektronix 453 scope, large display, $290. Psitech Plus, 707-745-4804, FAX: 707-745-1060.

TEKTRONIX TM506 $200, TM504 $125, TM503 $125, 7854 mainframe $1200. HP 6268A $750. HV supplies (Spellman, Glassman, Gamma) to 80KV. Call Bob 505-672-9192 (evenings), FAX: 505-672-3145.

DATA I/O wanted! Looking for all late model Data I/O & other programmers. Ron, 408-241-7376.

SPECTRUM ANALYZER plug-ins: HP 8553B $295; HP 8552B $395; Cable clones: 141T to 8443 $95; 141T to 8445 $95; 141T maintenance set of three cables $245. Wade, 309-523-3262.

CALIBRATED SOLID-STATE TEST EQUIPMENT AFFORDABLY PRICED: TEKTRONIX OSCILLOSCOPES, PLUG-INS, CALIBRATORS, HEWLETT-PACKARD SWEEPERS, SPECTRUM ANALYZERS, POWER METERS, FREQUENCY COUNTERS, FLUKE DVMS. 408-738-4206, FAX: 408-736-6946. LIST/SASE: 912-D MARIA LANE, SUNNYVALE, CA 94086.

POWER SUPPLY. Electronic Measurement SCR-6-600-10100 $600. DEXIS, 612-944-7670.

WANTED: TEK 7603 scope high voltage board. Also Tek M1 plug-in service manual. Call Paul, 410-795-8038.

WILTRON 560 scalar-analyzer, with two .01-18GHz detectors, two high directivity bridges, and miscellaneous calibration accessories $1,950. **TEKTRONIX 7L13** spectrum analyzer $1,875. **Wavetek 1018B** RF power meter $500. **HP 355E/F** VHF programmable attenuators $100 each. Guaranteed. Call Joe, 812-384-3362, FAX: 812-384-9464.

WAVEFORM MONITOR WANTED: TEKTRONIX MODELS 1480R OR 1485R PREFERRED. Will pay cash or trade for related equipment. Please call 705-292-5509 or FAX: 705-292-7970.

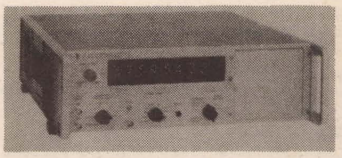
WANTED: WWVB RECEIVER made by the **True Time Instrument Co.; AUSTRON 2100C** receiver/comparator; **TRACOR 304D** Rubidium Standard with clock option. Call Bill, 1-800-526-0388.

WANTED: RUBIDIUM and Cesium standards "dead or alive." Corby Dawson, 805-736-0288.

WANTED: SERVICE monitors dead or alive. Motorola, IFR, Cushman, Wavetek. Fax your list. Call me last for best cash price. 408-929-2244 pager 510-498-6875.

TEKTRONIX 5440 oscilloscope with 5A48 & 5B40 plug-ins. Clean, like new, $350. 714-495-5566, FAX: 714-495-4742 or write for latest catalog of used equipment, PO Box 6955, Laguna Niguel, CA 92607-6955.

PROGRAMMABLE MULTIMETER, Ballantine Mod 9653 M, $95. Quantity discounts available. Psitech Plus, 707-745-4804, FAX: 707-745-1060.



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.

NETWORK ANALYZER HP 8410B $250, HP 8418A-H01 display holder $150, HP 8411A/018 harmonic converter $200, HP 8743A $200, HP 8412A $200, HP 8413 $200, HP 8620A $200, HP 5300A/5303B 525MHz counter $175, HP 5248L/5245B 3GHz counter $175. 602-732-2383.

WAVETEK STABILIZED sweep generator model #22, 11MHz, excellent condition, $925. S&G Electronic, 618 S. 62nd St., Philadelphia, PA 19143. 215-474-7663.

SURPLUS FLUKE EQUIPMENT: 8000A digital multimeter $75; 8300A digital voltmeter with option 1 & 2 $150; 8400A digital voltmeter with option 1, 2, 5, & 7 $150; 8600A digital multimeter $100; 8800A digital multimeter $125. ISA, 714-495-5566, FAX: 714-495-4742. PO Box 6955, Laguna Niguel, CA 92607-6955.

HP 8620C sweep mainframe $375, 86260A-001 12.4-18 GHz plug-in $795, 86242D 5.9-9.0 GHz $550, HP 3325A 21MHz synthesizer/function generator $2295, HP 8161A high performance pulse generator, NEW $20,400, OUR price $1,795. HP 5345A 500MHz counter $495. HP 5328A w/options $225. Call **TEST EQUIPMENT SALES,** 603-434-2544.

BIRD 6154 TERMALINE WATTMETER (New Boxed w/manual). Terminating wattmeter 5/15/50/105 watt full scale meter reading. Frequency range is 25 to 1000 MHz. VSWR is 1.1:1 maximum. Excellent 2-way radio and cellular radio servicing tool. quantities available. $180 post paid CONUS. Brian Kent (Kentronix), PO Box 2444, Farmingdale, NJ 07727. 908-681-3229, FAX: 908-681-3312.

CURVE TRACERS: Tek 577/D1 (storage) $1600. **Tek 577/D2** $1100. **Pepper Systems,** 214-353-0257.

455 PORTABLE Tektronix oscilloscope, B&K function generator, B&K transistor checker, B&K capacitance checker, Ultravarible pulse generator, TR1000 frequency counter. B&R Enterprise, PO Box 662, Portage, MI 49081.

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ALMOST FREE: Surplus RF, Microwave and Electronic test equipment at deep discount prices. Write ISA, PO Box 6955, Laguna Niguel, CA 92607-6955 or FAX: 714-495-4742 for catalog.

TEKTRONIX: 7704A 200MHz w/(2)7A26, 7B80, 7B85 $750. Tek 7904 w/7A26, 7A19, 7B92A $900. Tek 475 $650, Tek 465B-DM44 $650. Tek 2335 100MHz ruggedized portable $650. Biomation K500D, 9 chan 500MHz logic analyzer complete $750. HP 8616A 1.8-4.5 GHz mwave generator $800. VME card cages: 20 slot J1 & J2 backplanes, new. All equipment in excellent condition, fully tested, manuals, guaranteed. Call 510-530-5992 for details.

OSCILLOSCOPES: TEKTRONIX 7704, 150MHz, storage, $250; 7613R, 100MHz, storage; $250; 7313R, 25MHz, storage $125; HP 180TR, spectrum analyzer mainframe, $175; 180F, $75; 181A with 1801A & 1822A, $125; HP 8405A, vector voltmeter, $250; PRD LS 518 frequency meter, $65; RB7A vacuum relay, $45. All plus UPS. Frank Moreland, 14788 Poway Mesa Dr., Poway, CA 92064.

TEKTRONIX OSCILLOSCOPE, PORTABLE, MODEL 465 100MHZ WITH 2 PROBES $400. 316-721-8953.

TEK 2335 100MHZ portable scope $1100. Dexis Corp., 612-944-7670.

RADIOACTIVE SOURCE. Check your geiger counter. $10. **ELECTROMAN,** Box 24474, New Orleans, LA 70184.

WAVETEK EQUIPMENT for sale. 1 Sweep Generator 1405 $2,200. 1 Scope 1910 $950. 1 Scope 1901 $800. 1 Option I $250. 1 Foot Switch $50. Call Lee, 407-649-0010.

TEST EQUIPMENT manuals, most are Tektronix and Hewlett Packard. Send me your want list. Ed Matsuda, PO Box 390613, San Diego, CA 92149. Buy, sell, trade. Phone 619-479-0225, FAX 619-479-1670.

SECURITY

85

PHRACK MAGAZINE: Complete PD archives of the original Phreak/Hack Magazine on disk. Underground info on cellular, UNIX, VMS, Novell, ATM, and related loopholes. $10 cash, check or money order to Zippy Computers; Dept. NV; 2060 Emery Ave. #202, La Habra, CA 90631.

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7489	2.95
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74151	.49
74153	.49
74154	1.59
74155	.59
74156	.59
74157	.55
74159	1.89
74160	.89
74161	.59
74162	.89
74163	.79
74164	.79
74165	.89
74166	.89
74167	2.69
74170	1.49
74172	5.95
74173	.89
74174	.59
74175	.59
74176	.99
74177	.69
74178	3.49
74179	2.30
74180	.89
74181	2.29
74182	1.19
74184	3.49
74185	3.49
74190	1.29
74191	1.09
74192	1.09
74193	1.09
74194	1.29
74195	.89
74196	.99
74197	.85
74198	1.79
74199	1.19
74221	.59
74246	4.95
74247	4.95
74248	4.95
74249	4.95
74251	1.29
74259	1.79
74265	1.09
74273	2.95
74276	1.39
74278	2.19
74279	.59
74283	.95
74284	2.95
74285	2.69
74290	.99
74293	1.99
74298	.79
74351	2.59
74365	.69
74366	.69
74367	.49
74368	.55
74376	1.69
74390	1.39
74393	1.09
74425	1.69
74426	.99
74490	4.95

74LSxx

74LS00	.30
74LS01	.45
74LS02	.30
74LS03	.30
74LS04	.30
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74LS06	.55
74LS07	.55
74LS08	.40
74LS09	.30
74LS10	.35
74LS11	.35
74LS12	.35
74LS13	.40
74LS14	.45
74LS15	.40
74LS19	.47
74LS20	.30
74LS21	.34
74LS22	.34
74LS26	.34
74LS27	.34
74LS28	.45
74LS30	.35
74LS31	.35
74LS32	.40
74LS33	.40
74LS37	.35
74LS38	.35
74LS40	.35
74LS42	.45
74LS47	.89
74LS48	.89
74LS49	2.69
74LS51	.30
74LS54	.34
74LS55	.34
74LS63	.89
74LS73	.45
74LS74	.34
74LS75	.38
74LS76	.55
74LS78	.59
74LS83	.59
74LS85	.59
74LS86	.35
74LS90	.55
74LS91	.69
74LS92	.65
74LS93	.49
74LS95	.75
74LS96	.75
74LS107	.45
74LS109	.48
74LS112	.45
74LS113	.69
74LS114	.45
74LS122	.57
74LS123	.59
74LS124	2.69
74LS125	.45
74LS126	.45
74LS132	.45
74LS133	.59
74LS136	.49
74LS137	.59
74LS138	.49
74LS139	.49
74LS145	.69
74LS147	1.59
74LS148	.89
74LS151	.49
74LS153	.49
74LS154	1.49
74LS155	.59
74LS156	.59
74LS157	.59
74LS158	.38
74LS160	.38
74LS161	.47
74LS162	.89
74LS163	.55
74LS164	.59
74LS165	.69
74LS166	.65
74LS168	.99
74LS169	.99
74LS170	.69
74LS173	.45
74LS174	.49
74LS175	.45
74LS181	1.69
74LS189	3.95
74LS190	.59
74LS191	.59
74LS192	.79
74LS193	.69
74LS194	.69
74LS195	.69
74LS196	.59
74LS197	.59
74LS221	.69
74LS224	12.95
74LS240	.59
74LS241	.65
74LS242	.69
74LS243	.69
74LS244	.69
74LS245	.75
74LS247	.79
74LS248	.99
74LS249	1.29
74LS251	.59
74LS253	.59
74LS256	1.00
74LS257	.45
74LS258	.55
74LS259	.69
74LS260	.59
74LS261	4.95
74LS266	.45
74LS273	.79
74LS275	2.19
74LS279	.45
74LS280	.69
74LS283	.65
74LS290	.65
74LS293	.65
74LS295	1.09
74LS298	.79
74LS299	1.59
74LS322	1.59
74LS323	1.59
74LS324	2.09
74LS327	1.09
74LS348	1.09
74LS352	1.09
74LS353	.99
74LS363	2.29
74LS364	1.09
74LS365	.45
74LS366	.45
74LS367	.45
74LS368	.45
74LS373	.75
74LS374	.75
74LS375	.99
74LS377	.75
74LS378	.99
74LS379	.99
74LS385	2.09
74LS386	.55
74LS390	.89
74LS393	.79
74LS395	.89
74LS396	.89
74LS399	.89
74LS424	4.00
74LS447	1.19
74LS448	1.09
74LS465	1.09
74LS490	1.09
74LS534	1.29
74LS540	.99
74LS541	.99
74LS573	1.49
74LS574	1.49
74LS590	4.95
74LS595	5.95
74LS612	1.99
74LS620	2.99
74LS623	1.49
74LS624	2.19
74LS629	2.19
74LS640	1.09
74LS641	1.50
74LS643	1.28
74LS645	1.09
74LS646	2.39
74LS668	1.39
74LS669	.99
74LS670	.89
74LS674	14.95
74LS682	2.19
74LS683	2.19
74LS684	1.69
74LS685	8.00
74LS688	2.19
74LS689	3.50
74LS783	25.00

74Sxx

74S00	.35
74S02	.35
74S03	.35
74S04	.35
74S05	.35
74S08	.35
74S10	.35
74S11	.39
74S20	.35
74S22	.35
74S30	.35
74S32	.40
74S37	.25
74S38	.35
74S40	.35
74S51	.40
74S64	.35
74S65	.50
74S74	.35
74S85	.59
74S86	.25
74S112	.55
74S113	.35
74S114	.59
74S124	1.29
74S132	.35
74S133	.30
74S134	.45
74S135	.45
74S138	.40
74S139	.40
74S140	.55
74S151	.35
74S153	.35
74S157	.55
74S158	1.00
74S161	1.00
74S162	2.95
74S163	.50
74S169	2.00
74S174	.45
74S175	.35
74S181	2.00
74S182	1.09
74S188	1.99
74S189	1.89
74S194	.55
74S195	.55
74S197	.69
74S201	2.69
74S225	2.00
74S240	.79
74S241	.79
74S244	.69
74S251	.59
74S253	.89
74S257	.40
74S258	.45
74S260	.69
74S273	2.19
74S280	.45
74S283	1.00
74S287	1.99
74S288	1.79
74S299	1.49
74S373	.79
74S374	.79
74S381	3.69
74S387	1.99
74S399	1.09
74S412	3.00
74S471	2.99
74S472	2.99
74S474	4.95
74S570	2.95
74S571	3.00
74S573	2.69

74Fxx

74F00	.35
74F02	.35
74F04	.35
74F08	.35
74F10	.35
74F11	.35
74F14	.35
74F20	.35
74F21	.47
74F30	.47
74F32	.35
74F37	.47
74F38	.49
74F51	.59
74F64	.59
74F74	.35
74F85	2.09
74F86	.49
74F109	.65
74F112	.89
74F125	.69
74F138	.69
74F139	.69
74F148	1.09
74F151	.55
74F153	.69
74F157	.79
74F158	.69
74F160	1.49
74F161	.89
74F162	1.59
74F163	.89
74F164	.69
74F166	.89
74F169	3.39
74F174	.79
74F175	.79
74F182	2.09
74F189	14.99
74F191	3.09
74F193	2.95
74F194	1.29
74F195	1.79
74F240	.79
74F241	.89
74F244	.79
74F245	.79
74F251	.79
74F253	.79
74F257	.79
74F258	.69
74F259	1.19
74F260	.69
74F273	.89
74F280	.99
74F283	1.79
74F299	4.50
74F350	2.29
74F367	.99
74F373	.69
74F374	.69
74F377	1.19
74F381	4.49
74F399	1.59
74F521	1.29
74F533	2.29
74F573	2.99
74F574	2.99
74F623	1.59
74F646	4.95

74Cxx

74C00	.45
74C02	.45
74C04	.40
74C08	.40
74C10	.45
74C14	.69
74C20	.35
74C30	.45
74C32	.59
74C42	2.09
74C48	2.95
74C73	1.29
74C74	1.09
74C76	1.09
74C85	1.59
74C86	.69
74C90	1.59
74C93	1.59
74C95	1.09
74C150	4.95
74C151	2.95
74C154	3.95
74C157	1.99
74C160	1.59
74C161	.89
74C162	1.59
74C164	1.59
74C165	1.59
74C174	.89
74C175	.89
74C192	1.39
74C193	1.59
74C195	1.59
74C221	2.99
74C240	2.09
74C244	2.09
74C373	2.09
74C901	1.09
74C902	1.09
74C903	1.09
74C904	.59
74C905	6.95
74C906	1.25
74C907	.99
74C909	3.95
74C911	12.95
74C914	2.69
74C915	2.49
74C917	9.95
74C921	6.95
74C922	5.95
74C923	9.95
74C925	9.95
74C928	9.95
74C929	7.95

74HCxx

74HC00	.30
74HC02	.30
74HC04	.30
74HC08	.30
74HC10	.30
74HC11	.34
74HC14	.35
74HC20	.30
74HC21	.55
74HC27	.34
74HC30	.34
74HC32	.30
74HC42	.55
74HC51	.30
74HC73	.55
74HC74	.40
74HC75	.35
74HC76	.79
74HC85	.55
74HC86	.40
74HC93	1.39
74HC107	.45
74HC109	.45
74HC112	.45
74HC123	.50
74HC125	.55
74HC126	.59
74HC132	.59
74HC133	.49
74HC137	.79
74HC138	.49
74HC139	.49
74HC147	.89
74HC148	.89
74HC151	.59
74HC153	.45
74HC154	1.29
74HC157	.59
74HC158	.49
74HC161	.59
74HC163	.59
74HC164	.59
74HC165	.69
74HC166	.59
74HC174	.59
74HC175	.59
74HC191	.89
74HC192	.89
74HC193	.79
74HC194	.79
74HC195	.99
74HC221	.69
74HC237	.79
74HC238	.89
74HC240	.69
74HC241	.69
74HC242	.89
74HC243	.89
74HC244	.79
74HC245	.79
74HC251	.59
74HC253	.59
74HC257	.59
74HC258	.69
74HC259	.89
74HC273	.89
74HC280	.92
74HC299	1.09
74HC367	.69
74HC368	.69
74HC373	.69
74HC374	.69
74HC390	.59
74HC393	.69
74HC540	1.09
74HC541	.89
74HC573	.89
74HC574	.89
74HC595	1.29
74HC640	1.85
74HC652	1.79
74HC688	1.19
74HC4017	.99
74HC4020	.89
74HC4024	.99
74HC4040	.89
74HC4049	.59
74HC4050	.59
74HC4051	1.29
74HC4060	.79
74HC4075	.49
74HC4351	1.39
74HC4511	2.19
74HC4515	2.69
74HC4538	.79
74HC22106	8.95

74HCTxx

74HCT00	.30
74HCT02	.30
74HCT04	.35
74HCT08	.35
74HCT10	.35
74HCT11	.40
74HCT14	.47
74HCT20	.35
74HCT27	.35
74HCT30	.49
74HCT32	.35
74HCT38	.39
74HCT74	.45
74HCT75	.40
74HCT85	.89
74HCT86	.49
74HCT109	.49
74HCT123	.75
74HCT125	.59
74HCT132	.59
74HCT138	.59
74HCT139	.59
74HCT151	.59
74HCT154	1.99
74HCT157	.59
74HCT158	.59
74HCT161	.79
74HCT163	.59
74HCT164	.79
74HCT165	.79
74HCT166	.79
74HCT173	.69
74HCT174	.59
74HCT175	.59
74HCT191	.69
74HCT193	.79
74HCT194	.79
74HCT195	.79
74HCT237	.89
74HCT238	.79
74HCT240	.79
74HCT241	.79
74HCT242	.89
74HCT243	.79
74HCT244	.79
74HCT245	.79
74HCT251	.69
74HCT257	.69
74HCT259	.79
74HCT273	.79
74HCT280	.69
74HCT299	1.09
74HCT367	.69

Thousands more.. Full list includes - ALS, 4000, etc.

Drivers, Op Amps

DS00026	2.49
LM35CH	11.00
LM10	2.39
TL061	1.19
TL062	1.19
TL064	1.09
TL066	.99
TL071	.75
TL072	.75
TL074	1.09
TL081	.65
TL082	.65
TL083	1.09
TL064	1.09
LM150K	4.95
LM207	.50
LM208	.50
XR215	1.50
MAX231	2.99
MAX232	2.79
MAX233	6.50
MAX238	6.50
LM301	.49
LM301H	.89
LM307	.49
LM308	.75
LM309H	4.25
LM309K	2.09
LM310	1.89
LM311	.49
LM311H	.99
LM312H	5.50
LM316	4.00
LM317K	2.09
LM317T	.79
LM317	.69
TL317(TO92)	.70
LM318	1.35
LM319	1.49
LM322	.99
LM323K	3.39
LM323T	2.95
LM324	.50
LM329	.85
LM331	5.29
MAX333	6.90
LM334	1.09
LM335	1.59
LM336	1.19
LM337K	3.59
LM337T	.99
LM338K	4.95
LM338T	2.95
LM339	.55
LM340K	3.95
LM340T	.69
LM345K	2.95
LF347	.80
LM348	.65
LM350K	4.49
LM350T	2.99
LF351	.65
LF353	.60
LF355	.99
LF356	.89
LF357	1.00
LM358	.59
LM359	2.09
LM376	1.39
LM380	1.09
LM380N-8	1.19
LM381	3.95
LM382	2.49
LM383	3.69
LM384	2.09
LM385Z 1.2-	1.95
LM386N-1	.69
LM386N-3	.95
LM386N-4	1.29
LM387	1.89
LM389	1.49
LM390	1.79
LM391	3.95
LM392	1.29
LM393	.45
LM395K	9.95
LF398	1.99
LM399H	3.99
LF411	.85
LF412	1.35
ZN414Z	2.49
LF442	1.39
LF444	1.89
TL489	1.59
TL494	1.89
TL496	1.59
TL497	2.09
NE531T	1.99
LM555	.45
LM555C	.69
XRL555	.90
SE555	.75
LM556	.59
LM558	.79
NE564	1.79
LM565	1.59
LM566	1.29
LM567	.79
NE570	2.99
NE571	2.09
NE590	2.69
NE592	.45
NE602	1.95
MAX663	3.69
MAX666	3.89
MAX680	3.49
MAX690	5.99
MAX691	5.99
MAX692	6.50
MAX694	6.50
MAX695	6.50
LM709	.80
LM710	.80
LM711	.89
LM723	.59
LM723H	1.29
MAX732	5.50
LM733	.69
LM741	.40
LM741HC	1.09
LM747	.69
LM748	.69
LM1014	2.69
SA1027	6.99
MAX1232	3.29
LM1303	1.69
LM1310	1.39
MC1330	1.69
MC1349	2.09
MC1350	.99
MC1358	.99
MC1372	2.69
MC1374	2.00
MC1404	1.99
MC1405	1.99
MC1408-6	1.99
MC1408-8	1.89
MC1411	1.99
LM1414	1.69
MC1456	1.50
MC1458	.47
LM1488	.50
LM1489	.50
MC1496	.99
TCM1520	1.39
MC1558	2.59
MC1558G	2.59
MC1648	.90
MC1723CL	1.00
MC1733CL	1.00
LM1800	2.69
LM1812	7.95
LM1830	4.95
LM1871	5.95
LM1872	5.95
LM1877	3.95
LM1881	4.95
LM1889	3.95
LM1896	1.99
ULN2001	.79
ULN2003	.79
ULN2004	.79
XR2206	3.99
XR2207	2.49
XR2208	2.69
XR2211	2.69
XR2240	1.69
XR2242	1.50
XR2567	2.50
ULN2803	1.09
LM2877	2.19
LM2878	5.95
LM2900	2.19
LM2901	.69
LM2903	.49
LM2907	1.69
MPQ2907	2.69
LM2917	2.19
CA3018	1.50
CA3037	1.50
CA3039	1.99
CA3046	.89
CA3059	1.69
CA3060	2.95
CA3065	1.69
CA3080	.90
CA3081	.79
CA3082	1.09
CA3083	.79
CA3086	.79
CA3089	1.59
CA3096	1.69
TCM3105	6.95
CA3126	1.45
CA3130	.89
CA3140	.79
CA3146	1.09
CA3160	1.09
CA3161	1.99
CA3162	6.00
CA3183	.99
MC3302	.75
MC3340	1.69
MC3346	1.99
MC3360	1.50
MC3373	1.09
CA3401	1.50
MC3401	.90
MC3403	.70
MC3470	1.29
MC3479	4.29
MC3480	9.95
MC3486	1.09
MC3487	1.09
SG3524	1.79
LM3900	.69
LM3905	.99
LM3909	1.49
LM3911	1.99
LM3914	2.69
LM3915	2.69
LM3916	2.69
MC4001	4.00
MC4016	2.75
MC4024	2.79
MC4044	4.99
MC4136	1.19
RC4136	1.09
RC4151	1.09
RC4558	.79
MC4741	.50
NE5205	2.39
NE5532	1.19
NE5534	.99
NE5539	2.49
ICL7106	5.49
ICL7107	5.49
ICL7109	9.95
ICM7207	7.95
ICM7208	20.00
ICM7216	25.00
ICM7231	9.49
ICM7551	.89
ICM7556	1.49
ICL7660	1.99
ICL7663	3.25
ICL7665	3.49
UA78S40	1.29
ICL8038	3.79
ICL8211	2.49
LF13741	.99
LM13080	1.59
LM13600	.99
LM13700	1.29
75107	.79
75108	.89
75110	.89
75138	2.69
75150	1.29
75150 (SK)	1.29
75154	1.29
75160	3.75
75174	2.39
75175	2.39
75176	2.09
75188	.50
75189	.50
75365	.89
75450	.99
75451	.49
75452	.59
75453	.59
75454	.59
75477	.99
75491	.89
75492	.89
75493	.99
75494	.99
MC145026	1.69
MC145027	2.19
MC145028	2.19
MC145151	7.95
MC145406	2.29
MC146818	4.19

EPROM

1702	4.95
2516	4.95
2532	8.99
2708	4.95
2716	4.25
27C16	6.95
2732A	4.25
2732A-2	4.50
27C32	4.50
2764	3.95
2764-2	4.50
2764-15	4.95
27C64	3.50
27C64-2	3.75
27C64-15	3.95
27128	4.75
27128A-2	5.00
27128A-15	7.00
27C128	5.00
27C128-150	5.50
27256	4.95
27256-2	5.50
27256-15	5.75
27256-170	5.75
27C256	4.95
27C256-2	5.50
27C256-15	5.95
27C256-100	6.95
27512	6.00
27512-20	6.50
27C512	6.00
27C512-15	6.95
27C101-200	7.95
27C101-100	9.95
27C201-150	10.95
27C201-100	13.95
27C401-150	19.95
27C401-100	29.95

EEPROM

2816-450	3.75
2816-250	4.25
2816-150	4.50
28C16-150	3.95
2864-250	7.95
28C64-250	7.39
28C64-150	7.95
28C256-250	27.95
28C256-150	29.95

Dallas

DS1202	4.69
DS1228	6.49
DS1259	8.00
DS1260	15.00
DS1287	15.00
DS2130	17.00

SRAM

2016	2.69
2101	1.99
5101	2.79
2102	.99
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7808T	.59
7810T	.59
7812T	.59
7815T	.59
7805K	1.79
7812K	1.79
7815K	1.79
78M05	.59
78M08	.59
78M12	.59
78M15	.59
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CHECK THAT SPEAKER CAPACITOR!

by Jim Ford

If you have one of the newer handheld receivers, scanners, or transceivers and are using a small external or built-in speaker (2-3 inches), it would behoove you to check the value of the speaker coupling capacitor. In many cases, the value of the coupling capacitor is too large. This applies to some larger speakers as well, but the small speakers — including the ones in HTs (Handi-Talkies) — are particularly affected.

Communications audio is in the range of 200-300 Hz on the low end to approximately 3000 Hz on the high end. I have seen audio energy coupled down to 20 Hz in some recent transceivers.

One might ask what is the harm of coupling the audio to a lower frequency range than you need? The answer is that small speaker physics (magnet, cone, enclosure, etc.) can not handle the lower frequencies without distortion. Much intelligibility is in the higher audio range, but low frequencies predominate and often overpower the highs. Have you ever heard signals that seem reasonably strong, but you have to listen carefully to understand? The reason might be too many lows in relation to the highs in the audio.

Many of the recent vintage transceivers use LM380 or similar speaker driver ICs. They do a good job, except often the audio frequency shaping which could be done before the audio amplifier IC often isn't done properly.

Figure 1 shows the selected portion of a typical audio output stage. The electrolytic C1 is the culprit in this circuit. The frequency response of the system depends also upon the impedance of the speaker (4 or 8 ohms, typically).

The top row in Table 1 shows output coupling capacitor values versus frequency response (Hz) for 4 ohm (second row) and 8 ohm (last row) speaker impedances.

I have seen coupling capacitors of 1000 mF for 8 ohm impedance speakers. The table shows the 1000 mF capacitor to have a low frequency response of 20 Hz. A more proper value for an 8 ohm speaker would be approximately 100 mF or 150-220 mF for 4 ohm speakers.

Also, bear in mind that most electrolytic capacitors with values typical to the ones in Table 1 have poor capacitance value tolerances. They might be -10, +50%, which means a 200 mF capacitor could have a value from 180 to 300 mF.

A check of the junkbox revealed that almost all of the capacitors were at least 10% high, and some were more than that with one 300 mF marked capacitor actually measuring 501 mF! This often makes overcoupling of low frequencies even worse.

If the value of the capacitor in your rig is too large, a modification on the PC board is not necessary. If you series another capacitor with the one already on the PC board so that the total value is correct, you can mount it off the board right at the speaker and save yourself some motherboard trauma.

Remember two capacitors in series use the same formula as two resistors in parallel: C total = C1C2/C1+C2. For example, if you have a 470 mF capacitor on the motherboard, then a 150 mF capacitor in series would result in a total value of 114 mF — which would be about right for an 8 ohm speaker.

Also, the negative lead of the capacitor should go to the ungrounded speaker terminal. The voltage rating of the capacitor should be 16 volts for most 12 volt transceivers.

If your audio is still too muddy after making the coupling capacitor change, then there just may be one more simple change for those willing to attack their motherboard. There is often excessive high frequency roll-off in the circuitry preceding the audio output which also results in reduced intelligibility.

One transceiver that had a 43 Hz cut-off for the lows had approximately a 1.6 KHz roll-off for the high frequency (it varied slightly with the volume control setting). The thing to look for is some series resistance (perhaps at the center lead of the volume control) in the audio path with a shunt capacitor to ground at that point. See Figure 1, R3,C3. The formula to determine what roll-off you have is again F = .16 RC where the R is in ohms and C is in farads.

In Figure 1 for example, the R3, 10K, and C3, .01 mF result in a roll-off of 1592 Hz. A more appropriate C3 would be .005 MF resulting in a roll-off of double or just over 3 KHz. You can change the resistance, capacitance, or both, but it is probably best to change only the capacitance.

One might argue cutting off high frequency audio reduces hiss. This is true, but too low a cut-off reduces intelligibility even more. The filters in the IF section should take care of most of those high frequencies.

Just one or two simple capacitor changes to my Dual Band VHF/UHF, HTs, and HF transceivers resulted in much "brighter" and more intelligible audio. Check your schematics and leave the Hi-Fi components to your stereo in the front room. **NV**

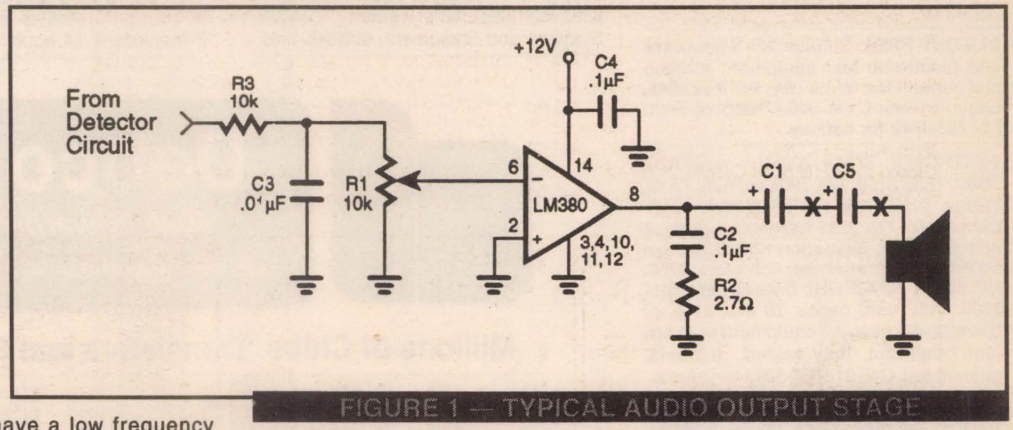

FIGURE 1 — TYPICAL AUDIO OUTPUT STAGE

Table 1 — Capacitance in Microfarads

Imp	68	100	150	220	330	470	680	1000	1500
4	585	399	265	181	121	85	59	40	27
8	293	200	133	91	61	43	30	20	13

Frequency (Hz)

If the above chart is not precise enough for you, use the formula F (Hz) = .16 RC where R is in ohms and C is in farads.

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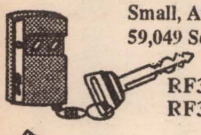

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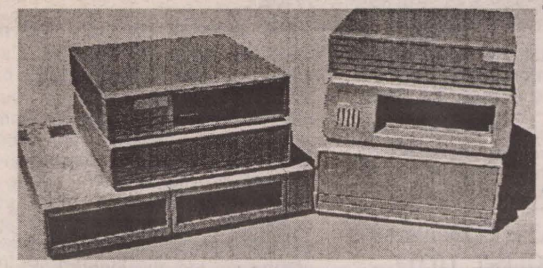

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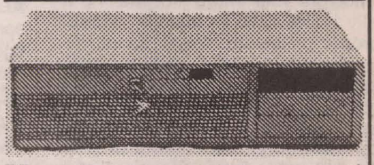

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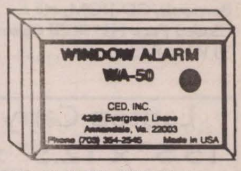

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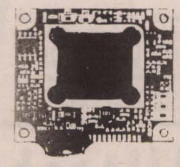

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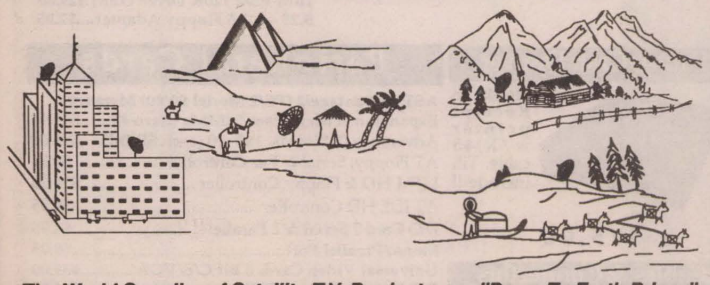

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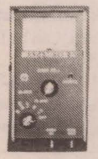

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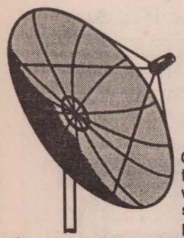

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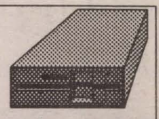

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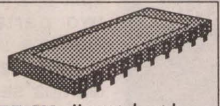

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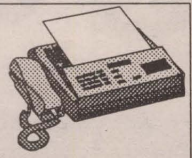

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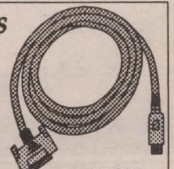

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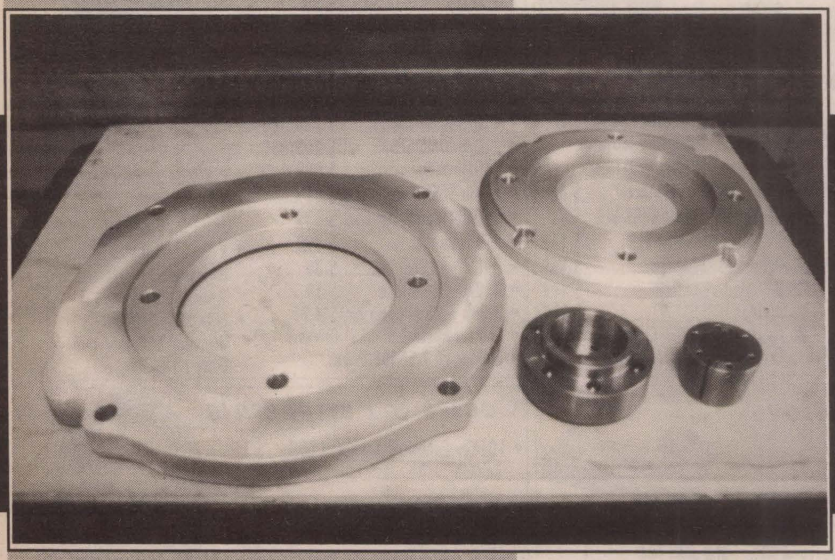
Electric Car Conversion:

Motor Adaptors

by Shari Prange

The motor adaptor is the interface between the car's original gas or diesel drive train and its new electric propulsion system. It mates the electric motor to the original clutch and transmission.

This article is part 5 of a continuing series detailing the process of converting a gas engine vehicle into an electric powered one. If you missed any of the series, back issues can be ordered by calling the Nuts & Volts orderline at 1-800-783-4624.



Parts of a motor adaptor: transmission plate (left); motor ring (upper right); hub (lower center); and bushing (lower right).

Parts of the Adaptor

There are two sections to the adaptor. The first is the plate. This is the large part that physically mounts the motor to the perimeter of the transmission bell housing.

The plate may actually come in two pieces: a large irregular piece that follows the transmission outline, and a smaller round piece that fits on the end of the motor. These two pieces then mate together.

There are some advantages to the two-part plate. A minimum thickness is needed between the transmission and the motor. This number is determined by the room needed inside the plate for the motor shaft and hub. This thickness can range from one to three inches.

A single piece of material this thick would be expensive, heavy, and require a lot more machine time to fabricate. By using a 5/8" plate for the larger transmission plate, and varying the thickness on the smaller diameter, less complicated motor plate, much weight and expense can be saved.

The second section of the adaptor is the hub. This mates the motor shaft to the flywheel, and it may also come in two pieces. The two pieces consist of the hub which bolts to the flywheel, and a tapered bushing which fits over the motor shaft.

Precision

I do not recommend home-built adaptors. This piece should be precision machined to tolerances in three decimal places. This is not done by tracing the transmission outline on a piece of cardboard. An experienced commercial adaptor designer with special measuring tools will spend up to two days on a CAD system designing a new adaptor. An experienced adaptor machinist will spend another day and a half producing the parts from the design.

A precision fit is crucial because of the high rpm and torque that will be transmitted through the adaptor from the motor. These forces will magnify any flaws. A slight misalignment will cause stresses on components that may lead to failures. A sloppy fit will work itself more loose in use, and lead to misalignments and movement where there should be none.

Materials

The kind of materials chosen for the adaptor are also important. The plate can and should be made out of aluminum, no less than 5/8" thick for adequate rigidity. Steel would be unnecessarily heavy and expensive to machine.

The hub, however, must be steel. All of the power of the motor is being transmitted through a fitting the size of a hockey puck. In addition, the motor shaft is keyed with a square steel key. If the slightest slop develops in the hub, the motor key will cut through aluminum like a sharp machine tool bit. When that happens, the driver becomes an instant pedestrian.

Hub Style

There are three basic styles of hubs used, but two of them have some serious drawbacks. One style uses one or more setscrews to hold the hub to the motor shaft, possibly combined with a bolt into the end of the shaft. The problem here is that threaded fasteners can work loose, especially in a high rpm/high torque application. If they do, the car stops moving.

Another style heat-shrinks the hub onto the motor shaft. This makes a very secure fit. In fact, too secure. If you ever need to remove that hub, it will be a major project.

Also, the hub needs to be positioned very precisely on the motor shaft. Achieving this precision with a red-hot piece of metal and getting it on the first try requires a lot of luck.

The best style is the taperlock hub. This is the industrial standard for high rpm/high torque power transmission.

The taperlock hub has a tapered inside diameter. It slides over a similarly tapered split bushing on the motor shaft. As the two parts are drawn together with machine screws, the split in the bushing is squeezed closed, and the bushing clamps securely onto the motor shaft. It can be installed loosely and adjusted until the proper position is achieved. Once tightened down, however, it will stay until a heavy-duty pulling tool is used to remove it.

Bearings

In the bad old days, when aircraft generators were commonly pressed into service as electric car motors, the adaptors had to have bearings built into them. Fortunately, the motors available today have internal bearings, which simplifies adaptor construction.

If the car has a pilot bearing built into the original engine crankshaft, the adaptor will need to have a pilot bearing built into the hub. This is done easily enough.

Clutch & Transmission

We are obviously maintaining the original manual transmission. There are several reasons

Electric Car Conversion

for this. In order to achieve reasonable acceleration and top speed, a direct drive system requires an AC motor and a high voltage battery pack — usually 300 volts or more. In lead-acid batteries, this means an unworkable amount of weight; in exotic lightweight batteries, it means unaffordable expense.

Similar performance can be achieved much more economically with a DC motor, a 96-120 volt system, and a manual transmission.

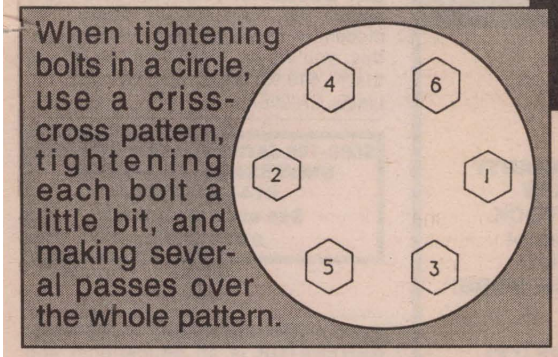
An automatic transmission has various problems. First, there are efficiency losses that lower performance.

Second, an automatic transmission is relying on a continually idling engine to provide fluid pressure. At a stoplight, the electric motor stops moving. When the light turns green, there is an unacceptably dangerous lag time while the transmission builds up pressure again. Then it engages with a snap. To overcome this problem requires the expense and complication of an added electric fluid pump.

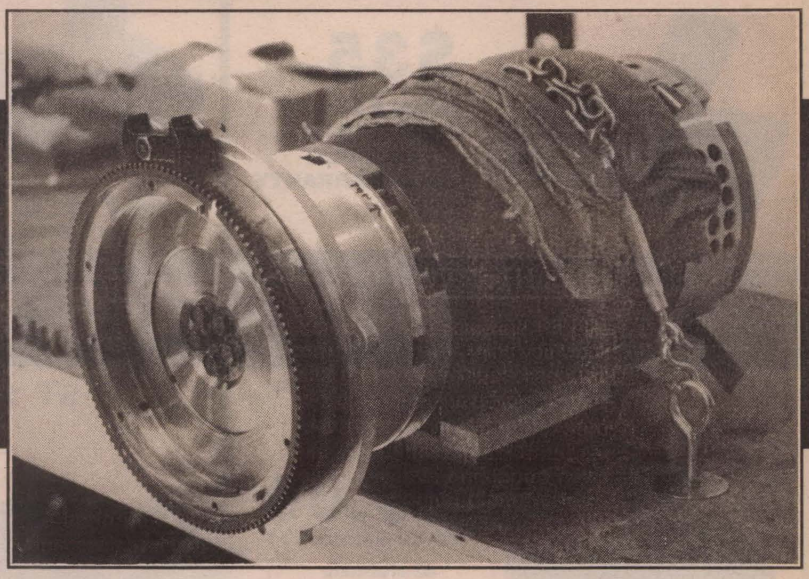
Finally, an electric motor has different optimum shift points from those of the gas engine for which the transmission was calibrated.

We are also maintaining the clutch. This is a safety feature, as it allows you to instantly disconnect the motor from the drive wheels in case of a problem, such as a seized wheel bearing. It also allows you to start smoothly from a stop. Without a clutch, the start is irritatingly abrupt.

While you are installing the motor, you might as well install new clutch parts. If you start with all new parts, you may not need to remove that assembly again for 80,000 miles, at which time the motor will need new brushes.



When tightening bolts in a circle, use a criss-cross pattern, tightening each bolt a little bit, and making several passes over the whole pattern.



The electric motor needs to be secured to the workbench while the adaptor and clutch are installed on it.

improve performance, it also shaves some safety margins.

If the series electric motor is unloaded at high rpm, it can run away and self-destruct very quickly. The weight of the flywheel puts enough load on the motor to help guard against that in the case of a missed shift at speed. Also, lightening the flywheel weakens it.

There are two other tricks with less downside. One is having the flywheel balanced. This will make smooth performance even smoother.

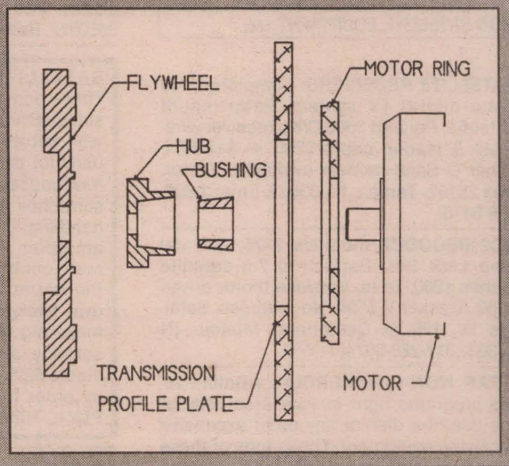
The other trick is removing the ring gear that is no longer needed. More important than the reduced weight is the reduction in resistance caused by air turbulence inside the bell housing.

Installation

It's much easier to install the motor and adaptor on the transmission on the workbench, then install the entire assembly in the car.

In order to tighten bolts, it will be necessary to secure the motor to the bench. This can be done easily with a couple of eyebolts installed in the bench and a padded chain across the motor, tightened by a turnbuckle.

When tightening bolts in a circular pattern, do not tighten one all the way, then move to the one beside it. Instead, tighten one a few turns, then move across the circle and tighten another a few turns. Continue criss-crossing until you have started all the bolts. Make several passes over the same pattern, tightening by a few turns each time, until they are all secure. This will give you an even fit, without any sections becoming cocked.



This diagram shows an exploded view of an adaptor using a two-part plate and a two-part taperlock hub.

Flywheel

If you have a good automotive hot rod machine shop in your area, there are a few little extras you can do. One is lightening the flywheel. This is a double-edged sword. While it may improve performance, it also shaves some safety margins.

Magic Number

When installing the electric motor, you want to mimic the original engine position as closely as possible. One of the measurements you need to duplicate is the relationship of the flywheel to the transmission.

As you disassemble the gas engine, measure the distance from the rear-most surface of the engine (where it mated to the transmission) to the rear-most flat surface of the flywheel. (This may or may not be the flywheel friction surface.) Measure it to three decimal places in inches.

This is the "magic number." When you are assembling the electric drive system, you will want to position the hub on the motor shaft so that this distance is maintained.

Attention to Detail

There are several factors in the design, fabrication, and installation of the adaptor that are critical to the success of the electric car conversion. However, with just a little patience, care, and attention to detail, you should have no problems. **NV**

It is important to duplicate the "magic distance" between the flywheel face and the transmission.

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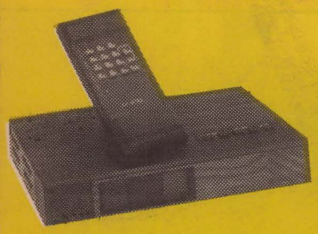

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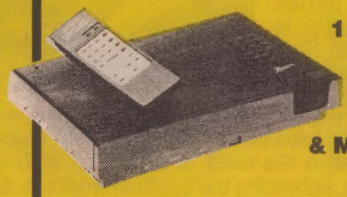

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```
#include <PIC16C56.h>
#use Delay(Clock=20000000)
#use RS232(Baud=9600,Xmit=pin_1,
                      RCV=pin_2)
main () {
 printf("Press any key to begin\n") ;
 getc();
 printf("1 khz signal activated\n") ;
 while (TRUE) {
    output_high(pin_8) ;
    delay_us(500) ;
    output_low(pin_8) ;
    delay_us(500);
  }
}
```

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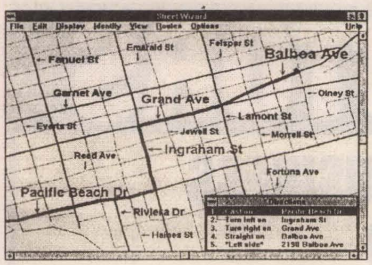

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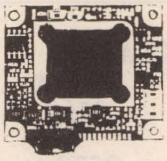

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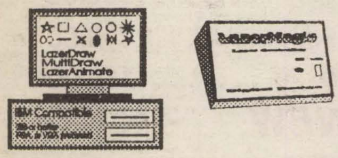

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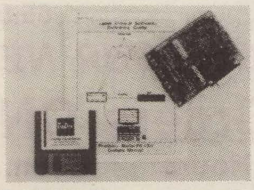

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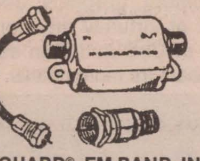

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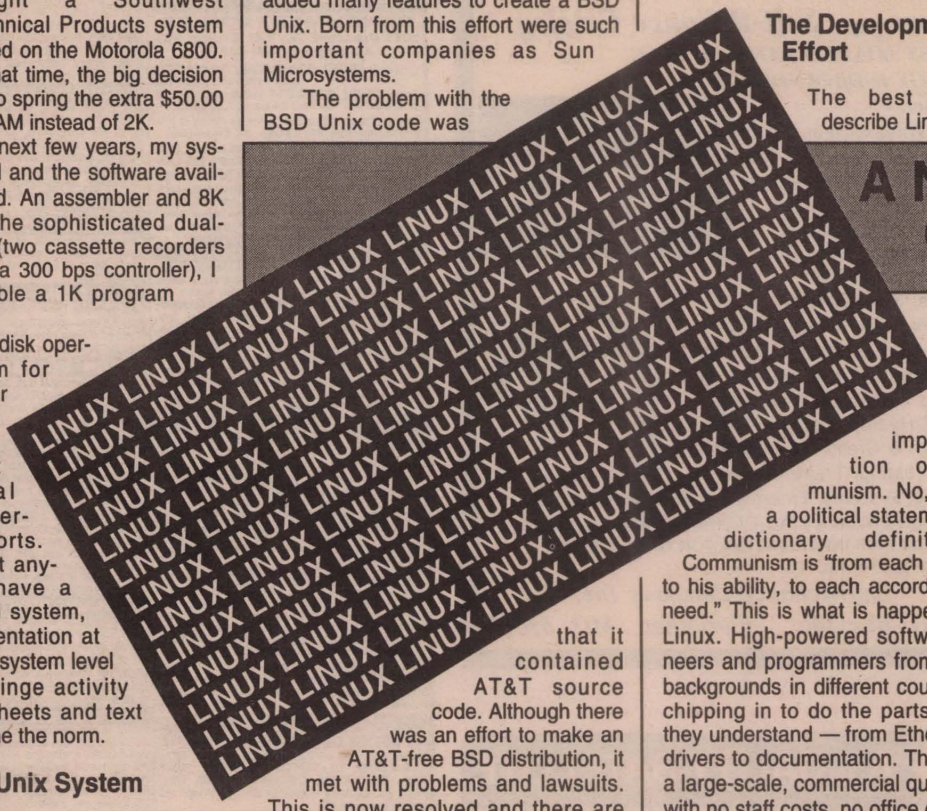
by Phil Hughes

Back in 1975, I started playing with what were to become "personal computers." I bought a Southwest Technical Products system based on the Motorola 6800. At that time, the big decision was whether to spring the extra $50.00 to get 4K of RAM instead of 2K.

Over the next few years, my system expanded and the software available expanded. An assembler and 8K Basic. With the sophisticated dual-tape system (two cassette recorders connected to a 300 bps controller), I could assemble a 1K program overnight.

I wrote a disk operating system for that computer complete with a 128K, 8" floppy, but commercial software overtook my efforts. Soon, almost anyone could have a "fancy" CP/M system, and experimentation at the operating system level became a fringe activity and spreadsheets and text editing became the norm.



Enter The Unix System

Even before my 1975 experience with personal computing, a new kind of operating system was being written at Bell Labs. Born in 1969, Unix started out as a hobby project, but quickly grew into a system that would do useful work. The initial use of Unix was text formatting, but it was designed by people who we would call hackers and offered great tools for software development.

Starting out on a Digital PDP-7 and then being ported to a PDP-11 (the mini computer of the day), Unix was very modest in size. But, as it became a commercial product, it grew into a large system with extensive capabilities. Today, hundreds of vendors offer the Unix operating system running on hardware ranging from Cray super computers down tothe lowly personal computers of yesterday. Today, you will find versions of the Unix operating system doing everything from designing nuclear reactors to publishing newspapers.

Enter Unix Clones

Unix has always been proprietary — just mail a check to AT&T (now to Unix Systems Labs, owned by Novell) and you can get the source code for about $100,000.00. This caused the rise of various Unix-like operating systems. Coherent from Mark Williams Company is the most well-known example. For $100.00 you can buy a Unix-like system that runs on a PC. But, like Unix, it is proprietary. You can't get the source code and make a change.

One effort to make Unix accessible to the masses came from the University of California at Berkeley. UC-Berkeley took the AT&T base and added many features to create a BSD Unix. Born from this effort were such important companies as Sun Microsystems.

The problem with the BSD Unix code was that it contained AT&T source code. Although there was an effort to make an AT&T-free BSD distribution, it met with problems and lawsuits. This is now resolved and there are "free" versions of the BSD code available today.

Enter The Linux Movement

A college student named Linus Torvalds at the University of Helsinki was playing with a Unix-like system written by Andy Tanenbaum. Minix, as it is called, wasn't really designed to be a Unix replacement, but rather a teaching system. Torvalds quickly discovered the limitations of Minix and decided to write his own operating system kernel.

Starting in 1991, Linus started developing this system using a C compiler and other utilities developed by the Free Software Foundation. By January '92, he had a rudimentary Unix-like system. Since that time, the Linux effort has grown from the work of Linus Torvalds and a few friends into an international movement involving hundreds of developers and tens of thousands of users.

Linux was designed specifically to run on Intel 80386 and higher processors. It offers virtually all the functionality of other PC-based Unix systems including multi-user, multi-tasking capabilities along with one amazing side benefit — it's free.

What makes this effort unique is that all the development is done in public view — for free — by people spread all over the world. This sort of effort has been possible because these people use the Internet to exchange information. Cooperation has been on such a level that when someone found out that Linus was still making payments on his laptop, they decided to take up a collection — over the Internet, of course — to raise money to pay off his system.

The Development Effort

The best way to describe Linux development is a successful implementation of Communism. No, this isn't a political statement. The dictionary definition of Communism is "from each according to his ability, to each according to his need." This is what is happening with Linux. High-powered software engineers and programmers from different backgrounds in different countries are chipping in to do the parts of Linux they understand — from Ethernet card drivers to documentation. The result is a large-scale, commercial quality effort with no staff costs, no office costs, and no marketing or distribution costs.

Because development is done in the open, anyone can request a feature or point out a bug and the developer can directly respond. The result is that new software is being written at breakneck speed and bugs are being fixed in a matter of days instead of months or possibly years.

For example, last year someone posted a message to Usenet asking if Linux supported a floptical disk. (This is a disk that has a SCSI interface and supports a 20MB removable disk the size of a 3.5" floppy.) Within hours, a follow-up message was posted that pointed out that such disk drives needed to be sent a special initialization sequence. The next follow-up was from the SCSI driver developer asking if anyone knew what that special sequence was. Finally, within 48 hours, the developer posted a message pointing out that he had added the required code to the SCSI driver and from where the new version of the new driver could be obtained.

What do you get with Linux?

Linux includes all the networking, development, graphics, and device support of virtually any commercial version of Unix and then some. See the sidebars for more details.

You can get a complete Unix-like system including everything you would expect in a commercial package with all the extras including editors, compilers, development software, text processing systems, shells, database systems, electronic mail and news, networking, communications programs, the X-windows graphics system, and even an assortment of games for almost no cost. Virtually all of the standard Unix utilities come from the GNU project, an effort of the Free Software Foundation. The purpose of the GNU project is to make POSIX-compliant software freely available and redistributable.

There are various vendors that package the Linux kernel with other freely redistributable software. Packages vary in size from seven floppy disks to a CD-ROM chock-full of

What is Included in a Linux Distribution?

A typical Linux distribution includes:

* Device drivers for most common peripherals
* Support for various file systems including MS-DOS and ISO-9660 (CD-ROM)
* TCP/IP and Network File System (NFS)
* Development software including:
  - C and C++ compilers
  - Fortran 77 translator
  - Pascal translator
  - Smalltalk interpreter
  - Lisp interpreter
  - Standard Unix development tools including make, lex, and yacc
* Text processing including TeX, groff, and doc
* Shells including the Posix-compliant bash
* Database systems including Ingres and Postgres
* Text editors:
  - vi
  - emacs
  - pico
* Internet mail programs:
  - mail and mailx
  - smail or sendmail
  - elm and pine
* Internet C-news system and the following news readers:
  - rn/trn
  - nn
  - tin
* Communications programs:
  - kermit
  - seyon
  - uucp
* Games
* MS-DOS emulator

software. The prices of these packages vary from free to around $60.00 and are, themselves, freely redistributable.

Will Linux Make Money?

Even though Linux is free, it will make money for lots of people. Here is why. First, to run Linux you need a computer. Offered the chance to have a real Unix-like operating system at home for free, many people will elect to either purchase a computer or upgrade a current system to support it. Thus, hardware will be purchased because Linux is available.

Next, some companies will elect to use multiple Linux systems as an alternative to either a single computer and dumb terminals or a single computer and X-terminals. And, in some cases, Linux will replace more expensive workstations.

An example is one company where I have consulted. Their initial requirements were fairly simple. Three to five local users plus a couple of modem lines. The users would either be in a database or using standard Unix editing and publishing tools. The solution was also fairly simple and consisted of a 386-based system running SCO Xenix and a few dumb terminals.

But, today, their requirements have grown. They need more horsepower and they need graphics capabilities at two of the desktops. To meet these requirements with traditional answers would require the purchase of at least two more copies of the Unix or Xenix operating system, networking software, and X-windows software as well as the additional hardware. Such a purchase is beyond the budget of the company so they continue to limp along with their current configuration.

If, instead, Linux is offered as an alternative, a solution can be found. Linux is freely copied, so the operating system cost is almost zero. And Linux includes both the needed networking software (NFS and TCP/IP) and X-windows. This means that other than having to purchase an upgrade for Xenix to add the networking, all the upgrade budget can be reserved for the purchase of the necessary hardware.

The difference here is that with the Linux solution, the customer got what they needed — a system upgrade — and the computer industry as a whole came out ahead because new equipment was purchased. Thus, what is called "free software" made money for some and solved the problems of others.

Finally, with a free operating system, some software developers will port their applications to this new platform making it possible for people to purchase the application. For example, a desktop publishing package running on Linux could offer the same functionality as it would running on a Unix workstation, but at a much lower cost.

The Future

I see an interesting future for Linux. First, it will remain a hacker's system for some. They will get the source code, play with it and, in the process, learn a lot about computers and operating systems. For them, whether it is an individual effort or part of their schooling, Linux will be the tool needed to pave the way into a successful career in computing.

Some of these hackers and some computer professionals will see Linux as a tool to develop a solution that otherwise couldn't be done. For example, they might want a computer system that could capture data off of a satellite using a special hardware board and process the data making it available to users. Armed with the source code for Linux, they could write the necessary driver programs to talk to this special hardware.

Even for the non-programmer, Linux can have a bright future. For example, the multi-user capabilities of Linux would make it easy to install a multi-line bulletin board system on a single computer running Linux along with a SLIP or Ethernet connection to the Internet. This capability exists today with other Unix-based systems, but the large savings on the cost of the operating system could make this sort of system a reality for a small company or individual that couldn't otherwise afford it.

Linux can and has replaced X-terminals. An X-terminal is a graphical terminal that is designed to talk to a host computer running as an X-windows server. As Linux comes with the necessary X-client software, as well as the necessary networking code (TCP/IP), Linux can easily do the task. Thus, an expensive, special-purpose terminal can be replaced with common, inexpensive PC hardware.

Linux can offer connectivity and server capabilities to other systems at a very low cost. For example, a PC running DOS and/or MS-Windows can be cheaply added to a network of Linux (and Unix) systems. This is because it is only necessary to add an Ethernet card and the networking software (such as Sun's PC-NFS) to the single PC. There is no networking cost associated with the Linux systems.

Development continues on a program called Wine. Wine is software that allows MS-Windows based applications to run on Linux systems. Rather than either emulate MS-Windows or just allow Linux to act as a platform for running MS-Windows, Wine runs MS-Windows applications directly by translating calls from the applications for MS-Windows services into their X-windows equivalents. While Wine is still being developed, its future looks promising. Because of its design, people will not have to purchase MS-Windows to use it. Further, it has all the potential to run as fast, or faster, than MS-Windows on the same computer hardware.

Interested in connecting to the Internet? Many people have Internet access by using their PC as a terminal and dialing up a local service provider. Many of these same service providers offer both uucp and SLIP connections. Linux includes both uucp, the standard Unix-to-Unix communications program, and SLIP, a TCP/IP-like protocol designed to allow connections over dial-up serial lines. Thus, with a Linux system you can be one step closer to the Internet by establishing a uucp account. Or, you could connect your Linux machine directly to the Internet by establishing a SLIP account.

For the casual user who wants to know more about multi-user systems or the mainframe Cobol programmer who has heard about Unix and C and wants to get their feet wet, Linux offers a virtually no-cost solution to test the waters. In computing, the way to learn something new is to give it a try. For anyone who currently has a reasonably sized PC, Linux can be installed on a partition on an existing disk, providing users with their own personal Unix (Linux) system to use as a learning tool.

Where does this lead? Does Linux replace every personal computer and every Unix system in the world? No, but it does offer an alternative to other commercial systems, a stepping stone for some, and a cost-effective solution for many more. NV

Hardware Support

Linux runs on computers with an Intel 386 or higher processor and an ISA, EISA, or VESA bus. Realistically, 4MB of RAM is needed and more is desirable for multi-user or graphics based systems. Disk storage needs can vary from 40MB to 200MB and above.

Supported disk devices include any MFM, RLL, IDE, or ESDI controller as well as many SCSI controllers with any size disk. All SCSI-based CD-ROM devices are supported as well as an assortment of lower cost CD-ROMs such as the Mitsumi.

Other supported peripheral devices include a host of sound cards including Soundblaster and Gravis UltraSound and a very large assortment of Ethernet adapters.

Where to get more information

The primary source of information on Linux are the comp.os.linux news groups on Usenet. But for those not connected to the Internet, the following additional resources are available:

SSC — A long-time publisher of Unix and C related books, SSC is now selling three different Linux distributions on CD-ROM as well as publications from the Linux Documentation Project. Contact SSC at (206) 527-3385 or via E-Mail at sales@ssc.com.

Linux Journal — An international magazine covering the Linux community. Articles include technical material, help getting started, and interviews with Linux personalities. Subscriptions are $19.00/year from Linux Journal, P.O. Box 85876, Seattle, WA 98145 or from SSC by phone at (206) 527-3385, fax at (206) 527-2806 or E-Mail at subs@ssc.com.

Free Software Foundation — A non-profit organization in charge of the GNU project. (GNU is a recursive pun meaning GNU's Not Unix.) They can be reached at (617) 876-3296.

Vendors of Systems with Linux Installed:
Fintronic — (415) 325-4474
PromoX Systems — (408) 733-2966

Vendors of Linux Distributions:
InfoMagic — (800) 800-6613
Linux Systems Labs — (800) 432-0556
Morse Telecommunications — (516) 889-8500
Prime Time Freeware — (408) 433-9662
Red Hat Software — (919) 309-9560
Signum Support AB (Sweden) — +46 (0) 13-21 4600
Trans-Ameritech — (408) 727-3882
Yggdrasil — (800) 261-6630

Commercial Software for Linux:
Tecplot data-visualization and plotting software — Amtec — (206) 827-3304
C++ Object DBMS — POET Software — (800) 950-8845
SWiM 1.2.3 (Motif) — Sequoia International — (305) 480-6118
PC Diagnostics — Windsor Technologies — (415) 456-2200

Events CALENDAR

Continued from page 43

AUGUST 28

IA - OTTUMWA — All Iowa Hamfest '94. **LOCATION:** Ottumwa Coliseum, 102 Church St. **HOURS:** 8am-3pm. **ADMISSION:** $4 adv., $5 door. **DEALER INFO:** Tables $4. **CONTACT:** Mary Beth Penne, N0IJP, 1204 N Elm St., Ottumwa IA 52501. 515-682-3825.

IL - SKOKIE — Super Skokie Computer Show. **SPONSOR:** A Computer Co., Inc. **LOCATION:** Holiday Inn Skokie, 5300 W Touhy Ave., I-94 W, exit at Touhy Ave. W, 6 blocks on right hand side. **HOURS:** 10am-3:30pm. **ADMISSION:** $5, under 12 free. **FEATURES:** AC - C. **DEALER INFO:** 80 6' tables $45 ea., electricity $10 extra. Setup 7am-10am. **CONTACT:** Mark, 312-486-1811, or write: A Computer Co., Inc., 2921 W. Diversey, Chicago IL 60641.

IL - WOODSTOCK — Hamfest & Computer Show. **SPONSOR:** Tri-County Radio Group, Inc. **LOCATION:** McHenry County Fairgrounds, Rt. 47 & Country Club Rd. **HOURS:** Flea Market: 6:30am-?, Exhibitors: 8am-? **TALK-IN:** 146.52 Simplex. **FEATURES:** FM. **DEALER INFO:** Setup Sat. by appointment or 6:30 Sun. Reservation deadline is Aug. 10. **CONTACT:** T.C.R.G., POB 3107, Skokie IL 60076-6107 or call Robert, N9KXG, 708-658-1678.

MI - NOVI — Great Lakes Computer Expo & Sale. **SPONSOR:** Progressive Computer Productions. **LOCATION:** Sheraton Oaks Hotel, I-96 & Novi Rd. **HOURS:** 10am-4pm. **ADMISSION:** Adults $4, Seniors/Students $3, under 12 free w/adult. **FEATURES:** C - DP - FP - F/R. **DEALER INFO:** Covered 8' table $40 ea. Expected attendance 1100-1600 **CONTACT:** Progressive Computer Productions, 23814 Michigan Ave., Ste. 237, Dearborn MI 48124. 313-425-9276.

MI - SAGINAW — Computer Trade Show. **LOCATION:** Saginaw Civic Center, Downtown Saginaw, exit from I-75 to I-675, follow signs. **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.

MO - SAINT CHARLES — Hamfest '94. **SPONSOR:** St. Charles ARC. **LOCATION:** Blanchette Park. **FEATURES:** CB - EX - F - FM. **CONTACT:** St. Charles ARC, POB 1429, St. Charles MO 63302-1429.

SEPTEMBER 2-3

IN - INDIANAPOLIS — Indianapolis Computer Swap Meet. **LOCATION:** Lafayette Square Mall, inside GC Murphy, 38th St. & Lafayette Rd. **HOURS:** 11am-6pm. **ADMISSION:** Free. **FEATURES:** C - DP. **CONTACT:** Ben Yanto, AGI Computer Fairs.*

LA - NEW ORLEANS — The New Orleans International DX Convention. **LOCATION:** Royal Sonesta Hotel, Bourbon St. **HOURS:** Fri.: 1pm-11pm, Sat.: 8am-Midnight. **CONTACT:** 504-283-4143 days, FAX: 504-524-2129.

SEPTEMBER 2-3-4-5

OH - CLEVELAND — Super Flea Market. **SPONSOR:** Mercury Productions. **LOCATION:** I-X Center. **HOURS:** 10am-4pm. **ADMISSION:** $1. **FEATURES:** DP - FM - F/R - S. **DEALER INFO:** 1 table $130, 2 + $99 ea. Setup 8am. Estimated attendance 30,000. **CONTACT:** Mercury Productions, POB 39130, Cleveland OH 44139. 216-248-0021.

SEPTEMBER 3

IN - HIGHLAND — Computer Possibilities Unlimited. **SPONSOR:** Bee Software. **LOCATION:** Lincoln Center, 2450 Lincoln. **HOURS:** 10am-3pm. **ADMISSION:** $5, under 12 free. **FEATURES:** AC - C - DP - FP - F/R - S. **CONTACT:** Info/Discount tickets: 219-931-3761.

MI - ROSEVILLE — International Canadian/American Mega-Fest Show. **SPONSOR:** E.S.P.S. Corp. **LOCATION:** Days Inn Hotel, 31960 Little Mack. I-94 to Gratiot, go to Masonic, make right, 1/4 mile on right. **HOURS:** 10am-4pm. **ADMISSION:** $4. **FEATURES:** C - CB - H. **DEALER INFO:** Setup 8am-9:45am. **CONTACT:** John or Sabrina, Bus: 313-884-7690/FAX.

SEPTEMBER 4

MI - TAYLOR — International Canadian/American Mega-Fest Show. **SPONSOR:** E.S.P.S. Corp. **LOCATION:** Holiday Inn, 20777 Eureka Rd. I-75 to Eureka Rd. on E side of Fwy. **HOURS:** 10am-4pm. **ADMISSION:** $4. **FEATURES:** C - CB - H. **DEALER INFO:** Setup 8am-9:45am. **CONTACT:** John or Sabrina, Bus: 313-884-7690/FAX.

SEPTEMBER 9-10-11

IL - ROLLING MEADOWS — DX Convention & Banquet. **SPONSOR:** Northern Illinois DX Assn. **LOCATION:** Rolling Meadows Holiday Inn "Holidome," 3405 Algonquin Rd. **CONTACT:** Bill McConnell, N9US, 708-397-9593.

SEPTEMBER 10

IN - FORT WAYNE — Hamfest/Computer Show. **SPONSOR:** Fort Wayne Radio Club. **LOCATION:** Allen County Fairgrounds, 5 mi. N of Ft. Wayne. **ADMISSION:** $4 adv., $5 door. **TALK-IN:** CB - T. **DEALER INFO:** Tables: Inside $15, Pavilion $10. $7 tailgate. **CONTACT:** John Goller, K9UWA, 4836 Ranch Rd., Leo IN 46765. 219-637-6426.

IN - MERRILLVILLE — Computer Possibilities Unlimited. **SPONSOR:** Bee Software. **LOCATION:** Michelangelo Hall, 6220 Broadway. **HOURS:** 10am-3pm. **ADMISSION:** $5, under 12 free. **FEATURES:** AC - C - DP - FP - F/R - S. **CONTACT:** Info/Discount tickets: 219-931-3761.

OH - CLEVELAND — Compvter Manial. **SPONSOR:** National Computer Exposition. **LOCATION:** Marriott Hotel, 4277 W. 150th St. at I-71. **HOURS:** 10am-4pm. **ADMISSION:** $5 w/ad, under 12 free. **FEATURES:** FP. **DEALER INFO:** Setup 8am-10am. Sellouts are common, early booking advised. **CONTACT:** Joe Bowen, 216-442-1776 or Ronald Nelson, FAX: 216-292-7746. National Expo's, Inc., 30799 Pinetree Rd. #230, Cleveland OH 44124.

SEPTEMBER 11

IA - DUBUQUE — Radiofest/Hamfest/Computer Expo. **SPONSOR:** Iowa Antique RC & Historical Society & The Great River ARC. **LOCATION:** Tri-State Blind Society, 3333 Asbury Rd. **HOURS:** 8am-3pm. **ADMISSION:** $2 adv., $3 door. **TALK-IN:** 147.24/84. **FEATURES:** EX - FM - FP - F/R - T. **DEALER INFO:** Tables $8, tailgter's space free. **CONTACT:** Loren Heber, N0YHZ, 9479 Laudeville Rd., Dubuque IA 52003 or Jerry Ehlers, N0NLU, 3115 Brunswick St., Dubuque IA 52001. 319-583-1016.

IL - DU QUOIN — Hamfest & Computer Swap Meet. **SPONSOR:** Shawnee Amateur Radio Assn. **LOCATION:** Du Quoin State Fairground. **HOURS:** 8am-2pm. **TALK-IN:** 147.09/69. **FEATURES:** CB - DP - EX - FM - F/R. **DEALER INFO:** Vendor space $5. **CONTACT:** Joey Helleny, KB9HNO, 618-457-8114 or write to: 600 S. 16th St., Herrin IL 62948.

IL - JOILIET — 10th Annual Hamfest & Computer Fair. **SPONSOR:** Bolingbrook Amateur Radio Society. **LOCATION:** Inwood Recreation Center, 3000 W. Jefferson St. (Rt. 52). **HOURS:** 8am-3pm. **ADMISSION:** $5. **TALK-IN:** 147.33 + KHz, 224.54-MHz. **FEATURES:** DP - EX - FM - F/R. **CONTACT:** 708-759-7005.

IL - ORLAND PARK — The Orland Park Computer Show. **LOCATION:** Orland Park Civic Center, 147th St & LaGrange Rd (Rt. 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 - FLINT — Computer Trade Show. **SPONSOR:** ComputerFest. **LOCATION:** Holiday Inn, Hill Rd. at I-75. **HOURS:** 10am-5pm. **ADMISSION:** $3. **FEATURES:** AC - C - DP - FP - F/R - S. **CONTACT:** Brian I. Brown, 1504 S Vassar Rd., Burton MI 48519-1345. 810-742-1329.

MI - SOUTHFIELD — Michigan Computer Festival. **SPONSOR:** Computer Support Services. **LOCATION:** Southfield Pavilion, 26000 Evergreen Rd. **HOURS:** 10am-4pm. **ADMISSION:** $4 seniors, $3 students, under 12 free. **FEATURES:** CB - DP - F/R - S. **DEALER INFO:** Setup 7:30am-9:45am. 8' tables draped & covered. 1-4 tables $50 ea., 5+ tables $40 ea. **CONTACT:** Computer Support Services, POB 1350, Taylor MI 48180. 313-295-2237.

OH - CLEVELAND — Compvter Manial. **SPONSOR:** National Computer Exposition. **LOCATION:** Holiday Inn/Hudson, 240 Hines Hill Rd., at I-80 Ohio Tpk (N. Exit 12). **HOURS:** 10am-4pm. **ADMISSION:** $5 w/ad, under 12 free. **FEATURES:** FP. **DEALER INFO:** Setup 8am-10am. Sellouts are common, early booking advised. **CONTACT:** Joe Bowen, 216-442-1776 or Ronald Nelson, FAX: 216-292-7746. National Expo's,Inc., 30799 Pinetree Rd. #230, Cleveland OH 44124.

OH - FINDLAY — 52nd Findlay Hamfest. **SPONSOR:** Findlay Radio Club. **SPONSOR:** Hancock County Fairgrounds. **FEATURES:** DP. **CONTACT:** 419-423-1440 or write to: Box 587, Findlay OH 45839.

SEPTEMBER 17

IL - KANKAKEE — Computer Fest '94. **SPONSOR:** Kankakee River Valley Computer Group. **LOCATION:** Kankakee County Fairgrounds. **HOURS:** 9am-3:30pm. **ADMISSION:** $4, 12 & under free. **FEATURES:** C - CB - DP - FP - F/R. **CONTACT:** 815-935-8590 or 815-935-1605.

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:** 8' $30 ea, 12' $40 ea. **CONTACT:** Progressive Computer Productions, 23814 Michigan Ave., Ste 237, Dearborn MI 48124. 313-425-9276.

OH - CLEVELAND — Computer Trade Show. **SPONSOR:** Peter Trapp Shows. **LOCATION:** Cuyahoga County Fairgrounds, Berea. **HOURS:** 10am-3pm. **ADMISSION:** $5, w/ad or coupon $1 off, under 11 free. **FEATURES:** C - FM - FP - F/R - T. **CONTACT:** Peter Trapp Shows.*

SEPTEMBER 17-18

IL - PEORIA — Peoria Superfest. **SPONSOR:** Peoria Area Amateur Radio Club. **LOCATION:** Exposition Gardens, Northmoor & University. **HOURS:** Gates open 6am, Commercial buildings open 8am. **ADMISSION:** $5. **TALK-IN:** 146.76/16. **FEATURES:** CB - DP - EX - F - FM - FP - F/R. **CONTACT:** Peoria Area ARC, POB 3508, Peoria IL 61612-3508. 309-685-6698.

SEPTEMBER 18

IL - GLEN ELLYN — Computer Central. **LOCATION:** College of DuPage, Physical Education Bldg. Main Arena, 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.

MI - FLINT — Computer Trade Show. **SPONSOR:** 5 Star Productions. **LOCATION:** Flint Holiday Inn, Gateway Centre, US-23 at Hill Rd. Exit 2 miles S of I-69. **HOURS:** 10am-5pm. **ADMISSION:** $4, $3 w/this ad. **FEATURES:** AC -C - CB - DP - FP - F/R. **CONTACT:** Five Star Productions, 810-768-6058 (pager).

MI - MOUNT CLEMENS — 22nd Annual Swap & Shop. **SPONSOR:** L'Anse Creuse Amateur Radio Club. **LOCATION:** L'Anse Creuse High School. **HOURS:** 8am-2pm. **ADMISSION:** $4 adv., $5 door. **TALK-IN:** 147.08/.68, 146.52 Simplex. **FEATURES:** C - DP - EX - FP - F/R - H - T. **DEALER INFO:** Inside table $10, trunk space $4. Setup 6am. **CONTACT:** Send SASE to: Dave Herrington, N8NLK, 810-465-2797, 165 Crocker Blvd., Mt. Clemens MI 48043-2546. For exam info: Don Olszewski, WA8IZV, 810-294-1567. Prodigy ID# SSTG41a.

OH - AKRON — Computer Trade Show. **SPONSOR:** Peter Trapp Shows. **LOCATION:** Tadmor Temple, 3000 Krebs Dr. **HOURS:** 10am-3pm. **ADMISSION:** $5, w/ad or coupon $1 off, under 11 free. **FEATURES:** C - FM - FP - F/R - T. **CONTACT:** Peter Trapp Shows.*

SEPTEMBER 24-25

IL - GRAYSLAKE — Radio Expo. **SPONSOR:** The Chicago FM Club. **LOCATION:** Lake County Illinois Fairgrounds, Rts. 45 & 120. **ADMISSION:** $5 adv., $6 door, good both days, under 12 free. **TALK-IN:** 146.16/76. **FEATURES:** EX - FM - FP - F/R - H. **CONTACT:** Radio Expo, Box 1532, Evanston IL 60204. 312-262-6773.

SEPTEMBER 25

MD - SAINT PETERS — Swapfest. **SPONSOR:** St. Peters Amateur Radio Club. **LOCATION:** St. Charles County Community College Campus, 4601 Mid Rivers Mall Dr. Take I-70 or Missouri Rt. 94 to Mid Rivers Mall Dr. **HOURS:** 7am-1pm. **ADMISSION:** $2. **TALK-IN:** 145.41, 444.275. **FEATURES:** EX - FM - F/R. **DEALER INFO:** Flea market space $3 (incl. one admission). **CONTACT:** Jay Underdown, W0OGS, 58 Judy Dr., St. Charles MO 63301. 314-723-4200.

OH - BEREA — 20th Annual Cleveland Hamfest & Computer Show. **SPONSOR:** Hamfest Assn. of Cleveland, Inc. **LOCATION:** Cuyahoga County Fairgrounds, Eastland Road Entrance. **HOURS:** 8am-2pm. **FEATURES:** B - DP - EX - F - FM - F/R. **CONTACT:** Marion Hill, WA8GZC, c/o Cleveland Hamfest Assn., POB 81252, Cleveland OH 44181-0252. 800-CLE-FEST. Cleveland Local: 999-7388.

OH - CANTON — Canton Computer Festival. **SPONSOR:** Computer Support Services. **LOCATION:** Canton Memorial Civic Center, 1101 Market Ave. N. **HOURS:** 10am-4pm. **ADMISSION:** $4, seniors/students $3, under 12 free. **FEATURES:** C - DP - F/R. **DEALER INFO:** 9,000 sq. ft. open exhibit space. 8' table draped & covered, 1-4 tables $35 ea., 5+ $30 EA. Setup 7:30am-9:45am. **CONTACT:** Computer Support Services, POB 1350, Taylor MI 48180. 313-295-2237.

SEPTEMBER 30-OCTOBER 1

TX - EL PASO — Annual Convention. **SPONSOR:** El Paso Chapter of The Quarter Century Wireless Assn. **FEATURES:** DP. **CONTACT:** Robert J. Carroll, Sr., K5IE, 10025 Suez Dr., El Paso TX 79925-4636.

OCTOBER 1

MI - ROSEVILLE — International Canadian/American Mega-Fest Show. **SPONSOR:** E.S.P.S. Corp. **LOCATION:** Days Inn Hotel, 31960 Little Mack. I-94 to Gratiot, go to Masonic, make right, 1/4 mile on right. **HOURS:** 10am-4pm. **ADMISSION:** $4. **FEATURES:** C - CB - H. **DEALER INFO:** Setup 8am-9:45am. **CONTACT:** John or Sabrina, Bus: 313-884-7690/FAX.

OCTOBER 2

IL - SKOKIE — Super Skokie Computer Show. **SPONSOR:** A Computer Co., Inc. **LOCATION:** Holiday Inn Skokie, 5300 W Touhy Ave., I-94 W, exit at Touhy Ave. W, 6 blocks on right hand side. **HOURS:** 10am-3:30pm. **ADMISSION:** $5, under 12 free. **FEATURES:** AC - C. **DEALER INFO:** 80 6' tables $45 ea., electricity $10 extra. Setup 7am-10am. **CONTACT:** Mark, 312-486-1811, or write: A Computer Co., Inc., 2921 W. Diversey, Chicago IL 60641.

MI - ANN ARBOR — Colossal Computer Sale. **SPONSOR:** Jewish Community Center of Washtenaw County. **LOCATION:** Washtenaw Community College, Job Skills and Campus Events Bldg., East Huron River Dr. **HOURS:** 9:30am-4pm. **ADMISSION:** $3. **FEATURES:** C (new & used) - F/R - Tax deductible donations of used equipment welcome. **DEALER INFO:** Tables $30. **CONTACT:** Judi Lindemann, 313-971-0990.

MI - TAYLOR — International Canadian/American Mega-Fest Show. **SPONSOR:** E.S.P.S. Corp. **LOCATION:** Holiday Inn, 20777 Eureka Rd. I-75 to Eureka Rd. on E side of Fwy. **HOURS:** 10am-4pm. **ADMISSION:** $4. **FEATURES:** C - CB - H. **DEALER INFO:** Setup 8am-9:45am. **CONTACT:** John or Sabrina, Bus: 313-884-7690/FAX.

OH - ASHLAND — North Central Ohio Hamfest. **SPONSOR:** Ashland Area ARC. **LOCATION:** County Fairgrounds on Claremont Ave. **HOURS:** 8am-3pm. **ADMISSION:** $3 adv., $4 door. **TALK-IN:** 147.105+. **FEATURES:** DP - FM. **DEALER INFO:** Tables $7 ea., 10' flea market space $3. **CONTACT:** Wallis Green, W3YXS, 3 E. Liberty St., Ashland OH 44805. 419-281-3903.

OCTOBER 8

ND - GRAND FORKS — Hamfest/Computer Fair. **SPONSOR:** Forx ARC **LOCATION:** Grand Forks Civic Auditorium, 615 1st Ave. N. **HOURS:** 8am-? **ADMISSION:** $5, families $7.50. **TALK-IN:** 146.94. **FEATURES:** B - EX - F - FM. **DEALER INFO:** Setup 7am. **CONTACT:** Bob Smith, ND1H, 1203 Shakespeare Rd., Grand Forks ND 58203. 701-746-9498.

OCTOBER 8-9

TX - EL PASO — 7th Annual International Hamfiesta. **DEALER INFO:** Indoor table space $10 both days. **CONTACT:** The International Hamfiesta, POB 10496, El Paso TX 79995.

OCTOBER 9

IL - PALATINE — Computer Central. **LOCATION:** Harper College, 1200 W. Algonquin Rd., Bldg. M. **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 - INDIANAPOLIS — Indianapolis Computer Fair. **LOCATION:** Quality Inn East, 3525 N Shadeland, near Pendleton Pike. **HOURS:** 10am-3pm. **ADMISSION:** $4, under 12 free. **FEATURES:** C - DP. **CONTACT:** Ben Yanto, AGI Computer Fairs.*

MI - LANSING — Hamfair '94. **SPONSOR:** Central Michigan ARC & Lansing CD Repeater Assn. **LOCATION:** Gardner Middle School, S of Jolly, 2 blocks W of Cedar. **HOURS:** 8am-1pm. **ADMISSION:** $4. **TALK-IN:** 145.39. **FEATURES:** C - FM - H. **DEALER INFO:** Setup 6am. Tables $10. **CONTACT:** LCDRA, POB 80106, Lansing MI 48908.

OH - FINDLAY — Findlay Computer Festival. **SPONSOR:** Computer Support Services. **LOCATION:** Hancock Arena, 3430 N Main St. **HOURS:** 10am-4pm. **ADMISSION:** $4, seniors/students $3, under 12 free. **FEATURES:** DP - F/R. **DEALER INFO:** 8' tables draped & covered. 1-4 tables $35 ea., 5+ tables $30 ea. **CONTACT:** Computer Support Services, POB 1350, Taylor MI 48180. 313-295-2237.

OCTOBER 14-15-16

NE - OMAHA — ARRL Midwest Division Convention. **SPONSOR:** AK-SAR-BEN ARC. **LOCATION:** Holiday Inn Convention Center, 3321 S. 72nd St. **FEATURES:** EX - F - FM. **CONTACT:** ARRL Midwest Division Convention, POB 24551, Omaha NE 68124-0551. FAX: 402-399-0848.

OCTOBER 15

IN - MERRILLVILLE — Computer Possibilities Unlimited. **SPONSOR:** Bee Software. **LOCATION:** Michelangelo Hall, 6220 Broadway. **HOURS:** 10am-3pm. **ADMISSION:** $5, under 12 free. **FEATURES:** AC - C - DP - FP - F/R - S. **CONTACT:** Info/Discount tickets: 219-931-3761.

OCTOBER 16

IL - ORLAND PARK — The Orland Park Computer Show. **LOCATION:** Orland Park Civic Center, 147th St & LaGrange Rd (Rt. 45). **HOURS:** 9:30am - 3pm. **ADMISSION:** Adults $5 - $1 off with copy of this

Events CALENDAR

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.

OH - TOLEDO — Toledo Computer Festival. **SPONSOR:** Computer Support Services. **LOCATION:** Masonic Great Hall, 4645 Heatherdowns. **HOURS:** 10am-4pm. **ADMISSION:** $4 seniors, $3 students, under 12 free. **FEATURES:** DP - F/R. **DEALER INFO:** 8' tables draped & covered $40. Setup 7:30am-9:45am. **CONTACT:** Computer Support Services, POB 1350, Taylor MI 48180. 313-295-2237.

PA - CARLISLE — 10th Annual CCARS Hamfest. **LOCATION:** The Eagles Recreation Center, Wolf's Bridge Rd. **HOURS:** 8am-? **TALK-IN:** 145.27. **FEATURES:** EX. **CONTACT:** CCARS c/o R.H. Altenburg, K3NLX, 10 Scarsdale Dr., Camp Hill PA 17011-7934. Phone: 717-761-6899, FAX: 717-975-0832.

OCTOBER 22

IN - HIGHLAND — Computer Possibilities Unlimited. **SPONSOR:** Bee Software. **LOCATION:** Lincoln Center, 2450 Lincoln. **HOURS:** 10am-3pm. **ADMISSION:** $5, under 12 free. **FEATURES:** AC - C - DP - FP - F/R - S. **CONTACT:** Info/Discount tickets: 219-931-3761.

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:** 8' $30 ea, 12' $40 ea. **CONTACT:** Progressive Computer Productions, 23814 Michigan Ave., Ste 237, Dearborn MI 48124. 313-425-9276.

OCTOBER 23

MI - WARREN — USECA Swap. **SPONSOR:** Utica Shelby Emergency Communications Assn. **LOCATION:** Macomb Community College, South Campus, 12 Mile Rd., & Hayes, K-Bldg. **HOURS:** 8am-? **ADMISSION:** $4, under 11 free w/adult. **TALK-IN:** 147.18+, 146.42 Simplex. **FEATURES:** C - E - EX - F/R - H. **DEALER INFO:** Tables $15. Info: Virginia, N8NLS, 313-268-0691 or Kevin, N8QVX, 313-772-8082. **CONTACT:** VE Testing: Bill, N8CVC, 313-468-8345. Club Info: Dave, KF8CT, 313-268-6730.

OH - LIMA — Lima Computer Festival. **SPONSOR:** Support Services. **LOCATION:** Veterans Memorial Civic & Convention Center, 7 Town Square. **HOURS:** 10am-4pm. **ADMISSION:** $4, seniors/students $3, under 12 free. **FEATURES:** C - DP - F/R. **DEALER INFO:** Setup: 7:30am-9:45am. 8' tables draped and covered: 1-4 $35 ea., 5+ $30 ea. **CONTACT:** Support Services, POB 1350, Taylor MI 48180. 313-295-2237.

OCTOBER 29

MN - SAINT PAUL — Hamfest Minnesota & Computer Expo. **SPONSOR:** Twin Cities FM Club. **LOCATION:** Main Arena, St. Paul Civic Center, Kellogg & West 7th St. **HOURS:** 8am-4pm. **ADMISSION:** $5 adv., $7 door. **TALK-IN:** 146.16/76. **FEATURES:** DP - EX - FM - F/R - S. **DEALER INFO:** Tables: $18 adv., $20 door. **CONTACT:** Hamfest Minnesota & Computer Expo, POB 5598, Hopkins MN 55343. 612-535-0637.

OCTOBER 30

IL - GLEN ELLYN — Computer Central. **LOCATION:** College of DuPage, Physical Education Bldg. Main Arena, 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 Co. 4-H Fairgrounds, Warm & Dry Community Bldg., 17 mi. N of Indy off I-65 at Exit 138. **HOURS:** 8am-4pm. **ADMISSION:** $3. **TALK-IN:** 147.105, 443.150. **FEATURES:** EX - FM - FP - F/R - T. **DEALER INFO:** Table & space $5. **CONTACT:** Sam Paul, WA9YZE, POB 186, Lebanon, IN 46052. 317-659-1720.

OH - COLUMBUS — Columbus Computer Festival. **SPONSOR:** Computer Support Services. **LOCATION:** Aladdin Temple, 3850 Stelzer Rd. **HOURS:** 10am-4pm. **ADMISSION:** $4, seniors/students $3, under 12 free. **FEATURES:** DP - F/R. **DEALER INFO:** 8' tables draped & covered. 1-4 tables $35 ea., 5+ tables $30 ea. **CONTACT:** Computer Support Services, POB 1350, Taylor MI 48180. 313-295-2237.

EASTERN REGION

AUGUST 6

MA - MARLBOROUGH — Boston Area Computer Show. **LOCATION:** Royal Plaza Trade Center, I-495 Exit #24-B, 1/2 mi. on right, 5 mi. N of Mass. Turnpike on Rt. 20. **HOURS:** 10am-3pm. **FEATURES:** C. **DEALER INFO:** 500+ tables. **CONTACT:** KGP Computer Show.*

NC - HIGH POINT — Hamfest. **SPONSOR:** High Point Amateur Radio Club. **LOCATION:** National Guard Armory, off Hwy. 29-70 (Business I-85) near the Kivett Dr., exit. **HOURS:** 8am-3pm. **ADMISSION:** $4 adv., $5 gate. **TALK-IN:** 147.765/.165. **FEATURES:** EX - FM. **CONTACT:** POB 1163, Jamestown NC 27282-1163 or call 919-887-3039.

NY - WHITE PLAINS — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Westchester County Center. **HOURS:** 9:30am-4:30pm **FEATURES:** C - FP. **CONTACT:** MarketPro, POB 4056, River Edge NJ 07661. 201-343-3740, FAX: 201-343-9420.

AUGUST 6-7

FL - JACKSONVILLE — Greater Jacksonville Amateur Radio & Computer Show/ARRL Northern Florida Section Convention. **LOCATION:** Osborn Convention Center. **HOURS:** Sat: 9am-5pm, Sun: 9am-3pm. **ADMISSION:** $6. **FEATURES:** AC - CB - DP - EX - F - FM - FP. **DEALER INFO:** Swap tables $18 for the weekend. Contact: David Phillips, KC4RQF, POB 9726, Jacksonville FL 32208. **CONTACT:** Greater Jacksonville Hamfest Assn., POB 27033, Jacksonville FL 32205. 904-350-9193.

PA - ALLENTOWN — PC Dealer Showcase. **SPONSOR:** StarWare. **LOCATION:** Lehigh Valley Mall, Rte 145. **HOURS:** Sat. 10am-9:30pm, Sun. 11am-6pm. **ADMISSION:** Free. **FEATURES:** AC - C - FP. **DEALER INFO:** Tables $95 ea. per day. **CONTACT:** StarWare, 800-523-0702.

Continued on page 128

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Questions & Answers
TECH FORUM

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

QUESTIONS

I am trying to replace my existing mechanical relay latch circuits with state-of-the-art Solid State technology. Does anyone know of a solid state latch that will provide a positive output of 5 to 12 volts when turned on by a ground to the input? The next ground input to the latch needs to release it.

Below is my current circuit and a block diagram of what I am searching for in the way of a Solid State replacement.

When the pushbutton is pressed, ground is connected to the winding of relay "OPER" via contacts 1 & 2, causing it to operate and hold operated via contacts 2 & 3. (Contacts 1, 2, 3 are arranged so that 2 & 3 make contact before 1 & 2 break contact (EMB).)

Operated relay "OPER" close ground through its contacts 2 & 3 causing relay "LOCK" to operate and remain operated as long as relay "OPER" is held up.

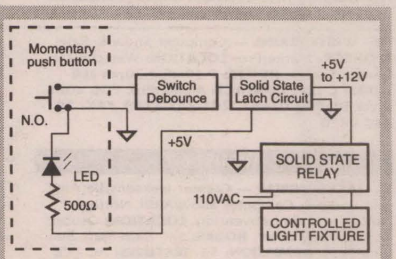

Figure 2. Proposed Conversion to Solid State Operation

Relay "OPER" closes +24 V via contacts 4 & 5 to operate the remote Solid State relay which turns on the associated light fixture. Relay "OPER" also closes +5 V via contacts 6 & 7 to light an LED at the remote control panel to indicate that the light fixture is turned on.

To turn off the light, the pushbutton is pressed again, closing ground via contacts 2 & 3 of the "LOCK" relay to the winding of the "OPER" relay, shunting it down and causing it to release. With the "OPER" relay released, the "LOCK" relay releases. Power to the Light Fixture is removed. The Remote Control Panel LED indicator is turned off.

William E. Baker
Independence, MO

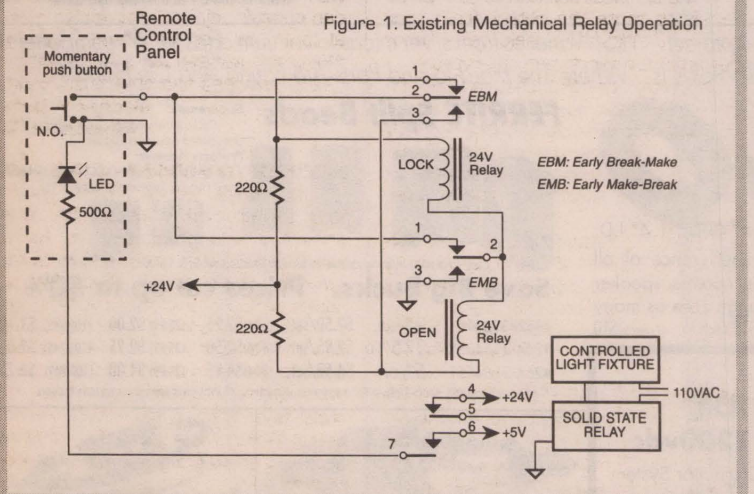

Figure 1. Existing Mechanical Relay Operation

I need information on the EICO 427 oscilloscope. Anything at all would help. I inherited this portable scope a few weeks ago without manuals or anything. The input ports even look different than any probe I've seen (I've only ever seen BNC). Also, since I don't have probes, I need sources for those (Tucker doesn't carry them).

Mike Keller
Lancaster, PA

I've come into possession of an IC511-C, 14 pin IC made by IOR. It's carded & therefore "unused," but the only information on the back is that it's an "Exact Replacement for DM-14, ECG718, HEP594, IC-17, LM1304N, MC1304P, UA732, etc." None of which I could find any information on. A pin-out and any specs would be greatly appreciated. (This may be a monostable Multivibrator.)

Mike Keller
Lancaster, PA

I am looking for a time and date stamp with RAM that will store up to 50 watch screens. One screen save for each button pushed. A recall button shows each recorded (time & date) entry. Both watch and memory should run on batteries.

Alnina
Cheltenham, PA

If I have two of the same Audio Speakers and they have their own crossovers internally, can these be wired in a series circuit to increase ohms from 6 ohms (each speaker) to 12 ohms with 2 speakers used in series or do crossovers prevent this?

S. Mercer
Las Vegas, NV

I need info, schematics and theory on a decoder for FM radio, to receive station ICN (Italian broadcasts). Is this an SCA transmission?

George Fazio
Brooklyn, NY

First, I would like to know how to connect either a Siltronix model 80-1 or 90-1 VFO to an SBE console II CB base station. The SBE radio says "Type SBE-16CB/T" on the front panel. Also the SBE has been converted from 23-channel to 40-channel operation. I'm not sure if this modification is a factor in being able to connect the VFO.

Second, I purchased a Uniden President model AX-144 mobile 40-channel SSB radio at a flea market. When I hooked the radio to the power supply and turned the power switch on, the S meter pegs to the right side and there is no receive. I checked to see if the radio was transmitting, and the wattmeter showed no forward power output. The meter in the radio stays pegged to the right in AM, LSB, and USB with the radio cover removed, I applied DC voltage and looked for obvious problems. One of the resistors (R-172) starts to smoke and bubble after about 10 seconds. I have no idea what value this resistor is since the color bands have been damaged. Also, I found some transistors (TR-8, TR-29, TR-33, TR-46) which have one of their leads soldered as if they had been repaired after being cut. I'm having trouble locating any schematics or information on this radio.

Any help on these two questions would be greatly appreciated.

Ted Sorge
Converse, TX

Recently, my 5/8 wave 2 meter antenna was blown off my trunk when an 18 wheeler went by in the opposite lane on a two lane road. How can I strengthen the magnet? I know how to remagnitize bar and horseshoe magnets, but not a round magnet. Help!

Also, how can I make more H and O "bubbles" for my electrolysis project? I tried 12 volts unsuccessfully.

James Mulhall
Fayetteville, NC

I need a circuit that will accumulate 5 min. on a timer each time a switch is activated, up to 20 min. (Like the timers used for pay showers.)

Edward Wruk
Crivitz, WI

I would like to know how to do a frequency (dB) decible chart using an ADC such as the MAX153. The PC

QUESTION INFO
TO BE CONSIDERED FOR PUBLICATION

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

INFORMATION/RESTRICTIONS
- No questions will be accepted that offer equipment for sale or equipment wanted to buy.
- Selected questions will be printed one time on a space available basis.
- Questions may be subject to editing.

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- Write legibly (or type). If we can't read it, we'll throw it away.
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ANSWER INFO
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- Due to space limitations, we can not reprint the original questions with the answer. The question number and the issue it appeared in are printed above the answer.
- Unanswered questions from a past issue may still be responded to.

(IBM) reads the ADC and plots the voltage read. Then the PC will print out a frequency response chart for the dB levels.

Wayne Chesser
Sunset, UT

As far as audio frequencies, why does solid state distort with odd harmonics and tubes with even?

Harry Werner
Angola, NY

What is a KBPC GT 2501? It should be a bridge rectifier, but I can't find any manufacturer, and I don't have specs for it or the power supply it came out of.

Anonymous

Being a novice, AC constantly baffles me. After putting a new cord on a very old toaster, I plugged it in and made sure the outside wasn't hot; it was. Out of curiosity, I plugged it in reversed and the case was no longer hot.

Being cautious, I pushed the plunger down and the case became hot again. With the plug in original position, case stops being hot when plunger is down. The toaster works, but I won't touch it. Can someone explain what's happening? Also, I know there's a short in one wire.

Mike Keller
Lancaster, PA

I have a satellite receiver brand name Sat-Vision model 737. I cannot find who made it. The remote control is gone; all the control it has on it is the channel control. I would like to put an audio control on it for bringing the audio and video together.

C.B. Bond
Pitkin, LA

I am looking for a practical circuit design that allows me to connect my video camera through a standard telephone line so the picture can be viewed on a remote TV set.

Bill Monroe
Sanford, FL

I need a versatile radio patch that could transmit and receive with the greatest range possible. It needs to be able to transmit any data from an ordinary phone jack (i.e., modem, fax, etc.). I saw "The Linker" advertised by Jec Tech in this magazine. Is that what I'm looking for? Any circuit design would be great, too. I understand the basics of electronics and frequency modulation, but I have little experience.

Jay L. Hutchinson
Chillicothe, MO

I would like to know if the BA1404 FM stereo transmitter IC can be crystal controlled. I use a transmitter hooked up to my Walkman in my car, but it drifts over time and I need to tweak the FM radio's tuning.

Pete Haas
Kent, OH

I'm building Dynamic Scattering Liquid Crystal Displays. Since E.M. Merck Co. stopped making D/S liquid last year, all I can acquire is MBBA. When I fill one of my > 12" x 12" LC cells with MBBA, even though the glass substrate is washed w/DE-I water, > 6 meg Ω, I have clarity problems. Where can I find a surface alignment polymer which will yield a homogeneous display?

D.P. Simmons
Chillicothe, OH

Hewlett-Packard HP 82906A printer looks exactly like an Epson FX-80 internally/externally. I cannot get it to print italics or bit mapped graphics. Originally set up for IEEE-488 interface via daughter board with centronics present but unused. I have removed IEEE board.

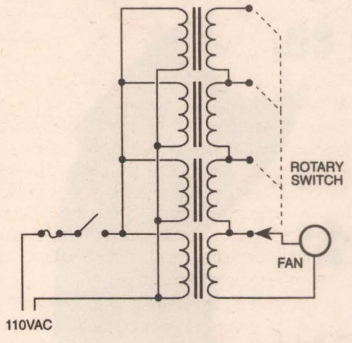
ROM 4A market H2FA4 and ROM 5A marked H2FA5. I have dip switch chart for FX80 and have tried most combinations. Also, J6 is Shorted and J7 is Open. (Not sure what they do, but an open at J6 stops any printer activity.) Any help locating HP manual (or will copy and return), and replacement/upgrade ROMs if they are necessary would be appreciated. *Nuts & Volts* advertiser Startech, (Carbondale, CO) has an upgrade kit for an FX80+. Could this HP printer be upgraded to an 80+ by changing out ROMs and/or other chips? I have an additional printer (same HP) that I would be willing to swap for info or parts to upgrade.

George C. Persico
Thiells, NY

ANSWERS

ANSWER TO #7941 - JULY 1994

The reason your "el-cheapo" ceiling fan is producing an annoying hum is probably because you are trying to control its speed using a conventional dimmer switch. Those switches produce a terribly distorted sinewave which drives inductive loads (such as motors and transformers) nuts. Make a speed control using 24 volt, at least 1.5 amp center-tapped transformers whose primaries are placed in parallel and outputs are placed in series as shown below. Then use a multi-pole rotary switch to select the various voltage taps. Since these "el-cheapo" ceiling fans typically pull less than one amp, fuse the whole circuit with a 1 amp slo blow in case one of your transformers ever go bad.



Dan Lash
Rome City, IN

ANSWER TO #6947 - JUNE 1994

The high pitched tone you are hearing on your scanner is probably a control signal similar to the 6KHz Supervisory Audio Tone (SAT) used on cellular systems to measure circuit quality and send data to the mobile terminal. This is usually removed by a low pass audio frequency filter in the receiver.

The simplest solution to your problem is to route the output from your scanner through a selectable filter designed for shortwave receivers.

I've used an MFJ "CW and SSB" filter for just this purpose and it works fine. Another possibility is the recently released DSP speaker unit from Radio Shack which automatically tunes to and removes continuous tones from audio signals.

Either of these filters will also give you more control of the audio coming from your scanner which can clean up an otherwise unlistenable signal.

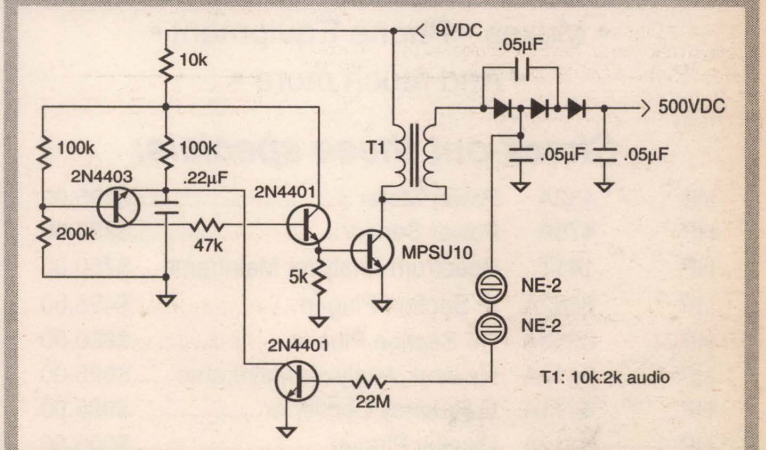
George R. Scott
Alexandria, VA

ANSWER TO #49410 - APR. 1994

Here is a circuit you can use to generate high voltage for the photomultiplier tube in the scintillator. This circuit is quite efficient, drawing virtually no current when the load is a photomultiplier used as a scintillation detector. Make sure that the voltage divider resistors on the PM tube are very high to conserve power, the higher the better (you couldn't survive the radiation level that would provide enough light to the PM tube to use the available current). If the high voltage circuit used a diode voltage multiplier chain, then connect the chain to the transformer just as the 3 diode doubler is connected. Lower the regulated voltage by removing one of the neons or selecting an appropriate zener. If a higher voltage is needed, simply extend the diode multiplier.

I have been seeing many discarded floppy drives at the metal salvage yard these days. If your local yard will let you look, go see if you can find the part there. I know it sounds unlikely, but you would be surprised what you can find.

Charles Wenzel
Austin, TX



ANSWER TO #69412 - JUNE 1994

In today's world, I think getting your son started in electronics at an early age is a great idea. As far as which company to choose, I would recommend Radio Shack. Radio Shack's series of "50 in one" through "250 and one" electronics kits are a great way to become familiar with simple electronic circuits. Some of these kits are specifically geared towards computer circuits and logic. I personally recommend these kits because they were my own way of entering the world of electronics when I was just slightly older than your son. Now, at the age of sixteen, I have an amateur radio license and enjoy using computers.

I wish you the best of luck and hope your son enjoys electronics as much as I do.

Ryan Ritchey
Lewistown, PA

ANSWER TO #69413 - JUNE 1994

Remote control of a shortwave radio can be as simple as buying the right radio. The Drake R-8, Icom R-71, and Lowe HF-150 are all remotely controllable via a computer interface. The HF-150 is extremely compact and offers both a computer interface or a remote keypad as external control options. You can either write your own software, or select any of numerous commercial offerings for both the PC or Macintosh. All these radios are available from ham radio suppliers such as Electronic Equipment Bank in Vienna, VA, or Tucker Electronics (a N&V advertiser).

If you must adapt a regular radio, select one which uses buttons for all the functions you wish to control. You can then interface to these buttons by bridging CMOS switches (e.g. the 4016 series) across them. These CMOS chips could then be controlled with a parallel interface card in your PC, or even the parallel printer port if you only need a limited number of functions. Such an arrangement can be easily handled from a BASIC program with the PRINT CHR$(x) function. You can consult any hobbyist design manual (such as *Forrest Mims Engineers Notebook* series) for information on CMOS switches and how to use them.

George R. Scott
Alexandria, VA

ANSWER TO #69416 - JUNE 1994

Loran receivers have traditionally been used to give mobile users a time and frequency calibration source, although they are rapidly being replaced by GPS receivers in this role. Extracting calibration data from a Loran receiver not designed as a time standard is a complex undertaking. If you really want to use your communications receiver to calibrate a frequency standard, here's a cheaper trick.

Continued on page 138

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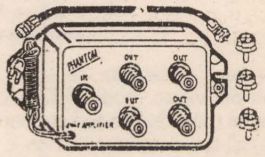

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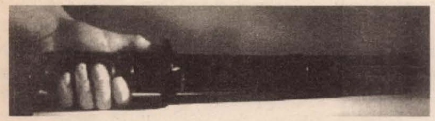

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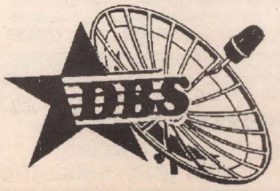

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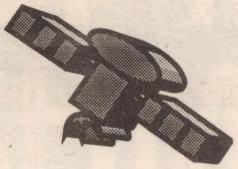

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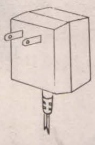

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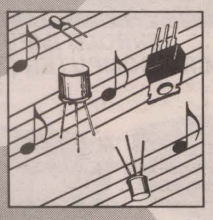

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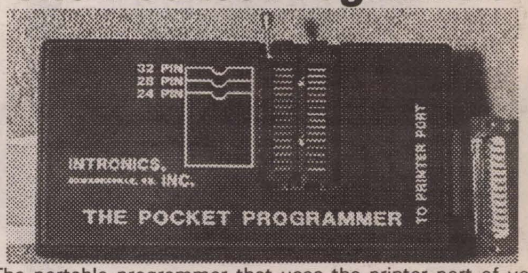

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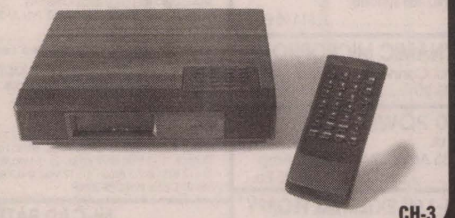

CH-3

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* CH 2/3 SWITCHABLE
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CH-4

* 86 CHANNELS
* LOADED WITH FEATURES
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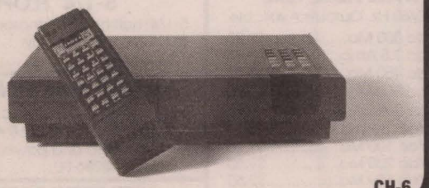
CH-5

* 99 CHANNELS
* UNSURPASSED PICTURE QUALITY
* COMPATIBLE TO S.A. 8500 THRU 8580 SYSTEMS EXCEPT 8570

ZENITH ST1XXX



CH-6

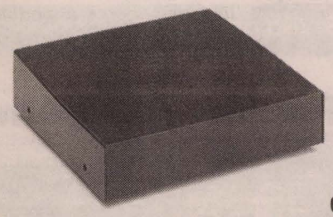
* VOLUME CONTROL
* ANTI FLASH TECHNOLOGY
* COMPATIBLE TO ALL ZENITH ST-XXXX SYSTEMS

PIONEER BA 6310

CH-7

* 99 CHANNELS
* CHANNEL MAPPING SWITCH
* COMPATIBLE TO ALL PIONEER SYSTEMS

JERROLD DMT-3 ADD ON



CH-8

* DIGITAL TUNING
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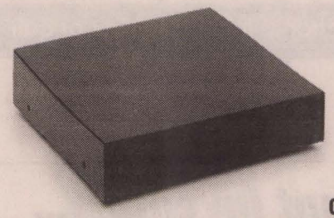
* COMPATIBLE TO ALL JERROLD SYSTEMS EXCEPT BASEBAND (DPBB)

SCIENTIFIC ATL. CMSA-3 ADD ON



CH-9

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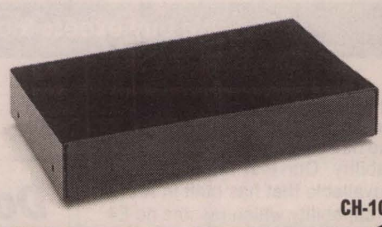
* ON/OFF LED INDICATOR
* COMPATIBLE TO S.A. MODELS 8500 THRU 8580 EXCEPT 8570

PIONEER PG-3 ADD ON



CH-10

* DIGITAL TUNING
* EXCELLENT PICTURE QUALITY
* COMPATIBLE TO PIONEER 5XXX AND 61XX TYPE SYSTEMS

JERROLD DQN7-30 CONVERTER

CH-11

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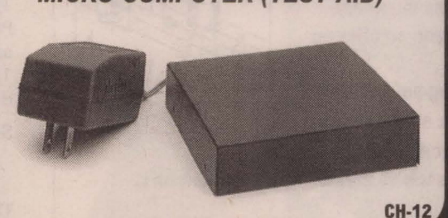

CH-12

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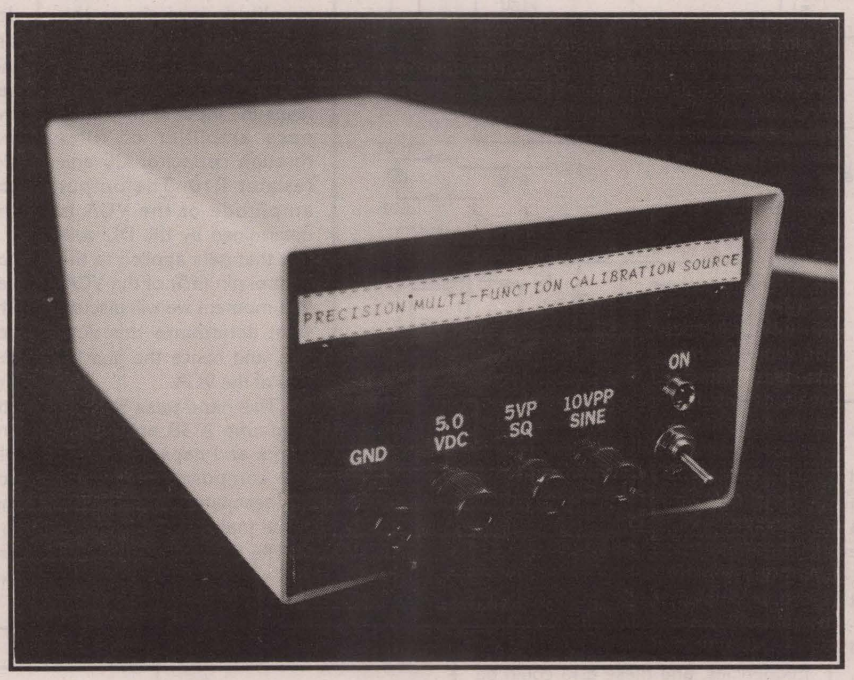
A PRECISION, MULTI-FUNCTION CALIBRATION SOURCE

by Richard Schroeder



Those of us involved in professional or hobby electronics use our oscilloscopes and meters often. We rely on these instruments to give us accurate readings. We know, however, that over a period of time *these* instruments can drift out of calibration and produce readings that are not accurate.

How can we know for sure that the time base or vertical calibration of our oscilloscope is correct? How can we know that our meter is reading correctly on its AC and DC functions?

One way would be to connect our instruments to a voltage and frequency source with known and trusted output characteristics — a sort of standard. Purchasing an instrument like this would prove too costly for most of us. Building our own would be fine if we could be sure that our unit could be trusted when completed. It would have to be low in cost, use off-the-shelf parts, and not require the use of additional precision equipment to get it calibrated. Calibrating a calibrator with our own uncalibrated equipment does not make good sense, does it?

The instrument described in this article will not only serve your calibration needs well, but it can be built using low-cost, off-the-shelf parts, and it does not require the use of precision equipment to calibrate it.

We call it a PRECISION MULTI-FUNCTION CALIBRATION SOURCE. The rather lengthy name was necessary in order to describe its many uses. It is multi-function in that it supplies a squarewave, a sinewave, and a DC voltage. The voltage levels of all three functions are fixed at 5 volts peak (VP) for the squarewave, 10 volts peak-to-peak (VPP) for the sinewave, and 5.0 volts DC. All of these carry an accuracy specification of ± 1%, which is respectable precision. The frequency of both the squarewave and sinewave is even more precise, being within .05% of the specified 1000 Hz. The squarewave, with its accurate frequency and amplitude characteristics, is ideal for time base and vertical calibration of oscilloscopes. The sinewave, with its precise level and low distortion characteristics, is ideal for meter calibration.

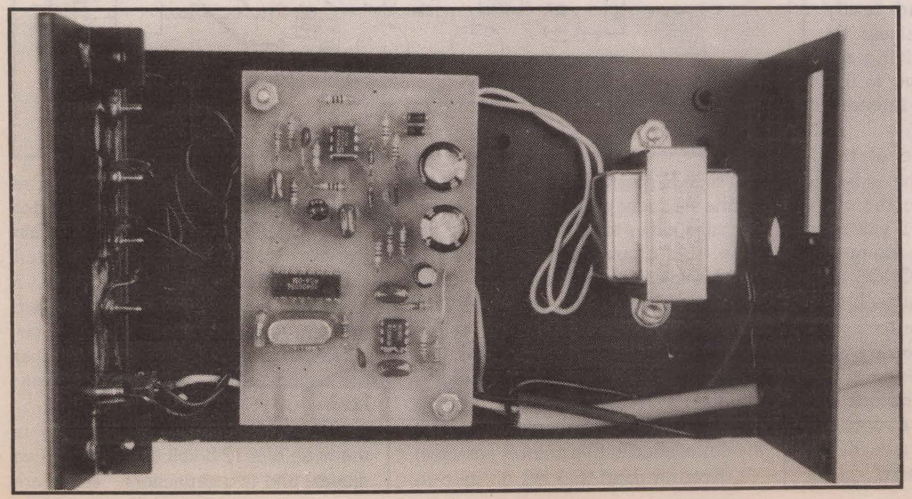
Multi-function, in our case, also means that the instrument can be used in different applications. For example, the squarewave output, in addition to its oscilloscope calibration use, can also be used as a digital signal source for low power TTL and CMOS circuitry. Also, the squarewave, having a perfect 50% duty cycle and a 5 volt peak level, can be used to check your meter on several of its DC ranges. In this case, the meter should read exactly 2.50 volts — think about it. The squarewave is also a must for checking and adjusting those 10:1 type oscilloscope probes.

The sinewave output, in addition to its use as a meter calibrator, can also serve as an audio signal source, and, similar to the squarewave, can be used for oscilloscope calibration, too. The DC output can be used for meter calibration (on DC ranges) or vertical (Y) channel calibration of an oscilloscope, assuming the latter has DC coupling capability.

The fixed levels were chosen for good reason, and will suit most applications. However, if they are too high for your applications, you may choose to construct the three resistor voltage divider pictured on the schematic diagram. This system will give you two additional reduced levels in decade steps that may suit your needs better. The resistors can be installed internally or connected externally only when needed. Keep in mind that this voltage divider will only work well on the sinewave or DC outputs. Outputs having low source impedance will be unaffected by the load that the voltage divider presents. Regardless of which output point you connect it to, point "B" will always be 1/10 of "A" and point "C" will always be 1/100 of "A." It should be noted that this system will increase source impedance (at the taps), which may degrade accuracy when operating into a load. However, if you do not load the points too heavily, the actual output level will be very close to the calculated level.

The sinewave output has a source impedance so low that loads of 200 ohms can be driven without affecting the output voltage. The source impedance of the squarewave and the DC outputs is much higher and is designed only for normal meter or oscilloscope loads. It needs to be noted that using the squarewave output to drive TTL chips will, in fact, lower the peak level, but, in this case, absolute level is not important.

The sinewave function of this instrument is perhaps the most valuable of all its features. Most low-cost calibrators, being intended for oscilloscope use, provide only a squarewave. This kind of signal is almost useless for checking the AC ranges on a meter. Actually, most meters — even when new — will meet factory specifications only when used on a pure sinewave. Here is where our unit excels. It supplies a precision 10 VPP low distortion sinewave signal at 1 KHz. It will work equally well on true RMS reading meters, or the more common AC reading meters. By the way, 10 VPP calculates out to 3.536 volts (AC).



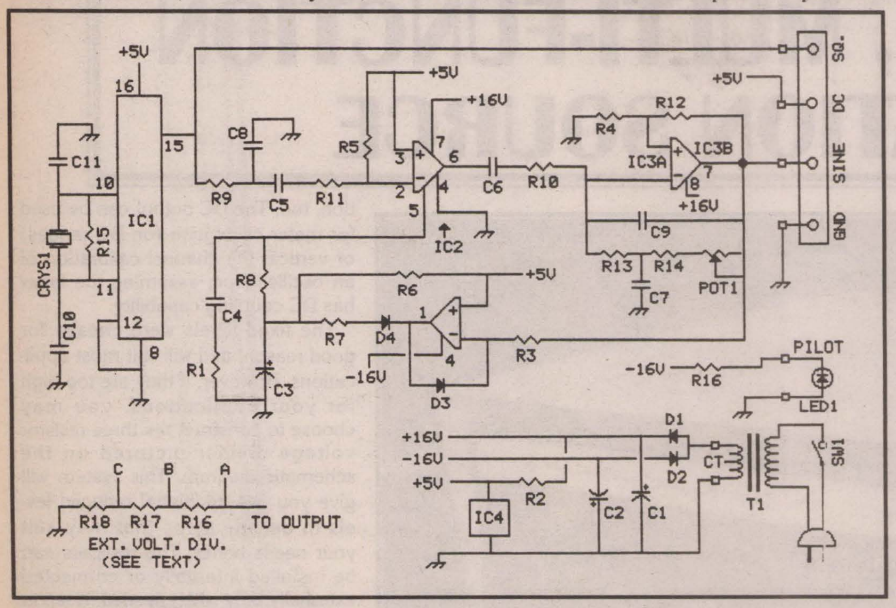
THE CIRCUIT – HOW IT WORKS

Please refer to the schematic diagram. Because the precision amplitude of the sinewave, the squarewave, and, of course, the DC, is dictated by IC4, let's consider this component first. This little device that looks like a small transistor is actually a complex integrated circuit (IC) that acts somewhat like a zener diode, but makes use of what is called "band-gap" technology. These are called by different names such as, "active zener diodes," "precision shunt regulator diodes," and "voltage references." Whatever it is called, it is used here as a precision voltage reference. All one really needs to know is that when a small current is made to flow through the device, a precise voltage gets developed across two of its three terminals (in our case, 5.0 volts ± 1%). It is this voltage that regulates the amplitude values of all three functions. Resistor R2 connected from the +16 volt line to the device supplies the required current to make it work.

The 1 KHz squarewave output of our instrument makes use of a quartz crystal for its precise frequency. A portion of IC1 is used to make it oscillate at its basic frequency of 1040 KHz. This IC also contains a series of divide by two blocks that are used to step the base frequency down to the desired 1 KHz. It is this frequency in the form of a squarewave that is brought out to the front panel. Actually, the IC makes available many of the divide by two frequencies, and these also could be brought out to the front panel if the builder desires. Keep in mind, however, that the sinewave circuitry only works at the 1 KHz frequency.

In regards to that strange sounding crystal frequency, let me say that though this frequency is not as popular as say 1 MHz, it is in fact an off-the-shelf part with some manufacturers and distributors. I would recommend that you purchase it from the firm indicated in the Parts List. The owner of the firm is a ham radio operator and really knows the crystal business. He was very kind in giving me some pointers on how to use the crystal with the intended integrated circuit.

The amplitude of the squarewave is determined by the voltage supplied to the chip. Because we use the 5 volt reference for the supply, along with the well engineered CMOS chip, the squarewave has a peak positive value very close to 5 volts and a low point value very close to ground. This precision is adequate for most oscilloscope calibration. Of course, if a more precise 5 volt level is needed, the DC output could be used.



Let's consider now how the precise 10 volt peak-to-peak sinewave is produced. There are three basic sections to this part of the circuit: a voltage controlled amplifier (VCA); a high Q band-pass filter tuned to 1 KHz; and a voltage comparator referenced to 5.0 volts.

The VCA gets its input signal from the 1 KHz squarewave point, but not directly. Resistors R9 and R11, and capacitors C5 and C8, serve to reduce the amplitude and shape the wave so that the VCA can properly handle it. The signal at the output of the VCA feeds the input of the band-pass amplifier or filter through capacitor C6 and resistor R10. The output amplitude of the VCA is determined by the DC voltage that gets applied to the control pin (#5) of the VCA. In a moment we will discuss what determines this voltage, and hence the gain or loss of the VCA.

The band-pass filter is made up of op-amp IC3B and a network of resistors and capacitors. The value of these components not only make the filter resonate at 1 KHz, but at the same time make the Q of the filter very high. The Q of the filter is further enhanced with the positive feedback provided by resistors R12 and R4.

High Q means the gain is very high at one frequency and very low at frequencies either side of that one. In our case, this characteristic is used to make a low distortion sinewave out of the squarewave that feeds it. Trim potentiometer (POT1) is used to set the filter frequency to exactly 1 KHz. The sinewave that appears at the output of the op-amp feeds its associated output terminal directly. As mentioned above, the impedance at this point is very low.

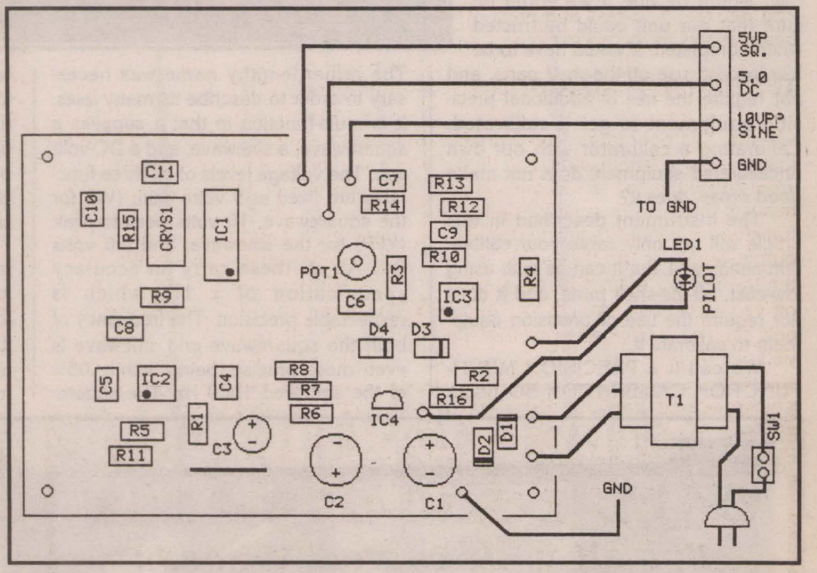
Keep in mind that left on its own, the band-pass filter would produce an uncontrolled output far in excess of the required 10 VPP. Here is where the comparator, which ultimately produces the control voltage for the VCA, comes in.

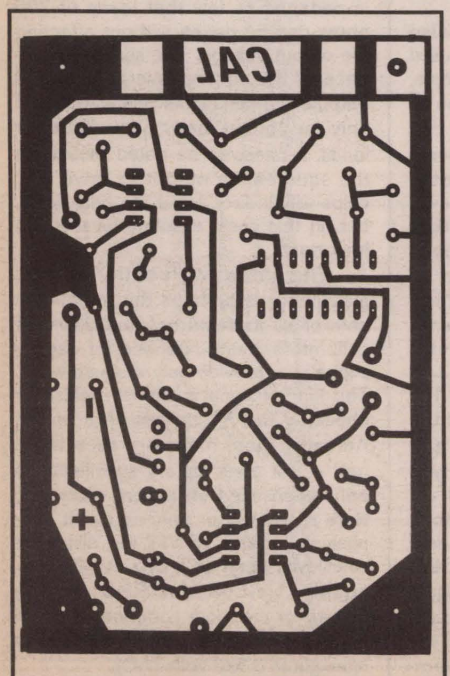
The comparator uses section "B" of op-amp IC3 and is simply an op-amp without the usual inverse feedback. The comparator is biased at the 5 volt reference level at its non-inverting (+) input. Its other input (-) receives the sinewave signal through resistor R3, across which there is no appreciable voltage drop. As the positive peak of the sinewave reaches (and tries to exceed) the 5 volt level, the output of the comparator switches from its normal positive voltage extreme to its negative extreme. This action, by means of diode D4 and resistor R7, tends to discharge or reduce the already positive charge on capacitor C3.

The positive charge or voltage comes through resistor R6 connected back to the 5 volt reference source. This voltage then, which is a result of both the fixed positive influence and the changeable negative influence (from the comparator), gets filtered a little more by means of capacitor C4 and resistors R1 and R8. This voltage, which can now be considered error or correction voltage, gets passed on to the gain control point of the VCA. Keep in mind that greater positive voltage produces greater gain, and lesser positive voltage produces lesser gain.

It should be clear then that as the total sinewave output reaches the desired 10 VPP level, the comparator and the VCA work together to maintain the correct level. By the way, even though only the positive sinewave excursion is monitored or compared, the zero offset and low distortion characteristics of the wave form assure that the negative half is also 5 volts peak, hence 10 VPP.

The basic DC power supply is made up of a 12.6 volt transformer, two diodes, and two capacitors. These are





configured as halfwave rectifiers to produce both a positive and a negative 16 volts DC. The positive voltage supplies the op-amps and the VCA. It also supplies the current for the 5 volt reference source. The negative voltage serves only the op-amp and the pilot LED. It should be noted that though the specified transformer has a center tap, the tap is not used.

CONSTRUCTION

You will probably want to start with the building of the printed circuit board (PCB). Refer to the parts layout diagram and install the parts as shown. If you are using the perf-board method of construction, it is suggested that you still follow the same general layout. Keep in mind that the diagram shows the component view, not the copper trace view. Also keep in mind that if you will be making your own PCB from the pattern shown, the pattern must be placed and processed in such a way that the "CAL" letters come out in a readable direction on the copper side of the finished product.

When installing the components on the board, pay close attention to any polarity markings on the components, such as the ± markings on the electrolytic capacitors and the color bands on the diodes. Then, of course, make the orientation agree with the diagram. Use good quality solder and be careful so as to avoid those troublesome solder bridges between traces. When the PCB is finished, check it over and get ready to test and adjust the board as well as the entire circuit.

TESTING AND ADJUSTING

For this operation, I recommend that you cut to length, strip, and tin the wires needed to connect all the components to the PCB. These will include the transformer, pilot LED, and perhaps the output terminals. As the center tap of the transformer will not be used, clip if off very short and connect to the PCB only the two outside wires (yellow and yellow). If you cut all the wires to around 5 inches in length, you will find that most of them can be left in place, as all the components are later mounted in a cabinet. For now, make the solder connections and spread everything out on the bench.

Before applying power, set the trim potentiometer to its approximate mid range and connect your meter (set to its 5 volt AC range) and your oscilloscope to the sinewave output point.

Apply power. If all is well, the 1 KHz sinewave should appear. At this point, adjust the trim potentiometer for maximum output. The output level should, of course, only come up to the 3.54 volt (AC) point as indicated on your meter, or 10 VPP as indicated on the oscilloscope. This is the only adjustment that needs to be made.

Make a quick check of the squarewave output point. It should look like the perfect squarewave — no round corners, no tilt, no droop, a 50% duty cycle, and a repetition rate of 1000 cycles per second. If it doesn't look good, your scope needs repair.

If the instrument does not work properly, a few important points in the circuit to check might be: (1) the +16 and -16 volt points; (2) the 5 volt reference point; and (3) the squarewave source at pin #15 of IC1. Always remember that poor solder connections and wiring errors seem to be the chief causes of the no-workee syndrome.

When your circuit is working properly, you will want to put it in a nice case or cabinet. The case I used (as pictured) was a surplus job purchased at ABC Electronics in Pomona, CA. The cost was only $5.00 and it included the line cord and lots of other goodies. The front panel in the form of an overlay was made from a piece of scrap Formica — note the fancy wood grain finish. This arrangement covered all of the odd placed holes that were present in the original front panel. I applied some paint and press-on lettering and came out with a nice-looking instrument. The instrument name was simply typed on paper, cut to size, and glued in place. The pictures should give you some ideas as to how you might like to mount the parts and lay out the panel.

THINK CALIBRATION! **NV**

PARTS LIST

RESISTORS (all 1/2 watt, 5% tolerance, carbon, unless noted otherwise)
R1: 100 ohms
R2,R3,R4,R5,R16: 1K ohm
R7: 2.2K ohm
R8: 4.7K ohm
R14: 13K ohm
R13: 16K ohm
R10: 68K ohm
R9,R11: 100K ohm
R12: 150K ohm
R6: 220K ohm
R15: 10M ohm

OPTIONAL VOLTAGE DIVIDER RESISTORS
R16=9090 ohms, 1% type
R17=909 ohms, 1% type
R18=100 ohms, 1% type

CAPACITORS
C1,C2: 1000 microfarad, 25 volt, electrolytic, radial leads
C3: 47 microfarad, 25 volt, electrolytic, radial leads
C4,C5,C6,C7: .1 microfarad, 50 or 100 volt, PCB mount
C8,C9: .001 microfarad, 50 or 100 volt, PCB mount
C10,C11: 47 picofarad, 50 or 100 volt

DIODES
D1,D2: 1N4002, (last of the four digits not important)
D2,D3: 1N4148

INTEGRATED CIRCUITS
IC1: CD4060BE, oscillator/divider
IC2: LM3080N, VCA, (3080 only important numbers)
IC3: NE5532N, dual low noise op-amp, (TLO 82: fair substitute)
IC4: LM336Z-5.0, voltage reference/shunt regulator

POTENTIOMETER
POT1: 5K ohm, trim potentiometer, horizontal mount, Radio Shack #271-281

SWITCH
SW1: SPST, miniature toggle

TRANSFORMER
T1: 12.6 volt CT, .45 amp, Radio Shack #273-1365

QUARTZ CRYSTAL
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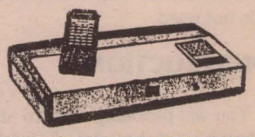

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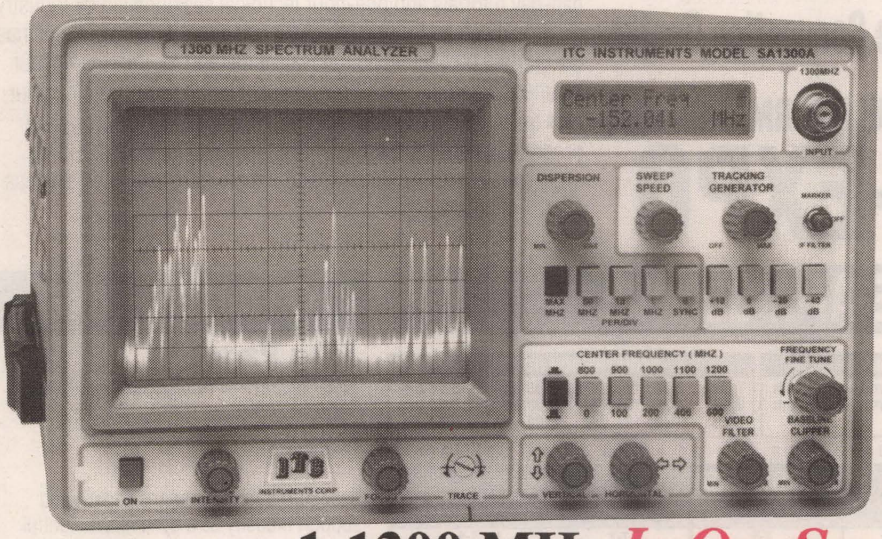

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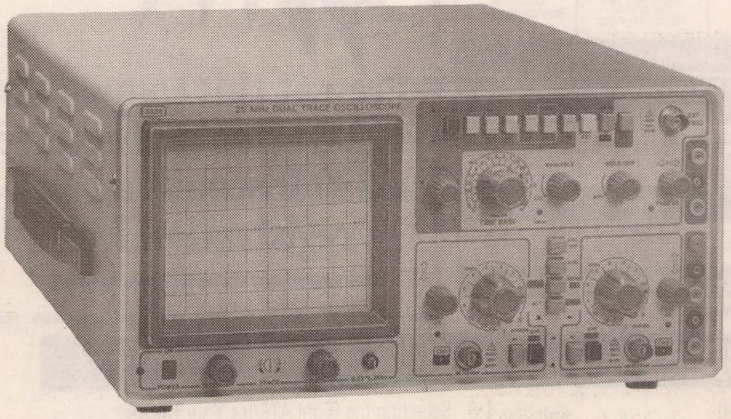

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	T-2 Gaining A Foothold in the UNIX Workstation Service	T-4 New strategies and Tactics for Servicing the Multivendor Environment	T-6 Establishing and Managing a Self Maintenance Program	T-8 Selecting the Right ATE for Your Needs	T-10 New Issues and Approches in Services Marketing

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	A1 HELP DESK	A2 SER. MGMT.-SYS.	A3 MARKETING	A6 SELF-MAINT.	A7 TPM-1	A8 TPM-2
10:00 am - 6:00 pm	EXHIBITS OPEN					
10:00 am - 10:50 am	Building an Effective Helpdesk	Solution Centered Support—New Answer...	Applying Marketing Fundamentals to the Service	Fourth-party Support Industry Trends	Successful Service Partnerships	Implementing ISO 9000 in the Service Industry
11:00 am - NOON	KEYNOTE ADDRESS: John Paget • Rm A4&5					
12:00 pm - 12:50 pm	Microcomputer Asset Management Software and Hardware Inventory	Creating the High Performance Professional Services Organization	Hands Free Support: The Next Frontier			
1:00 pm - 1:50 pm	A Model Help Desk for the '90s	Optimizing Customer Service Levels...	New Approaches Toward Marketing & Selling Services	Case Study: Self Maintenance at AT&T Network	Integration in SCSI Test Equipment: The Step Beyond	Service Trends for Today's Technology
2:00 pm - 2:50 pm	Help Desks as Knowledge Desks:	Self Maintainers Aren't Born... They're Trained	Developing New Business in the Service Market	Flexible Support for In-House Maintenance...	The Technology of Mass Storage Peripheral Reconditioning	The Wireless Customer Service Solutions
3:00 pm - 5:00 pm	PANEL: Self Maintenance • Rm A4&5					

Thursday Aug. 18, '94 — SERVICE & SUPPORT WORLD EXPO '94

	A1 SER. SOFTWARE	A2 SER. MGMT.-SYS.	A3 MARKETING	A6 SELF-MAINT.	A7 TPM-1	A8 TPM-2
9:00 am - 10:00 am	Support Software Innovations:	Using a Service Management System...	Listen to What You Don't Want to Hear!	Case Study: The Interrelationship of Total Quality/Downsizing	Strategic Assessment of New Trends...	Product Disposition Service-The Environmentally...
10:00 am - 6:00 pm	EXHIBIT HOURS					
10:00 am - 11:00 am	Support Alternatives for the '90s	Outsourcing Opportunities - Asset Management and Related Services	Customer Retention and Development Strategies...	Case Study: Combining Vendor Warranty...	A Better Understanding of ISO 9000	Innovations in Customer Service
1:00 pm - 3:00 pm	PANEL: Network Support Alliances • Rm A4&5					

*** All schedules are current at press time but remain subject to change.**

KEYNOTE SPEAKER

John Paget

Vice President of Multivendor Customer Services, Americas, Digital Equipment Corporation

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1. Planning for Quality: Strategies for Growth (Full-Day) — Bill Pollock
2. Gaining A Foothold in the UNIX Workstation Service Market (Full-Day) — Mark Johnson, Apex Computer
3. Harnessing a Help Desk (Full-Day) — Dick Szymanski, Integrity Support Consulting
4. New strategies and Tactics for Servicing the Multivendor Environment (Full-Day) — Don Blumberg, D.F. Blumberg & Associates
5. Implementing ISO 9000 (Full-Day) — Rich Gurecki, Tryonics, Inc.
6. Establishing and Managing a Self-maintenance Program (Full-Day) — Brad Porter, Great Eastern Technology
7. Supporting Multivendor Networks (Half-Day) — Dave Taylor, Computers Made Simple
8. Selecting the Right ATE for Your Needs (Half-Day) — Bob Stasonis, Rob Gregory, Schlumberger
9. Disaster Recovery Planning (Half-Day) — Andres LLana, Jr., Vermont Studies Group Inc.
10. New Issues and Approches in Services Marketing (Half-Day) — Michael Blumberg, D.F. Blumberg & Associates

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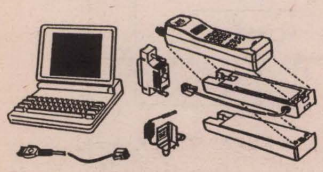

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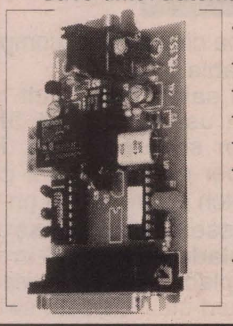

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by Robert M. Harkey

Of all the circuits for intermittent windshield wiper controls that I've seen and tried over the years, this one is the best. I've been using it in a pickup truck for nearly three years — it works fine and has never failed. Nothing very fancy — the entire circuit is wired point-to-point on the back of the time delay pot which is mounted under the dash on an "L" bracket.

So what's so good about it? See Figure 1. Basic timing is accomplished by the old workhorse 555 IC. The resistor and capacitor network on pins 6, 7 and 8 sets the minimum delay at two seconds and the maximum at 20 seconds. My experimentation has shown that's right for me, but you can change it to suit yourself. The 555 output on pin 3 drives a 2N3906 PNP transistor to provide the proper input to the IRF740 power MOSFET. The MOSFET does the work and switches the wiper motor on at the end of the delay time. (I originally used a 12 volt relay but switched to the MOSFET to get rid of the noise and make the circuit more compact and reliable.)

As I said, this circuit has been in use in my old GMC truck for several years. The GM wiper circuit uses a cam and switch arrangement on the drive assembly to cause the wiper blades to "park" in the proper place when the wipers are turned off. This cam switch is open when the blades are parked; the dash mounted wiper switch is in parallel with the cam switch.

See the simplified circuit in Figure 2. The intermittent circuit is wired to the cam switch as shown. When activated, and with the dash switch in the off position, the power MOSFET puts a ground on one side of the wiper motor and the motor starts running. Shortly afterwards, the cam switch closes and forces the motor to continue running (regardless of the MOSFET's on/off status) until the "park" position is reached and the cam switch opens. The motor then stops and one cycle is complete.

From this explanation, it is obvious that the MOSFET only has a load on it for a very short time at the start of the cycle. The MOSFET in my installation has never been heatsinked and has never gotten even warm. This is due to the very low duty cycle and the low "on" resistance of the device (less than .5 ohm). About a year after the initial installation in my truck (and I was convinced that the circuit was trouble free), I potted the entire circuit in clear RTV to prevent accidental shorts and it has been that way since.

Some simplification of the circuit may be possible. By using a "P" channel MOSFET, it may be possible to drive the MOSFET directly from the 555 and eliminate the 2N3906. But I haven't tried this mainly because of my circuit being potted and the lack of a "P" channel power MOSFET in my junkbox. (Incidentally, DIGIKEY Corp. is a good source for power MOSFETs.)

I've found that many people don't use the power MOSFETs because of their susceptibility to damage by static electricity.

A simple way to avoid this problem during installation is to push the FET's pins through a small (1/2 inch) piece of the black conductive foam. Do all your soldering, etc. with the foam in place. When the circuit is completed, tear the foam off the pins with forceps or long nose pliers and your FET will be in good shape and ready to go to work.

So, if you need an intermittent wiper control, get out the soldering iron and junk box and try this circuit. **NV**

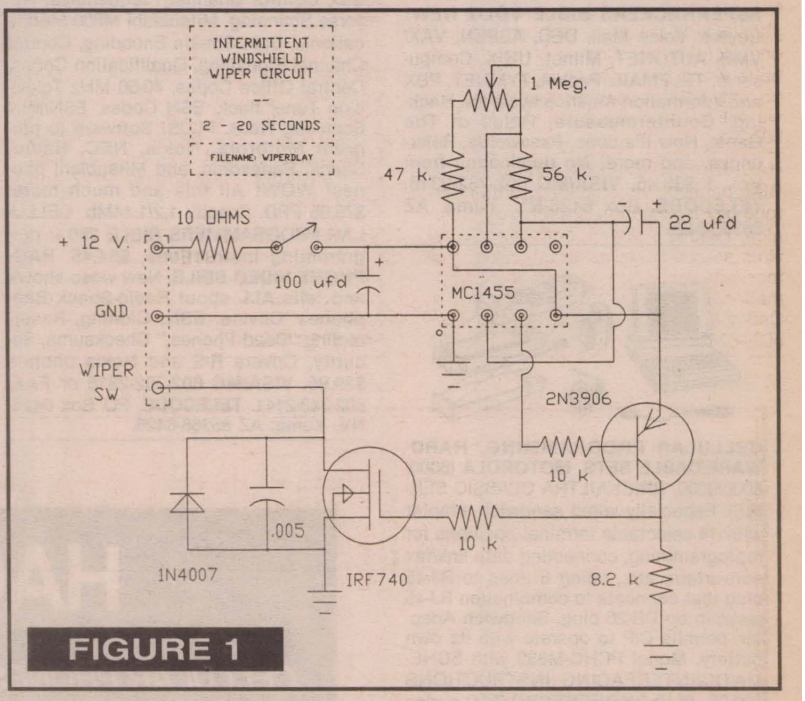

FIGURE 1

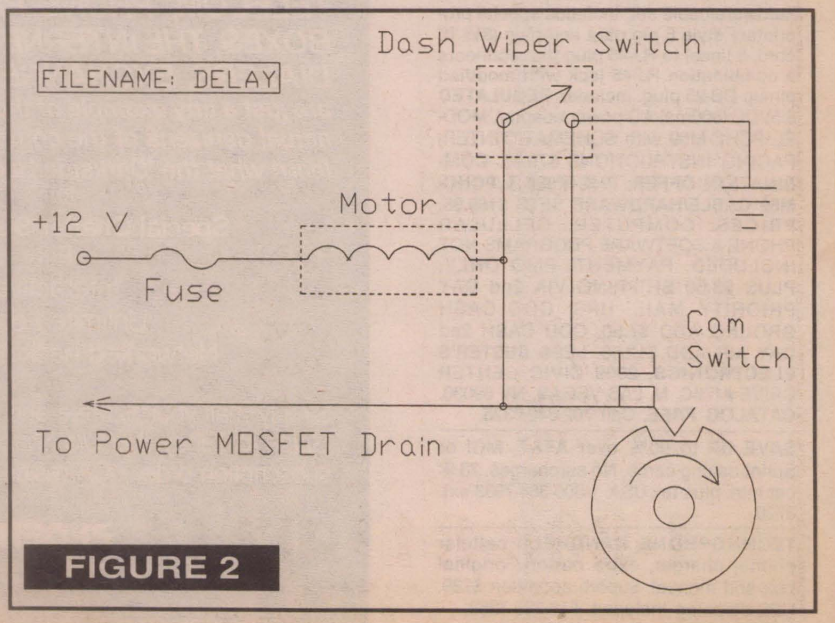

FIGURE 2

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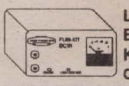

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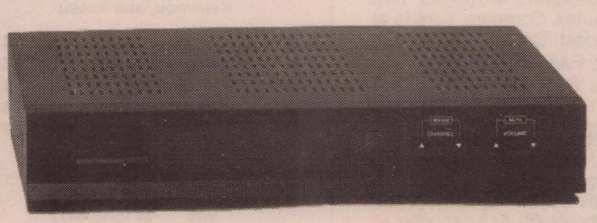

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THE LASER EXPERIMENTER

by
Anthony Charlton

Welcome! In this installment, we shall build a device for monitoring the turbidity of a liquid, and begin an explanitory series of how some modern consumer equipment use lasers in their operation. For starters this month, we'll describe how a CD player works.

Turbidity is described as the amount of solid material that is suspended in a liquid. Particles may be non-toxic or toxic or infectious to various degrees. They also may range in size from something that is visible to the eye down to the size of tiny microscopic bacteria.

Turbidity is different from a material that is DISSOLVED in a solution. The laser is very useful in detecting particles, since because the beam is so brilliant, it can be reflected off particles in a process called SCATTERING. In an absolutely pure liquid, very little light is scattered from particulate matter. Compare that to a liquid like milk, which is a mixture of fats, water, sugar, and other substances. The particulates in milk are so easily scattered by light, that you can see a laser beam shining through a gallon-sized beaker of pure water to which only a few drops of milk have been added.

Laser Can Detect Polluted Water

At my home, I have an annoying situation since a surface well provides the household's water. It's irksome because this well is prone to collecting particulate matter after a good thunderstorm strikes or during a snow thaw. And the particulate matter is transmitted through the piping to the home. Ergo, the tap water becomes cloudy after such weather events. The problem was solved by installing a filter that extracts all particulates down to the micron size. It even has a charcoal filter which makes the water taste fresh and clean. But before that was put in, I made a monitoring device to check the water for particulates, and used the water for cooking and drinking only when the laser showed it was clean (since dirt in the water may often include bacteria).

My neighbor, incidentally, has a similar problem. He has a well 200 feet deep, and his deep-well pump keeps bringing up a fine turbid dust which includes — of all things — fool's gold! (It was from him I learned about this filter. The anecdote also proves that a deep well is not necessarily a clean one.)

But if you feel that your water may contain unwholesome or annoying turbidity, here's a chance to keep watch of it yourself. There are many types of nasty stuff that can destroy the quality of your water. One is chemical pollutants which the laser can't test for. If you suspect them, there are do-it-yourself water test kits available from scientific supply houses. This route is cheaper than having your water constantly tested by a chemical laboratory. However, I must caution there could likely be laws in your area regulating water quality that would pooh-pooh the home testing of water because it wouldn't meet some or another bureaucratic standard.

Scattered particles are clearly shown up by a laser

The Laser Turbidity Tester can detect a variety of suspended substances including minerals, organic material, one-celled animals (some of which can cause nasty illnesses. For instance, the infamous Montezuma's Revenge is caused by a species of Amoeba), algae, and larger bacteria. It cannot detect Coliform bacteria, simply because that must be cultured in a laboratory to determine IF it's Coliform and to quantify the bacteria count per unit volume. Coliform is generally the result of decay. A dead frog in your surface well could quite easily give you a Coliform count that is justifiably unsafe to drink unless the water is boiled first. (Besides, I doubt it would make for social popularity to use such water while mixing cocktails, eh?)

One form of bacteria that is potentially dangerous is fecal Coliform. That is a pretty good indicator that there is animal or human detritus getting into the water supply. This is not to be fooled around with, as it can cause severe illness. We mention that here because if you've ever gotten ill after drinking your water, have it tested and don't play amateur.

The laser can test for turbidity in other liquids besides water. As an example, I was having trouble growing a crystal of Rochelle salt for use in an experiment. I didn't know why crystals would spread all over the bottom of a beaker, and not increase the size of a "seed" crystal like what was supposed to happen.

The problem was revealed when I took a laser and shone it through a solution of the chemical. Even though I used distilled water to mix the solution, it was revealed that the chemical itself was impure, having turbidity caused by an undissolveable solid in it. That solid was serving as the seed to grow crystals by the hundreds on the bottom of the beaker, where the solution was densest, and hence most likely to grow crystals rather than at the seed crystal, which was suspended by a fine piece of nylon line.

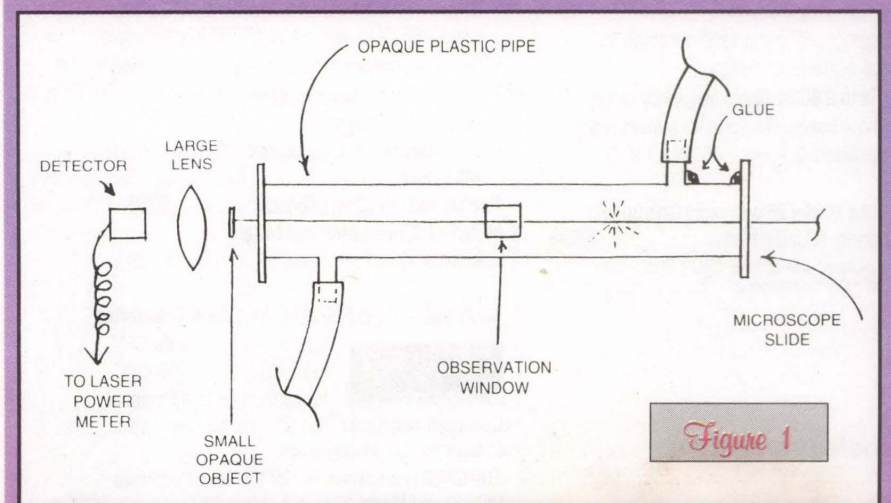

Figure 1

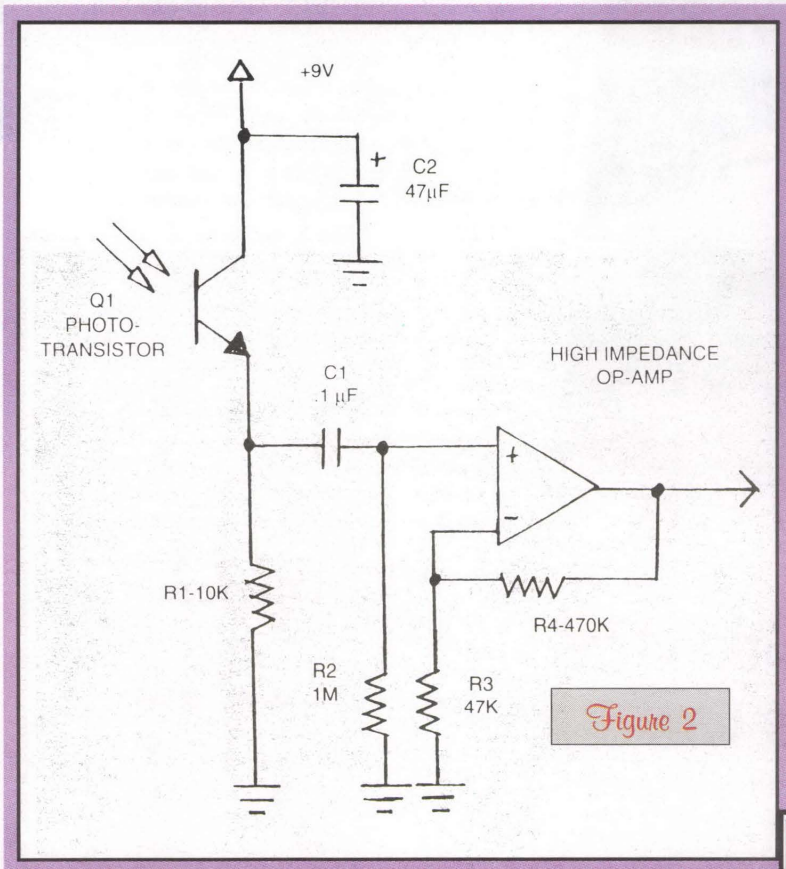

Figure 2

Take a look at the photograph, which shows several things:

1) Refractions of the beam from the beaker.

2) Reflection from the books the beam strikes.

3) Finally, the thin trace where the beam enters the beaker, and scatters off the undissolveable solid matter suspended in the liquid.

This is not a scientifically accurate photo, since it was chosen to be pretty as well as illustrative of the concept. With a practical device, the beaker is replaced with a cell which excludes external light. It also utilizes a sensor that quantifies the amount of scattered light electronically.

Such a cell is shown in Figure 1 and consists of a plastic pipe that is closed on both ends with a microscope slide, equipped with a "viewing port" and has two pinched-off rubber tubes connected to nipples glued to the pipe for filling and emptying the cell. Dimensions are essentially arbitrary. I used a 6" length of black plastic PVC pipe 1/2" in diameter.

The microscope slide was chosen for the ends, despite its fragility, since because it's thin, it refracts and reflects less laser light than glass or plastic of conventional thickness. In fact, the best material for the ends would be a very thin plastic, such as Butyrate in the 10-mil thickness range, but that is harder to glue to.

Ordinary silicone RTV is used to secure the glass in place on the plastic. The slide may easily be cut to size using a conventional glass cutter. Score the slide lightly first on one side, place the score over a hard surface like a table edge, and quickly press down the slide and simultaneously pull it away from the score. Wear gloves if you haven't done operations like this before.

There are two ways to use this cell. The first is to monitor the reflected pulses from individual particles that scatter laser light. This method is used when the particles are large or rather reflective. In this case, you'd mount the phototransistor at the observation window so it can see the particles as they float by it.

The circuit in Figure 2 shows a high-gain AC amplifier that will detect the pulses produced. A high-impedance, high-gain operational amplifier is required here. The circuit is configured as a non-inverting amplifier with a gain of 50. Here's how it works: As the light is scattered off the suspended particles, the resistance of Q1 drops each time it receives some light. Thus, a small current flows which is proportional to the amount of turbidity. If the particles are of the same size and reflective quality, a proportional result may be obtained according to concentration. Capacitor C1 passes the AC component through it, and to the amplifier. Resistor R1 provides a small negative bias so the amplifier's output is near zero voltage with no signal at Q1.

A variety of peripheral devices may be connected to the output. You could connect an LED though a resistor to the op-amp so that it would flash each time a particle was detected by the laser. Or you could attach a current buffer such as a gate of a Schmitt trigger and connect that to a small speaker so you would hear a click each time a particle passed through the beam. Another idea is an integrator, which is a good-sized capacitor with a high-value bleed resistor across it. That way, a charge would accumulate in proportion to the density of the turbidity, and you could get a quantifiable DC voltage to measure.

The second way to use the cell is to directly measure the amount of laser light scattered by the particles as a whole down the full length of the cell. The more the scattering, the higher the turbidity. This works well with tiny particles, like the milk in our example. For this form of measurement, you'd shine the beam down the length of the tube, and block the main portion of the beam with an opaque object, preferably black, like black crepe paper. A large lens is used to catch the scattered laser light, and focus it on a laser power meter. You can use a solar cell in conjunction with your multimeter as an arbitrary power meter. Set the meter on the microampere current range. Or construct the power meter featured in this column in the June '93 issue.

As usual, we'd like to hear about any experiments done with this or other laser apparatus. Write us at the Laser Experimenter's P.O. box if you would like to share your ideas and results.

Inside The Optical System of a Compact Disk Player

Figure 3 shows the optical system of a CD player. As you're probably well aware of by now, a CD player uses a laser diode, also called a semiconductor laser, to read the audio from the disk. CDs are able to pack a good deal more information on their special disk than is possible for magnetic tape, and more importantly, reproduce that audio information with a much higher sound quality. Why? Because the density of information storage is so high.

The CD uses light to read its data, instead of magnetic granules to store information, and the resolution of light is much greater than granules. It's a good time to point out that whatever the storage medium may be, that given an increased data storage capability, the potential opens up for a richer, more dynamic interaction with the person using it.

SOURCES

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.

Midwest Laser Products, P.O. Box 2187, Bridgeview, IL 60455; ph: (708) 460-9595, FAX: (708) 430-9280. Free catalog. Carries new and used laser equipment and inexpensive start-up systems.

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. Free catalog. Top quality electronic parts supplier.

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Allegro Electronic Systems, 3 Mine Mountain Road, Drawer NV, Cornwall Bridge, CT 06754. Mail order supplier of He-Ne laser systems, experimenter-level laser communication & data acquisition kits; plans, specialized equipment & hard-to-find electronic parts. Catalog $1.00.

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, or FAX: (216) 237-0656.

Small Parts, Inc., 13980 N.W. 58th Court, P.O. Box 4650, Miami, FL 33014-0650. Free catalog. Catalog requests: (305) 558-1255.

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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Geo-Monitor, 65 Washington Street, #400, Santa Clara, CA 95050; ph: (408) 749-6770. FAX: (408) 249-3780.

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The first alarm system designed to protect you as well as your car...

Revolutionary new vehicle security system is the first of its kind to focus on the safety of the vehicle driver as well as the vehicle itself.

By Charles Anton

Do you wonder why car alarms have countless features to protect your car, but nothing to protect you? After all, what's more important your car or the safety of you and your family?

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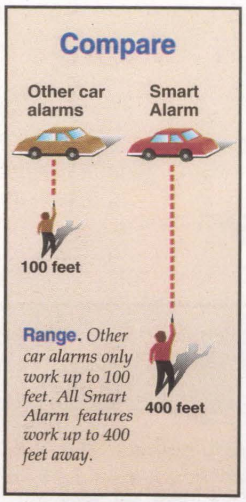

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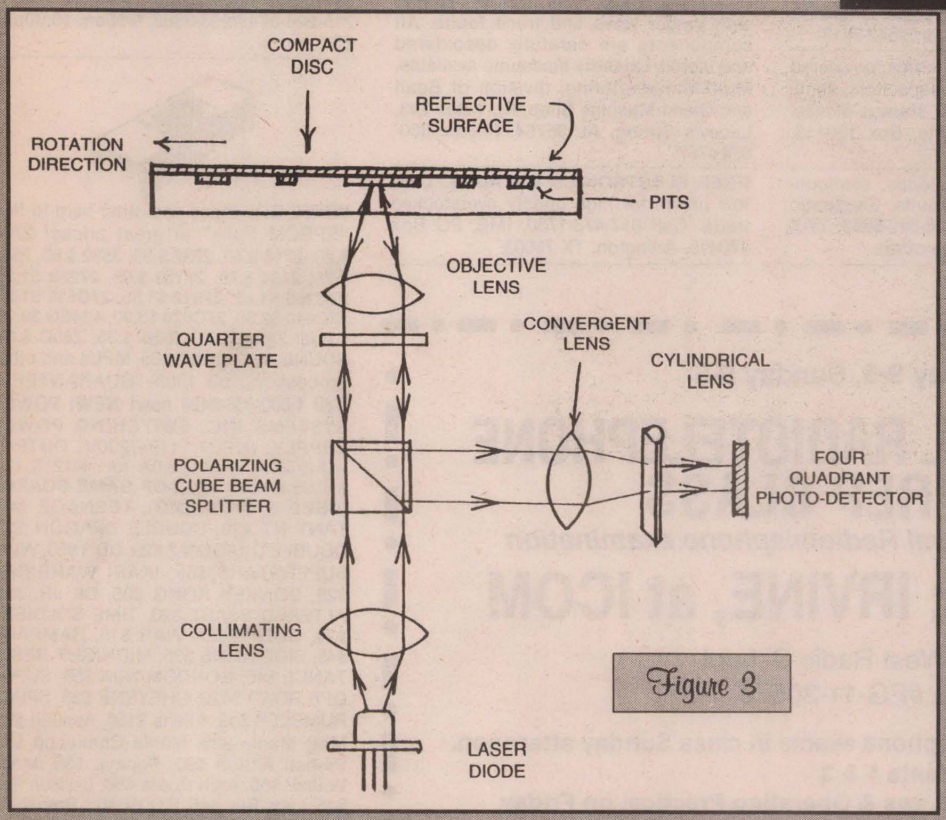

Figure 3

Let's take a tangent for a second, and compare the PDP-8L mini-computer I worked with in high school in the early 70s. The operating system had to be loaded by hand using switches on the computer's front panel; the mathematical language it used had to be loaded by paper tape (which took 12 minutes) and you could do a few interesting little computational programs with the machine, provided their length did not exceed the maximum 4K bytes available — and we all thought that was a big deal. Now, I have an XT-clone with a 120 megabyte hard drive on my desk! This system has a VGA monitor, all the awe-inspiring software programs and yet I regularly get teased that this system is "a dinosaur!"

The point is, there is a certain reverence for the technology of the day, if you are aware of its precursors. Comparing magnetic tape to a CD player is similar to comparing the PDL-8L to the XT. The reader is welcomed to keep that analogy in mind as we continue to describe modern laser-based consumer equipment and how they work in the next few columns.

A Compact Disk uses pits in its surface to store the information it contains. The pits are very small, on the order of 1 micrometer (micron), which is 1000 nanometers (nm). Considering laser light emitted from the diode is 780 nm in wavelength, you can see the pits are only slightly bigger than a single wavelength of the laser used to read them! Incidentally, 780 nm light is barely visible to the eye, and if you run across any CD players whose MECHANICAL systems have failed, salvage the diode to experiment with.

The "read" laser beam is focussed to a small diameter of 1-2 microns, and the pits are burned in at the recording facility by a "write" laser also focussed to a similar size. Each pit is the result of a reflective coating that has been vaporized at the area. When the pits are read, the laser beam follows the optical path shown in Figure 3.

The beam is first collimated by a lens close to the laser diode, and sent through a polarizing cube beam splitter. Part of the beam goes towards the disk, and that portion goes through a quarter-wave retardation plate, and is focussed sharply onto the CD's surface.

The disk has many thousands of tiny rings of information stored on its surface; indeed the tiny nature and the quantity of pits is why you get that "rainbow effect" from a disk, the result of the pits reflecting individual wavelengths of light according to the CD's orientation to the light source and the nature of the light source. When the pits are illuminated, most of the light is diffused on the surface of the disk, and just a little bit returns back through the objective lens.

That light represents the digital data stored on the CD, and the difference between the light diffused and the light returned represent the digital logic signal "0" or "1" depending upon which optical intensity it was at. So no pit means the light was diffused and corresponds to a digital "0" whereas a pit, burned into the disk's surface way down to the reflective coating, returns more light, and is interpreted as a digital "1."

Once the reflected beam is focussed by the objective lens, it next encounters the beam splitter, which polarizes it again, and sends the processed, reflected beam through a lens which focusses it once more, and then through a cylindrical lens which converts the focussed spot into a line of light, just like you would draw a line on a piece of paper with a pen. That line of light falls on a four-quadrant photodiode, which is like a phototransistor except it's a diode that responds to light by increasing its reverse or "leakage" current.

All diodes have a reverse current value, usually measured in micro (10 -[6]), or nano (10 -[9]) amperes. The difference with the photodiode is it's faster, more sensitive, and cheaper than phototransistors that would do the same job. The photodiode also has a special geometry (hence the unusual name "four-quadrant") that enables more efficient detection of low levels of light.

The photodiode converts the light into a digital-level electrical signal, which is amplified and processed by the audio circuitry to ultimately enable you to hear this enhanced quality of sound characteristic of CD players. The photodiode also produces control signals for the proper focussing and tracking of the laser beam.

Usage of the polarizing beam splitter and the quarter-wave plate serve to prevent the reflected beam from the CD's surface from re-entering the laser diode. The laser diode contains tiny mirrors which would re-reflect some of this returned beam, along with the "fresh" beam from the diode. Such an occurance would result in feedback problems, analogous to placing a microphone too close to a speaker, except the feedback would be in the form of light-induced noise instead of audio feedback howl, and of course such noise would severely degrade the performance of the CD player. This system is by the way, entirely non-contact, and eliminates the problems with other methods of recording such as wear, de-magnetization, and dust.

Geophysical Newsletter

The column on "Building A Laser Seismometer" (LEjun94), received some interesting letters. One response came from *Geo-Monitor*, a publication dedicated to "Earthquake Prediction, Amateur Geophysical Monitoring, and Earth Mysteries" who sent a very interesting set of newsletters. This is an outstanding amateur publication, nicely laid out and typeset and captivating by virtue of its variety of topics.

One item that received coverage is: there may be a way to predict earthquakes in advance by monitoring anomalies in the earth's electrical and magnetic signals in the 2-20 Hz range. Further studies are planned in this area, and undoubtably *Geo-Monitor* will keep us informed.

Geo-Monitor is available by subscription for $22.00 for one year (12 issues) by 1st class mail, $30.00 overseas airmail, $2.00 for a sample copy. CA residents add $1.65 sales tax per subscription. The address appears in the "Sources" section of this column.

Next month, we shall look at more consumer devices that use lasers, and build a temperature sensor to add on to the Lazerwave Data Transmitting and Aquisition System that has appeared over the past several months. We'll also give an index to that system and the issues in which relevant articles appeared, and clear up some reader questions regarding the same. **NV**

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.

Closing Quote:

"If you can look into the seeds of time, and say which grain will grow, and which will not, speak then to me."

— William Shakespeare, Macbeth

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 if using your name and address is okay. We can now respond to your letters personally on a "as time permits" basis. Your FAX number, which will be kept confidential, will speed replies.

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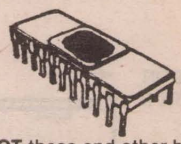

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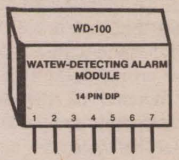

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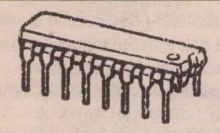

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PUBLICATIONS 140

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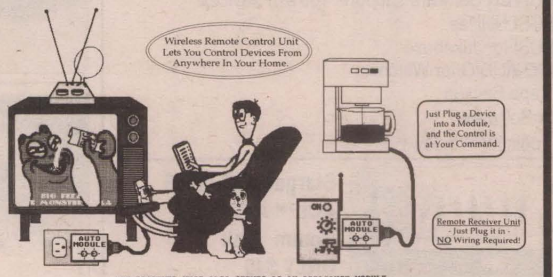

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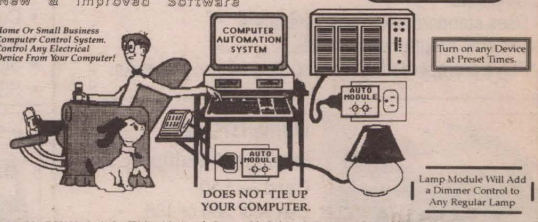

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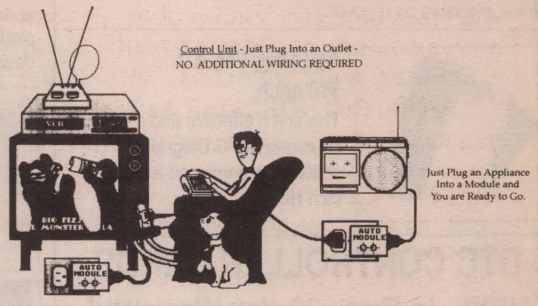

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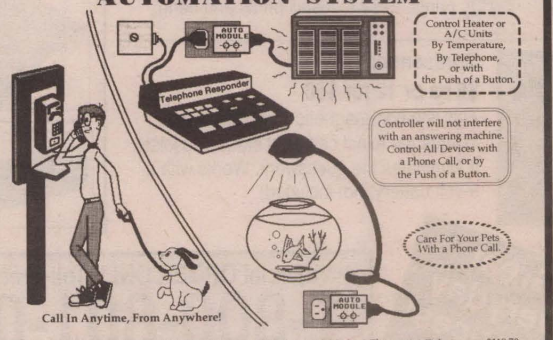

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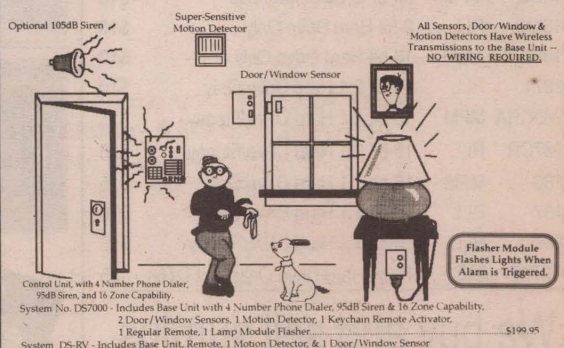

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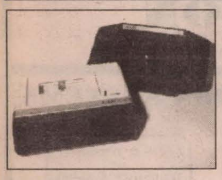

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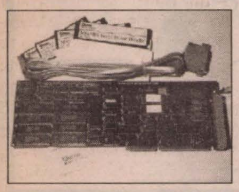

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Use your 386 or 486 computer as a file server for up to 8 RS-232 or RS-422 high-speed terminals. With manuals, cable and PC-MOS and SCO XENIX software. Use multiple cards for increased capacity. SCO Unix driver available on request.

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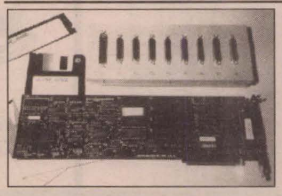

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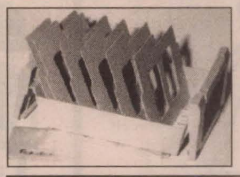

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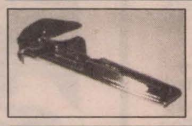

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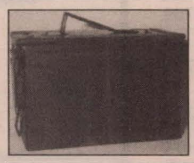

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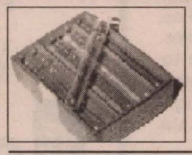

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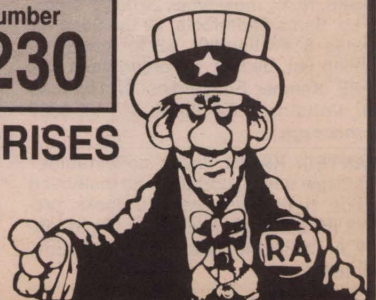

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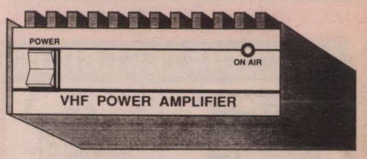

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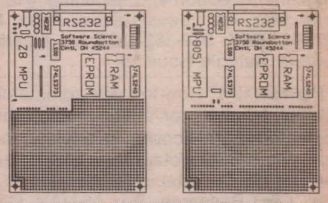

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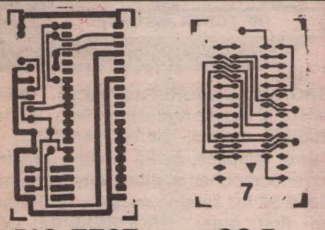

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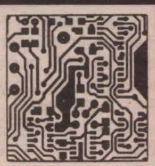

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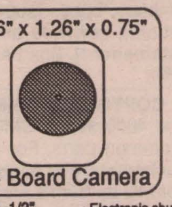

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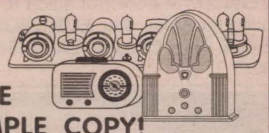

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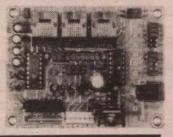

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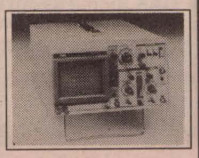

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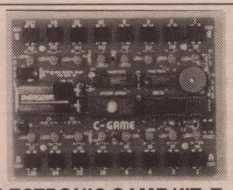

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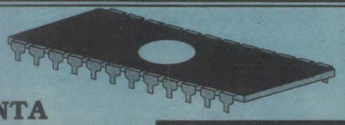

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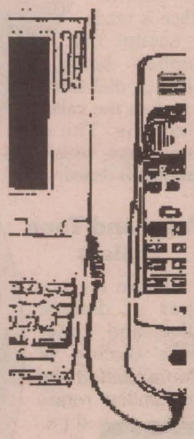

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Build a Telephone Line Analyzer

by
Fred Blechman

When your telephone quits working, it could be the result of any number of different causes. If you are familiar with telephone operation and have a multimeter, you can track down most problems — but you can simplify the task with the Telephone Line Analyzer.

This device checks for proper DC line voltage, AC ring voltage, and loop current, and will detect an open or short circuit in a detachable line cord. You can build the Telephone Line Analyzer from scratch with parts from your "junkbox," or build it from a kit (Elenco Model TT-400) that contains all the parts, including a specially marked meter and a custom cabinet.

Telephone Operation

The primary purpose of the telephone is to transmit and receive voice signals that allow two people with telephones to communicate. To be of practical value, the telephone must be connected to a switching network capable of connecting each telephone to many other telephones.

To accomplish this switching, each subscriber telephone is connected to the telephone company's "Central Office" by two wires referred to as the "local loop." A simplified diagram of this connection is shown in Figure 1.

The "Tip" and "Ring" designation of the + and - leads comes from the days of the manually-operated switchboard. The tip of the plug that the operator used to connect telephones carried the + lead, and the ring immediately behind the tip carried the - lead.

Normally the phone is hung up — "on hook." When you wish to place a call you merely pick up the telephone ("off hook") and a small current flows in the local loop. This current activates a relay in the Central Office indicating that service is being requested. When the Central Office is ready to accept the number being called, a dial tone is sent to your telephone.

When you "dial" a number (rotary or pulse), pulses or tones are decoded at the Central Office. A path is established to the telephone being called. This path may be a simple wire connection to a telephone connected to the same Central Office, or it may go via wire, microwave link, or satellite to a telephone connected to a distant Central Office.

To signal the incoming call, a ringing signal is placed on the local loop by the Central Office of the called telephone. The ringing signal is a 90 volt alternating current (AC) 20 Hertz per second (Hz) signal superimposed on the direct current (DC) voltage of the local loop. A ringing tone is also sent to the calling telephone. When the called party picks up the phone, the ring signal stops and voice communication is established.

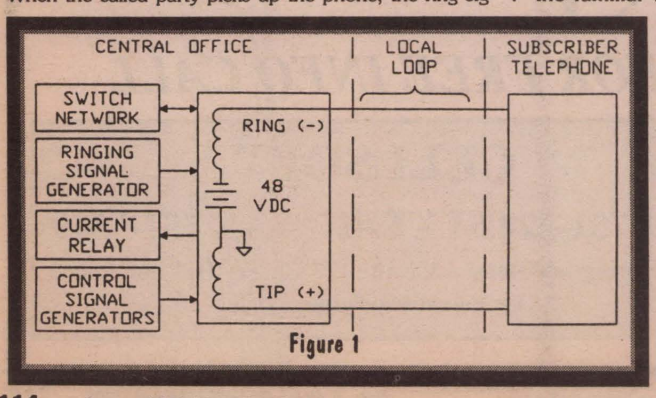


Figure 1

The Telephone Instrument

A simplified schematic diagram of a traditional rotary dial telephone is shown in Figure 2. The dialing mechanism here creates pulses. In the newer electronic type telephones, tone dialing is used, and many of the bulky parts of the old rotary telephone are replaced by transistors, integrated circuits, and piezoelectric buzzers.

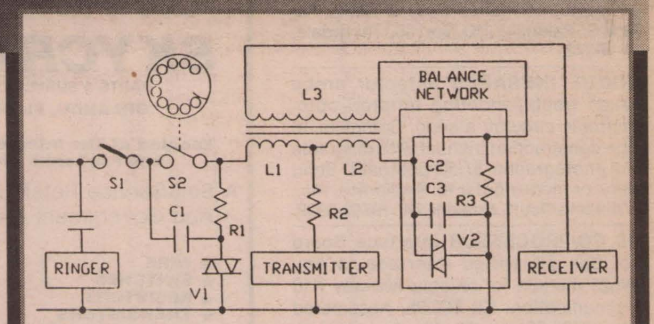


Figure 2

When the hook switch (S1 in Figure 2) is open (on hook) no current flows in the local loop. The nominal 48 volts DC (VDC) from the battery in the Central Office appears on the tip and ring input to the telephone set. When the receiver is lifted (off hook), switch S1 closes and a current of about 20 to 120 milliamperes (ma) flows in the local loop. The resistance of the local loops drops the voltage at the telephone to about 6 VDC.

The current flow activates a relay in the Central Office, requesting service. When the Central Office is ready to accept the number being called, a dial tone is sent to the calling telephone. The dial tone stops when the first digit is dialed.

Pulse and Tone Dialers

There are two types of dialers: pulse and tone. Pulse dialing is accomplished by the familiar rotary dial shown in Figure 2. The dial is rotated to the stop and then released. A spring in the dialer returns the dial to its null position. As the dial returns, the dial switch, S2, opens and closes at a fixed rate. This switch is in series with the S1 hook switch (which is now off hook, and therefore closed).

Each opening of the dial switch interrupts the current in the local loop, thus generating a series of pulses, as shown in Figure 3. The number of current interruptions corresponds to the digit dialed. Dialing a zero sends 10 pulses.

The dial pulses are sent at a rate of 10 pulses per second, so there are 100 milliseconds (ms) between pulses. Each pulse consists of a "mark" interval during which loop current flows, and a "space" interval indicating loop current interruption. In America, the mark interval is 40 ms and the space interval is 60 ms, giving a mark/space ratio of 40/60. In Europe the mark/space ratio is usually 33/67.

Tone dialing is accomplished using a keyboard of 12 keys arranged in four rows and three columns, as shown in Figure 4. Seven distinct frequencies are generated within the telephone instrument. The lower frequencies of 697, 770, 852, and 941 Hz are associated with rows R1 through R4. The higher frequencies of 1209, 1336, and 1477 Hz are associated with columns C1 through C3.

To send any digit, two frequencies are sent to the Central Office simultaneously. For this reason, this method of dialing is referred to as "dual-tone multi-frequency," or DTMF. This is accomplished by having any of the 12 keyboard buttons mechanically close two switches simultaneously.

For example, if the "2" key is pressed, then switches SC2 and SR1 are both closed simultaneously, generating tones at 697 Hz and 1336 Hz. The "column" switches SC1, SC2, and SC3 are ganged to the "row" switches SR1, SR2, SR3, and SR4, as shown in Figure 4.

The Transmitter

The transmitter consists of a metal diaphragm and a metal case insulated from each other, as shown in Figure 5. The case is filled with carbon granules. Wires are connected to the case and diaphragm, and a current is put through the carbon granules. When you speak into the transmitter, the sound waves of your voice strike the diaphragm and cause it to vibrate. This causes the carbon granules to compress and expand. When compressed, the resistance of the carbon granules is less than when expanded. The change of resistance causes a corresponding change in the current. The current thus varies in step with the sound waves of your voice.

In newer electronic type telephones, the carbon granule transmitter is replaced by an electret or other

Telephone Line Analyzer

type of microphone. An electret microphone is made up of a capacitor with a dielectric material that holds a permanent electric charge. Sound waves striking a plate of this capacitor cause the plate to vibrate and thus generate a small voltage across the capacitor. This voltage is amplified by a field effect transistor (FET) mounted inside the microphone. The signal from the microphone is then amplified before being sent to the Central Office via the local loop.

The Receiver

There are several different types of receivers. In principle, they work the same as the speakers in your radio and TV. The speaker consists of a small coil attached to a diaphragm. The coil is mounted over a permanent magnet as shown in Figure 6.

Coil current in one direction causes the coil and diaphragm to be repelled from the permanent magnet. Coil current in the other direction causes the coil and diaphragm to be attracted to the permanent magnet. If a current of audio frequency is sent through the coil, the diaphragm vibrates and generates sound waves in step with the current. Thus, if the current from the transmitter is sent through the coil, the sound produced will duplicate the sound striking the transmitter.

Ringer

As shown in Figure 2, the ringer is connected across the tip and ring inputs in series with a capacitor to block the on-hook 48 VDC line voltage. A typical mechanical bell ringer consists of a permanent magnet attached to an armature as shown in Figure 7.

When an alternating current of 20 Hz is passed through the coils, the armature is alternately attracted to one coil and then the other. The hammer attached to the armature thus strikes one bell and then the other to produce the ringing sound.

In electronic type telephones, the hammer and bell ringer are replaced by a piezoelectric buzzer driven by an electronic oscillator. A piezoelectric material changes its dimensions when a voltage is applied. When the oscillator is running, it applies a 3,000 to 4,000 Hz AC voltage to the piezoelectric buzzer. The buzzer changes its dimensions and produces a 3,000 to 4,000 Hz sound. Since the oscillator is turned on only during 1/2 of each cycle of the 20 Hz ring signal, the buzzer produces sound that is switched on and off 20 times each second.

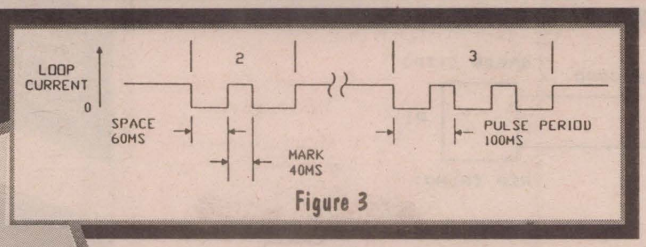


Figure 3

Induction Coil/Balance Network

When transmitting and receiving is done over the same two wires, the problem arises that current from the transmitter flows through the receiver. The speaker then hears his own voice — the "sidetone" — from the receiver. Too much sidetone may be objectionable to the speaker and cause him to speak too softly. However, a small amount of sidetone is desirable to keep the telephone from sounding dead.

The Balance Network of older telephones, as shown in Figure 2, requires some explanation. The induction coil and balance network limit the sidetone. The impedance of the balance network approximately matches the impedance of the local loop. Thus, about half of the current from the transmitter flows through L1 and the local loop, and the other half flows through L2 and the balance network. The currents in L1 and L2 induce voltages in L3 of opposite polarity, thus limiting voltage across the receiver to an acceptable level. When receiving a signal from the local loop, the currents in L1 and L2 induce voltages in L3 of the same polarity and these voltages combine to drive the receiver. Newer telephones perform this function electronically.

Circuit Description

Now that you have some understanding of how a telephone system works, the schematic of the Model TT-400 Telephone Line Analyzer (Figure 8) can be explained. Basically, it consists of a specially marked, one milliampere meter movement with the necessary parts to read telephone line current and voltage.

As you may already know, a milliampere meter can read current greater than the basic meter movement by using a parallel path for current around the meter. Also, a meter can read voltage by adding series resistance to reduce the current flow to the meter's basic movement. By the proper selection of resistor values, you control the full scale meter readings.

The plug at the end of the TT-400 telephone cord, P1, plugs into a wall telephone jack. If wired properly (green is DC positive, red is return), this feeds positive voltage to J1, with the return through J2.

Assuming the wall jack is properly wired, and switch S1 is in the LOOP position (as shown) and nothing is plugged into input jack, J7, the local loop current from the Central Office flows through diode D1, through terminals 5 and 6 of S1, through potentiometer R1 and resistor R2, through terminals 3 and 2 of S1, through the DC meter, and returns to the Central Office through diode D4.

But notice resistor R4. This allows some current to go back to J2 through D4 without passing through the meter. This is known as a "shunt." By the proper selection of resistor values, and setting potentiometer R1 to the proper value on calibration (as described later), the full-scale meter reading is 60 ma, making the beginning of the LOOP OK marking on the meter face about 20

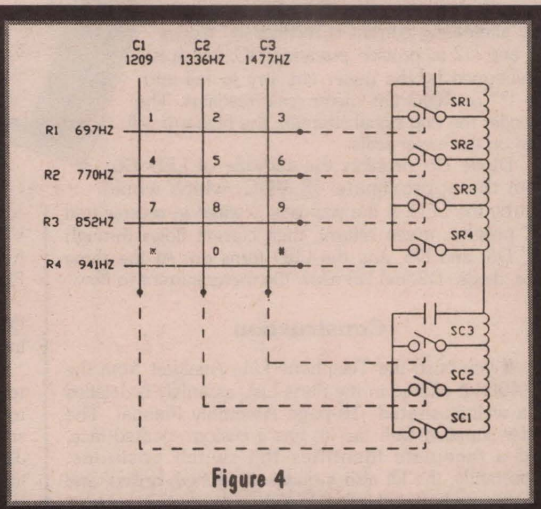


Figure 4

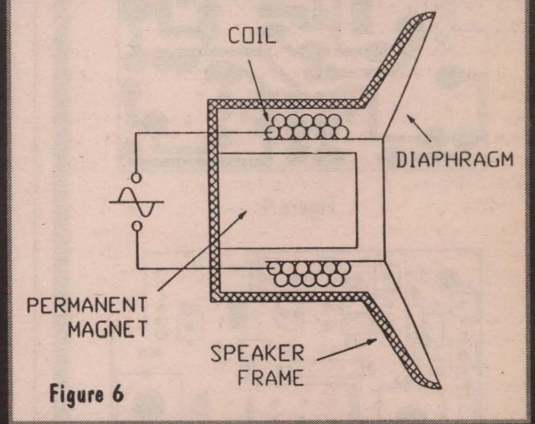


Figure 6

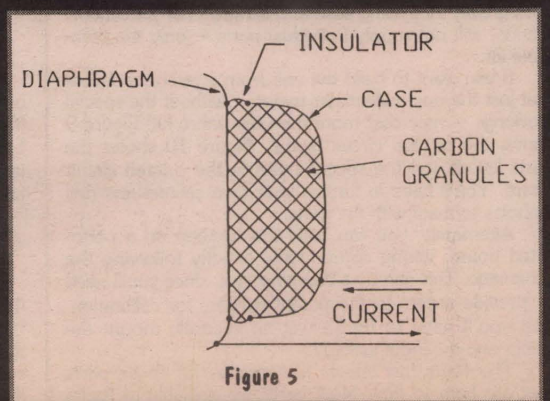


Figure 5

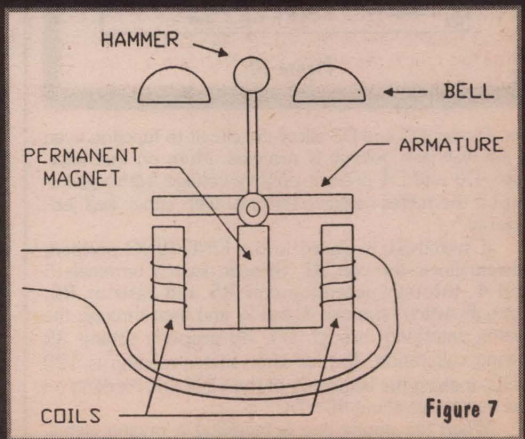


Figure 7

Telephone Line Analyzer

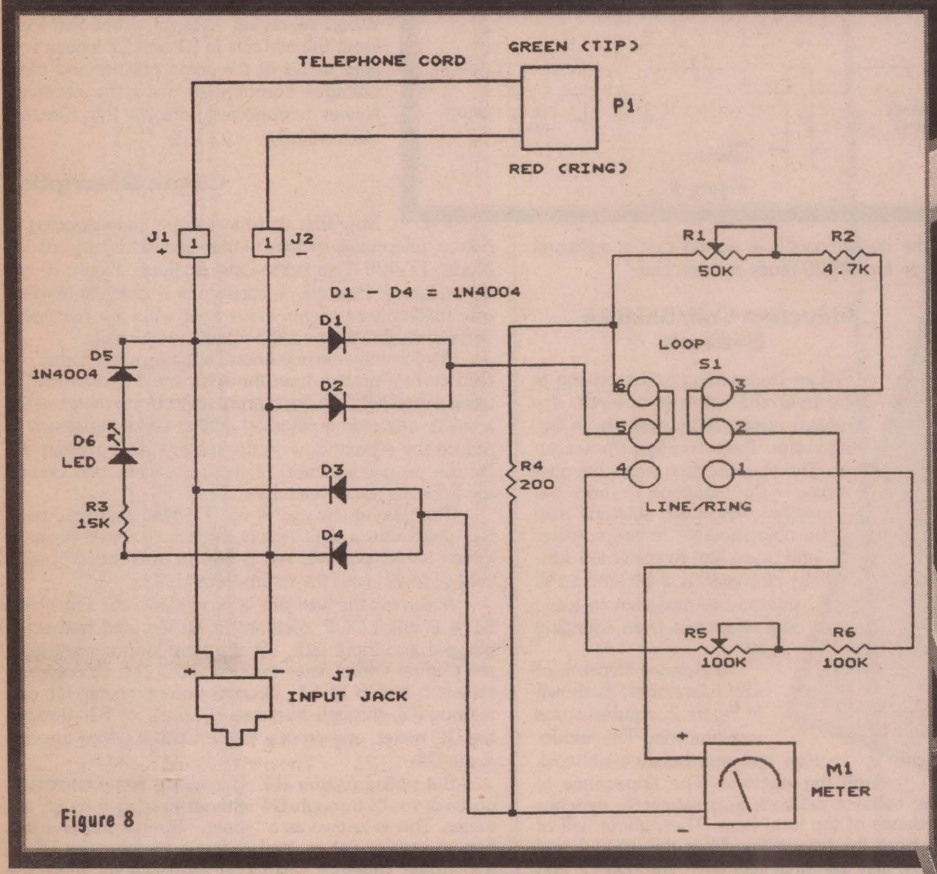
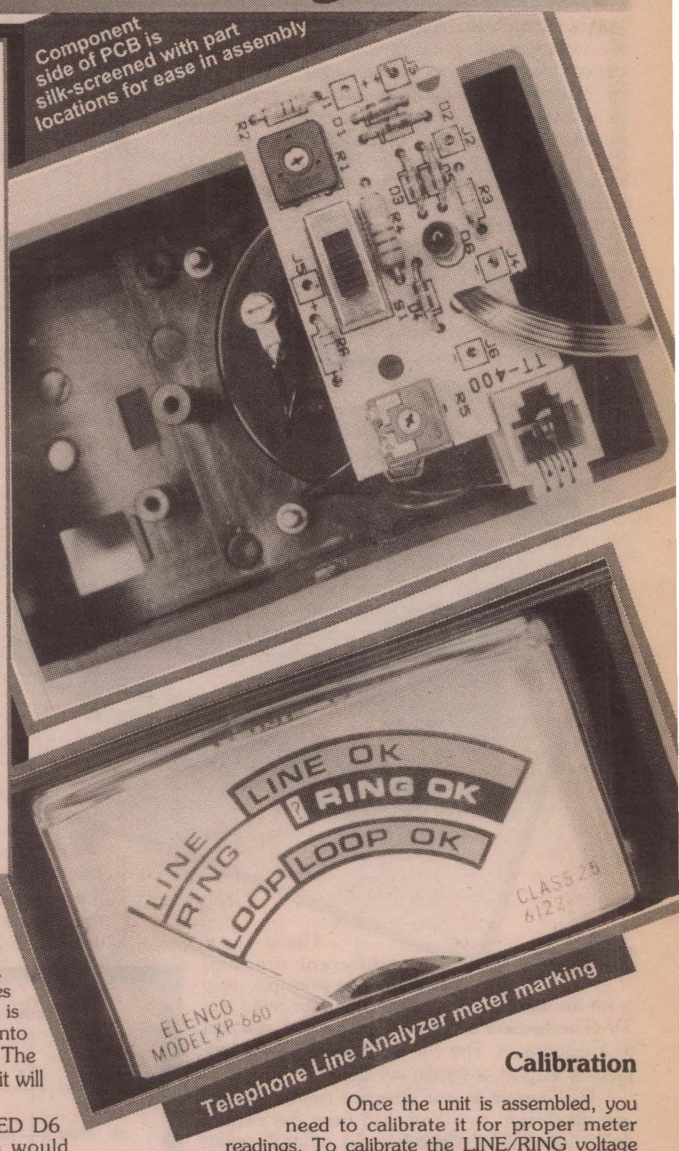


Figure 8



Telephone Line Analyzer meter marking

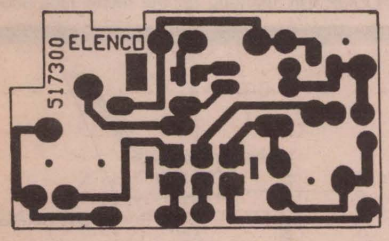


Figure 9

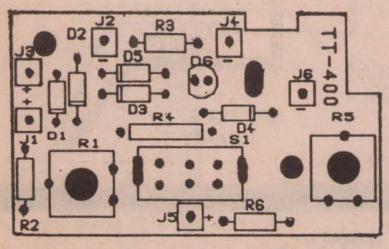


Figure 10

ma. Diodes D2 and D3 allow the circuit to function even if the wall jack polarity is reversed. More on that later. Also, D3 and D4 prevent positive voltage from appearing on the meter negative terminal with either wall jack polarity.

If switch S1 is placed in the LINE/RING position, current flows through D1, through switch terminals 5 and 4, through potentiometer R5 and resistor R6, through switch terminals 1 and 2, and then through the meter, returning through D4. By properly setting R5 during calibration, the full-scale meter reading is 120 VDC, making the beginning of the LINE OK marking on the meter face about 40 VDC.

When the phone line is receiving a ringing signal, about 90 volts of alternating current is applied on top of the normal 48 VDC voltage 20 times a second. The negative half-cycles of this alternating current cause the LED to flicker. The alternating current is rectified by diodes D1 and D2 to provide pulsating DC, which is conditioned by the meter circuitry to fall into the "?" or RING OK meter scale readings. The stronger the ring signal strength, the higher it will read on the meter scale.

Diode D5 protects the cathode of LED D6 from the approximate 48 VDC, which would destroy the LED. If the wall jack is wired in reverse (red DC positive, green return), then current flows through R3, D6, and D5, and the LED turns on. At the same time, diodes D2 and D3 allow the meter current to flow.

Construction

If you build the Telephone Line Analyzer from the TT-400 kit offered in the Parts List, assembly is detailed in a well-illustrated, 16-page Assembly Manual. The meter supplied with the kit has a custom marked face, and a faceplate identifies the switch positions. Importantly, the kit also includes an etched, drilled, and silk-screened printed circuit board, and a custom cabinet, both greatly increasing ease of assembly. The kit vendor, Elenco, will not supply individual parts — only the complete kit.

If you want to build the unit from scratch, be aware that just the one milliameter meter — without the special markings — may cost more than the entire kit! Figure 9 shows the printed circuit layout. Figure 10 shows the parts layout and the special holes in the printed circuit board. You'll have to furnish your own cabinet and drill all holes to mate with the parts.

Alternately, you can build the circuitry on a perforated board, wiring components directly following the schematic. This can be a daunting task, since you'll need to provide access to the potentiometers for calibration, and you'll have to find a way to securely mount the meter and the input jack, J7.

The Parts List shows the sources for those parts that are hard to find. Most parts are available at Radio Shack and other electronic suppliers.

Calibration

Once the unit is assembled, you need to calibrate it for proper meter readings. To calibrate the LINE/RING voltage scale, set S1 to the LINE/RING position, and apply 20 VDC. Adjust R5 until the meter needle is at one sixth full scale (the last line of the letter N as shown in Figure 11).

Reverse the voltage at J1 and J2, making J2 positive. The LED should light brightly and the meter reading should drop.

To calibrate the LOOP current scale, set switch S1 to LOOP. Using a source of variable voltage, or an appropriate dropping resistor with a fixed voltage source, apply 20 ma of direct current between J1 and J2, with J1 positive. With a milliammeter in series reading 20 ma, adjust R1 until the meter needle is just at the beginning of the LOOP OK scale.

Troubleshooting

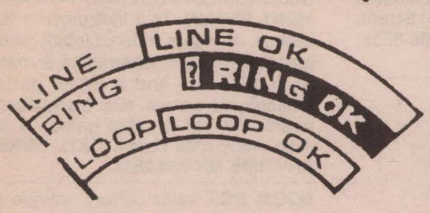
If something isn't working, it is usually due to a bad connection or solder joint, a part in "backwards," or (rarely) a defective part. Make sure all diodes (and the LED) are properly oriented, that the incoming cable and jack J7 are wired properly, that the meter connections are not reversed, and that all connections are good.

Using the Telephone Line Analyzer

Four significant tests can be performed with the TT-400: Line/Polarity Test, Line Cord Test, Ring Test, and Loop Test. The easiest is the Line/Polarity Test. Just set the TT-400 switch to LINE/RING and plug the phone cord from the TT-400 directly into a telephone wall jack. If all phones on the line are hung up, this measures the local loop on-hook voltage, moving the meter needle

Telephone Line Analyzer

Figure 11



into the LINE OK area of the face.

The polarity part of this test is just a matter of looking at the LED. The LED should NOT light! If it does, the wall jack is wired with reverse polarity for the red and green wires; green should be positive.

Now plug a telephone into the TT-400 INPUT jack. With all phones on the line hung up (on hook), nothing should change. Lift the receiver and the meter needle should drop to near zero (actually, about 6 VDC).

If the meter reads below the LINE OK area, the telephone plugged into the TT-400, or an extension phone, may be defective; unplug them one at a time to see if this brings the meter reading into the LINE OK area. If not, the problem is in the telephone line itself.

For the Line Cord Test, set the switch to the LINE/RING position. Plug one end of the line cord to be tested into the telephone wall jack and the other end into the TT-400 "INPUT" jack. If the wall jack is wired properly, the LED *should* light (since the input jack, though marked INPUT, is actually an OUTPUT to a telephone). The meter should read in the LINE OK area. Jiggle the line cord. If the meter needle is erratic or drops near zero, the line cord is bad.

To perform the Ring Test, the switch should be in the LINE/RING position, with the TT-400 plugged into the telephone wall jack, and a telephone plugged into the TT-400 INPUT jack. All telephones on the line should be hung up. The meter should read in the RING OK area, or at least in the "?" area. Now either call this phone number from another phone line, or have a friend call this phone number. When the phone rings, the LED should flicker, and the meter needle should increase about one eighth inch up scale.

If the meter does not increase, or the phone does not ring, you may have too many extension phones or devices on the same phone line. Each device has a REN (ringer equivalence number) that should be indicated on its nameplate. The total of all RENs (just add them) should be 5.0 or less.

To perform the Loop Test, put the TT-400 switch in the LOOP position to measure local loop current. (Note: Anyone calling you while the TT-400 is connected to the wall jack with the switch in the LOOP position will get a busy signal!) Plug the TT-400 line cord into the telephone wall jack. The meter should read in the LOOP OK area. Plug a telephone into the TT-400 INPUT jack. With all phones on-hook, nothing should change. If the meter needle drops, remove phones from the line until it's back to normal. Be aware that sometimes high demand from the Central Office can lower the local loop current. If it seems low, check it several times at 20 minute intervals. **NV**

Fred Blechman has written over 650 magazine articles and five books about electronics and microcomputers since 1961.

Parts List

D1-D5 — 1N4004 1 amp 400 PIV diode
D6 — Red light emitting diode
P1 — Telephone cable assembly (Western Electric D4QK-7, Mouser 17MP107)
J7 — Telephone modular jack (Western Electric 623K4, Mouser 16HK623)
R1 — 50,000 ohm 1/4 watt potentiometer (Mouser 569-25PR-50K)
R2 — 4,700 ohm 1/4 watt 5%
R3 — 15,000 ohm 1/4 watt 5%
R4 — 200 ohm 1 watt 5%
R5 — 100,000 ohm 1/4 watt potentiometer (Mouser 569-25PR-100K)
R6 — 100,000 ohm 1/4 watt 5%
S1 — DPDT switch
M1 — 1 milliampere DC panel meter (Mouser 564-72T-2001)
Miscellaneous: Wire, solder, cabinet, circuit board

Source: A complete Telephone Line Analyzer Kit, which includes ALL parts, specially-marked meter, printed circuit board, cabinet, wire, solder, and detailed Assembly Manual, is available from:

Elenco Electronics, Inc.
150 West Carpenter Avenue
Wheeling, Illinois 60090
Phone: (708) 541-3800

Kit TT-400K: $21.50 plus $3.00 shipping USA.
Assembled TT-400: $33.25 plus $3.00 shipping USA.
Illinois residents add 7.75% sales tax.

SPECIFICATIONS

DC LINE VOLTAGE (On Hook) TEST	
Switch Position:	LINE/RING
Line OK:	1/3 Full Scale= 40 VDC input
	Full Scale= 120 VDC input
Reverse Polarity:	"REV POL" LED ON
Accuracy:	3% at 40 VDC
RING TEST	
Switch Position:	LINE/RING
RING "?":	20 Hz 40-48 Vrms on 48 VDC
RING OK:	20 Hz 48-130 Vrms on 48 VDC
(Note: "REV POL" LED will flicker during ringing.)	
LOOP TEST	
Switch Position:	LOOP
LOOP OK:	1/3 Full Scale= 20 ma input
	Full Scale= 60 ma input
Accuracy:	3% at 20 ma

#155 MANUALS—SCHEMATICS WANTED *cont.*

I WOULD like to get a schematic for a Dokorder audio tape deck model #7140 made by Denki Onkyo. I'll pay for schematic or copy. Nicholas TV Service, 79 Broadway, Park Ridge, NJ 07656. Denki Onkyo is out of business.

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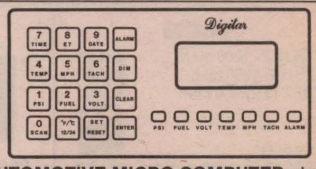

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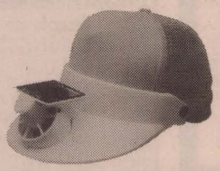

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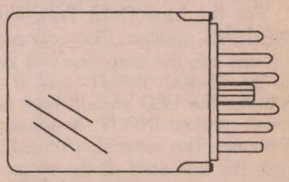

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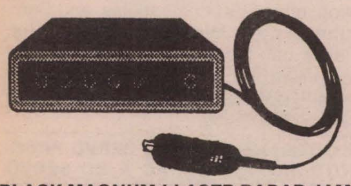

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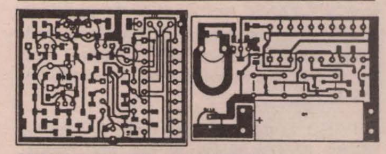

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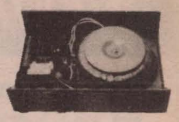

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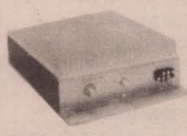

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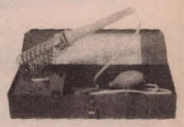

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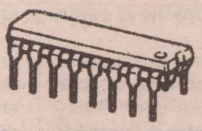

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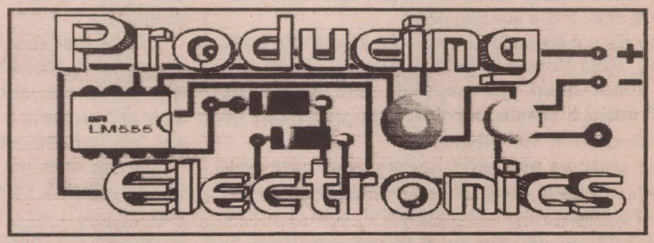

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AMATEUR ROBOTICS

by Karl Lunt

I recently got a chance to review Network Cybernetics Corporation's AI CD-ROM (revision 2). Although the title implies this is a disc filled with Artificial Intelligence software, many of the programs will prove useful (and fun) for robotics enthusiasts as well.

This CD-ROM is an ISO-9660 format disc, compatible with CD-ROM drives on nearly any type of machine, including PCs, Macs, and Amigas.

The disc contains about 275 Mb of software, all of it compressed with PKZIP. The files are divided into directories based on subject matter.

Some of the compressed files do not contain executable software. Instead, they hold .GIF images, text files, or databases useful to researchers or hobbyists.

Occasionally, the compressed files contain not only PC-based executables, but source files suitable for compilation on other platforms, such as Macs and UNIX systems.

The root directory on the CD-ROM contains a file named 00_index.txt. This is a directory listing of all files in all subdirectories on the disc, complete with a one-line comment describing each file. Printing this file generates about 40 pages of printout, but the listing comes in handy when you want to browse through the different directories.

Additionally, each subdirectory contains its own 00_index.txt file, listing the files (with comments) in that subdirectory.

I browsed through some of the subdirectories, trying one or two programs that sounded interesting. What follows are some of my notes and observations.

\ROBOTICS

The file 6811srvo.zip contains a text file originally posted to the comp.robotics newsgroup on usenet. The comment in the 00_index.txt file implies that this file contains assembler source for controlling R/C servos from a 6811.

Strictly speaking, this isn't true. The file contains text describing basically how the technique works, but the text certainly couldn't run through an assembler as is. Still, it is a starting point.

The file robofest.zip contains 28 snapshots from the May 1993 Robofest, held in Austin, TX, by the Austin Robot Group. The snapshots have been saved as .GIF images, suitable for displaying with many of the public-domain .GIF viewers.

The pictures are fairly low-res, but quite presentable. I wish the Austin Robot Group had included some explanatory text for each snapshot. I would have enjoyed descriptions of the people and robots in the photos.

File ir_pd.zip contains a text file, posted to comp.robotics in February 1993, describing an IR proximity detector built with a 3900 op-amp and a 555 timer. The author, Bob Lee of Bowling Green State University, included a schematic of his design. The schematic was created with text characters, and clearly shows why text-based schematics are difficult to read, write and understand.

File sonar.zip contains a good technical article on sonar system design and theory, based on the Polaroid Ultrasonic transducer kit. The article was written by Jess Jackson and Jerry Burton of the Robot Society of Southern California. The article is well written and very informative, but it references schematics and figures that are not supplied on the CD-ROM.

File sonarart.zip contains the text from an article by Keith Payea, originally published in 1993 in the Encoder, the newsletter of the Seattle Robotics Society. The article, entitled "Sonar on the Cheap," describes a simple, but effective, sonar ranging circuit that can be driven by common MCUs such as the 68hc11. The text gives some Digi-Key part numbers for key components, but needed schematics and figures are not supplied.

This theme of missing schematics and other key documentation quickly became irritating. I understand why it happens. Often, an article's schematic exists only as line-art, or as a CAD drawing in some drafting package.

It can prove very time-consuming to translate such a schematic into some common type of data file, suitable for printing by the end user. Sure, Postscript is a pretty universal file format, but getting from the author's original artwork to an accurate Postscript file can be difficult, if not impossible.

Still, the schematics are so vital that I wish the CD-ROM publishers would put more effort into providing both text and schematics. Keith's article, without the schematic, is little more than interesting reading. With the schematic, you could build a working sonar unit in a couple of evenings.

The file cmurobot.zip contains a text file listing major robotics papers published at Carnegie Mellon University (CMU) during 1991. This list was compiled by someone at CMU as a personal effort. The list contains citations, titles, and abstracts of each paper. The file also includes notes on ordering copies of any paper, though the method might have changed in the last three years.

The file joystick.zip contains C and ASM source files for reading a PC's joystick. The source code does not include an author's name, but it does carry the notation "Firmware Furnace #4." This implies the files are somehow related to Ed Nisely's column of that name; check out the early *Circuit Cellar Ink* magazines.

Note that this file contains the source code, makefiles, and executables for two joystick routines, one slow and one fast. It does not contain any text from the articles.

It also does not provide information on which C compiler was used. I can tell you it wasn't Microsoft Quick C version 2.5. Although the file joyfast.c compiled, the makefile contained unrecognizable instructions for the link operation.

This is another area in which I wish the CD-ROM publishers would take the extra step. The original article must have described the compiler and linker used in creating the executables. Why can't the CD-ROM publisher pass that information along in the disc files?

Better yet, I'd like to see the CD-ROM publishers work with either the original author or another highly technical person, to supply makefiles and related information for several popular compilers. Then the user could quickly customize the supplied software, starting from a program known to compile properly on his or her system.

The file robotfaq.zip contains the text, in two parts, of a sample "Frequently Asked Questions" file for the comp.robotics newsgroup. This file, commonly known as the FAQ file, is usually updated once a month or so and posted to comp.robotics.

This copy of the comp.robotics FAQ file is dated 4 June 1993, and was prepared by Kevin Dowling of the CMU Robotics Institute. The FAQ file contains a wealth of information on robotics, including sources for parts and software, pointers to important papers, and FTP sites that carry robotics information.

Most widely-read newsgroups have a FAQ file. Its creation and maintenance is usually a labor-of-love, taken on by one or more contributors to help all readers of the newsgroup. I consider the FAQ files one of the most useful and powerful elements of the Internet culture. Thanks to Network Cybernetics for including a sample FAQ file on their CD-ROM.

\AI

The AI subdirectory contains "files on computer planning, reasoning, cognition, consciousness, and creativity." It also contains the source code listings for all programs listed in issues of *AI Expert* magazine, through the June 1992 issue. It also contains many additional files, all related to Artificial Intelligence.

The file aie9206.zip is one of about 50 files related to the *AI Expert* magazine. It contains the source code for the June 1992 issue of the magazine, as supplied on the CD-ROM.

I chose this file purely at random, to get a feel for the code provided. The code was written for the Zortech C++ compiler and, per the comments, "trains a CMAC to produce an odd parity bit when given an input vector with three components."

Since my AI background is a little weak, I haven't a clue what this software does. The program

```
iobase    equ  $1000          start of I/O regs
baud      equ  $2b            offset to BAUD
sccr2     equ  $2d            offset to SCCR2

      ldx      #iobase        point x at I/O regs
      ldaa     #$30           9600 baud with 8 MHz xtal
      staa     baud,x         write to BAUD
      ldaa     #$0c           enable rcvr and xmtr
      staa     sccr2,x        write to SCCR2

          SCI initialization in assembly language
-------------------------------------------------------------

hex

102b  constant  baud          ( addr of BAUD register )
102d  constant  sccr2         ( addr of SCCR2 register )

   init-sci
   30  baud  c!               ( 9600 baud with 8 MHz xtal )
   0c  sccr2 c!               ( enable rcvr and xmtr )


              SCI initialization in tiny4th
-------------------------------------------------------------
```

accompanied an article written by George Burgin. The text of the article is not given, nor is a makefile supplied.

\AL (Artificial Life)

The file em22.zip contains a set of programs, developed in Denmark, that claim to be some type of evolution machine, version 2.2. Unfortunately, the compressed Turbo C source files were secured with a password.

The accompanying readme file indicates that you should contact the authors, either by mail, E-mail, or phone. Supposedly, you would then be given the password to unlock the files. I didn't bother.

I don't mind seeing demo versions of programs on a CD-ROM, provided they are high-quality and their number is kept to a minimum. But what possible good does it do to take up CD-ROM space with locked software such as this? This program's developers should either distribute a working demo version, distribute the unlocked source, or get out of the game.

I also believe that Network Cybernetics should consider pulling this file, and any others like it, from its upcoming Revision 3 disc.

The file mcroants.zip contains a PC-based graphical simulation of an ant colony. Ants in the colony move around, locating "food pellets" and "eating" them. These ants can share food, mate with other ants, or, if they eat one of the poison pellets, die.

Offspring share genetic information from both parents. The program records each ant's genetic coding and vital statistics. The file also includes an article on genetic algorithms. This is a well-done program, excellently designed and fun to watch.

```
(
( The following three variables serve as vectors
( for all character I/O routines.  The core words
( EMIT, KEY, and ?TERMINAL actually fetch the
( contents of the appropriate variable and execute the
( word found there to perform their function.
(
( Thus, by simply writing the address of a different
( word into one of these vectors, you can alter the I/O
( device used by EMIT, KEY, or ?TERMINAL.
(

variable  OutVector             ( holds address of word to
                                ( send character to active
                                ( output device


variable  InVector              ( holds address of word to get
                                ( a character from active
                                ( input device

variable  CheckVector           ( holds address of word to
                                ( test for character on active
                                ( input device


:  emit            ( c -- )
   OutVector  @  execute
;


:  ?terminal            ( -- f )
   CheckVector  @  execute
;


:  key             ( -- c )
   begin
      ?terminal
   until
   InVector  @  execute
;


:  emit-sci    ( c -- )        ( send char at tos to SCI port
   begin
      scsr  c@                 ( get the status
      80  and                  ( check transmit-empty bit
   until                       ( loop until SCI is ready
   scdr  c!                    ( send char out the SCI port
;

:  ?terminal-sci    ( -- f )   ( test SCI for available char
   scsr  c@                    ( check SCI status
   20  and                     ( return 0 if nothing there
;



:  key-sci     ( -- c )        ( get char, put on stack
   begin
      ?terminal                ( see if a char is available
   until                       ( loop until char is there
   scdr  c@                    ( get char and leave on stack
;



:  Init-SCI        ( -- )      ( initialize SCI
   30  baud  c!                ( set baud = 9600
   0c  sccr2  c!               ( turn on xmtr and rcvr

   [']  emit-sci               ( get address of sci output
   OutVector  !                ( and initialize outvector

   [']  key-sci                ( get address of sci input
   InVector  !                 ( and initialize invector

   [']  ?terminal-sci          ( get address of sci check
   CheckVector  !              ( and initialize checkvector
;

                Vectored execution in tiny4th
```

\ANN (Artificial Neural Nets)

The files nets30a, nets30b, and nets30c.zip contain the C source code for the NASA NETS v3.0 neural net tool set. It compiled under Microsoft Quick C version 2.5 after minor changes to the makefile; I had to change all references in the makefile from "cl" to "qcl."

The resulting executable loads and runs, but the menu options presented are beyond my understanding. The NETS package includes makefiles for Borland C and Microsoft C on the PC, Think C on the Mac, and other compilers/platforms.

\CA (Cellular Automata)

File dr_life.zip contains an excellent VGA Life game. This is the ever-popular computer game, first developed by John Horton Conway and introduced in *Scientific American* many years ago.

dr_life is a superb rendering of this game, with a simple but powerful user interface. Setting the initial pattern is easy and painless, thanks to a nicely designed menu system and mouse interface. The program ran with lots of pep on my 40 MHz 386. You get the executable and a docs file, but no source.

\CHAOS

File fw108.zip contains a demo version of Fractal Witchcraft, a fast, robust Mandelbrot and Julia-set generator and viewer. The demo version includes a picture show made of several .pcx files, created with FW.

The demo lets you use the keyboard to repeatedly zoom in on any selected region of either mathematical set. You can then specify the size (large, medium, or small) of the resulting display. The size basically controls the length of time the program will take to complete the requested display.

Thus, you can use small or medium displays to get a quick view of your selected area, then request a large display when you are happy with the smaller ones.

This demo version does not allow you to save any displays you create as .pcx files; you'll need to register and buy the full-up version for that capability. Still, the slide show is excellent and the display speed was quite good. Very entertaining.

\EMBEDDED

This directory contains 20 Mb of compressed files related to embedded control, a field very similar to robotics.

File mcx11v15.zip contains the source code, documentation, and several example files for the MCX 68hc11 MicroControl Executive, version 1.5. This is a true multi-tasking executive suitable for use in any 68hc11-based robot or embedded system.

Note that the documentation file is dated April 1990. The manual states that you can download the MCX files from Motorola's FREEWARE BBS (512/891-3733, 9600 8N1). Additionally, recent posts to the comp.robotics newsgroup indicate that at least one FTP site carries an echo of all FREEWARE BBS files. Thus, you could probably get a more recent version of these files, if you wanted to do some digging.

Assembling MCX generates two .s19 files, containing 68hc11 executable code. The file system.s19 contains the full MCX run-time executive. This file includes all support for the semaphores, queues, and services provided by MCX.

The file test.s19, as supplied in the .zip file, is a sample executable file that tests all of MCX's capabilities. You would normally replace test.s19 with your own executable file, containing code for the tasks you want your robot to perform. The .zip file also includes the source for the test program, so you can see how to write assembly language files for use with MCX.

Note that MCX is very small. The entire run-time executive fits in just 1.3K and requires less than 256 bytes of RAM. I haven't loaded it into a BOT-Board and tried it yet, but I can foresee lots of possibilities for such a small executive.

\DATA

By far the most bizarre directory in the entire CD-ROM, this directory contains 20 megs of compressed data files. These are usually ASCII text files, intended to serve as testing grounds for user-developed AI software.

For example, suppose you are working on a stock market prediction program. Your program would use historical stock market behavior to somehow predict future trends. You could then invest, based on these predictions, retire early, and play with robots all day long.

But you will need test data, and lots of it, for your program to munch on. Which brings us back to this directory.

File nvest063.zip contains, according to its comment line, "Stock market data for years '89, '90, '91 & '92 in two formats."

Other data files in this directory contain mushroom data from the Audobon Society Field Guide, a Landsat multi-spectral pixel value database, a solar flare database (with 1389 instances), and a wine recognition and chemical analysis database.

You also get an ASCII file containing the CIA World Factbook for 1991. I found this hugely entertaining. Using nothing more sophisticated than list.com, I could cruise through this file and read about countries I never knew existed. For each country, the file covers facts such as currency, political system, population groupings by religious, economic, and political factors, flag design, and more.

This directory also includes the complete text for

several books, including *The Time Machine* and *War of the Worlds*, by Jules Verne, and *Moby Dick*. It also includes two versions of the Bible and a translation of Sophocles' *Oedipus* trilogy.

In all, this directory includes about 80 files of data for all kinds of subjects. If you are developing AI software for handling data, this could be a quick source of extensive data for you.

\PROG (programming languages)

The \PROG directory contains 44 megs of compilers, assemblers, and tools for all kinds of programming languages and platforms. You name it, it's probably in here somewhere.

ABC, Algol-60, AWK, BOB, COBOL, dBASE, Fortran-to-C translators, IFP, J, MAX, Micro-COBOL, Oberon, OPS5, Estelle, Q-Pro, ADA, VisiCLANG, LOGO, Forth, Modula-2, Pascal, SNOBOL, ICON. The list of languages represented on this disc is amazing.

Two large groups of files contain the GNU C/C++ source files and tools for DOS and for OS/2. These were the most recent ports as of the CD-ROM's creation. For DOS, this means version 2.1.1 of the GNU assembler and version 2.3.8 of the FLEX system. I would imagine more recent ports exist, which you can track down on the Internet.

Another large group of files contains several PC-based Forth compilers. Available systems include 4th-83, eForth, F83 version 2.1.0, Fifth version 1.8, Lake Ontario Forth-83 version 1.28, MiniFORTH version 2.5, Pygmy Forth version 1.3, and Zen Forth version 1.6. If you have been looking to try a PC-based Forth, you'll find what you want in these files.

Overall impressions

The Network Cybernetics AI CD-ROM will keep you fascinated and occupied for weeks, if not months. You can check out comp.robotics, try out different computer languages, learn 80x86 assembly language, view graphics images, make your PC talk, or play with AI concepts and tools.

The price for the Revision 2 CD-ROM was quoted as $129.00 plus $5.00 per disc for domestic shipping, $10.00 per disc for foreign shipping. You can order by contacting Network Cybernetics for the dealer nearest you. Note that shipments to foreign countries may be subject to export restrictions.

Stepper motors

While I'm in review-mode, I'll mention the *Step Motor System Design Handbook*, by Albert C. Leenhouts.

I don't do much stepper motor design, though several people in the Seattle Robotics Society (SRS) are heavily into it. *Nuts & Volts* has already run one article by Dan Mauch, who used stepper motors to create a three-axis, PC-driven CNC drill press from a stock Black and Decker-type unit.

Additionally, I did a contract job for a company whose product used stepper motors to drive a three-axis amorphous carver. I wrote the driving software, but wasn't involved in designing the mechanical or electrical systems behind the steppers.

Still, I've been involved enough with stepper motors over the years to know how difficult it can be to design a good stepper system. Issuing properly timed step pulses via software is the barest beginning.

Designing a stepper system properly requires knowledge of the motor's internal design, its electrical characteristics, the mechanics of the motor, coupling, and load, and the design of the driving electronics.

True, you can usually slap an oversized stepper, beefy electronics, and a honking power source together and get something to work. But understanding all the system elements can lead you to a more robust, efficient design; one you can be proud to show others and one you know will work reliably.

To learn more about all phases of stepper system design, pick up a copy of *Step Motor System Design Handbook*. This book contains 12 chapters, starting with an introduction to step motor control and ending with four real-world design examples.

The book includes listings of several PC-based stepper system design tools, written in a generic version of BASIC. You can type the programs in from the book or, for an additional cost, purchase a PC-format disc with all the programs in source form. I don't know if the programs will run on a Mac or Amiga, but the BASIC seems generic enough that they should.

The book is well-written, the example designs are typical, real-world problems, and the systems elements covered are reasonably up-to-date. The book was rewritten in 1991.

Engineers whose opinions I value, consider this book to be excellent. I like the systems-level approach it takes. The math is fairly intense, but the supplied programs let your PC deal with that. You just need to understand the mechanics and electronics involved, and the book takes you step by step (no pun intended) through the details. Recommended.

The book alone costs $95.00 in singles; the source disc is an additional $200.00. Note that the SRS was able to negotiate a considerable discount for a group purchase of 11 books with discs, so it pays to get your club involved.

Exploring tiny4th

I've written a lot of 68hc11 assembly language code, mostly out of necessity. This is because I usually write for single-chip or small-memory systems, and the extra code created by most compilers pushes the program length beyond the limits.

This need to write small but powerful programs led to my creation of tiny4th. tiny4th is a PC-based 68hc11 cross-compiler, designed around a subset of the Forth programming language.

tiny4th's strong suit is compact executable code. A tiny4th executable consists of two parts. The first part is the kernel, or run-time executive, written in 68hc11 assembly language. The tiny4th distribution package contains the source code for a standard tiny4th run-time executive.

The second part of the executable is a series of eight-bit tokens, corresponding to the source code compiled by tiny4th.

Once you have created an executable file, which is simply a Motorola .s19 file, you download the entire executable into the code space of your target 68hc11 system. I usually use PCBUG11, a Motorola public-domain tool, for this operation.

All that remains is to reset the 68hc11. It automatically initializes and runs the executive, which, in turn, begins running your tiny4th program.

The tiny4th compiler accepts as input an ASCII text file containing the source for your program. The compiler outputs an ASCII text file containing assembly language source. This output file is then passed to the Motorola ASMHC11 public-domain assembler; the assembler, in turn, creates the final executable file.

The entire tiny4th package, including the compiler, assembler, and sample source files, is available from the San Francisco Robotics Society of America BBS, the Pylon BBS, and from ftp sites such as cherupakha at MIT. The latest released version of tiny4th is version 2.1.

tiny4th and the SCI

Forth's initial dictionary contains very few words for handling character I/O. At the most primitive level, you get KEY, ?TERM, and EMIT. These words get a character, test for the presence of an incoming character, and output a character.

Note that Forth does not specify any underlying mechanism for moving characters to and from the user. For example, most PC-based Forths use the DOS BIOS routines for character I/O. The exact technique, however, is up to the implementer, and the BIOS concept certainly won't work on a small 68hc11 system.

tiny4th's run-time executive does not even support these three character I/O words. I didn't want to take up the code space if the application didn't need serial I/O. But tiny4th is like most Forth systems; if it doesn't have what you want, just add it.

The usual method of moving characters between the user and a 68hc11 is the Serial Communications Interface, or SCI. The SCI lets your code exchange 8-

```
hex

102e  constant  scsr          ( addr of status reg )
102f  constant  scdr          ( addr of data reg )

:  ?terminal        ( -- f )
   scsr  c@                   ( get the status )
   20  and                    ( leave only RDRF bit )
;


:  key          ( -- c )
   begin
      ?terminal               ( check the status )
   until
   scdr  c@                   ( get the char )
;


:  emit         ( c -- )
   begin
      scdr  c@                ( check output buffer )
      80  and                 ( loop until empty )
   until
   scdr  c!                   ( send character )
;

              Low-level SCI routines, tiny4th

-------------------------------------------------------------
```

```
iobase    equ   $1000         start of I/O regs
scsr      equ   $2e           offset to status reg
scdr      equ   $2f           offset to data reg

qterm
          ldx   #iobase       point x at I/O regs
          ldaa  scsr,x        get the status
          anda  #$20          leave only RDRF bit
          rts

key
          bsr   qterm         is char available?
          beq   key           loop until yes
          ldaa  scdr,x        get char
          rts

emit
          ldx   #iobase       point x at I/O regs
emit1
          ldab  scsr,x        check output buffer
          bpl   emit1         loop until empty
          staa  scdr,x        send character
          rts

          Low-level SCI routines, assembly language

-------------------------------------------------------------
```

or 9-bit characters at high baud rates, and supports features such as error-checking and interrupt generation.

Motorola implemented the SCI as a group of registers in the I/O area, usually located from $1000 to $103f. The SCI registers are:

BAUD ($102b)	SCI baud rate register
SCCR1 ($102c)	SCI control register 1
SCCR2 ($102d)	SCI control register 2
SCSR ($102e)	SCI status register
SCDR ($102f)	SCI data register

Despite the number of registers involved, the initialization for most applications is simple and only takes a few instructions.

All code examples in this article assume the target 68hc11 uses an 8 MHz crystal. Different crystal frequencies will generate different baud rates for the same BAUD register values. Consult the Motorola *M68HC11 Reference Manual* for details.

In its simplest form, initializing the SCI requires two steps. First, you must select the desired baud rate by writing the proper value to BAUD. Then, you must enable the SCI receiver and transmitter. Refer to the accompanying listing on SCI initialization in assembly language.

The same function, written in tiny4th, generates about the same amount of code. Refer to the accompanying listing on SCI initialization in tiny4th.

The three low-level I/O words, written in assembly language, show how easy it is to perform serial communications using the SCI. Refer to the accompanying listing on low-level SCI routines in assembly language.

The routine QTERM checks for the presence of a character in the SCI receive buffer. Note that this routine does not fetch that character, it only indicates its presence.

Upon exit from QTERM, the A register will be zero if no character is available, or non-zero if a character is available.

The routine KEY returns a character from the SCI. The incoming character is returned in the A register. Note that KEY sits in a tight loop, calling QTERM, until the SCI holds an incoming character. If, for some reason, QTERM never returns a non-zero value in this loop, your program will hang in KEY.

The routine EMIT outputs the character in the A register. Note that EMIT sits in a tight loop, polling the status register, until the SCI is ready to accept the outgoing character. If, for some reason, the status register never returns a ready condition in this loop, your program will hang in EMIT.

The corresponding code in tiny4th is also quite simple. Refer to the accompanying listing of low-level SCI routines in tiny4th.

tiny4th uses its data stack to pass data between words. Thus, a word that calls ?TERMINAL can expect a flag on the top of the stack (TOS) that is TRUE if a character is available, or FALSE if no character is available.

KEY invokes ?TERMINAL repeatedly, until ?TERMINAL returns a TRUE value. KEY then reads the SCI data register and returns the incoming character on the TOS. As with its assembly-language counterpart, KEY will lock up if ?TERMINAL never returns a TRUE.

EMIT reads the status register repeatedly, waiting for a 1 in bit 7. This indicates the output buffer is empty. When this occurs, EMIT writes the value on the TOS to the SCI data register. EMIT locks up if the output buffer never reports as empty.

These three words provide enough low-level power to exchange characters serially between the 68hc11 and a host terminal. Other, more powerful Forth I/O words are built by invoking combinations of these three words.

For example, the word . (pronounced "dot") outputs the TOS as a string of ASCII digits, followed by a space. The output string will be in the current radix. That is, if the current radix is 16, the number will be output in hexadecimal.

The current radix is traditionally controlled by the number stored in the Forth system variable BASE.

EMIT, KEY, and ?TERMINAL, as defined here, all use the SCI to exchange serial data. But this can prove limiting. Suppose, for example, you needed to read characters from the SCI and also from another device, perhaps an eight-bit parallel port.

You could certainly define low-level words for exchanging data with the parallel port. These words would mimic the functions of KEY, ?TERMINAL, and EMIT, but they would have to be called by other names.

This means you would end up with duplicate high-level words, half of which work for the SCI and the other half for the parallel port. This, even though both sets of words basically perform the same functions.

One way to avoid this unnecessary duplication involves vectored execution. This means that a routine — such as EMIT — gets its behavior from a previously modified variable, rather than from a hard-coded routine.

All you have to do to change the behavior of EMIT is to change the value in the variable.

The accompanying listing of vectored SCI routines shows how easy this technique is to implement in tiny4th. Note the changes to EMIT, KEY, and ?TERMINAL. Each routine now fetches a value from the appropriate variable and executes the function contained at that address. Change the address stored in a variable, and you change the behavior of the corresponding word.

Now you can create low-level I/O routines for as many devices as you want. To "activate" a device, simply use ['] and copy the addresses of the three low-level routines into the proper variables.

All subsequent invocations of EMIT, KEY, and ?TERMINAL will now talk to the "active" device, ignoring all others.

This technique is hardly new, and is not limited to Forth. You can easily implement this same concept in assembly language or C. It results in flexible, robust code that is quite easy to work with. You pay a small penalty in speed, but that is usually not a problem in I/O routines.

The released tiny4th system includes a number of library source files, some of which contain the above code. These files serve as tested, working starting points, letting you quickly develop your own custom applications without first reinventing the wheel.

Again, this is hardly a new concept, but its power can be overlooked sometimes. One of the strongest features of C is the ANSI standard library set of functions, included in some form with nearly all compiler systems. Being able to draw on large libraries of functions with universally accepted behaviors really speeds up code development.

I have tried to achieve some of this standardization with my tiny4th library files. By including tiny4th code that provides some of the more standard Forth high-level words, I hope to ease the creation of 68hc11 applications. **NV**

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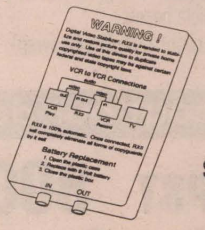

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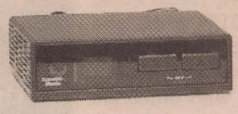

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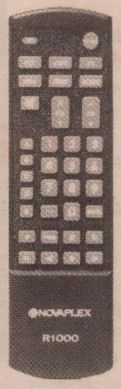

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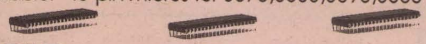

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CABLE FAULT LOCATORS repaired and sold. **DYNATEL** 500, and 573 for sale. We repair 500, 573, 755, EMSII marker locators, Biddle Meggers, and others. With a ninety day warranty and a five day turnaround. **RED BALL ELECTRONIC,** 800-635-9591.

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Events CALENDAR

Continued from page 81

AUGUST 7

MA - WELLESLEY — Ham Flea Market. **SPONSOR:** The Wellesley ARS & Babson Wireless Club. **LOCATION:** Trim Hall, Babson College. **HOURS:** 9am-2pm. **FEATURES:** EX - FM. **DEALER INFO:** Tables: Barbara Holdridge, N1ICQ, 107 Church St., Westwood MA 02090. 617-329-2628. **CONTACT:** Exams: Gerry Driscoll, NV1T, 107 Church St., Westwood MA 02090. 617-444-2686.

MD - UPPER MARLBORO — Southern Patuxent Hamfest. **SPONSOR:** Southern Patuxent ARC. **LOCATION:** The Show Place Arena. **HOURS:** 7am-2pm. **ADMISSION:** $5. **TALK-IN:** 147.150+. **FEATURES:** AC - C - DP - E - F/R - H - T. **DEALER INFO:** $25 indoor space, $5 tailgate space. Saturday setup noon-8pm. **CONTACT:** SPARC Hamfest, POB 399, St. Leonard MD 20685. 410-586-2177.

ME - PORTLAND — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Verrillo's Conv. Ctr., at Howard Johnson Motor Lodge, I-95 (Maine Turnpike) Exit 8. **HOURS:** 10am-3:30pm. **ADMISSION:** $7, 14 & under free w/adult. **FEATURES:** C. **DEALER INFO:** Setup 8am. **CONTACT:** Northern Computer Shows.*

NJ - SOMERSET — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Garden State Exhibit Center. **HOURS:** 9:30am-4:30pm. **FEATURES:** C - FP. **CONTACT:** MarketPro, POB 4056, River Edge NJ 07661. 201-343-3740, FAX: 201-343-9420.

NY - WHITE PLAINS — WECA Summerfest '94. **SPONSOR:** Westchester Emergency Communications Assn. **LOCATION:** Westchester County Center, Bronx River Pkwy. & Rt 119. **HOURS:** 9am-2pm. **ADMISSION:** $5, under 14 free w/adult admission. **TALK-IN:** 147.060. **FEATURES:** AC - DP - EX - F - FP - F/R. **DEALER INFO:** Setup 6am. **CONTACT:** Jeanne Raffaelli, N2NQY, 544 Manhattan Ave., Thornwood NY 10594. 914-962-9666.

PA - NEW KENSINGTON — Hamfest. **SPONSOR:** Skyview Radio Society. **LOCATION:** Clubgrounds off Rte. 366. **HOURS:** 8am-3pm. **ADMISSION:** $2. **TALK-IN:** 146.04/64. **CONTACT:** Michael Peltz, N3MRU, 11 Manorfield Dr., Delmont PA 15626-1573. 412-468-8699.

PA - WARRINGTON — Hamfest '94. **SPONSOR:** Mid Atlantic Amateur Radio Club. **LOCATION:** Bucks County Drive-In Theater, 6 mi. N of PA Turnpike Exit 27 — Willow Grove/Doylestown Exit. **HOURS:** 8am-? **ADMISSION:** $5. **TALK-IN:** 147.06, 146.52. **FEATURES:** DP - FP. **DEALER INFO:** Setup 7am, $3 selling spaces. **CONTACT:** Box 352, Villanova PA 19085.

VA - BERRYVILLE — 44th Annual Hamfest & Computer Show. **SPONSOR:** Shenandoah Valley ARC. **LOCATION:** Clarke County Ruritan Fairgrounds. **HOURS:** 6am-? **ADMISSION:** $5. **TALK-IN:** 146.22-82 & 52 Simplex. **FEATURES:** AC - C - CB - DP - E - EX - FM - FP - F/R - H - RV-S - T. **DEALER INFO:** Tailgaters additional $7 per space. **CONTACT:** Irv Barb, KD4BHV, 703-955-1745, Rt. 3 Box 5385, Berryville VA 22611.

AUGUST 8-9-10-11-12

VA - MCLEAN — Surveillance Expo '94. **LOCATION:** McLean Hilton. **FEATURES:** S. **CONTACT:** Surveillance Expo, POB 20254, Washington DC 20041 or fax to 703-318-8223.

AUGUST 12-13

VT - BURLINGTON — 42nd Annual Hamfest. **SPONSOR:** Burlington ARC. **LOCATION:** Old Lantern Campgrounds. **ADMISSION:** $5. **FEATURES:** DP. **CONTACT:** Burlington ARC, POB 312, Burlington VT 05402.

AUGUST 13

FL - ORLANDO — Computer Fair. **SPONSOR:** "We're Show Offs!" **LOCATION:** Holiday Inn, 7900 S. Orange Blossom Trail. **HOURS:** 10am-3pm. **ADMISSION:** Adults $4, $3 w/ad, under 12 free. **FEATURES:** AC - C - DP - FP. **DEALER INFO:** $40/1 table, $75/2 tables, $25/ea. add. **CONTACT:** "We're Show Offs!" 813-545-5265.

NJ - HACKENSACK — Computer Show. **LOCATION:** Rothman Athletic Center, Rt. 4 to Hackensack Ave. S, left at Temple Ave. traffic light to end of road. **HOURS:** 10am-3pm. **FEATURES:** C. **DEALER INFO:** 500 tables. **CONTACT:** KGP Computer Show.*

PA - PHILADELPHIA — NorthEast Philadelphia Computer Show & Flea Market. **SPONSOR:** East Coast Services. **LOCATION:** Bayerischer Volksfest Verein, 9940 Haldeman Ave. **HOURS:** 9:30am-3:30pm. **FEATURES:** FP. **DEALER INFO:** Tables: $45 adv., $60 door. **CONTACT:** East Coast Services, POB 18396, Philadelphia PA 19120. FAX: 215-927-6432.

VA - ANNANDALE — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Northern Virginia Community College. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro, POB 41044,

Bethesda MD 20814. 301-530-2355.

WV - HUNTINGTON — Hamfest & Computer Show. **SPONSOR:** Tri-State Amateur Radio Assn. **LOCATION:** Huntington Civic Center, corner of 8th St & 3rd Ave. **HOURS:** 8am-? **ADMISSION:** $5, under 12 free. **TALK-IN:** 146.76-. **FEATURES:** EX - F - FM - F/R. **DEALER INFO:** Setup 6am. **CONTACT:** Georgia, KA8QME, 304-522-1811.

AUGUST 14

FL - SAINT PETERSBURG — Computer Fair. **SPONSOR:** "We're Show Offs!" **LOCATION:** Best Western Mirage Hotel, 5005 34th St. N. (US 19 N). **HOURS:** 10am-3pm. **ADMISSION:** Adults $4, $3 w/ad, under 12 free. **FEATURES:** AC - C - DP - FP. **DEALER INFO:** $40/1 table, $75/2 tables, $25/ea. add. **CONTACT:** "We're Show Offs!" 813-545-5265.

KY - FRANKFORT — Central Kentucky ARRL Hamfest. **SPONSOR:** Bluegrass Amateur Radio Society, Inc. **LOCATION:** Western Hills High School, Exit 53 off I-64. **ADMISSION:** $5 adv., $6 door. **FEATURES:** AC - CB - EX - F - FM - . **DEALER INFO:** Inside tables $15 before Aug. 1, $25 after. **CONTACT:** Bill De Vore, N4DIT, 112 Brigadoon Pkwy., Lexington KY 40517. 606-257-3343 or 606-273-8345.

MA - SWANSEA — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Venus De Milo, I-195 Exit 3 (Providence & Fall River Area. **HOURS:** 10am-3:30pm. **ADMISSION:** $7, 14 & under free w/adult. **FEATURES:** C. **DEALER INFO:** Setup 8am. **CONTACT:** Northern Computer Shows.*

MD - GREENBELT — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Martins Crosswinds. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro, POB 41044, Bethesda MD 20814. 301-530-2355.

MD - WESTMINSTER — Carroll County Hamfest & Computer. **SPONSOR:** Summit Amateur Radio Assn. **LOCATION:** Carroll County Agricultural Center, at the end of Smith Ave. **ADMISSION:** $5. **TALK-IN:** 224.68, 224.64, 146.52. **FEATURES:** FM - T. **DEALER INFO:** Tailgating $5 per space, inside tables $8. Info: Alan Parker, KS3L, 410-859-1475. **CONTACT:** SARA Hamfest, 607 Brentwood Rd., Linthicum MD 21090.

NC - CHARLOTTE — Hamfest & Computer Fair. **SPONSOR:** Charlotte Amateur Radio Club. **LOCATION:** Roll-A-Round Skate Center, 8830 E. Harris Blvd. **HOURS:** 8am4pm. **ADMISSION:** $4 adv., $5 door. **TALK-IN:** 147.06-, 444.85 + . **FEATURES:** AC - C - CB - DP - E - FM - FP - F/R - H - RV-S - T. **DEALER INFO:** 8' tables $7 adv., $10 door. Chairs $1 ea. Setup 5am. Tailgaters 1 ticket plus $2 per space. **CONTACT:** Sam Robertson, 704-522-4971 x3330.

PA - EASTON — Hamfest & Computers. **SPONSOR:** Delaware-Lehigh Amateur Radio Club, Inc. **LOCATION:** Career Institute of Technology, 5335 Kesslersville Rd. **ADMISSION:** $4, unlicensed spouse & children under 12 free. **TALK-IN:** 146.70. **FEATURES:** C - EX - F - F/R - T. **DEALER INFO:** Inside table $25, tailgating $7. **CONTACT:** Bill Goodman, K3ANS, 610-253-2745 office, 610-258-5063 home.

AUGUST 20

FL - FORT LAUDERDALE — Narisaam Computer Show. **SPONSOR:** NARISAAM, Inc. **LOCATION:** Holiday Inn West, 5100 N State Rd 7. **HOURS:** 10am-4pm. **ADMISSION:** $5, $4 w/ad, under 12 free. **FEATURES:** AC - C - FP. **CONTACT:** NARISAAM.*

PA - FORT WASHINGTON — Computer Show. **LOCATION:** Ft. Washington Expo Center (near Philadelphia), PA Turnpike Exit #26, 1/2 mile to light, turn right and follow signs to Expo center. **HOURS:** 10am-3pm. **FEATURES:** C. **DEALER INFO:** 250+ tables. **CONTACT:** KGP Computer Show.*

AUGUST 20-21

AL - HUNTSVILLE — Huntsville Hamfest. **LOCATION:** Von Braun Civic Center. **HOURS:** 9am-? **ADMISSION:** $5 both days, children free. **TALK-IN:** 146.34/94. **FEATURES:** AC - B - CB - DP - F - FM. **CONTACT:** Huntsville Hamfest, POB 12534, Huntsville AL 35815.

GA - MARIETTA — Atlanta Area Computer Show. **LOCATION:** Cobb County Civic Center, 548 S. Marietta Pkwy. I-75 exit 112, Hwy 120 W. **HOURS:** Both days: 9am-5pm. **ADMISSION:** $5 both days, $4 Sun only. **FEATURES:** AC - C - DP - FP - F/R - RV-S. **DEALER INFO:** 8-ft tables $35 for both days. **CONTACT:** POB 295, Riverdale GA 30274. 404-907-6225.

AUGUST 21

DE - GEORGETOWN — Delmarva Hamfest. **SPONSOR:** Sussex Amateur Radio Assn. **LOCATION:** Del Tech Community College, on Delaware 18, (Beach Route) 1/4 mi. W U.S. 113. **HOURS:** 8am-2pm. **TALK-IN:** 7.075, 224,84. **FEATURES:** FM - T. **DEALER INFO:** Inside table $8, tailgating $5. **CONTACT:** Delmarva Hamfest, Rt. 2 Box 244G, Georgetown DE 19947.

FL - PALM BEACH GARDENS — Narisaam Computer Show. **SPONSOR:** NARISAAM, Inc. **LOCATION:** Palm Beach Gardens Marriott, 4000 RCA Blvd. **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 The 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:** FP. **DEALER INFO:** Tailgate room for 400 sellers. $10 per space at gate, $8 adv. includes 1 admission. Setup 7am. For info call 617-253-3776. Mail advance reservations before the 5th. **CONTACT:** W1GSL, POB 82 MIT BR., Cambridge MA 02139.

NH - MANCHESTER — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Center of NH, Expo Complex at Holiday Inn, I-293 Exit 5. **HOURS:** 10am-3:30pm. **ADMISSION:** $7, 14 & under free w/adult. **FEATURES:** C. **DEALER INFO:** Setup 8am. **CONTACT:** Northern Computer Shows.*

AUGUST 26-27-28

CT - VERNON — 20th Eastern VHF/UHF Conference. **LOCATION:** Quality Inn & Conference Center, 51 Hartford Turnpike. **FEATURES:** B - DP. **CONTACT:** Byron Blanchard, N1EKV, 16 Round Hill Rd., Lexington MA 02173. 617-862-1380 evenings.

AUGUST 27

NJ - BRIDGEWATER — Hamfest. **SPONSOR:** Somerset County Amateur Radio Society, Inc. **LOCATION:** Somerset County 4-H Center, Milltown Rd. **HOURS:** 8am-1pm. **ADMISSION:** $4, XYLs & Harmonics, under 12 free. **TALK-IN:** 146.52, 224,88. **FEATURES:** C - DP - E - F/R - H - T. **DEALER INFO:** Indoor space $15, electricity $5, outdoor tailgating $10. **CONTACT:** Donna, 908-369-4533; George, N2RQH, 908-369-4533; Pete, WA2OCN, 908-429-9093.

NJ - EDISON — Computer Show. **LOCATION:** Raritan Center Exposition Hall, NJ turnpike Exit #10, right after toll, follow signs into Raritan Center Industrial Park. **HOURS:** 10am-3pm. **FEATURES:** C. **DEALER INFO:** 1,300+ tables. **CONTACT:** KGP Computer Show.*

NY - CHAFFEE — 3rd Annual Chaffee Hamfest & Computer Show. **SPONSOR:** Pioneer Radio Operators Society. **LOCATION:** Manion Park just off Rt. 16, approx. 30 mi. S of Buffalo. **HOURS:** 7am-3pm. **ADMISSION:** $3 adv., $4 door. **TALK-IN:** 145.390, 444.175. **FEATURES:** CB - DP - FM - FP - F/R - T. **CONTACT:** Paul Sumski, KA2ZMC, POB 334, Arcade NY 14009. 716-492-3198.

PA - YORK — Computer Trade Show. **SPONSOR:** Peter Trapp Shows. **LOCATION:** York Interstate Fairgrounds. **HOURS:** 10am-3pm. **ADMISSION:** $6 w/ad or coupon $1 off, under 11 free. **FEATURES:** C - FP - F/R. **CONTACT:** Peter Trapp Shows.*

AUGUST 27-28

DE - NEWARK — PC Dealer Showcase. **SPONSOR:** StarWare. **LOCATION:** Christiana Mall, I-95 Exit 4A. **HOURS:** Sat. 10am-9:30pm, Sun. 11am-6pm. **ADMISSION:** Free. **FEATURES:** AC - C - FP. **DEALER INFO:** Tables $95 ea. per day. **CONTACT:** StarWare, 800-523-0702.

AUGUST 28

NY - YONKERS — Hamfest — Computerfest. **SPONSOR:** Yonkers Amateur Radio Club. **LOCATION:** Yonkers Municipal Parking Garage, Main St. **HOURS:** 9am-3pm. **ADMISSION:** $5, XYL, YL & kids under 12 free. **TALK-IN:** 146.865, 440.150. **FEATURES:** C - CB - DP - F/R - H - . **CONTACT:** YARC, POB 378 Centuck Sta., Yonkers NY 10710-0378 or call Jim, 914-969-5182 or John, 914-963-1021.

PA - MATAMORAS — Hamfest. **SPONSOR:** Tri-State ARC. **LOCATION:** The Pavilion at Best Western Inn, Exit 11 from I-84. **HOURS:** 8am-? **ADMISSION:** $5 Buyers, $9 Sellers. **TALK-IN:** 146.16/146.76 100Hz PL, 144.75/145.350 100Hz PL. **FEATURES:** DP. **CONTACT:** Bob, N3NPT, 717-296-4551; Paul, KD3L, 717-491-4808; or Ray, WY2D, 914-856-1733.

TN - LEBANON — Hamfest. **SPONSOR:** Short Mountain Repeater Club. **LOCATION:** Cedars of Lebanon State Park, US Hwy. 231, 7 mi. S of I-40. **HOURS:** 7am-3pm. **ADMISSION:** Free. **TALK-IN:** 146.91. **FEATURES:** F/R. **DEALER INFO:** Outdoor facilities only, exhibitors bring your own tables. **CONTACT:** Mary Alice Fanning, KA4GSB, 4936 Danby Dr., Nashville TN 37211. 615-832-3215.

SEPTEMBER 3-4

NC - SHELBY — 37th Annual Shelby Hamfest. **SPONSOR:** Shelby ARC. **LOCATION:** Cleveland County Fairgrounds. **TALK-IN:** 146.28/88. **FEATURES:** CB - FM - FP - RV-H - T. **DEALER INFO:** Barbara Elliott, N4MRZ, POB 191, Fallston NC 28042. 704-538-7919. **CONTACT:** John T. Ledford, N4GOQ, 3410 Oakcrest Dr., Shelby NC 28150. 704-482-4507.

Continued on page 132

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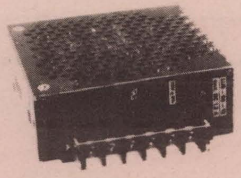

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Tex-Comp
11550 Zelzah Avenue
Granada Hills 91344

Unicorn Electronics
10010 Canoga Avenue, Unit B-8
Chatsworth 91311

Wheeler's CB
40095 Forest Road
Big Bear Lake 92315

CANADA

Com-West Radio Systems Ltd.
8179 Main Street
Vancouver, BC V5X 3L2

RP Electronic Components
2113 W. 4th Avenue
Vancouver, BC V6K 1N7

COLORADO

Electronics Brokers
4747 Pearl Street, Unit 2
Boulder 80301

Fistell's Micro Electronics
7023 E. Colfax
Denver 80220

International Tesla Society
2220 E. Bijou Street
Colorado Springs 80909

Western Test Systems
530 Compton #C
Broomfield 80020

CONNECTICUT

Archway News
64 Bank Street
New Milford 06776

Derric Electronics
1660 Whitney Avenue
Hamden 06517

Salcon
33 Brook Road
Enfield 06082

FLORIDA

Alfa Electronics Supplies
1502 S. State Road 7
Hollywood 33023

ANI Specialties
1581 Gretchen Avenue
Lehigh Acres 33971

Clarks Out of Town News
303 S. Andrews Avenue
Fort Lauderdale 33301

International Radio & Computers, Inc.
3804 South U.S. 1
Fort Pierce 34982

J.T. Communication
579 NE 44th Avenue
Ocala 32671

Mike's Electronic Distributing Co.
1001 NW 52 Street
Fort Lauderdale 33309

Skycraft Parts & Surplus, Inc.
2245 W. Fairbanks
Winter Park 32789

Sunnys At Sunset
8260 Sunset Strip
Sunrise 33322

Tinker's Workshop
3207 13th Street
Saint Cloud 34769

GEORGIA

Omar Electronics
2130 Highway 81 SW
Loganville 30249

IDAHO

RJM Electronics, Inc.
4204 Overland Road
Boise 83705

The Current Source
5159 Glenwood
Boise 83714

ILLINOIS

MRK Group Ltd.
46 E. Irving Park Road
Roselle 60172

NUTRON Computers & Electronics, Inc.
821 E. Rosevelt
Lombard 60148

Pick's Electronics
Lewis Park Mall
Carbondale 62901

INDIANA

Brice's Library
7399 N. Shadeland Ave. #152
Indianapolis 46250

New Horizons
Corner of SR 26 & SR 55
Pine Village 47975

SHF Microwave Parts
7102 West 500 South
La Porte 46350

KANSAS

Lloyd's Radio & Electronic, Inc.
220 W. Harry Street
Wichita 67213

Revcom Electronics
1104 S. Main
Scott City 67871

KENTUCKY

Security World Plus
212 Pike Street
Covington 41011

MARYLAND

Maryland Radio Center
8576 Laureldale Drive
Laurel 20707

MASSACHUSETTS

BNF Enterprises
119 Foster Street
Peabody 01960

Eastbridge Electronics
49 Cedar Street
East Bridgewater 02333

MICHIGAN

Hal-Tronix, Inc.
12671 Dix-Toledo Highway
Southgate 48195

Little Professors Book Center
22174 Michigan Avenue
Dearborn 48124

Purchase Radio Supply, Inc.
327 East Hoover Avenue
Ann Arbor 48104

MINNESOTA

Satellite City
2663 County Road I
Moundsview 55112

MISSOURI

Accurate Instruments
3123 Weatherford Road
Independence 64055

Electronics Exchange
8644 St. Charles Rock Road
St. Louis 63114

Independence Electronics
119 S. Main
Independence 64050

Missouri Radio Center
630 NW Englewood
Kansas City 64118

Stewart & Associates
244 Mid River Center #200
St. Peters 63376

NEBRASKA

Ladd Electronics Co.
111 N. 41st Street
Omaha 68131

NEVADA

Less Buster's Electronics
Broad Acres Mall
2930 N. Las Vegas Blvd. #VSTG-22
North Las Vegas 89030

Radio World
1656 Nevada Highway
Boulder City 89005

NEW HAMPSHIRE

Cahill Electronics
160 Main Street
Kingston Plaza
Kingston 03848

Electronic Orphanage
97 Eddy Road
Manchester 03102

NEW JERSEY

Tech-Systems
1309 Route 71
Belmar 07719

NEW MEXICO

Consumertronics
2011 Crescent Drive
Alamogordo 88310

Vonns Electronics Co.
1306 East Madrid
Las Cruces 88001

NEW YORK

All Phase Video Security, Inc.
70 Cain Drive
Brentwood 11717

Audio-Video Exchange

MS Associates
615 S. Main Street
North Syracuse 13212

GS & E
182 Avenue D
Rochester 14621

Hirsch Sales Co.
219 California Drive
Amherst 14221

Tony's Equipment
10065 Morley Road
North Collins 14111

VHF Communications
453 Buffalo Street
Jamestown 14701

NORTH CAROLINA

North State Tech Services
4608-M Industry Lane
Durham 27713

OHIO

A1 Salvage/ Military Surplus Depot
132½ E. 3rd Street
Dayton 45402

Bigelow Electronics
186 E. Jefferson Street
Bluffton 45817

Compustuff
2751 Medina Road
Medina 44258

Computer Keyways
611 S. Main Street
Miamisburg 45342

Computers & Engineering
519 Bailey Street
Hamilton 45011

Digital One
7601 Mentor Avenue
Mentor 44060

Hosfelt Electronics, Inc.
2700 Sunset Boulevard
Steubenville 43952

Innovative Ideas
962 Kenmore Boulevard
Akron 44314

Leo's Book Shop
330 North Superior Street
Toledo 43604

Mendelson Electronics
340 E. 1st Street
Dayton 45402

North Olmsted Amateur Radio Depot
29462 Lorain Road
North Olmsted 44070

Powermaxx, Inc.
1587 U.S. Route 68 North
Xenia 45385

The Electronics Exchange, Inc.
355 Morgan Avenue
Akron 44311

Wizard Engr. & Electronics
1782 Arlington
Toledo 43609

OREGON

News & Smokes
2295 W. Main Street
Medford 97501

News & Smokes #8
259-C Barnett Road
Medford 97501

Norvac Electronics
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Beaverton 97005

Portland Radio Supply
234 SE Grand Avenue
Portland 97214

Powell's Technical Bookstore
33 NW Park
Portland 97209

PENNSYLVANIA

Asher Technology Services
69 Gingerbread Lane
East Stroudsburg 18301

Business & Computer Bookstores, Inc.
213 N. Easton Road
Willow Grove 19090

Lehman Scientific
2997-F Cape Horn Road
Red Lion 17356

Shop N Drive
3050 Canby Street
Harrisburg 17103

Surplus Al
RD 1 Box 337
Hunlock Creek 18621

The Insideoutlet
415 Arch Street
Norristown 19401

PUERTO RICO

Marval Security Equipment
Calle 6 #13, Ext. San Agustin
Rio Piedras 00926

SOUTH CAROLINA

555 Electronics
5646 Farrow Road
Columbia 29203

ASA
4551 Hwy. 17 Bypass South
Myrtle Beach 29577

Discount Software
Route 1 Box 195 Highway 6
Cross 29461

R&D Associates
514½ West Avenue
North Augusta 29841

TENNESSEE

GBC Electronics
125 Birch Street
Blountville 37617

Schultz Electronics
160 Main Street
Mount Carmel 37645

TEXAS

Mouser Electronics
2401 Highway 287 North
Mansfield 76063

Tanner Electronics
1301 W. Beltine #105
Carrollton 75006

Tucker Surplus Store
1805 Reserve Street
Garland 75042

UTAH

Omega Electronics
1500 North 150 West
Provo 84604

VIRGINIA

Electronic Equipment Bank
516 Mill Street
Vienna 22180

Riley's Distributing
1045 Edom Road
Harrisonburg 22801

Satellite Headquarters
9310 Timberlake Road
Lynchburg 24502

WASHINGTON

A-B-C Communications, Inc.
17550 15th Avenue NE
Seattle 98155

Amateur Radio Supply Co.
5963 Corson Avenue S. #140
Seattle 98108

Supertronix
18650 68th Avenue South
Kent 98032

WEST VIRGINIA

IBIM-Colorsat
Route 1 Box 113
Morgantown 26505

WISCONSIN

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

Cudahy News & Hobby Center, Inc.
4758 Packard Avenue
Cudahy 53110

E.H. Yost & Co.
7344 Tetiva Road
Sauk City 53583

Rich's Surplus
Route 2 Highway H North
Stanley 54768-9418

Continued from page 129

NJ - CHERRY HILL — PC Dealer Showcase. **SPONSOR:** StarWare. **LOCATION:** Cherry Hill Mall, Rte 38. **HOURS:** Sat. 10am-9:30pm, Sun. Noon-5pm. **ADMISSION:** Free. **FEATURES:** AC - C - FP. **DEALER INFO:** Tables $95 ea. per day. **CONTACT:** StarWare, 800-523-0702.

SEPTEMBER 10

FL - ORLANDO — Computer Fair. **SPONSOR:** "We're Show Offs!" **LOCATION:** Holiday Inn, 7900 S. Orange Blossom Trail. **HOURS:** 10am-3pm. **ADMISSION:** Adults $4, $3 w/ad, under 12 free. **FEATURES:** AC - C - DP - FP. **DEALER INFO:** $40/1 table, $75/2 tables, $25/ea. add. **CONTACT:** "We're Show Offs!" 813-545-5265.

MA - WILMINGTON — Computer Show. **LOCATION:** Shriner's, formerly NE Trade Center in Woburn, MA. N of Boston at I-93 Exit #39, right at bottom of ramp, follow signs to end of road. **HOURS:** 10am-4pm. **FEATURES:** C. **DEALER INFO:** 500 tables. **CONTACT:** KGP Computer Show.*

NY - BALLSTON SPA — Hamfest. **SPONSOR:** Saratoga County RACES Assn., Inc. **LOCATION:** County Fairgrounds. **HOURS:** 7am-3pm. **TALK-IN:** 146.40/147.00, 147.84/147.24. **FEATURES:** DP - EX - F/R - RV-H. **DEALER INFO:** Setup Fri. 7pm-8:30pm. **CONTACT:** N2FEP, POB 41, Rock City Falls NY 12863.

PA - ERIE — Erie Hamfest '94. **SPONSOR:** Radio Association of Erie. **LOCATION:** Franklin Twp. Fire Hall, 6 mi. S of I-90 on PA Rt. 98 (Exit 4) or from I-79, take Exit 38 (Rt. 6N, Albion) W 2.5 mi., then Rt. 98 N for 2.8 mi. **HOURS:** 8am-2pm. **ADMISSION:** $4, under 12 free. **TALK-IN:** 146.01/61. **FEATURES:** C - DP - E - FP - F/R - H - T. **DEALER INFO:** Tailgating $4 per space plus admission ticket. Indoor 8' table $8. **CONTACT:** Tom McClain, N3HPR, 3954 Solar Dr., Erie PA 16506. 814-833-1640.

PA - UNIONTOWN — 45th Annual Gabfest. **SPONSOR:** Uniontown ARC. **LOCATION:** Club Grounds on Old Pittsburgh Rd. off Rt. 51 and the 119 by-pass. **HOURS:** 8am-? **TALK-IN:** 147.045+, 147.255+. **FEATURES:** DP - FP - F/R. **CONTACT:** Carl or Joyce, 304-594-3779.

SEPTEMBER 10-11

NC - CHARLOTTE — Charlotte Area Computer Show. **LOCATION:** Metrolina Expo Center, 7100 North Statesville Rd. I-77 N to Exit #16A, (1st 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. **DEALER INFO:** 8-ft. tables $35. **CONTACT:** POB 295, Riverdale GA 30274. 800-746-9001.

SEPTEMBER 11

FL - SAINT PETERSBURG — Computer Fair. **SPONSOR:** "We're Show Offs!" **LOCATION:** Best Western Mirage Hotel, 5005 34th St. N. (US 19 N). **HOURS:** 10am-3pm. **ADMISSION:** Adults $4, $3 w/ad, under 12 free. **FEATURES:** AC - C - DP - FP. **DEALER INFO:** $40/1 table, $75/2 tables, $25/ea. add. **CONTACT:** "We're Show Offs!" 813-545-5265.

MA - SOUTH DARTMOUTH — 7th Annual Hamfest & Flea Market. **SPONSOR:** South Eastern Mass Amateur Radio Assn. **LOCATION:** Club Grounds, 54 Donald St. **HOURS:** 8am-3pm. **ADMISSION:** $2. **TALK-IN:** 147.000/147.600. **DEALER INFO:** Tables: $8 adv., $10 door. **CONTACT:** Michael Enos, POB 79064, North Dartmouth MA 02747.

MD - GAITHERSBURG — FARFEST. **SPONSOR:** Foundation for Amateur Radio. **LOCATION:** Montgomery County Agricultural Center Fairgrounds, Exit 11 off I-270. **FEATURES:** CB - EX - FM - T

NY - SUFFERN — ARRL 1994 Hudson Division Convention. **SPONSOR:** Hudson Amateur Radio Council. **LOCATION:** Rockland Community College Field House. **HOURS:** 9am-? **TALK-IN:** 147.165. **FEATURES:** F - FM. **CONTACT:** 914-426-1488.

PA - BUTLER — Hamfest. **SPONSOR:** Butler County Amateur Radio Assn. **LOCATION:** Farmshow grounds. **HOURS:** 9am-4pm. **ADMISSION:** $5. **DEALER INFO:** 8' table space $10. **CONTACT:** Send SASE to: Joe Stahlman, WA3BVQ, 499 Keister Rd., Slippery Rock PA 16057 or call 412-794-8383.

SEPTEMBER 17

NH - NASHUA — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Resurrection Center, 1.5 miles W of Rt. 3 (Exit 6). **HOURS:** 10am-3:30pm. **ADMISSION:** $7, 14 & under free w/adult. **FEATURES:** C. **DEALER INFO:** Setup 8am. **CONTACT:** Northern Computer Shows.*

NJ - WAYNE — Computer Show. **LOCATION:** William Paterson College, Re Center, 300 Pompton Rd. Near I-80, Rt. 23 and Rt. 46. **HOURS:** 10am-4pm. **FEATURES:** C. **DEALER INFO:** 400 tables. **CONTACT:** KGP Computer Show.*

NY - SYRACUSE — Computer Trade Show. **SPONSOR:** Peter Trapp Shows. **LOCATION:** NY State Fairgrounds, International Bldg. **HOURS:** 10am-4pm. **ADMISSION:** $6, w/ad or coupon $1 off, under 11 free. **FEATURES:** AC - C - FP - FR. **CONTACT:** Peter Trapp Shows.*

PA - BERWICK — Hamfest/Computerfest. **SPONSOR:** Columbia Montour ARC. **SPONSOR:** Nescopeck Township Firehall Grounds, 5.2 miles S of Berwick on Rt. 93. **HOURS:** 8am-? **ADMISSION:** $3, XYL & kids under 12 free. **TALK-IN:** 147.225 +600, 146.52 Simplex. **FEATURES:** EX - F/R - T. **DEALER INFO:** 8' space $10, tailgating $1 per 8' space plus general admission. **CONTACT:** Dave, WC3A, 717-752-6851.

SEPTEMBER 17-18

VA - VIRGINIA BEACH — Virginia Beach Hamfest & Computer Fair/ARRL Roanoke Division Convention. **LOCATION:** Virginia Beach Pavilion Convention Center. **HOURS:** Sat: 9am-5pm, Sun: 9am-3pm. **ADMISSION:** $5 adv., $6 door, good for both days, under 12 free. **FEATURES:** CB - FM - FP - T. **DEALER INFO:** Commercial Booths: Lewis Steingold, W4BLO, 1008 Crabbers Cove Ln., Virginia Beach VA 23452. 804-HAM-FEST. **CONTACT:** Tickets & Tables: Manny Steiner, K4DOR, 3512 Olympia Ln., Virginia Beach VA 23452. 804-HAM-FEST.

SEPTEMBER 18

CT - NEWTOWN — Western CT Hamfest. **SPONSOR:** Candlewood ARA. **LOCATION:** Edmond Town Hall, Rt. 6. **HOURS:** 8am-1pm. **ADMISSION:** $4, under 12 free. **TALK-IN:** 147.12+. **FEATURES:** C - CB - DP - FM - F/R - T. **DEALER INFO:** Tables $10, tailgaters $6. Setup 7am. **CONTACT:** Ken Weith, Box 3441, Danbury CT 06813. 203-743-9181.

MA - CAMBRIDGE — Tailgate Electronics, Computer & Amateur Radio Flea Market. **SPONSOR:** MIT Radio Society and The 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:** FP. **DEALER INFO:** Tailgate room for 400 sellers. $10 per space at gate, $8 adv. includes 1 admission. Setup 7am. For info call 617-253-3776. Mail advance reservations before the 5th. **CONTACT:** W1GSL, POB 82 MIT BR., Cambridge MA 02139.

NJ - PENNSAUKEN — 46th Annual Hamfest/Computer Show. **SPONSOR:** South Jersey Radio Assn. **LOCATION:** Pennsauken High School parking lot. **HOURS:** 8am-3pm. **ADMISSION:** $4 adv., $5 gate. **TALK-IN:** 145.290-. **FEATURES:** C - DP - EX - FP - F/R - T. **DEALER INFO:** 8' tailgate space $5. **CONTACT:** Diane Nafis, N2LCQ, 17 Roosevelt Dr., Laurel Springs NJ 08021. 609-227-6281.

NY - ROCHESTER — Computer Trade Show. **SPONSOR:** Peter Trapp Shows. **LOCATION:** Weidner Road Armory, Rochester. **HOURS:** 10am-3pm.

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SEPTEMBER 21-22-23-24

NY - ROCHESTER — 33rd Historical Radio Conference. **SPONSOR:** Antique Wireless Assn. **LOCATION:** Thruway Marriott Hotel, 716-359-1800. **FEATURES:** FM - F/R. **CONTACT:** AWA, Box E, Breesport NY 14816.

SEPTEMBER 24

FL - TITUSVILLE — 4th Annual Hamfest. **SPONSOR:** Titusville Amateur Radio Club. **LOCATION:** Fox Lake Park, 1 mi. E of town, over I-95 on Fox Lake Rd. **HOURS:** 8am-5pm, rain or shine. **ADMISSION:** Free. **FEATURES:** C - FM - FP - F/R - H - T. **DEALER INFO:** Tables $5, tailgating $3. **CONTACT:** Les Griner, K4SJC, 407-267-1565.

NY - HORSEHEADS — 19th Annual Elmira International Hamfest/Computerfest. **SPONSOR:** Elmira Amateur Radio Assn. **LOCATION:** Chemung County Fairgrounds. **HOURS:** 6am-4pm. **ADMISSION:** $3 adv., $4 door, 10 & under free. **FEATURES:** CB - DP - EX - FM - FP - F/R. **DEALER INFO:** Jay, 607-733-0761. **CONTACT:** VE Testing: Bill, 607-962-1134; Ticket Inquiries: Dave, 607-589-4523.

PA - ALLENTOWN — Computer Trade Show. **SPONSOR:** Peter Trapp Shows. **LOCATION:** Days Inn Conference Center, Rtes 22 & 309. **HOURS:** 10am-3pm. **ADMISSION:** $6, w/ad or coupon $1 off, under 11 free. **FEATURES:** AC - C - FP - FR. **CONTACT:** Peter Trapp Shows.*

VA - SOUTH BOSTON — Fallfest '94. **LOCATION:** Halifax Senior High. **HOURS:** 9am-3pm. **TALK-IN:** 147.060. **FEATURES:** AC - CB - DP - E - EX - FM - FP - F/R - H - S - T. **CONTACT:** Kathy Hendricks, POB 144, Hurdle Mills NC 27541. 910-597-2959.

SEPTEMBER 25

FL - NEW PORT RICHEY — 4th Annual Pasco County Hamfest. **SPONSOR:** Suncoast Amateur Radio Club. **LOCATION:** Recreation Center, 6630 Van Buren. **HOURS:** 9am-3:30pm. **ADMISSION:** $5, under 12, YL & XYL free. **TALK-IN:** 145.35, 147.15. **FEATURES:** AC - DP - EX - FP. **DEALER INFO:** Sellers: $15 ea. (incl. chair, table & 1 admission). Electricity $5 extra. **CONTACT:** Laura, KD4OVK, 813-868-3305 or for exams: Marv, WC2G, 813-938-7810.

MA - FRAMINGHAM — Fall Flea Market. **LOCATION:** Framingham High School, A St., 1.3 mi. N of Rts. 9 & 126 junction. **HOURS:** Early Bird: 9am, General Admission: 10am. **ADMISSION:** Early Bird $5, General $2. **TALK-IN:** 147.15. **FEATURES:** C - DP - E - EX - FM - FP - F/R - H - T. **DEALER INFO:** 6' table adv. $10, $14 door. Tailgate space $10. **CONTACT:** Tables: Lew Nyman, K1AZE, 508-879-7456; Exams: Dick Marshall, WA1KUG, 508-877-0563.

NJ - SOMERVILLE — NJ Guitar & Electronics Flea Market. **LOCATION:** Fairgrounds of the Falcon Camp, 140 Falcon Camp Rd., off Rt. 206. **HOURS:** 9am-6pm. **FEATURES:** FM. **DEALER INFO:** Outside tailgaters, rain or shine w/table $35, outdoor Pavillion w/roof & elec. $65, Indoor exhibit hall $95. **CONTACT:** Tri-State Music Fairs, 510 Auten Rd., #2A, Hillsborough NJ 08876. Voice/Fax: 908-359-0124.

NY - YONKERS — Giant Electronic Fleamarket. **SPONSOR:** Metro 70cm Network. **LOCATION:** Lincoln High School, Kneeland Ave. **HOURS:** 9am-3pm rain or shine . **ADMISSION:** $5, under 12 free. **TALK-IN:** 440.425R, 445.425T, PL156.7. **FEATURES:** DP - FP - F/R. **DEALER INFO:** $15 1st table, $10 ea. additional in adv. All tables $20 at door. **CONTACT:** Otto Supliski WB2SLQ, 914-969-1053.

OCTOBER 1-2

AL - HUNTSVILLE — Computer Show. **LOCATION:** Von Braun Civic Center, 700 Monroe St. **HOURS:** Sat: 9am-5pm, Sun: 10am-4pm. **ADMISSION:** $5 both days, $4 Sun only. **FEATURES:** AC - C - DP - F/R - RV-S. **DEALER INFO:** 8-ft tables $45. **CONTACT:** POB 295, Riverdale GA 30274. 404-907-6225, 800-746-7001.

KY - LOUISVILLE — Greater Louisville Hamfest/ARRL KY State Convention. **SPONSOR:** The Greater Louisville Hamfest Assn. **LOCATION:** Commonwealth Convention Center, 4th & Jefferson Sts. **ADMISSION:** $6 adv. w/SASE, $8 door, $6 Sunday at door. **FEATURES:** AC - CB - EX - F - FM. **DEALER INFO:** Commercial vendors, 812-948-0037; Flea Market, 812-282-4898. **CONTACT:** 812-294-4905.

MA - BOXBORO — New England ARRL Convention. **SPONSOR:** Federation of Eastern Massachusetts ARA. **LOCATION:** Host Hotel & Convention Center, Rt. I-495. **FEATURES:** CB. **CONTACT:** 617-631-7388, FAX: 617-631-0857 or write Eugene H. Hastings, 18 Churchill Rd., Marblehead MA 01945.

OCTOBER 8

FL - SAINT PETERSBURG — "We're Show Offs!" St. Pete Computer Fair. **SPONSOR:** "We're Show Offs!" **LOCATION:** Best Western Mirage Hotel, 5005 34th St. N. (US 19 N). **HOURS:** 10am-3pm. **ADMISSION:** Adults $4, $3 w/ad, under 12 free. **FEATURES:** AC - C - DP - FP. **DEALER INFO:** $40/1 table, $75/2 tables, $25/ea. add. **CONTACT:** "We're Show Offs!", 813-545-5265.

NJ - TEANECK — Hamfest. **SPONSOR:** Bergen Amateur Radio Assn. **LOCATION:** Fairleigh Dickinson University, Rt. 4 River Road Exit. **HOURS:** 8am-2pm. **ADMISSION:** $3, XYLs & Harmonics free. **TALK-IN:** 146.79/19. **DEALER INFO:** Spaces $10, w/power $20. **CONTACT:** Jim Joyce, K2ZO, 201-664-6725 before 10pm.

OCTOBER 8-9

GA - NORCROSS — Atlanta Area Computer Show. **LOCATION:** North Atlanta Trade Center, 1700 Jeurgens Ct. I-85 N to exit #38 (Indian Trail) & right to Oakbrook Parkway, turn right to Jeurgens Ct. **HOURS:** Sat: 9am-5pm. Sun: 10am-4pm. **ADMISSION:** $5 both days; $4 Sun. only. **FEATURES:** AC - C - DP - FP. **DEALER INFO:** Setup Sat. 6am-9am. 8' table $45 + $6.00 business license. **CONTACT:** POB 295, Riverdale GA 30274. 404-907-6225.

MA - MARLBOROUGH — Computer Show. **LOCATION:** Royal Plaza Trade Center, W of Boston. I-495 Exit #24-B, 1/2 mi. on right, 5 mi. N of Mass Turnpike on Rt. 20. **HOURS:** 10am-3pm. **FEATURES:** C. **DEALER INFO:** 250+ tables. **CONTACT:** KGP Computer Show.*

TN - MEMPHIS — MemFest '94/ARRL Delta Division Convention. **LOCATION:** Shelby Farms Show Place Arena. **HOURS:** Sat: 8:30am-4pm, Sun: 8:30am-2pm. **ADMISSION:** $5. **FEATURES:** B - DP - EX - F. **DEALER INFO:** Exhibitor: Russ Summer, KD4JUD, 901-272-8455 (days); Flea Market: Lee Bowers, KA4KUW, 901-867-3461 (evenings). **CONTACT:** Mary Moore, AC4GF, 901-758-0661 or write: MemFest '94, POB 751841, Memphis TN 38175-1841.

OCTOBER 9

FL - ORLANDO — "We're Show Offs!" Orlando Computer Fair. **SPONSOR:** "We're Show Offs!" **LOCATION:** Holiday Inn, 7900 S. Orange Blossonm Trail. **HOURS:** 10am-3pm. **ADMISSION:** Adults $4, $3 w/ad, under 12 free. **FEATURES:** AC - C - DP - FP. **DEALER INFO:** $40/1 table, $75/2 tables, $25/ea. add. **CONTACT:** "We're Show Offs!", 813-545-5265.

OCTOBER 14-15

FL - STARKE — 4th Annual Starke Hamfest & Computer Show. **SPONSOR:** Amateur Radio Club, Bradford Area. **LOCATION:** Bradford County Fairgrounds, US-301. **HOURS:** Fri: 4pm-11pm, Sat: 8am-4pm. **ADMISSION:** Families $3, tailgaters $4. **TALK-IN:** 145.15, 146.82, 146.52. **FEATURES:** F/R - T. **DEALER INFO:** Tables $5. **CONTACT:** Send SASE to: Dan Phillips, K4RVD, 8214 Carl Brook Rd., Keystone Heights FL 32656. 904-475-2695.

OCTOBER 15

NC - SANFORD — CCARS Fall Festival. **SPONSOR:** Central Carolina ARS. **LOCATION:** Lions Club Fairgrounds, 7th St. & Weatherspoon St. **HOURS:** 8am-? **FEATURES:** DP. **DEALER INFO:** Setup 7am. **CONTACT:** Pat Maggart, WA9VTM, 8512 Deep River Rd., Sanford NC 27330.

NY - SYRACUSE — Hamfest. **SPONSOR:** Radio Amateurs of Greater Syracuse. **LOCATION:** American LegionValley Post, off W. Seneca Turnpike (Rt. 173), between S. Salina St. & Valley Dr. **HOURS:** 8am-3pm. **ADMISSION:** $5, 16 & under free. **TALK-IN:** 147.90/30. **FEATURES:** C - CB - EX - F - FM - F/R. **DEALER INFO:** Flea Market space $3. **CONTACT:** RAGS, POB 88, Liverpool NY 13088. 315-469-0590.

TN - GRAY — 14th Annual Tri-Cities Hamfest. **SPONSOR:** Kingsport, Bristol & Johnson City Radio Clubs. **LOCATION:** Appalachian Fairgrounds, off I-181. **ADMISSION:** $5. **FEATURES:** FM - RV-H. **CONTACT:** POB 3682 CRS, Johnson City TN 37602.

OCTOBER 16

MA - CAMBRIDGE — Tailgate Electronics, Computer & Amateur Radio Flea Market. **SPONSOR:** MIT Radio Society and The 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:** FP. **DEALER INFO:** Tailgate room for 400 sellers. $10 per space at gate, $8 adv. includes 1 admission. Setup 7am. For info call 617-253-3776. Mail advance reservations before the 5th. **CONTACT:** W1GSL, POB 82 MIT BR., Cambridge MA 02139.

PA - BENSALEM — Tradefest. **SPONSOR:** Penn Wireless Assn. **LOCATION:** Robert Yezzi Fair-

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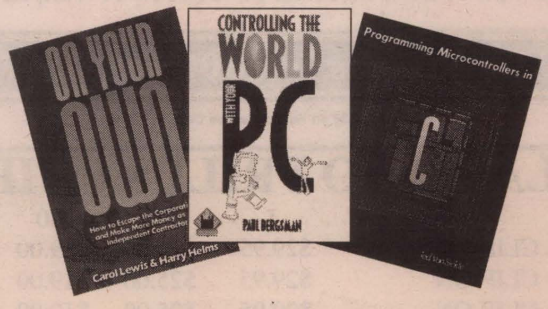

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grounds, Hulmeville Rd. **HOURS:** 8am-2pm. **ADMISSION:** $5 per person, $10 per carload. XYLs, YLs & under 12 free. **TALK-IN:** 145.25/144.65, 146.925/146.325, 448.225/443.225 and 146.52 Simplex. **FEATURES:** DP - EX - F/R - T. **DEALER INFO:** Setup 6am. $8 per 6x10' tailgate slip. **CONTACT:** John, N3NUB, 215-355-0879.

OCTOBER 20

FL - FORT LAUDERDALE — Narisaam Computer Show. **SPONSOR:** NARISAAM, Inc. **LOCATION:** Holiday Inn West, 5100 N State Rd 7. **HOURS:** 10am-4pm. **ADMISSION:** $5, $4 w/ad, under 12 free. **FEATURES:** AC - C - FP. **CONTACT:** NARISAAM.*

OCTOBER 20-21-22-23

NY - LONG ISLAND — Personal Computer & Electronics Expo. **SPONSOR:** Expositions, Inc. **LOCATION:** Nassau Veterans Memorial Coliseum, Exit M-4 from Meadowbrook Pkwy., Hempstead Turnpike, Uniondale. **FEATURES:** C - CB - F/R. **CONTACT:** Expositions, Inc., 249 E. Park Ave., Long Beach NY 11561. 516-889-6000, 800-886-8000, FAX: 516-889-6123.

OCTOBER 21

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.*

OCTOBER 23

PA - GREENSBURG — Hamfest. **SPONSOR:** Foothills ARC. **LOCATION:** Greensburg Hose Co. #1, off Rt. 66 N. of Greensburg. **HOURS:** 8am-2pm. **ADMISSION:** $2. **TALK-IN:** 147.18. **FEATURES:** FM. **DEALER INFO:** Inside tables $10. **CONTACT:** Larry Gaebel, WA3TLT, 412-834-7137.

PA - SELLERSVILLE — Hamfest. **SPONSOR:** RH Hill ARC. **LOCATION:** Sellersville National Guard Armory, Rt. 152, 5 mi. S. of Quarkertown & 8 mi. N of Montgomeryville. **ADMISSION:** $5. **TALK-IN:** 145.31. **FEATURES:** EX. **DEALER INFO:** Indoor table $18, outdoor space, no table $6. **CONTACT:** Linda Erdman, POB 29, Colmar PA 18915. 215-679-5764.

OCTOBER 30

MD - WESTMINSTER — Mason-Dixon Computer & Hamfest. **SPONSOR:** Penn-Mar & Carroll County ARCs. **LOCATION:** Carroll County Ag. Center. **HOURS:** 8am-? **ADMISSION:** $5. **TALK-IN:** 145.410-. **FEATURES:** EX - F/R - S - T. **DEALER INFO:** Setup 6am. 8' table $15, 12' tailgate space $5. Gary Viands, KE3FN, 717-259-7342. **CONTACT:** Exam info: Page Evans, NE3P, 789 Gettysburg Rd., Littlestown PA 17340. 717-359-7610.

FOREIGN

AUGUST 5-6-7

CANADA - VERNON, BRITISH COLUMBIA — 3rd Annual Sky High Hamfest. **SPONSOR:** North Okanagan RAC. **LOCATION:** Silver Star Mt. Resort. **FEATURES:** FM - F/R. **CONTACT:** ARC, POB 1706, Vernon BC V1T 8C3, Canada. Hotel reservations: 1-800-663-4431.

AUGUST 6-7

CANADA - MISSION, BRITISH COLUMBIA — Amateur Radio & Emergency Preparedness Exposition. **LOCATION:** Mission Fairgrounds, 7th Ave. & Taulbut St. **HOURS:** Sat: 9am-5pm, Sun: 10am-3pm. **ADMISSION:** $5, under 12 free. **TALK-IN:** 146.600, 144.430. **FEATURES:** DP - FM - FP - F/R - RV-S - S. **CONTACT:** AREP Expo, c/o District of Mission, POB 20, Mission, B.C. V2V 4L9. Voicemail: 604-820-3788 *103, FAX: 604-826-8633. Packet: VE7MIS@VE7KIT, B.C., Canada.

AUGUST 21

CANADA - MONTREAL, QUEBEC — 6th Annual CIDX International Radio Festival. **CONTACT:** Sheldon Harvey, 79 Kipps St., Greenfield Park, Quebec, Canada J4V 3B1. 514-462-1459.

OCTOBER 6-7-8-9

MEXICO - PUERTO VALLARTA — Annual Convention. **SPONSOR:** Mexican Federation of Ham Radio Operators. **LOCATION:** Vallarta Casa Grande Hotel. **FEATURES:** F/R. **CONTACT:** Federacion Mexicana De Radioexperimentadores, A.C., Molinos, 51, Desp. 307 y 308, Col Mixcoac Mexico D.F.C.P. 03910. FAX: +011-525-273-1019.

OCTOBER 7-8-9

UNITED KINGDOM - OLD WINDSOR, BERKSHIRE — RSGB 1994 International HF & IOTA Convention. **LOCATION:** Beaumont Conference Centre. **FEATURES:** S. **CONTACT:** Neville Cheadle, G3NUG, tel/fax +44-442-62929. "Further Felden," Long Croft Ln., Felden, Hemel Hempstead, Herts. HP3 OBN, UK.

MONTH AT A GLANCE

AUGUST 1994

AUGUST 3-4-5-6
IL - Elgin - Antique Radio Club of IL Radiofest 1994

AUGUST 5-6-7
CANADA - Vernon, BC - North Okanagan RAC Hamfest
ID - Idaho Falls - WIMU Hamfest
IL - Utica - 3905 Century Club Eyeball

AUGUST 6
CA - Santee - Santee Swap Meet
IL - Carlinville - Macoupin County ARC Hamfest
IN - Goshen - Elkhart County Radio Assn. Hamfest
IN - Indianapolis - WA9SNT Hamfest
IN - Valparaiso - Porter County ARC Hamfst/ComputerShow
MA - Marlborough - KGP's Computer Shows*
MD - New Carrollton - CMA Computer Shows
MD - Timonium - Intertech Group Computer Show*
MI - Roseville - Int'l Canadian/American Meg-Fest Show
MO - Springfield - SMARC Hamfest
NC - High Point - High Point ARC Hamfest
NY - White Plains - MarketPro Computer Show & Sale
OH - Cleveland - Peter Trapp Computer Trade Shows*
OH - Columbus - Voice of Aladdin ARC Hamfset

AUGUST 6-7
CANADA - Mission - B.C. - Amateur Radio/Emergency Expo
FL - Jacksonville - Radio/Computer Show-ARRL N. FL Conv
ID - Idaho Falls - Eagle Rock ARC WIMU Hamfest
PA - Allentown - Starware PC Dealer Showcase

AUGUST 7
CA - Livermore - Livermore ARC Swap Meet
IL - Peotone - Hamfesters Radio Club Hamfest
IN - Angola - Land of Lakes ARC Hamfest
MA - Wellesley - Wellesley ARS/Babson WC Ham Flea Mkt
MD - Upper Marlboro - Southern Patuxent ARC Hamfest
ME - Portland - Northern Computer Shows & Sales*
MI - Dearborn - Computers & You Computer Show
MI - Taylor - Int'l Canadian/American Mega-Fest Show
NJ - Somerset - MarketPro Computer Show & Sale
NY - White Plains - WECA Summerfest '94
OH - Akron - Peter Trapp Computer Trade Shows*
OH - Randolph - Portage ARC Hamfest
PA - New Kensington - Skyview Radio Society Hamfest
PA - Warrington - Mid-Atlantic ARC Hamfest
VA - Berryville - Shenandoah Valley ARC Hamfest
VA - Fairfax - Intertech Group Computer Show*
WI - Marshfield - Marshfield ARS Picnic Potluck/Swapfest
WV - Mineral Wells - Mid Ohio Valley ARC Hamfest/Comp

AUGUST 8-9-10-11-12
VA - McLean - Surveillance Expo 94

AUGUST 8-9-10-11-12-13
OR - Portland - Nat'l Professional Electronics Convention

AUGUST 12-13
VT - Burlington - Burlington ARC 42nd Annual Hamfest

AUGUST 13
CA - Glendale - MarketPro Computer Shows*
CA - Los Altos Hills - Foothill College Flea Market
CA - Santa Rosa - MarketPro Computer Shows*
FL - Orlando - We're Show Offs Computer Show
IL - Quincy - Western Illinois ARC Ham Radio/Comp Swap
IN - Indianapolis - AGI Computer Fairs*
NJ - Hackensack - KGP's Computer Shows*
NV - Reno - Sierra Nevada ARS Reno Hamfest
PA - Philadelphia - NorthEast PA Computer Show/Flea Mkt
VA - Annandale - MarketPro Computer Show & Sale
WA - Tacoma - Radio Club of Tacoma Flea Market
WV - Huntington - Tri-State ARA Hamfest/Computer Show

AUGUST 13-14
LA - Bossier City - Shreveport ARA Ark-La-Tex Hamfest

AUGUST 14
CA - Oxnard - MarketPro Computer Show*
FL - St. Petersburg - We're Show Offs Computer Show
IA - Cedar Rapids - Cedar Valley ARC Hamfest
KY - Frankfort - Bluegrass ARS Central KY ARRL Hamfest
KY - Louisville - Meka Enterprises Computer Fair South
MA - Swansea - Northern Computer Shows & Sales*
MD - Greenbelt - MarketPro Computer Show & Sale
MD - Westminster - Summit ARA Hamfest & Computer
MI - Grand Rapids - Computers & You Computer Show
NC - Charlotte - Charlotte ARC Hamfest/Computer Fair
OH - Columbus - AGI Computer Fairs*
OH - Paulding - Paulding County ARG Hamfest
PA - Easton - Delaware-LeHigh ARC Hamfest

AUGUST 19-20-21
MN - Bloomington - Digital Communications Conference

AUGUST 20
CA - Santee - Santee Swap Meet
FL - Ft. Lauderdale - Narisaam Computer Show*
NM - Albuquerque - Duke City Hamfest
OH - Toledo - Nat'l Computer Expo Compvter Mania
PA - Ft. Washington - KGP's Computer Shows*
VA - Tysons Corner - CMA Computer Shows
WA - Longview - Lower Columbia ARA Swap Meet

AUGUST 20-21
AL - Huntsville - Huntsville Hamfest
CA - Northridge - American Computer Mega Show
CA - San Diego - MarketPro Computer Show*
GA - Marietta - Atlanta Area Computer Shows

AUGUST 21
CANADA - Montreal, Quebec - CIDX Int'l Radio Festival
CA - Sacramento - MarketPro Computer Show*
DE - Georgetown - Sussex ARA Delmarva Hamfest
FL - Palm Beach Gardens - Narisaam Computer Show*
IL - Orland Park - The Orland Park Computer Show
MA - Cambridge - MIT RS & Harvard Wireless Hamfest
MI - Madison Heights - Computers & You Computer Show
NH - Manchester - Northern Computer Shows & Sales*
OH - Cincinnati - Greater Cincinnati ARA Hamfest
OH - Cleveland - Nat'l Compter Expo Compvter Mania
OH - Marysville - Union County ARC Hamfest/Comp Show
OH - Toledo - Computer Support Services Comp. Festival
OH - Warren - Warren Amateur Radio Assn. Hamfest
VA - Hampton - Intertech Group Computer Show*

AUGUST 26-27-28
CA - San Diego - Southwestern Division Convention
CT - Vernon - 20th Eastern VHF/UHF Conference

AUGUST 27
CA - Vallejo - MarketPro Computer Show*
IN - Indianapolis - National Computer Fairs Computer Show
KS - Chanute - Chanute Area ARC Hamfest
MI - Westland - Great Lakes Computer Expo & Sale
MN - Roseau - Lake of the Woods Repeater Assn. Hamfest
NJ - Bridgewater - Somerset County ARS Hamfest
NJ - Edison - KGP's Computer Shows*
NY - Chaffee - Chaffee Hamfest & Computer Show
OR - Hillsboro - NorthWest Computer Show & Sale
PA - York - Peter Trapp Computer Trade Shows*
WI - Rhinelander - Northwoods ARC Swapfest

AUGUST 27-28
DE - Newark - Starware PC Dealer Showcase
OH - Dayton - Dayton Microcomputer Assn. Computerfest

AUGUST 28
IA - Ottumwa - All Iowa Hamfest 94
IL - Skokie - A Computer Co Super Computer Show
IL - Woodstock - Tri-County Radio Group Hmfst/Comp Shw
MI - Novi - Great Lakes Computer Expo & Sale
MI - Saginaw - Computers & You Computer Show
MO - St. Charles - St. Charles ARC Hamfest
NY - Yonkers - Yonkers ARC Hamfest/Computerfest
PA - Matamoras - Tri-State ARC Hamfest
TN - Lebanon - Short Mountain Repeater Club Hamfest

SEPTEMBER 1994

SEPTEMBER 2-3
IN - Indianapolis - AGI Computer Fairs*
LA - New Orleans - New Orlenas Int'l DX Convention

SEPTEMBER 2-3-4-5
OH - Cleveland - Mercury Productions Super Flea Market

SEPTEMBER 3
CA - Santee - Santee Swap Meet
IN - Highland - Computer Possibilities Unlimited
MD - New Carrollton - CMA Computer Shows
MI - Roseville - Int'l Canadian/American Mega-Fest Show

SEPTEMBER 3-4
CA - Ventura - MarketPro Computer Show*
NC - Shelby - 37th Annual Shelby Hamfest

Continued on page 138

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Don Lancaster's

RESOURCE BIN

number thirty one

A "Magic Machine" for desktop publishing.

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 (602) 428-4073 weekdays 8-5 MST.

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 a super special sign-up deal for you *Resource Bin* readers. Ten free hours and zero first month minimums. See the trailer blurb for details.

The "Magic Machine"

Just about any field has a legendary *magic machine*. A device that, while only *slightly* improved over previous stuff, literally turned the corner for an entire industry. Obvious examples are the Model T Ford, the DC-3 aircraft, a RCA 630 color TV, or an Apple IIe.

What really came down is that each of these just happened to be in the right place at the right time. Much of their success was blind luck. All they really did was find a parade and get in front of it. All of the needed bits and pieces already just barely existed in klutzy previous products. But these magic machines just happened to get it all together.

At precisely the time the rest of the technology crossed thresholds that made it all possible.

At long last, the power of the press lies in owning one. PostScript desktop laser printers have long promised to completely blow away traditional jiffy printing. A dream until recently.

Hewlett Packard has introduced their *LaserJet* 4M+. Which I do feel time will prove to be *the* magic machine for all desktop publishing. The first machine which clearly is *cheaper*, *higher quality*, *faster*, and *simpler* than any B&W jiffy printing. Besides offering incredibly *better* photo halftones.

At least for 5,000 or fewer identical copies. With "internal" economics.

At first glance, the improvements in the 4M+ over earlier machines do not seem that big a deal. But they occur at a magic time when everything else is also finally falling into place.

The 4M+ starts with a proven and well supported *Canon* scanning laser engine. Authentic Adobe PostScript level 2, version 2013. An underlying resolution of 600 x 600 over which a *resolution enhancement technology* is placed that gives a superb final print quality that clearly exceeds nearly all ink-based jiffy printing. Absolutely outstanding photo halftones.

Print speed is 12 pages per minute. A bolt-on duplexer option. Multi trays hold nearly a thousand sheets.

Page device memory compression to greatly ease the amount of memory needed. Full service manuals readily available. So are parts and training. Easily refillable toner cartridges with very good third-party economics. Fast network options. Auto switching.

As near as I can tell, there's only one glaring 4M+ defect. A total lack of hard disk or other SCSI support. But that one seems so dumb to me that it *surely* will be soon corrected.

A cost around $1,690.00 street. What is even neater is that you can now *double* your printer speed simply by buying another one! Get five of these dudes for, say $8,500.00 and you could pretty much replace any $240,000.00 *DocuTech* from *Xerox*. At well under *four percent* of the cost! And minus the hassles.

Let's look at some current resources for desktop laser publishing. We'll see how tech advances make the 4M+ a landmark *magic machine*.

Resolution

How much resolution is "enough?" Early laser printers offered a 300 dots per inch resolution. While clearly better than the dot matrix or inkjet of its time, there were problems with "jaggies," with photo halftones, and with smaller text. On photo halftones, you were severely limited to 37 gray levels at 53 spots per inch, down to a mere 10 photograys at 106 SPI.

Which just barely *missed* being "car shopper tabloid" quality.

But plain old 300 DPI certainly can be improved. Simply by working with the media, rather than fighting it. For instance, most users *still* insist upon using the *seventeenth* most putrid gray available at 300 DPI. You can also pick resolution-friendly fonts (*Stone*) over resolution-hostile fonts (*Optima*). And matching your layout style to what your resolution can handle.

The best phototypesetters offer 2600 DPI. But because jiffy printing is an analog procedure sensitive to such things as dot gain, operator skill, ink balance, humidity, plate quality, run life, and the phase of the moon, the effective perceived resolution of jiffy printing often varies all over the lot. Typically, your final results will only end up around 600 DPI.

The resolution problem is this: For any given technology, doubling your resolution demands *four* times as much memory. Your page make-up takes *four* times longer. You'll also need tighter machine tolerances. And potentially *explosive* ultra-fine toners.

Upping to 600 DPI certainly makes sense. The quality improvement over 300 DPI is stunning. You now can get 37 gray levels at a dense 106 spots per inch. Which makes up the difference between bad photos and good ones.

But further "brute force" increases in resolution may not be at all cost or time effective. Instead, you watch out for simple and cheap stunts that can create the *illusion* of higher res. The 4M+ offers several of these.

One is called *resolution enhancement technology*. This is simply a magic and cheap post-processing which smooths out the jaggies by permitting partial sized final dots. With *zero* speed or memory penalty. Very few people can spot any difference at all between a resolution enhanced 600 DPI and a full and true 1200 DPI.

The next one is called *spot dithering*. Traditional printer's

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Don looks at new developments in direct toner printed circuits.

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halftone spots consist of *one* dot that builds as you go darker into your grays. Instead, you could create *multiple* dots per halftone cell. You get the full gray range of a larger halftone cell, but the virtual grain of a smaller one. This is a 4M+ option that creates the illusion of 120 corrected grays at 106 SPI.

Properly preprocessing your photo images can also add value. Two tricks known as *histogram equalization* and *gamma correction* make sure that you use as many of the available grays as are available. And evenly distribute them over your entire range between black and white. *Adobe Photoshop* is one of many packages which offer image improvement utilities. You can also easily write your own.

Another limitation of not enough grays can be the presence of steps in any gray gradient. A new technique called *error diffusion* easily cures this with some preprocessing.

There's also a true spotless halftone technique waiting in the wings that uses random fine dots. But these have poor dot gain that tends to favor the darker shades on the 4M+. But you can expect this to be solved.

One trick: If you ever need more res, run everything double size and then photoreduce it. This quadruples your effective resolution.

The bottom line: Before the 4M+, ordinary 600 x 600 DPI printing was "as good as" most jiffy printing. But the 4M+ is clearly better on photos.

PostScript

As we've seen a number of times in the past, PostScript is a totally device independent and fully *general purpose* computer language that happens to excel at dirtying up otherwise clean sheets of paper. PostScript is *the* best method for self publishing.

Most users prefer such PostScript generating application packages as *Pagemaker* or *Illustrator*. But my own preference is to work directly in raw PostScript, which gives me far more flexibility and control. Even if you stick to the mainstream packages, the more you understand PostScript, the better your final results.

The 4M+ is not really a printer. It is really a powerful PostScript general purpose computer that, as an almost inconsequential afterthought, just happens to have this attached print engine. Your 4M+ internal PostScript computer is an outstanding device. It is as powerful or even more powerful than your host machine. And far more fun to program.

There always appears to be "turf fights" going on over who is to be in control. The host computer always wants to be boss. And the network supervisor always wants to have total say in comm matters. But to me it makes the most sense to *do as many printer related tasks inside of the 4M+ PostScript computer as you possibly can*. Whenever possible, use your printer as a standalone device.

Some PostScript aps generate very slow code. The way to deal with these is to *compile* the PostScript output. The distiller in Adobe's *Acrobat* package is one good solution. Another replaces slow code with page forms.

In any self-collating or on-demand printing, each page gets made up, used *once*, and then erased. On the fly. It is super important to minimize all the page makeup speeds. On the 4M+, typical properly compiled PostScript files will make up and print at the full mechanical speed of the printer. Put another way, the page feeding time is longer than the page makeup time.

More compiling details appear in SPEEDUP.PS and ACRO2EPS.PS.

Hard Disk Options

A local hard disk for a PostScript laser printer is extremely valuable. I would personally say it is *absolutely essential*. These have been routinely sold by *Apple* and *QMS* for years.

One or more hard disks let you operate largely unattended by either a user or a host computer. It very much speeds things up, since 99% of your comm can get eliminated. It lets you store hundreds of fonts.

All document pages can be stored on hard disk for instant access, which turns out to be *insanely* faster than resending your files over and over again. Disk files can also be used for executive or programmable control of the printer. And CD-ROM drives can be added for instant access to images and clip art. Eventually, you'll put all of your demand printing items on a write-your-own CD ROM.

Tricky-to-print pages or images can be converted into instant-print forms and stashed to a disk. Disks are also extremely handy for input logging, file manipulation, and countless other PostScript-as-language uses.

Whenever a PostScript printer first gets turned on, each of the characters used in each and every size has to get converted into a bitmap. This file of bitmaps is called a *font cache*. Font caching is very slow, compared to the actual character reuse.

With a hard disk, the font cache is more or less permanent. Thus, hard disks can eliminate any speed penalty every time you turn your printer on or off. Hard disk caches can also be used for forms and patterns.

You also end up with much more useful memory in the printer, since you do not have to stash downloaded fonts and other VM-gobbling code directly in the printer. This extra free memory lets you run fancier jobs (or more poorly written ones!), improves network comm, prevents most odd VM blowups, and lets you run full duplex and auto jam recovery even at full legal page sizes.

And, of course, network traffic is dramatically slashed when you use a local hard disk.

There are several work-arounds to a hard disk. PostScript level II permits strings as file objects. So you could persistently download the strings in main memory as a way of faking disk files. Level II also has a strong *forms* capability. For multiple runs, you can just download forms and then reuse them. There was a bad bug in early level II machines that prevented you from using forms and multiple trays at the same time. This has apparently been eased in the 4M+. More info in FORMSBUG.PS.

As with a duplexer, the hard disks should be a snap-on option added to a standard machine.

Recharging Economics

The original idea on desktop laser printers was that all the stuff that goes bad gets put into one "throwaway" cartridge. The cart would hold a fresh toner supply, mag transfer rollers, a charging scheme, an imaging drum, and a spent toner holding tank. Most maintenance problems would vanish. And the manufacturers would make a fortune since they'd retain control.

The only little oint in the flyment was that playing "by the rules" turned out to be outrageously expensive.

Your per-sheet toner costs could easily exceed a nickel per page side.

And *completely dominate* your long term economics.

It did not take hardware hackers long to discover that you could refill these carts, dramatically and forever changing laser printer economics. A $115.00 cart can often be refilled for as little as $4.50 in a simple two-minute process. And getting the toner costs down around cents per page side. *Cheaper* than jiffy print ink. And the crucial key to profitable small scale or home printing.

The manufacturers responded to this by making the drum wear out shortly after one cycle. One trick was to use excessively abrasive toner. To which hardware hackers added third party hard drums. And a "pixie dust" drum lubricant powder coating.

The toner wars continue. The latest bad-guys trick is to provide postpaid "recycling packages" whose real goal is to get all their carts back and thus *prevent* cheap and convenient local third party recycling. This is blatant ecopornography of the vilest sort. To which the hardware hackers respond by shipping bricks back in the prepaid recycling packs.

At long last, the 4M+ uses a fairly easy-to-recycle cartridge. Sometimes you can get away by just pouring new toner in through a convenient cap. At least for your first refill. Otherwise two screws and two plastic dogs field strip the cartridge, letting you access the imaging drum and the spent toner holding tank. With care and a third party hard drum, you can easily get dozens of refills per cartridge.

You do have to use fine grain toner in the 4M+ if you are to

achieve full resolution. Picking the wrong or an inefficient toner may also quickly fill the spent toner holding tank.

Ads for recharging materials and supplies appear in *Recharger*. A great source for laser printer rebuild kits, training, and parts is *Don Thompson*.

Recharging info on the EX cartridge used in the 4M+ does show up in the August '94 *Electronics Now* and also as HACK79.PS on *GEnie* PSRT.

Duplex Printing

A *duplex printer* prints on both sides of the page. Duplex printers can be automatically self-collating. Just what you'll want for either newsletters or Book-on-demand publishing. They also use much less paper.

Duplex throughput can be vastly higher. They are far more operator friendly, and there is ridiculously less scrap. Any error on a duplex book trashes one easily replaced page. The same backside error done on a regular printer destroys most of the book.

Once you've used duplex printing, you will *never* want to go back to a simplex only printer. Ever.

A true duplex printer would need *two* imaging stations. Instead, a laser printer will print one side, route the page back down through a *switchback* mechanism and then print the other side. The trick is to *interchange* your leading and trailing page edges.

To speed things up while the page is going back around, *pipelining* gets used on longer jobs. Thus, a typical duplex page printing sequence is 2 - 4 - 1 - 3 - 6 - 8 - 5 - 7. Surprisingly, duplex printing can be just about as fast as simplex printing.

Extra memory is needed in duplex modes, especially when using auto jam recovery. This is greatly eased in the 4M+ which uses a new hardware page device compression scheme.

There are two ways you might like to print a duplex page, called *normal* and *tumble*. Normal mode is used for ordinary full size portrait books and newsletters. Tumble mode is used for calendars or folded pages.

Duplexing laser printers are not yet common. The usual chicken-and-egg problem of way too few of the end users knowing how great they are.

And to some apparent industrial politics and machine use restrictions. Ferinstance, the older *QMS* Turbo 820 printer has all the empty space and brackets and bolts for an internal duplexer. But no duplexer was ever offered for sale.

Two common early duplexing laser printers were the *Hewlett-Packard* 2D and 3D. Because these were different from their higher volume LJ2 and LJ3 parents, a fairly stiff cost premium was involved. And very few sold.

The obvious solution was to make the parent printer support a *bolt-on* or a *slide-in* duplexing mechanism. This way duplexing can be cheaply added to a high volume, low cost parent machine. At current costs around $600.00 list and $400.00 street. Third-generation duplexers should be much cheaper.

They are really nothing but some power rollers, a one-turn clutch or two, some bent metal, and a small brain-dead microcontroller.

The *Hewlett Packard* 4SiMX was one of the first higher volume mid-range lasers to use a slide-in duplexer. HP has graciously loaned me one of these, and their duplexing performs nearly flawlessly. The slide-in mechanism inserts in a slot underneath the main printing path. Switchback gets done as the page goes out the front under the paper trays and then reverses.

While not quite as fast, rugged, or as easily maintained, the 4M+ offers most of the performance of an older 4SiMX at less than half the price. For self-collating BOD printing, the 4M+ faster PostScript page make-ready time largely negates the 5 PPM feeding advantage of the 4SiMX. More on the 4SiMX in HP4SIMX.TXT on *GEnie* PSRT.

The 4M+ has promised a low cost bolt-on duplexer "real soon now." I have yet to see one. It will snap onto the back of the machine.

Toner Durability

No, toner is not yet as durable or as flexible as ink. But it is more than good enough for typical users. And specialty third party toners exist for such things as ultra-black graphics, printed circuit direct etching, MICR magnetic check printing, the direct transfer decals, and T-shirt thermal transfer printing. Other exciting new toners wait in the wings.

Two nasty toner habits: vinyl may leach toner. So a toner image might stick or transfer to a premium page protector or your new white couch. If you ever get toner on your clothes, be sure to wash them in *cold* water. Heat permanently sets the toner.

There's several ways to increase the toner's durability. One is *Bakerizing* where you place toner in contact with a thin sheet of mylar and apply heat and pressure. The toner will calender, and turn into a durable jet black of a very high gloss.

You have to see this to believe the results. Especially on business cards.

Kroy Color or the other hot stamp effects can also improve appearance and durability. But products remain outrageously overpriced here.

Another route is lamination, where you lock in your toner underneath a plastic sheet. This is especially useful for menus and book covers. One low cost source is USI. Another possibility is a hybrid route that jiffy prints your covers or high wear areas and uses BOD for the rest. The best and most flexible binding scheme I've found is the *Pentabind* from *Unibind*.

Artists fixative sprays aren't that great, since they tend to diffuse the toner and smear badly. But there's an absolutely wonderful new *Laser Buddy* product that literally is Bakerizing in a can. You spray it on, and the toner gets blacker and more glossy. The cost is about $8.00 per can. I routinely use this great stuff for all camera-ready work.

Three tips: Be certain to use Laser Buddy outdoors in a well ventilated area. And avoid thumbprints while drying. Wait at least an hour before using page protectors.

What about color? You could get color toner carts for such things as spot color or special effects. But they don't really look that great, they are hard to find, and are expensive.

There are bunches of new full color laser printers coming on line, with prices in the $6,000 to $9,000 range. But this whole field is still up for grabs. I don't expect the color magic machine to arrive for a few years yet.

For More Info

More info on the 4M+ is available from *Hewlett-Packard*. The separately purchased repair manuals come from *HP Manuals*. And info on becoming a printer developer is available through *HP Peripherals Group*.

The best street pricing on HP laser printers usually shows up in *Computer Reseller* magazine. You can also check *InfoWorld* and *MacWeek*.

More on durability solutions and unusual toners from *Recharger*, from Frank Miller's *DynaArt Designs*, or in TONERTRX.PS on *GEnie* PSRT.

For more on PostScript, start with Adobe's red and blue books, and my STARTUP.PS and SPEEDUP.PS files on *GEnie* PSRT. More on BOD publishing appears in my *Book-on-demand* kit, per my nearby *Synergetics* ad.

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 (602) 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 fast modem access, use (800) 638-8369 and enter HHH. When prompted, enter JOINGENIE. When asked for a keyword, 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.

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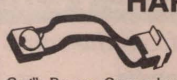
HEAT TRANSFER MARKING PENS

Add colors to the computerized design or use alone. Set/5 Colors (red, orange, yellow, green, blue) wide pens **$15.00**, narrow pens **$14.00**.



HARD-TO-GET PRINTER RIBBONS

Gorilla Banana, Commodore 1525 **$8.00**; Adam Coleco **$12.00**; TI-850/855 **$6.00**; Centronics 700 Zip Pack **$5.00**; C. Itoh Prowriter Jr., Riteman C+/F+ **$6.00**; Riteman Inforunner **$8.00**; Commodore MPS-801 **$5.00**; MPS 803 **$5.00**; Decwriter LA30/36 **$4.00**; Apple Scribe **$4.00**; Mannisman Tally Spirit 80, Commodore 1526 **$5.00**; Epson JX-80 4-Color **$14.00**.

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Events CALENDAR

Continued from page 134

NJ - Cherry Hill - Starware PC Dealer Showcase

SEPTEMBER 4

CA - Livermore - Livermore ARC Swap Meet
MI - Taylor - Int'l Canadian/American Mega-Fest Show

SEPTEMBER 9-10-11

IL - Rolling Meadows - Northern IL DX Convention/Banquet

SEPTEMBER 10

CA - Los Altos Hills - Foothill College Flea Market
FL - Orlando - We're Show Offs Computer Show
GA - Statesboro - Statesboro ARC Hamfest
IN - Ft. Wayne - Ft. Wayne RC Hamfest/Computer Show
IN - Merrillville - Computer Possibilities Unlimited
IN - Spencer - Owen County ARA Hamfest
MA - Wilmington - KGP's Computer Shows*
ME - Windsor - Augusta ARA Hamfest
NY - Ballston Spa - Saratoga County RACES Assn. Hamfest
OH - Cleveland - Nat'l Computer Expo Compvter Mania
PA - Erie - Radio Association of Erie Hamfest
PA - Uniontown - Uniontown ARC Gabfest
VT - Berlin - Central Vermont ARC Hamfest

SEPTEMBER 10-11

CA - Glendale - MarketPro Computer Show*
CA - San Diego - MarketPro Computer Show*
NC - Charlotte - Charlotte Area Computer Show

SEPTEMBER 11

FL - St. Petersburg - We're Show Offs Computer Show
IA - Dubuque - Iowa ARC Radiofest/Hamfest/Comp. Expo
IL - Du Quoin - Shawnee ARA Hamfest/Computer Swap
IL - Joliet - Bolingbrook ARS Hamfest
IL - Orland Park - The Orland Park Computer Show
MA - South Dartmouth - South Eastern MA ARA Hamfest
MD - Gaithersburg - Foundation/Amateur Radio FARFEST
MI - Flint - ComputerFest Computer Trade Show
MI - Southfield - Michigan Computer Festival
NY - Suffern - ARRL Hudson Division Convention
OH - Cleveland - Nat'l Computer Expo Compvter Mania
OH - Findlay - Findlay Radio Club Hamfest
PA - Butler - Butler County ARA Hamfest

SEPTEMBER 17

AZ - Scottsdale - F.A.R.E. Hamfest
CA - Santee - Santee Swap Meet
CA - Sebastopol - SCRA Radio Flea Market
IL - Kankakee - Kankakee River Valley Computer Fest '94
MI - Westland - Great Lakes Computer Expo & Sale
NH - Nashua - Northern Computer Shows & Sales*
NJ - Wayne - KGP's Computer Shows*
NY - Buffalo - Rochester ARA Hamfest
NY - Syracuse - Peter Trapp Computer Trade Shows*
OH - Cleveland - Peter Trapp Computer Trade Shows*
PA - Berwick - Columbia Montour ARC Hamfest/Comptrfest
TX - Wichita Falls - Wichita Falls ARS Hamfest

SEPTEMBER 17-18

CA - Westwood - American Computer Mega Show
IL - Peoria - Peoria Area ARC Superfest
VA - Virginia Beach - Roanoke Division Hamfst/Convention

SEPTEMBER 18

AZ - Pheonix - Computer & Electronic Swap Meet
CT - Newtown - Candlewood ARA Western CT Hamfest
IL - Glen Ellyn - Computer Central Computer Show
MA - Cambridge - MIT RS & Harvard Wireless Hamfest
MI - Flint - Five Star Productions Computer Trade Show
MI - Mt. Clemens - L'Anse Creuse ARC Hamfest
NJ - Pennsauken - South Jersey RA Hamfest/Computer Show
NY - Rochester - Peter Trapp Computer Trade Shows*
OH - Akron - Peter Trapp Computer Trade Shows*
VA - Tysons Corner - CMA Computer Shows

SEPTEMBER 21-22-23-24

NY - Rochester - Antique Wireless Assn. Radio Conference

SEPTEMBER 24

FL - Titusville - Titusville ARC 4th Annual Hamfest
NY - Horseheads - Elmira ARA Int'l Hamfest/Computerfest
PA - Allentown - Peter Trapp Computer Trade Shows*
VA - South Boston - Fallfest '94

SEPTEMBER 24-25

CA - Fullerton - American Computer Mega Shows
IL - Grayslake - The Chicago FM Club Radio Expo
PA - York - Keystone/York/Hilltop Hamfest

SEPTEMBER 25

CA - Santa Ana - ACP Swap Meet
FL - New Port Richey - Suncoast ARC Pasco Cty Hamfest
MA - Framingham - Framingham ARA Fall Flea Market
MO - St. Peters - St. Peters ARC Swapfest
NJ - Somerville - NJ Guitar/Electronics Flea Market
NY - Yonkers - Metro 70cm Network Electronic Flea Market
OH - Berea - 20th Annual Cleveland Hamfest/Cmptr Show
OH - Canton - Computer Support Services Comp. Festival
OH - Cleveland - Cleveland Hamfest Assn. Hamfest

SEPTEMBER 30-OCTOBER 1

TX - El Paso - Quarter Century Wireless Assn. Convention

OCTOBER 1994

OCTOBER 1

CA - Santee - Santee Swap Meet
MD - New Carrollton - CMA Computer Shows
MI - Roseville - Int'l Canadian/American Merga-Fest Show
WA - Bremerton - North Kitsap ARC Hamfest/Elec. Swap

OCTOBER 1-2

AL - Huntsville - Area Computer Shows
KY - Louisville - Hamfest/ARRL KY State Convention
MA - Boxboro - New England Division Convention

OCTOBER 2

CA - Livermore - Livermore ARC Swap Meet
IL - Skokie - A Computer Co Super Computer Show
MI - Ann Arbor - Colossal Computer Sale
MI - Taylor - Int'l Canadian/American Mega-Fest Show
OH - Ashland - Ashland Area ARC N. Central Ohio Hamfest

OCTOBER 6-7-8-9

MEXICO - Puerto Vallarta - MX Fed. Ham Radio Oper Conv.

OCTOBER 7-8-9

UK - Old Windsor, Berkshire - RSGB Int'l HF & IOTA Conv.

OCTOBER 8

FL - St. Petersburg - We're Show Offs Computer Show
ND - Grand Forks - Forx ARC Hamfest/Computer Fair
NJ - Teaneck - Bergen ARA Hamfest
OR - Medford - Rogue Valley ARC Swap Meet

OCTOBER 8-9

GA - Norcross - Atlanta Area Computer Shows
MA - Marlborough - KGP's Computer Shows*
TN - Memphis - MemFest 94/ARRL Delta Div. Convention
TX - El Paso - 7th Annual International Hamfiesta

OCTOBER 9

FL - Orlando - We're Show Offs Computer Show
IL - Palatine - Computer Central Computer Show
IN - Indianapolis - AGI Computer Fairs*
MI - Lansing - Central Michigan ARC Hamfair '94
OH - Findlay - Computer Support Services Comp. Festival

OCTOBER 14-15

FL - Starke - ARC Bradford Area Hamfest/Computer Show

OCTOBER 14-15-16

NE - Omaha - ARRL Midwest Division Convention

OCTOBER 15

CA - Santee - Santee Swap Meet
IN - Merrillville - Computer Possibilities Unlimited
NC - Sanford - Central Carolina ARS Fall Festival
NY - Syracuse - Radio Amateurs of Syracuse Hamfest
TN - Gray - 14th Annual Tri-Cities Hamfest

OCTOBER 15-16

CA - San Diego - American Mega Shows Computer Show

OCTOBER 16

IL - Orland Park - The Orland Park Computer Show
MA - Cambridge - MIT RS & Harvard Wireless Hamfest
PA - Bensalem - Penn Wireless Association Tradefest
PA - Carlisle - 10th Annual CCARS Hamfest
VA - Tysons Corner - CMA Computer Shows

OCTOBER 20

FL - Ft. Lauderdale - Narisaam Computer Shows*

OCTOBER 20-21-22-23

NY - Long Island - Personal Computer & Electronics Expo

OCTOBER 21

FL - West Palm Beach - Narisaam Computer Shows*

OCTOBER 22

IN - Highland - Computer Possibilities Unlimited
MI - Westland - Great Lakes Computer Expo & Sale

OCTOBER 22-23

CA - Pasadena - Int'l Computers Shows & Sales
FL - West Palm Beach - Palm Beach Repeater Assn. Hamfest

OCTOBER 23

MI - Warren - USECA Swap
OH - Lima - Computer Support Services Comp. Festival
PA - Greensburg - Foothills ARC Hamfest
PA - Sellersville - RH Hill ARC Hamfest

OCTOBER 29

MN - St. Paul - Twin City FM Club Hamfest

OCTOBER 30

IL - Glen Ellyn - Computer Central Computer Show
IN - Lebanon - Boone & Clinton County ARCs Hamfest
MD - Westminster - Mason-Dixon Hamfest & Computer
MI - Southfield - Michigan Computer Festival
OH - Columbus - Computer Support Services Comp/Festival
OH - Marion - Marion ARC Hamfest

TECH FORUM

Continued from page 83

Buy or build a simple 10MHz crystal oscillator. Then couple the signal from this oscillator to your shortwave receiver by draping a wire from the oscillator over the radio, or placing it near the set's antenna. Tune in WWV on 10MHz and listen for the beat frequency, which will probably be a low pitched tone. Tune the oscillator to zero this beat frequency and you'll have a frequency source calibrated to within a few hertz in NIST standards.

An excellent source for a cheap temperature compensated 10MHz oscillator is a replacement master oscillator for the Radio Shack PRO-2005 scanner. Bill Cheek describes calibrating this device in his *Scanner Modification Handbook*, available from several radio suppliers, CRB Research, or Commtronics (a N&V advertiser).

Another handy frequency standard is the 3.579545MHz oscillator in your color television set. This oscillator is frequency-locked to that of the transmitting station when the set is receiving a color picture. If the picture is from a major network, the frequency will be directly traceable to NIST standards.

George R. Scott
Alexandria, VA

ANSWER TO #6948 - JUNE 1994

The ultrasonic unit probably does not have many parts useful for a metal locator. An inexpensive device would consist of a 6" DIA coil with a few hundred turns of wire to act as the inductor of a tuned LC tank audio oscillator. When the coil comes close to metal, the inductance and, hence, oscillator frequency change. Since the ear is very sensitive to frequency changes, the detector will be quite sensitive.

The sensitivity will depend on the object size material and on surrounding ground conditions. Budget metal detectors can be bought for about $40 from Radio Shack and other sources.

Paul Szozdowski
Euclid, OH

ANSWER TO #4945 - APRIL 1994

There are three main classes of potting material: Silicone based, Urethane based dense foam, and far and away the most commonly used, epoxy resins.

Epoxies come in clear (can be dyed any color), to opaques (white through a rainbow of colors to black). They also come in various grades from a slightly gummy state to cement hard. Some companies making potted modules for vehicular use mix epoxy with sandblasting sand — a nasty, nasty trick.

Is it possible to defeat potted modules? In a word, yes! Being contact reverse engineers, we do this constantly and have never yet failed to get our schematic, although we can make a heck of a mess doing so. Silicone and Urethane based compounds can be laboriously picked away at room temperature. These are probably used more for weatherproofing or temperature stabilization than security.

Epoxies are another ball game. We use two methods to attack them, depending on the grade, coating thickness, circuit board material, type of circuit components used, etc.

1) For epoxy coated ceramic substrates, relatively thin pots over fiberglass or paper (phenolic) circuit boards, or relatively small potted blocks, we use chemical means. There are many chemicals on the market to "dissolve" epoxy, formulated for the different grades used.

Dissolve is rather a misnomer as we have found NOTHING which cleanly dissolves epoxy (or silicons or urethane materials for that matter) and allows it to wash away from the circuit cleanly. We use plain old 99.5% pure Dimethylsulfoxide (DMSO) available at yor local pharmacy.

This, along with complete immersion of the potted object and 160°F heat, will cause the epoxy to become spongy in layers. A half hour or so will allow us to scrape off a layer of a 1/16 inch or so — a lengthy and annoying process. Since DMSO works pretty well on all grades except the very hardest used for IC cases themselves, we loose the shells of film resistors, disc, monolithic, tantalum frags, and poly capacitors. These we then have to measure to get values. Paper and fiberglass boards are totally unaffected, as are transistor and IC housings and the part numbers on the same. What we do NOT use chemicals for is epoxy over glass epoxy boards. DMSO turns glass epoxy boards into green Jello, allowing the traces to float around - not a viable way to salvage the circuitry.

2) Under very high heat (600-700°F) epoxies become friable (about the same consistency of a pencil eras-

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er) and can be scraped away in flakes and chunks. By being extremely careful and taking a lot of time, one can save resistor and capacitor shells, salvage transistor and IC numbers, and keep from digging the traces out of glass epoxy boards.

Bottom line: Once we get down to the circuit board, even if you have used multilayer boards with NO traces on the upper and lower layers (NO traces showing on either side of your board), we will still extract your schematic from our continuity probing processes. Potting circuits will definately protect you from the timid and slow us down some, but WILL NOT PROTECT you from those of us who are super curious and willing to take the time and energy to get at the truth.

Remember: WHAT MAN DOES, MAN CAN UNDO!

Bomarc Services
Casper, WY

ANSWER TO #69426 - JUNE 1994

Pull-up and pull-down resistors are resistors (their value can range from several ohms to several megohms depending on the application) connected from the input or output of a logic gate or transmission line either to ground or a negative supply voltage (a pull-down) or to a positive supply voltage such as +5V (a pull-up). Sometimes both a pull-up and pull-down resistor exist on the same line. There are many reasons for doing this, some of which are given below:

1) Line termination — All cables, buses, wires, circuit board traces, etc., transmit electrical signals along them with a finite speed, bandwidth, and characteristic impedance depending on the materials used. Serious distortions in the signal shape can occur if the line is not "matched" at both its ends with its characteristic impedance (usually 50 or 75 ohms for coax cable, 300 ohms for some antenna lines, etc.). Sometimes a series resistor is used to do this while other times, a pull-up resistor, pull-down resistor, or combination of both are used. When properly terminated, a signal which reaches the end of the line will not produce a "reflection" that travels back down the line toward the source. If the source is improperly terminated, another reflection is produced and on and on. Eventually, these reflections will die out, but not before screwing up the shape of the signal. In addition, maximum power is transferred to a load that is matched to the driving line.

2) Logic conversion — When interfacing different logic families together, the voltage levels representative of logic 1s and 0s of the driver's output must fall within the corresponding range of the receiving gate's input. For example, when driving a CMOS gate (with a transition region of 2.5V) with a standard TTL output (which is typically only guaranteed to go to 2.4V for a logic high) it is customary to place a pull-up resistor to +5V at the output of the TTL gate to "pull-up" the logic high state from the minimum guaranteed 2.4V to 3.5 or 4.5V (the actual value depends on the resistor value chosen and the input current of the gate or gates). Typical values are 1K to 47K. CMOS outputs driving TTL inputs need no pull-up/pull-down resistors since the CMOS output voltage swings are compatible with the TTL input range.

3) Open collector outputs — A popular type of output driver for motors and signal buses is the open collector driver. The output consists of a floating transistor collector lead. This output MUST be pulled-up to a positive supply which can even be 100s of volts for some devices (older style NIXIE tube drivers for example) so long as the transistors break down voltage is not exceeded. In addition, multiple OC drivers can be wired together to create a "wired-or" configuration where the output will go low if ANY of the transistors are ON. A similar situation exists when using ECL devices which commonly use floating transistor emitter leads which must be pulled-down to a negative supply voltage (typically -5.2V).

4) Tri-state lines — Tri-state output drivers can exist in either a logic high state, logic low state, or a "disconnected from circuit" state referred to as Hi-Z or high impedance. Using tri-state buffers on data lines allows multiple sources to drive the same set of lines.

If the situation ever exists when NO driver is active, the data lines will "float" and may confuse the receiving gates. Thus, either pull-up or pull- down resistors are placed on each line in the bus to pull them all to a known value when the bus is inactive.

The above list is by no means exhaustive. I commonly use 2.2K pull-up resistors on logic gate inputs when debouncing switches and push-buttons. Knowing when and where to use pull-up and pull-down resistors and also determining their correct values is an important skill to develop in electronic design. From now on, whenever you see a pull-up or pull-down resistor in a circuit, try to determine what it is doing there. You may learn something very important about what the circuit is doing!

Jay Rabkin
Pasadena, CA

ANSWER TO #7942 - JULY 1994

The LM78xx series of voltage regulators (LM7805, LM7806, LM7812, LM7815) are extremely easy to use (embarrassingly easy as a matter of fact). They are fixed voltage, 3-terminal devices which can supply about 1 amp of current when properly cooled. The last two digits in the part number specifies the regulated output voltage which is produced. A similar (and slightly superior) set of parts is the LM340-xx series (LM340-5, etc.) which have identical pinouts but a 1.5 amp max current capability and better thermal performance and load regulation. Figure 1 shows a typical wiring configuration (the capacitors are for filtering and are non-critical). Figure 2 gives the pinouts for the two most popular packages (the TO-3 "power transistor" case uses a K suffix e.g., LM7812K or LM340K-12 while the TO-220 "plastic power transistor" case uses a T suffix, e.g. LM7812T or LM340T-12). The pinouts for both series are identical.

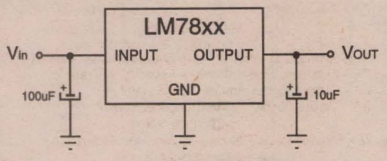


FIG 1

Although easy to use, some design rules should be observed. First, the input voltage (Vin or INPUT) should not greatly exceed the desired output voltage. The difference in input/output voltage must be dropped across the regulator and will cause a large amount of power to be consumed in the regulator itself. In other words, it will get HOT! This will reduce the ability of the regulator to supply current to your desired load. Adequate heat sinking with airflow will be required when the maximum amount of regulator current is needed or when a large input/output voltage differential exists. A good rule of thumb is to keep the input voltage from two to three volts higher than the output voltage. This minimum amount of voltage differential is required for proper operation of the regulator (especially at higher output currents).

The spec sheet for the parts actually specifies a maximum input voltage of 35V. However, with this high of an input voltage, the part would probably immediately heat-up and go into thermal shutdown (a safety feature to protect the part).

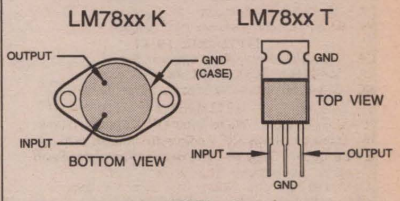


FIG 2

Note that higher current regulators are also available. For example, the LM350 series are rated at 3 amps. Negative voltage regulators are also available as the LM79xx or LM320-xx series of parts. When using these devices, the input voltage must be negative with respect to the GND pin of the regulator and at least 2-3 volts more negative than the desired (negative) output voltage. Note that the pinouts of these series of parts are NOT THE SAME as those for the 78xx series! Figure 3 shows the pinouts for the common TO-3 and TO-220 packages.

Note also that the polarity of the capacitors shown in Figure 1 must be REVERSED since now GND is more positive than either the input or output voltages.

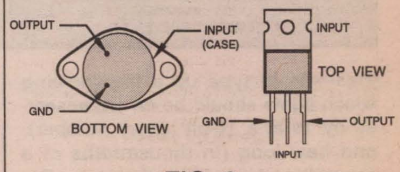
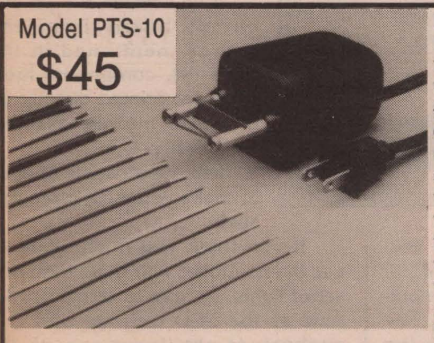


FIG 3

The LM317 device is an "adjustable" voltage regulator with a current rating of 1.5 amps. Its pinout is different from both the positive and negative regulators and is given in

Continued on page 142



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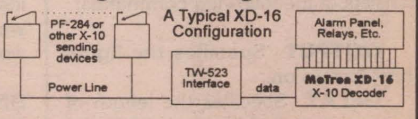

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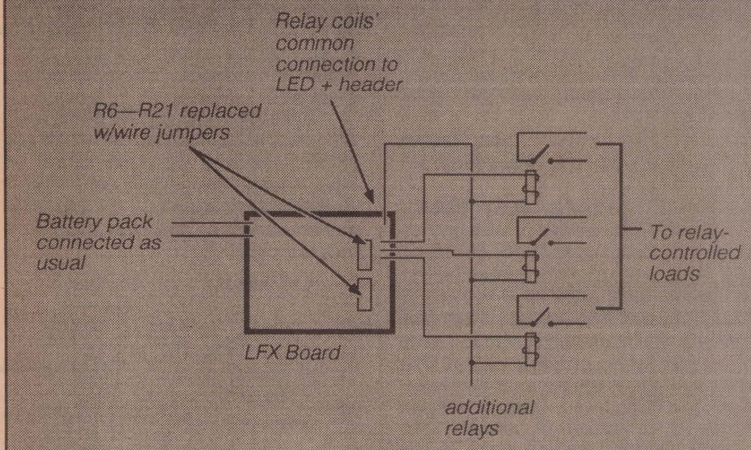
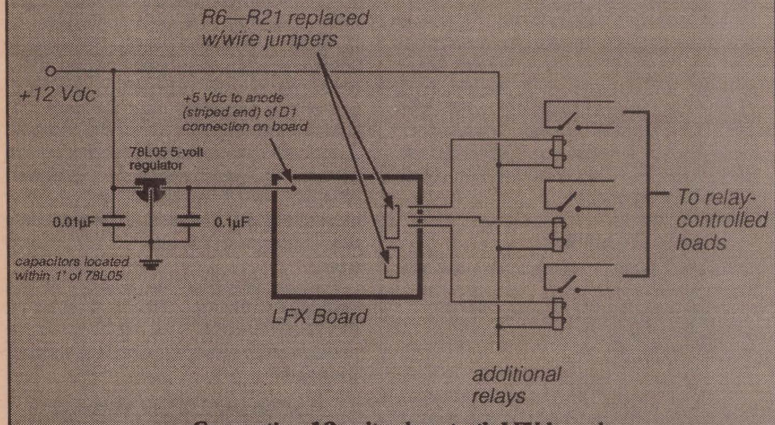
LFX Programmable Light Controller

Continued from page 48



Connecting 5 to 6 volt relays to th LFX board

Figure 6. You can substitute relays fo LEDs to control larger loads with the LFX.



Connecting 12 volt relays to th LFX board

Operator	Synonym(s)	Meaning/Example
+	(none)	add: 56 + 13 = 69
-	(none)	subtract: 69 - 13 = 56
*	(none)	multiply: 2 * 7 = 14
/	(none)	divide: 14 / 2 = 7
|<	SHL, SHIFT_LEFT	shift bits left: 0110b |< = 1100B
>|	SHR, SHIFT_RIGHT	shift bits right: 0110b >| = 0011B
<<	RL, ROTATE_LEFT	rotate bits left, same as shift left, but the highest bit (representing the 16th output) is recirculated to the lowest bit: 1100000000000000b << = 1000000000000001b
>>	RR, ROTATE_RIGHT	rotate bits right, same as shift right, but the lowest bit (representing the 1st output) is recirculated to the highest bit: 1100000000000001b >> = 1110000000000000b
&	AND	logical AND: 1011b & 1100b = 1000b
|	OR	logical OR: 1011b | 1100b = 1111b
^	XOR	logical exclusive-OR: 1010b ^ 1111b = 0101b
\	NOT, INVERT	logical NOT: 1110b \ = 0001b
<>	SWAP	byte swap: 1111000010101100b <> = 1010110011110000b
MRL	MIRROR_RL	mirror copy bytes, right-to-left: 1111000010101010b MRL = 0101010110101010b
MLR	MIRROR_LR	mirror copy bytes, left-to-right: 1111000010101010b MLR = 1111000000001111b

Table 1

idea was to type up a file showing which lights should be on (represented by 1s in a 16-bit binary number), and how long (in thousandths of a second) to leave hem that way. For example, a marquee-type flasher would be programmed this way:

```
OUTPUT 1010101010101010b
DELAY 500
OUTPUT 0101010101010101b
DELAY 500
```

While that's easy to understand, it wouldn't be much fun to write a 127-step sequence if you had to type in the exact sequence of outputs. So I wrote a small and very simple programming language for the LFX. It consists of the following commands:

OUTPUT Specifies the lights (bits) to turn on.

DELAY Specifies the length of time to wait before executing the next OUTPUT command.

REPEAT Specifies the number of times to repeat a series of OUTPUT and DELAY commands. The commands to be repeated must be between the REPEAT command and a closing LOOP command. REPEAT loops cannot be nested. One REPEAT must be closed out with a LOOP command before another can begin.

LOOP Marks the end of a REPEAT loop.

SYMBOL Lets you substitute a word or letter for a number.

DITTO A special kind of symbol that holds the previous value assigned to a DELAY or OUTPUT command.

REM Allows you to insert comments in your programs. LFX ignores comments, but they can help you organize your library of light effects by inserting comments to explain what they do and how they work.

The commands OUTPUT, DELAY, REPEAT, and SYMBOL all need a number to act on. Numbers can be in decimal, hexadecimal (hex), or binary formats, like so:

```
Decimal: 185
Hex: 0B9H
Binary: 10111001B
```

You can use the number system that makes sense for the job at hand. For example, I always use decimal to specify DELAYs. It's easy to remember that a DELAY of 1000 is equal to 1 second. I frequently specify OUTPUT in binary, because a 1 represents ON and a 0 represents OFF. I included hex because most programmers like to use it as shorthand for binary.

You can also represent numbers as math and logic expressions. You can use these to calculate values for DELAY or move bits around in OUTPUT. However, unlike full-blown programming languages, you can only have one expression per command. You cannot use something like 2 * 3 + 1, but 2 * 3 is OK. The math/logic operators are listed in Table 1.

An example program is in order. The one in Table 2 is called YoYo.

Notice the use of DITTO. Each trip through the REPEAT loop, the previous time value is multiplied by 0.9. So the first delay is 0.18 seconds, then 0.16, 0.14, 0.13, 0.12 . . . and so on. At the same time, the output bit is being shifted to the left. The second REPEAT loop reverses the process, shifting the output to the right and increasing the delay each loop.

```
REM  YoYo: A single dot of light starts at the right side
REM  and travels across the LEDs, accelerating as it goes.
REM  When it reaches the left, it turns around and comes
REM  back, decelerating in the process.

SYMBOL Start = 0000000000000001b

OUTPUT Start
DELAY 200
REPEAT 15
  OUTPUT DITTO |<
  DELAY DITTO * 0.9
LOOP
REPEAT 15
  OUTPUT DITTO >|
  DELAY DITTO * 1.1
LOOP
```

Table 2

To create an LFX program, you type it in a text-editing program (like EDIT, included with DOS 5 and later) or a word processor capable of saving an ASCII text file. Save the file, making note of the file name and path. Then feed it to LFX.EXE by typing LFX <filename>. For example, if the previous program were saved as YOYO.LFX on a floppy in drive A: in a directory named LIGHTS, you'd type LFX A:\LIGHTS\YOYO.LFX.

The LFX software analyzes your program for errors and, if it's okay, downloads it to the controller via the COM1: serial port. If there's a problem with your program, LFX tells you what it is, and the line number of your text file at which the problem occurred. The most common problems are typos, and failure to put spaces between elements of a math or logic expression. LFX doesn't care how many spaces you insert between commands or elements of an expression, as long as there is at least one.

Construction

LFX consists of a controller board, battery pack, and serial downloading cable. Figures 2, 4, and 5 show how to construct each of these. No special techniques are required.

If you obtain the printed circuit board from the source mentioned in the parts list, component locations are printed directly on the board, making assembly even easier.

Here are a couple of hints to make your LFX more versatile:

If you think you might want to use the controller with more than one set of lights, be sure to install header pins at the LED outputs and DIP sockets at the locations of R6 through R21. That way, if your load requirements change, or you decide to use relays to control more powerful lights, you can use DIP header plugs to install jumpers in the resistor

locations.

If you aren't familiar with DIP header plugs, you should be. As the name suggests, they're plugs that fit into standard IC sockets. On the back of the plug is a series of fork-shaped contacts to which you can solder components. To make plug-in jumpers for the resistors, you need two 16-pin headers. Solder wires between opposite pairs of pins: 1 and 16, 2 and 15, 3 and 14 . . . The same goes for making removable resistor packs, except that you would install 1/4 to 1/2 watt resistors instead of jumper wires.

Even more convenient are ready-made resistor-network packages, like those included in the kit mentioned in the parts list. These resemble ICs, but contain resistors connected as described above. They are great time savers for projects requiring several resistors of the same value. If you're installing them in sockets, take care. The pins are softer than those on normal ICs and bend readily.

To connect your LEDs or relays to the controller, you'll need connectors that fit the machine-pin headers. I used the socket strips mentioned in the parts list. They come in 36-pin lengths that must be separated with a hacksaw to make the 8- and 4-pin sections needed for LFX. They have solder-tail terminals designed for circuit-board mounting, but they work just fine with wires attached. I use a little hot glue to make the connections less vulnerable to damage from handling.

These are the same connectors used in 4-pin sections for the battery and serial connections. Although the connections are staggered so that mixing up the connectors or installing them backwards won't damage anything, you should mark the connectors and circuit board to indicate correct orientation. A dot of paint on the connector and board should do it.

Checkout and Use

Connect LEDs to the outputs of the board as shown in Figure 1. The anodes (+ connections) are the longer leads; cathodes are marked with a flat spot on the base of the LED. If you purchased the kit from the source in the parts list, your EEPROM is preprogrammed with the LED sequence YoYo described earlier in the article. Just connect LEDs and power and watch the show.

If you have an unprogrammed EEPROM, or you have tired of watching YoYo and want to try another sequence, follow these steps:

Connect the downloading cable to your PC's COM1: serial port. (If COM1: isn't available for some reason, use COM2:. In the instructions that follow, type LFX2 wherever LFX is specified.)

Fire up your PC and connect power to the LFX board. The LEDs will remain off. Put the disk containing the LFX software into one of the floppy drives. If it's drive A, type A: to switch to that drive. Then type LFX TEST.SEQ. The program will begin assembling that file. When it's done, it will download the data to the LFX controller. At this time, the LEDs will flicker in apparently random order. They are responding to patterns of data in the TEST sequence. When the download is complete, the sequence will run. Test is designed to flash all of the LEDs and check all EEPROM memory locations. If an LED doesn't light at some point during the sequence, you have a bad connection.

Use the same procedure to download other programs. If a program is already loaded and running on the controller, press S1 before downloading another. If the serial cable is connected, the LEDs will go out and the controller will wait for new data. If you do this by mistake and want to cancel the download, just disconnect power from LFX, then remove the downloading cable. The data in the EEPROM will be intact.

To program your own sequences, I suggest that you begin by examining and modifying the programs on the LFX software disk. Save them under different names and hack away. The LFX software will catch your worst errors, but may not be able to tell the difference between a properly formatted program that doesn't make sense, and a perfectly good program. Here are the few things that the software definitely is fussy about:

- A program step must include one OUTPUT command followed by one DELAY command. If you put two OUTPUTs or two DELAYs in a row, you'll get an error message.
- Programs must generate 1 to 127 steps. The EEPROM won't store more steps than that, and it doesn't make any sense to have a zero-length sequence.
- SYMBOLs must not be redefined.
- Math/logic expressions can't have more than one operator. For example DITTO * 2 is legal, but DITTO + 6 * 2 is not. LFX does not recognize parentheses, used in other languages to group expressions, either.
- Every element in a line, including operators like +, -, <<, etc., must be separated from its neighbors by a space or tab character.
- Comments, which begin with REM, apostrophe ('), or semicolon (;), must be on separate lines.
- Only one command is allowed per line.
- Lowercase and uppercase are the same to LFX, so symbol, SYMBOL and SyMbOl are the same thing to the software.
- Hex numbers beginning with A through F must be preceded by a zero (0) to prevent the program from mistaking them for symbols.

Since LFX programs are text files, they can be transmitted over any medium that accepts text, including Internet and online services. If you're trying to achieve a special effect, want to see other folks' LFX programs, or want one of your programs included on future LFX disks, E-Mail the author at the address in the parts list.

The Big Time

LFX is an inherently safe project. Operating from battery power and running LEDs, it does not pose a threat to life or equipment. However, if you decide to switch AC power with LFX, you're getting into the Big Time. There isn't sufficient space here to cover all of the safety precautions associated with AC wiring. That's what electrical codes, electricians, and experienced friends are for. Be careful and work safely.

If you are unsure of your ability to assemble a safe arrangement to power AC lights with LFX, ***DON'T.*** With 500 mA worth of safe, low-voltage drive per channel, you can have plenty of fun with LEDs or low-voltage filament bulbs. **NV**

Vendors' contact information

Hosfelt Electronics — (connectors, battery holders, LEDs, wire, capacitors, resistors, relays), 2700 Sunset Boulevard, Steubenville, OH 43952; (800) 524-6464

Digi-Key — (EEPROMs, connectors, LEDs, resistors, relays), 701 Brooks Avenue South, P.O. Box 677, Thief River Falls, MN 56701-0677; (800) 344-4539.

Jameco Electronic Components — (LEDs, headers, connectors, battery holders), 1355 Shoreway Road, Belmont, CA 94002; (800) 831-4242.

Parallax Inc. — (Tools for programming PIC microcontrollers), 3805 Atherton Road, Rocklin, CA; (916) 624-8333.

Parts List

Semiconductors
U1 — Microchip 93LC66 512-byte serial EEPROM (Digi-Key 93LC66-P/ND; see note below for sources, compatibility notice)
U2 — PIC16C55 programmed with LFX firmware (see note below for source)
U3, U4 — ULN2803A Darlington inverter/driver (Jameco; see note below)
CR1 — 4 MHz ceramic resonator with integral capacitors, (Digi-Key PX400)
D1 — 1N914 silicon diode
LED1 through LED16 — LEDs (use your choice of color/package type)

Resistors (all are 1/4 watt, 5% unless otherwise indicated)
R1, R5 — 1,000 ohm
R2 — 10,000 ohm
R3 — 47,000 ohm
R4 — 22,000 ohm
R6 through R21 — 150 ohm (for ease of assembly, use two 16-pin DIP resistor networks, such as Digi-Key 761-3-R150)

Capacitors
C1, C2 — 0.1uF ceramic disk or monolithic capacitors, 50 WVDC or higher
C3 — 10uF electrolytic, 16 WVDC or higher

Miscellaneous
Battery holder: Four C or D cells
S1 — Momentary contact SPST pushbutton switch (Digi-Key P8034S mounts directly to circuit board, but others may be used)
J1, J2 — 4-pin section of single-row stake header material, 0.100" spacing (Digi-Key WM4002)
PL1, PL2 — 4-contact section of header socket strip (Hosfelt 21-231)
PL3 — Female DB-9 connector (PC/ATs and later) or male DB-25 (PC-XTs)
3.5 x 4 inch piece of single-sided printed circuit board material, etching supplies
IC sockets: One 8-pin, two 16-pin, and one 28-pin
Miscellaneous connections: Machine-pin headers for LED outputs (Hosfelt 21-197)
Solder, hookup wire, hot glue (or other glue)

Notes: Do not substitute manufacturers other than Microchip for U1 (the 93LC66) as these parts are not compatible.

The following components are available from:
Scott Edwards Electronics
964 Cactus Wren Lane
Sierra Vista, AZ 85635

U2 (the programmed PIC 16C55 controller), and CR1 (4 MHz resonator), $15.00
U1 (the 93LC66 EEPROM with preloaded sequence), $5.00
3.5-inch PC disk with the LFX software, $7.00 (Sorry, 5-1/4" disks not available)
PIC program source code listing for U2 (the PIC 16C55) in Parallax assembly dialect, 3.5-inch PC disk and hard copy, $25.00
Printed-circuit board, $15.00
A complete package including all parts and software (except hook-up wire, solder, and batteries), $55.00 Package includes a DB-9 connector for PC COM1 port; please specify DB-25 if your older PC requires this connector. The package also includes 16 bright red or green LEDs — please state color preference when ordering. (Mix-and-match is okay; e.g., eight green and eight red. If you don't state a preference, you'll get 16 red LEDs.) All prices are postpaid; checks, money orders, or institutional POs only. Arizona residents receive a discount equivalent to the sales tax on all items.

The author will answer questions regarding this project. Contact Scott at Compuserve 72037,2612; Internet 72037.2612@compuserve.com; or phone (602) 459-4802.

Figure 4. Note that the GND terminal is now called ADJ or adjust. A typical circuit is shown in Figure 5 with the output voltage being set by the two resistors R1 and R2. A pot can be used as shown or, two fixed resistors can be used with the output voltage given by Vout = 1.25 (1 >>> R2/R1). The resistor labeled R1 should be left at 240 ohms for best performance.

It should be noted that this circuit can also be used with the "fixed" type voltage regulators discussed above (it works by raising the voltage at the GND pin thus tricking the regulator into producing a higher voltage) but the equation given above will be different.

Note that the output voltage of all these regulators may not be EXACTLY 5V, 12V, etc. The output voltage can typically vary by ±4% (i.e., ±0.2V for a +5 regulator and ±0.5V for a 12V one). I also highly recommend getting copies of Motorola's and National's "Linear" databooks which have dozens of voltage regulators, their spec sheets with numerous application circuits along with many, many other devices of interest (op amps, comparators, TV circuits, analog switches, etc.).

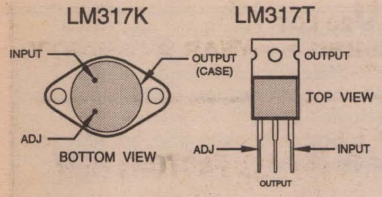


FIG 4

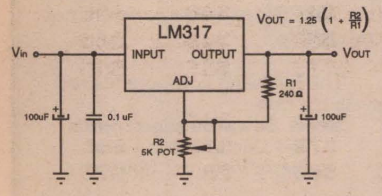


FIG 5

Jay Rabkin
Pasadena, CA

ANSWER TO #69423 - JUNE 1994

Either your information is incomplete or your description of your problem is inaccurate. The SWITCHES command is an internal command in DOS since version 6.00. The SWITCHES command can be found in the online DOS reference under MS-DOS 6.x. by typing HELP SWITCHES. The /F and /W switches show the following functions:

/F skips the 2-second delay after displaying the "Starting MS-DOS..." message during startup.

/W specifies that the WINA20.386 file has been moved to a directory other than the root directory. You need to use this switch only if you are using Microsoft Windows 3.0 in enhanced mode and have moved the WINA20.386 file from the root directory to another directory.

I tried adding SWITCHES=/FW to my config.sys file and got an error message (invalid option). When I used SWITCHES=/F/W my multi config.sys and autoexec.bat worked just as good as always. Are you aware that in order for the multi-config option to work in your autoexec.bat file you must include GOTO <CONFIG> and your autoexec.bat file must have labels that match the labels you are using in your config.sys file?

I have always used SWITCHES=/F in the first line of my DOS 6.x config.sys file. Below is an excerpt from each of my config.sys and autoexec.bat files.

CONFIG.SYS FILE

```
[common]
switches=/F

[menu]
menuitem=NORM,Normal Bootup -
QEMM
menuitem=LOW,DOS Hi - Everything
Else Low
menudefault=NORM,10

[NORM]
DEVICE=C:\QEMM\QEMM386.SYS
RAM X=A000-BFFF
DOS=HIGH,umb
more commands go here

[LOW]
DEVICE=C:\WINDOWS\HIMEM.SYS
DOS=HIGH
DEVICE=C:\DOS\SETVER.EXE
BREAK ON

BUFFERS=40
FILES=20
FCBS 2,0
COUNTRY=001,,C:\DOS\SYS\COUN-
TRY.SYS
DEVICE=C:\SYS\V7ANSI.SYS
DEVICE=C:\SYS\MOUSE82.SYS
DEVICE=C:\DOS\SYS\RAMDRIVE.SY
S 1536 128 80 /E

[common]
SHELL=C:\COMMAND.COM /E:350
/p
```

AUTOEXEC.BAT FILE

```
@echo off
BREAK ON
VERIFY ON
C:\DOS\MODE COM1:9600,N,8,1
C:\DOS\MODE COM2:9600,N,8,1
GOTO <CONFIG>

:NORM
C:\COMM\LAN50\NEX000 IRQ=5
IOBASE=300 16-BIT VERBOSE
C:\QEMM\LOADHI /R:1
C:\COMM\LAN50\ALLANBIO
C:\QEMM\LOADHI /R:1
C:\COMM\LAN50\REDIR 386
LOGINS=3
PATH
C:\DOS;C:\UTIL\COM;C:\UTIL\GEM;
C:\UTIL\EXE;C:\WINDOWS
SET TEMP=g:\
GOTO LAST

:LOW
C:\COMM\LAN50\NEX000 IRQ=5
IOBASE=300 16-BIT VERBOSE
C:\COMM\LAN50\AILANBIO
C:\COMM\LAN50\REDIR 386
LOGINS=3
PATH
C:\DOS;C:\UTIL\COM;C:\UTIL\GEM;
C:\UTIL\EXE;C:\WINDOWS

:LAST
```

George McLam
Sacramento, CA

ANSWER TO #6949 - JUNE 1994

A negative ion generator article appeared in the January 1991 and February 1991 issues of *Radio Electronics*. The output can beadjusted.

Dennis Gifford
Henagar, AL

ANSWER TO #69425 - JUNE 1994

Synchronizing your camera and VIC20 would not be easy. It might be better to buy a video titler if your intent is to add text to video. Damark (Tel. 1-800-729-9000) is currently selling a JVC Model JXT66 Titler for only $130.00.

Paul Szozdowski
Euclid, OH

ANSWER TO #69418 - JUNE 1994

A game-show buzz-in circuit like the one used in TV's "Jeopardy" was requested. I recently built one of these circuits for some corporate games and will pass on an abbreviated version of that circuit and one other possible circuit which I have not tested, but should do a pretty good job. My circuit was for eight players, not the three you requested, but the circuit is easily adaptable. A three player circuit is shown here; however, the counter chosen, a 74142, will allow up to 10 players.

The circuit in Figure 1 uses a clock-driven counter to momentarily enable each of the player switches. The clock speed is chosen sufficiently fast such that a tie (or near tie) will have to be within thousandths of a second. If there occurs such an extremely small period between closure of player switches, the tie will be broken randomly based on where the counter is when the switches are closed. In most cases, the time between the first and any subsequent switch closures should be greater than many full counter revolutions, but the random tie breaker is built in if needed. If you're having trouble understanding this, picture a clock with a hand whirring around thousands of times per second and three people jamming their fingers in to stop it at locations 4, 8, and 12. Whoever stops the hand is the winner.

Concerning components: I used 7474 D flip-flops with Preset and Clear, a 74142 counter, and a 7430 8-in NAND. (3-in NAND shown in Figure 1 circuit) A 555 timer clock or one of those ready-made crystal clock modules will work fine to clock the 74142 counter. The faster the better, but do not exceed any chip specs.

Excellent buttons can be fashioned using A3M XLR (audio) connectors and a pushbutton switch that just fits in place of the three-pin part of the connector. This method provides a comfortable device to fit in your hand and built-in strain relief.

Version 2 (Figure 2) eliminates the clock and counter components and may conceivably allow a tie to occur — although that's probably not too likely. Instead of rapidly and momentarily enabling each switch, this circuit waits for one of the switches to close and disable the rest.

This circuit is simpler and cheaper, but I haven't breadboarded it and don't know exactly how it will behave.

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TECH FORUM

(Notes for Figures 1 & 2) A buzzer can be triggered off of the NAND gate's output using a 555 timer for a one-shot to further trigger a buzzer or another 555 oscillator. Solid state relays can be used to allow the logic level output to control 120V AC lights.

Apart from these solutions, this would be a very easy application for the BASIC or counterfeit STAMP.

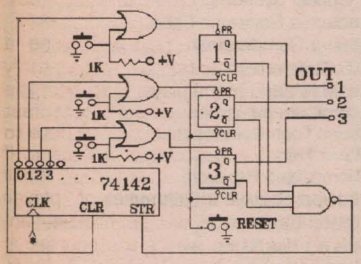

Figure 1

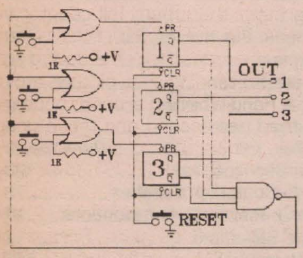

Figure 2

Thomas Holloway
Miami, FL

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New Product News

Continued from page 51

read the VL-EXT's status to verify a completed connection before running the actual board test. When the test is complete, the program commands the VL-EXT Card to disconnect the PC signals and powers off the test board so it can be replaced. Manual operation is similar, except it is initiated by a switch on the VL-EXT card.

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For more details, contact:

ICS ELECTRONICS CORP
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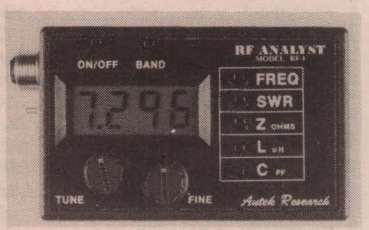
FAX: 408-263-5896

FIVE-FUNCTION DIGITAL RF ANALYST



The pocket-sized RF ANALYST™, available from Autek Research, is designed to check and adjust antennas, feedlines, and RF networks.

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New Product News

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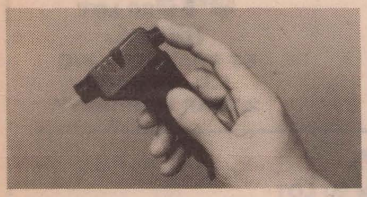

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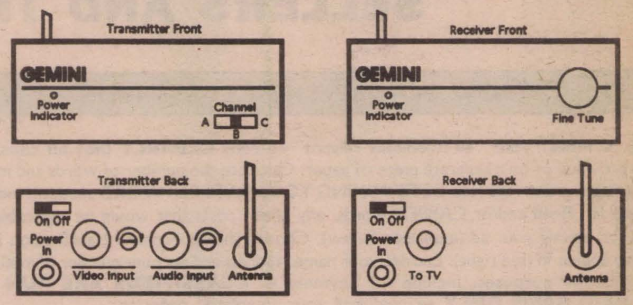

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#VA-5000
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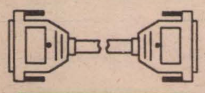


From $2.75 each

DB25 Cable

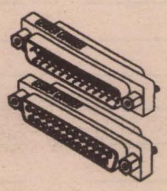
Gold contacts with all pins wired. Molded and shielded cables with thumbscrews.

Male to Male

#CC-MM3	3 feet	$2.75
#CC-MM6	6 feet	$3.00
#CC-110	10 feet	$4.00
#CC-151	15 feet	$5.00
#CC-251	25 feet	$9.00
#CC-253	50 feet	$14.00
#CC-171	100 feet	$25.00

Male to Female

#CC-3MF	3 feet	$2.75
#CC-6MF	6 feet	$3.00
#CC-100	10 feet	$4.00
#CC-150	15 feet	$5.00
#CC-250	25 feet	$9.00
#CC-252	50 feet	$14.00
#CC-172	100 feet	$25.00



Gender Changers

Slim Line Male

#GC-09M-2	DB9	$2.00
#GC-15M-2	DB15	$3.00
#GC-25M-2	DB25	$2.50
#GC-36M	Cent. 36	$6.00
#GC-37M-2	DB37	$5.00
#GC-HDM	HD15 VGA	$5.00

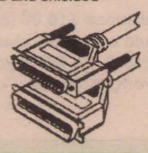
Slim Line Female

#GC-09F-2	DB9	$2.00
#GC-15F-2	DB15	$3.00
#GC-25F-2	DB25	$2.50
#GC-36F	Cent. 36	$6.00
#GC-37F-2	DB37	$5.00
#GC-HDF	HD15 VGA	$5.00

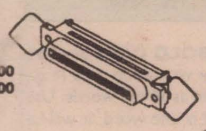
Parallel Printer Cable

DB25 to 36 Pin Centronics Molded and shielded IBM Compatible

#CC-PR3	(3 Foot)	$2.75
#CC-PR6	(6 Foot)	$3.00
#CC-PR1	(10 Foot)	$4.00
#CC-P15	(15 Foot)	$5.00
#CC-PR2	(25 Foot)	$9.00
#CC-PR5	(50 Foot)	$14.00



Amphenol IDC



Male

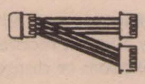
#CN-681	50 pin SCSI	$3.00
#CN-545	36 pin parallel	$2.00

Female

#CN-680	50 pin SCSI	$1.50
#CN-546	36 pin parallel	$2.00

6" Power Supply "Y"

for 5.25" disk drives & hard drives, etc.



#CC-DRY
$1.50
30 up $1.00 each

Ten Base-T Cables

Level 5

#TE-068-L5	6 Feet	$6.00
#TE-128-L5	12 Feet	$8.00
#TE-258-L5	25 Feet	$12.00
#TE-508-L5	50 Feet	$23.00
#TE-108-L5	100 Feet	$32.00
#TE-08C-TL5	1000 feet Spool	$148.00

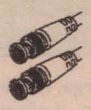
Thin-Net

RG-58 with BNC Connectors

#RG-58-10	10 feet	$4.00
#RG-58-25	25 feet	$6.00
#RG-58-50	50 feet	$8.00

Custom lengths also available

#RG-58	1000 feet Spool	$130.00



Specials

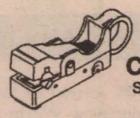
Paladin BNC Connectors 75¢ each

3 piece crimp type with gold pin for RG-58 Ethernet

PALADIN®

#CN-548

60¢ each



Coax Stripping Tool

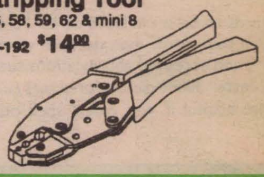
Strips RG-6, 58, 59, 62 & mini 8

#TM-192 $14.00

BNC Crimp Tool

Ratchet Type • Crimps RG-58, 59, 62

#TM-292 $20.00



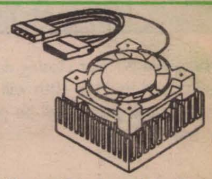
Internal Ribbon Cables

12" 50-Pin
one device SCSI HDD Cable
#CC371

24" 34 pin
one device IDS Cable
CC-374

50¢

12 for $5.00



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486/AT CPU.
Easy hook-up to power!
Clips to chip or stick to chip.
Please specify.

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$10.00 each

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* 586 now available

Accessories

PS/2 IBM Keyboard Replacement Cable

Modular to 6 pin Mini Din
Beige Coiled Cable

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Amplified Stereo Speakers

Built-in stereo amplifier
Great for CD ROM or Sound Blaster Cards
Use four C batteries
Power supply available

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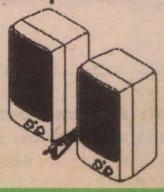
$19.50 per set



Double Disk Convertor

The original disk converter.
3.5" Double Density Disk to 1.44 MB High Density Disk.
Made of heavy gauge steel.
For all computers!

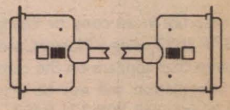
#TM-319

$19.95 each 2 up $18.00 each

6 Foot SCSI Cable - 50 Pin Amphenol

Male to Male
IBM/MAC
Double Shielded
Highest Quality Made

$7.00 each



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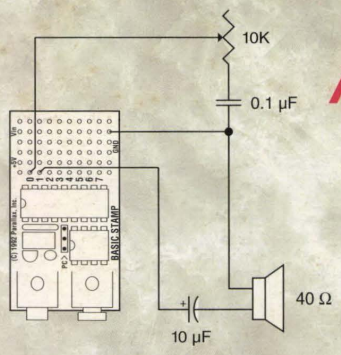
BASIC STAMP™

Stamp-Sized Computer Runs BASIC

The BASIC Stamp is a 1.5x2.5-inch computer that runs BASIC programs written on your PC. It has 8 I/O lines, which can easily be programmed for serial communications, potentiometer input, pulse measurement, button debounce, tone generation, PWM, etc. And all by just adding a resistor and/or capacitor, if anything.

The circuits on this page show some of the things our customers are doing with Stamps.



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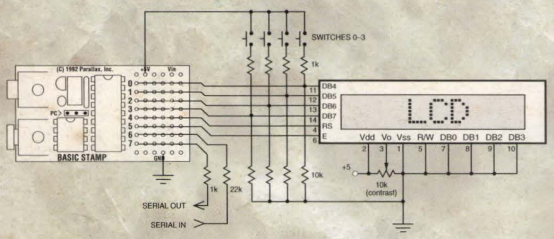
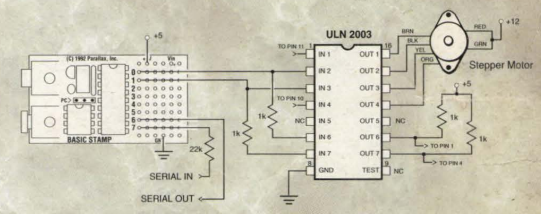
Noise Maker

In this application, the Stamp reads the pot and outputs a variable tone or white noise.



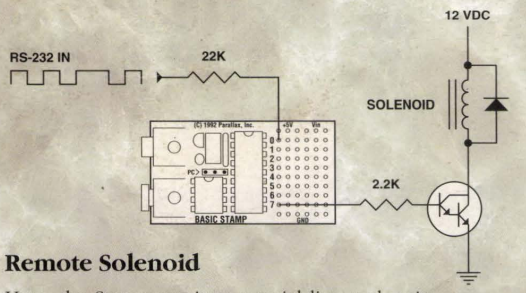
Micro-Terminal

In this application, the Stamp receives serial data and displays it on the LCD. The state of the four buttons is then transmitted serially.



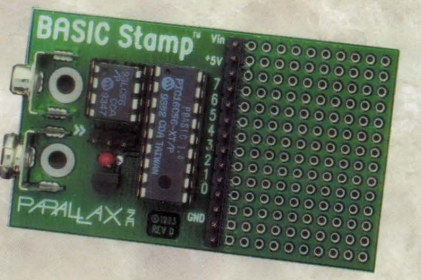
Stepper Motor Controller

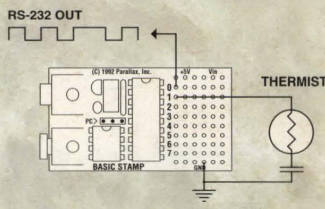
This circuit makes the Stamp into a remote stepper motor controller. Using serial communications, the Stamp sends out a request for number of steps and delay between each. When it receives the data, the Stamp steps the motor as directed.



Remote Solenoid

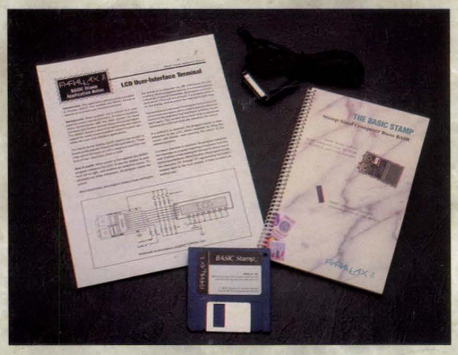
Here, the Stamp monitors a serial line and waits for a specific code. If the code is received, then the Stamp activates the solenoid.





Serial Temperature Sensor

Here, the Stamp uses the POT instruction to read a thermistor. The reading is linearized and then sent out serially.



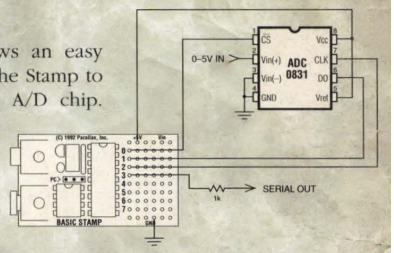
Stamp Programming Package **$99**

Stamps sell for $39, and lower prices start at just four units.

Writing programs for the Stamp is easy. The BASIC Stamp Programming Package contains everything you need to program Stamps using your PC. The package includes our editor software, programming cable, manual, application notes, and free technical support. The package is available for $99 (please note: Stamps are sold separately).

Serial A/D

This circuit shows an easy way to connect the Stamp to a common 8-bit A/D chip.



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