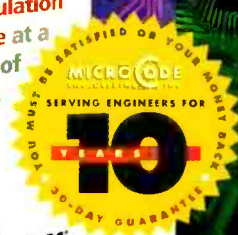
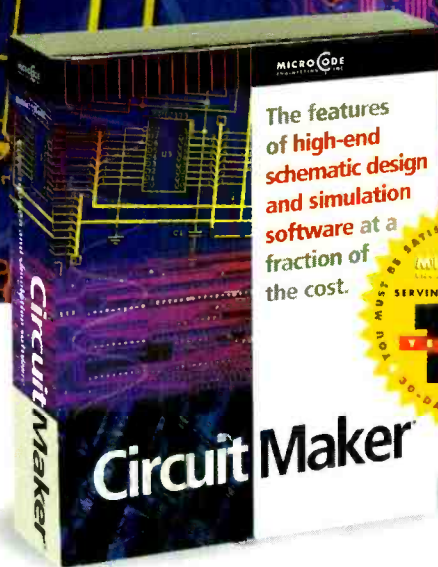


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CONTENTS

AUGUST 1999

ON THE COVER

31 Automate Your Home With an Expandable X-10 Controller

Say "automated home" and many will conjure up an image of cartoon-character George Jetson's house. Well, we're not quite there yet, but we're coming closer. For example, consider the venerable X-10 standard. Though it's been with us since the late 1970s, products using the standard are still very viable, and new capabilities are being added all the time. Its one shortcoming, however, is that it is difficult to control the various modules in a system in a unified, logical way—until now. This month's cover story is an expandable controller that lets you take complete control of your X-10 system and your home. — *Christopher A. Nielsen*



TECHNOLOGY

14 Prototype

Flywheel-based mechanical batteries, "smart" airplanes, super-sensitive magnetic-field detectors, and more.

37 Low-Power FM Transmitters

Here's the gear you need if you want to join the growing ranks of clandestine radio broadcasters. — *Andrew Yoder*

78 Taking the "Ouch" Out of Drug Injections

Get the medicine your body needs in the most efficient way possible without getting "stuck" in the process. — *Bill Siuru*

AND MORE

2 EDITORIAL

4 Q&A

8 LETTERS

27 NEW PRODUCTS

86 NEW LITERATURE

BUILD THIS

71 Controlling Servos From a Computer

This easy-to-build interface lets you control servos for any application using your personal computer.

— *Ricardo Moro-Vidal*

SPECIAL SECTION

40A ProService Magazine

An official journal of NESDA (National Electronics Service Dealers Association), IS CET (International Society of Certified Electronics Technicians), and NAIS (National Independent Appliance Servicers).

DEPARTMENTS

9 SERVICE CLINIC

Video problems in monitors.

— *Sam Goldwasser*

18 EQUIPMENT REPORT

Grand Ultraview Pro PC-to-TV converter.

20 ANTQUE RADIO

Digging into a Model 70 cathedral radio.

— *Marc Ellis*

22 DX LISTENING

Buying new and used shortwave receivers. — *Don Jensen*

25 COMPUTER CONNECTIONS

Flat-panel displays.

— *Konstantinos Karagiannis*

80 TECH MUSINGS

Looking at "miracle" antennas, and more.

— *Don Lancaster*

88 ADVERTISING INDEX

88 ADVERTISING SALES OFFICE

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EDITORIAL

Customer Service

From time to time, we have all experienced a severe lack of service from some unexpected direction. One typical example is a complete lack of cooperation from a manufacturer in getting a problem with some piece of electronics gear resolved. And when that happens, we all have the bad habit of passing that type of story along.

Well, here is another one of those stories, but this is a good-news story. So if you really don't like reading good news, please skip it.

A few days ago, my six-year old Motorola Model 610 2-line cordless phone started acting up. Every time I picked it up and dialed, it insisted on pulse dialing the selected number. Yes, if I remembered to push the "Tone/Pulse" button before dialing, it would temporarily return to the Tone mode. I went looking for the manual, and of course discovered that it was nowhere to be found.

My next step was to visit the manufacturer's Web site, www.motorola.com, on the Internet. There I discovered that Motorola doesn't even make cordless phones anymore, and no information regarding my unit was to be found on the site.

Well, since I was already there, I fired off an e-mail asking for help. Now remember, as far as the company knew, this was not an e-mail from the Editor-in-Chief of an electronics magazine—it was just another run-of-the-mill e-mail from a consumer.

Before I got off line, about an hour later, AOL announced "You Have Mail". It was from Motorola! And best of all it told me exactly what to do. In addition, they said that they would be sending me a replacement copy of the manual.

The manual arrived today, and it motivated me to sit down and document this experience and share it with you. You would be surprised how many "bad news" stories this one exceptional experience has canceled out. Congratulations, Motorola; keep up the good work!



Larry Steckler, EHF/CET
Editor-in-Chief

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Q & A

READERS' QUESTIONS, EDITORS' ANSWERS
CONDUCTED BY MICHAEL A. COVINGTON, N4TMI

More About That Fried Ohmmeter

Q After reading the question about the sick ohmmeter in the March 1999, issue, I looked in a manual for a really old Simpson 260 and found the circuit was somewhat different from your educated guess. I had the same problem (high readings on the $R \times 1$ scale) with a Simpson 260 that was given to me, and the problem turned out to be a burned-out 11.5-ohm resistor (R16), probably from attempting to measure a voltage while the VOM was set in the $R \times 1$ position.—Tom Fattarusio, El Cerrito, CA

A Many thanks! The correct circuit is shown in Fig. 1. Simpson chose to put most of the resistance in series with the meter so there would only be one critical low-value resistor.

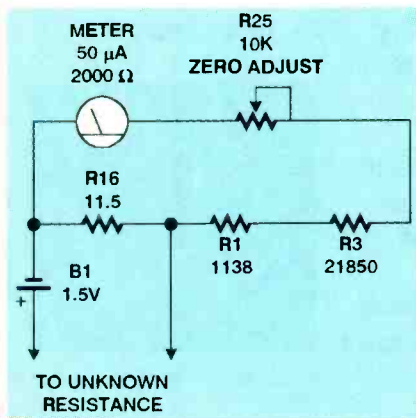


FIG. 1—HERE'S THE CORRECT CIRCUIT for the $R \times 1$ range on a Simpson 260 meter. Thanks to reader Tom Fattarusio for the update.

Because it is sometimes connected directly across a 1.5-volt battery, the 11.5-ohm resistor should be rated at least $\frac{1}{4}$ watt ($P = E^2/R = (1.5)^2/11.5 = 2.25/11.5 = 0.2$). Fortunately, 11.5 ohms is a standard value for $\frac{1}{4}$ -watt, 1%-precision, metal-film resistors. For a quick-and-dirty substitute with some loss of accuracy, parallel two ordinary 22-ohm

$\frac{1}{8}$ -watt resistors. That will at least tell you whether you've replaced the right component; you can then get a more accurate resistor for the final repair.

Breadboarder's Dilemma

Q Are discrete (through-the-hole-mount) components going away entirely? If so, how will we be able to use prototyping boards for training purposes in the not-too-distant future?—C. B. L., Virginia Beach, VA

A I think resistors, capacitors, and diodes are still going to be available with wire leads for the foreseeable future; they're needed for repair purposes and for higher-power circuits. Surface-mount components work best in circuits that are assembled by automated machinery and in high-frequency applications where conventional components would have too much stray capacitance.

A more critical problem is that many newer ICs are available only in surface-mount form, so you can't plug them into solderless breadboards. You can't even plug them into sockets of some other kind; they can only be used by soldering them to printed-circuit boards.

One option is to do your breadboarding with printed circuits, as many of us did in the early days of DIP packages, before solderless breadboards became common. Make a printed-circuit board that connects the IC to an array of pads or holes; then add any components that you wish. Or even connect the IC to a row of pins that will plug into your solderless breadboard.

Ready-made boards to do both of these things, called "Surfboards," are made by Capital Advanced Technologies, 309 Village Drive #A, Carol Stream, IL 60188; Web: www.capitaladvanced.com; Tel: 630-690-1696; and are available from many distributors, including Digi-Key, 701 Brooks Ave. S., Thief River Falls, MN 56701; Tel: 800-344-4539; Web: www.digkey.com. Figure 2 shows

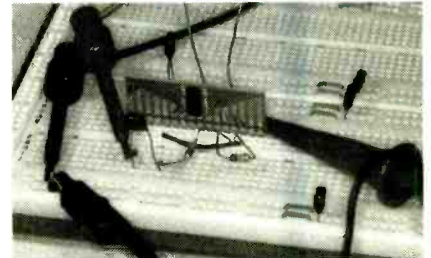


FIG. 2—A "SURFBOARD" allows surface-mount ICs to be plugged into a breadboard.

a Surfboard in action.

Soldering a surface-mount IC to a circuit board isn't as hard as it looks. Use a very sharp-pointed soldering-iron tip, work with a magnifying glass or wear reading glasses, and start by getting a small droplet of solder on the tip of the iron. Using this droplet, tack-solder one of the corner pins of the IC in place. Then adjust the position of the whole IC, solder the remaining pins, and finally re-do the pin you initially tack-soldered. Surface tension helps pull the solder and the IC into the correct positions.

Many schools and design labs are reducing their use of breadboards by simulating circuits electronically. Two good circuit-simulation software packages, *Electronics Workbench* and *CircuitMaker*, are regularly advertised in this magazine. I've used both and found them very helpful. If you're on a low budget, download the demo version of Intusoft's circuit simulator at www.orcad.com/products/pspice/eval_f.htm (See Fig. 3). It's a little less user-friendly and is limited to 50 components, but the price is right—free! See also www.intusoft.com for another good free demo.

All of these circuit simulators are derived from SPICE (Simulation Program with Integrated Circuit Emphasis), a computer program developed at Berkeley in the 1970s for use by IC designers. In general, you can't breadboard an IC before building it, so

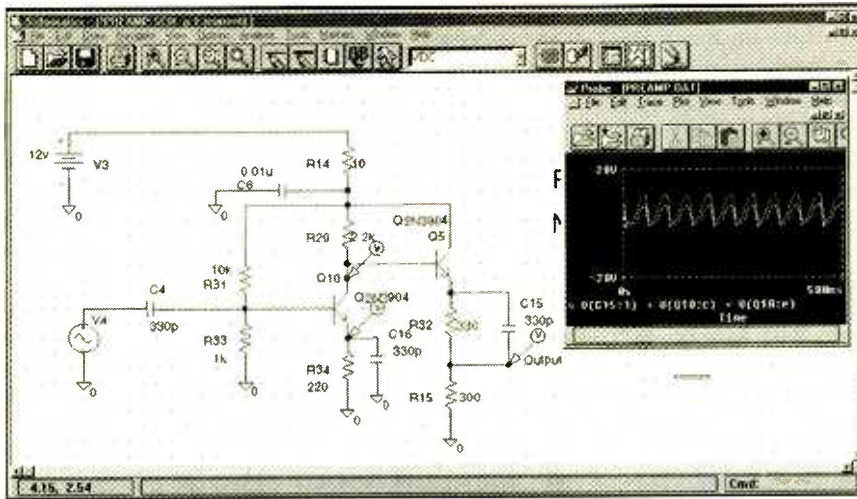


FIG. 3—FREE CIRCUIT-SIMULATION SOFTWARE can be downloaded from www.orcad.com and www.intusoft.com (see text).

electronic simulation is essential. SPICE has its own programming language for describing circuits (“node lists”), but nowadays, all circuit simulators let you draw your circuit as a schematic diagram, then hook up virtual power supplies, oscilloscopes, and the like.

SPICE-based simulators model transistors very accurately, since they’re based on semiconductor physics. Many IC makers publish accurate SPICE models of their op-amps and other ICs. SPICE isn’t as good at modeling transformers, speakers, and other components whose electrical properties are not precisely known, but the art of modeling these things is rapidly advancing. Also, SPICE models of special-purpose ICs, such as audio amplifiers, are generally unavailable. And, notoriously, oscillators in SPICE models fail to start because SPICE’s “perfect” components lack the slight imbalances and noise that oscillator circuits rely on. Still, SPICE-based simulation is just the thing for designing basic analog circuits such as amplifiers and filters. You can try different resistances and capacitances much more quickly on the computer than on the breadboard.

How To Make Diodes More Sensitive

Q I have noticed something strange about RF diodes: If you shine a tungsten lamp on them, or a candle, or sunlight, it makes them work better. Why?—D. W., London, England

A Every diode has a threshold or “turn-on” voltage below which it does not conduct. The turn-on voltage depends on the semiconductor material; it’s about 0.3 V for germanium and 0.6 V for silicon. As you’ve discovered, light and heat reduce the turn-on voltage. LEDs, with a turn-on voltage of about 1.8, are particularly sensitive to light, which means they can be used as light receivers as well as light emitters, as pointed out by Forrest Mims many years ago.

For lower turn-on voltages, you can use a Schottky diode (about 0.2 V) or even a “back diode” (near 0 V, but unable to block more than a few volts in the reverse direction). Special-purpose diodes are discussed in the *ARRI Handbook for Radio Amateurs*, published by the American Radio Relay League, Newington, CT 06111, and in other amateur radio manuals.

Clock Chips Wanted

Q Would you know of a source for clock chips? I like to make 6-digit clocks, using extra-large LEDs to create large characters. I’ve used the National Semiconductor MM5314N and MM5375 and the Mostek MK50250N, purchased mainly from Jameco, but these are no longer available. Jameco still has the MM5314N, which I don’t like for circuitry reasons and because the price is too high (\$19.95).—J. R., Portland, OR

A LED clocks have been out of fashion for a long time, and the chips you mentioned were discontinued more than

a decade ago, although Holtek (www.holtek.com) still makes a 4-digit clock, the H1391.

Three 6-digit LED clock chips are still available through the replacement-semiconductor industry. They are the NTE2060 (=MM5387), NTE2061 (=MM5316), and NTE2062. The Philips ECG2060, ECG2061, and ECG2062, respectively, appear to be equivalent. These should be easy to get from almost any parts distributor, including RadioShack (on special order); however, the supply is starting to dry up since these chips too are no longer being made.

Somewhat sketchy data sheets can be downloaded from www.nteinc.com; if you’re familiar with other clock chips, these data sheets should be sufficient. More detailed data sheets have been published by Philips ECG, P.O. Box 967, Greeneville, TN 37744; Web: www.ecgproducts.com.

Another way to make an LED digital clock is to program a microcontroller. This is in fact a popular project for microcontroller hobbyists; check www.dontronics.com and the various microcontroller manufacturers’ Web sites for programs you might use.

Two Signals, One Ear

Q I would like to be able to hook a pair of stereo headphones to two amplifiers. One is the output of an aircraft radio; the other is a portable CD player. I don’t want to risk damaging the amplifiers by tying them directly together. I also don’t want to use an amplified mixer because of possible problems in case of battery failure. Could some kind of transformer matching network be designed?—G. L., Milliken, CO

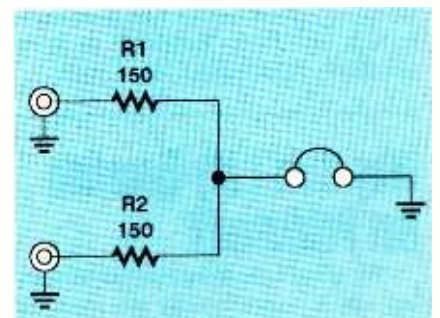


FIG. 4—PROTECTIVE RESISTORS let two amplifiers drive one pair of mono headphones. For stereo, use one circuit for each channel.

A All you need are resistors to protect the amplifiers from each other while feeding both signals to the headphones (see Fig. 4). If you're using 32-ohm Walkman-style headphones, try 150-ohm resistors and change them as necessary to get adequate volume. Many high-fidelity amplifiers drive headphones through resistors to protect them from overloading.

The other alternative is of course to feed one signal to one ear and the other signal to the other ear.

Composite To S-Video

Q My computer's video digitizing card has an S-video input, but my video camera only has a composite video output. Can you give me a circuit that will convert composite video to S-video?—H.M.M., Montijo, Portugal

A I assume you have already verified that the computer is compatible with the same video standard as the camera (probably 625-line PAL in Portugal; 525-line NTSC in the United States).

The difference between S-video (separate video, Y/C video) and composite video is that S-video systems use two separate wires for chrominance (color) and luminance (brightness). Composite video systems combine the two. If you connect a composite video signal to the luminance input of an S-video connector (pin 3, using pin 1 as ground), you should get a black-and-white picture. Beyond that, separating chrominance from luminance is not simple, and when it's done, the resulting signal won't be as sharp as if it were originally S-video.

Some good general information about video technology is on the web at www.magnavox.com under "Today's Technology." There is also a magnificent set of video-related web links maintained by Tomi Engdahl at www.hut.fi/Misc/Electronics/video.html.

Why Didn't My Question Get Published?

We often hear from readers wondering why a question they sent to Q&A didn't get published. There are two important reasons: Due to the process, it takes a long time between when an item is sent in and when it reaches print, and

not all questions are chosen.

Like any monthly magazine, we have to prepare articles and columns several months before they appear in print, and with Q&A, we have to maintain a backlog so there are always more questions to answer. As a result, it can easily take five months from receipt of a question to publication of its answer.

Only about 25% of the questions that come in are actually used. Regrettably, we don't have the time or personnel to answer the others at all—and we certainly can't fax back an immediate reply, as

some people occasionally request.

We choose questions that are of wide interest, have clear, straightforward answers, and are within our areas of expertise. The best questions focus on a small circuit or a specific design problem. Requests for complete construction projects can be passed along to writers, but they generally can't be answered in Q&A.

We usually avoid high-voltage or high-power projects that would injure the builder or damage expensive equipment if mis-wired. We also avoid pro-

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Many electronic component manufacturers have Web pages; see the directory at <http://www.hitex.com/chipdir/>, or try addresses such as <http://www.ti.com> and <http://www.motorola.com> (substituting any company's name or abbreviation as appropriate). Many IC data sheets can be viewed online. www.questlink.com features IC data sheets and gives you the ability to buy many of the ICs in small quantities using a credit card. You can also get detailed IC information from www.icmaster.com, which is now free of charge although it formerly required a subscription. Extensive information about how to repair consumer electronic devices and computers can be found at www.repair-faq.org

Books: Several good introductory electronics books are available at RadioShack, including one on building power supplies.

An excellent general electronics textbook is *The Art of Electronics*, by Paul Horowitz and Winfield Hill, available from the publisher (Cambridge University Press, 1-800-872-7423) or on special order through any bookstore. Its 1125 pages are full of information on how to build working circuits, with a minimum of mathematics.

Also indispensable is *The ARRL Handbook for Radio Amateurs*, comprising 1000 pages of theory, radio circuits, and ready-to-build projects, available from the American Radio Relay League, Newington, CT 06111, and from ham-radio equipment dealers.

Copies of past articles: Copies of past articles in **Electronics Now** and **Popular**

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Electronics Now and many other magazines are indexed in the *Reader's Guide to Periodical Literature*, available at your public library. Copies of articles in other magazines can be obtained through your public library's interlibrary loan service; expect to pay about 30 cents a page.

Service manuals: Manuals for radios, TVs, VCRs, audio equipment, and some computers are available from Howard W. Sams & Co., Indianapolis, IN 46214 (1-800-428-7267). The free Sams catalog also lists addresses of manufacturers and parts dealers. Even if an item isn't listed in the catalog, it pays to call Sams; they may have a schematic on file which they can copy for you.

Manuals for older test equipment and ham radio gear are available from IA Manuals, PO Box 802, Council Bluffs, IA 51502, and Manuals Plus, PO Box 549, Tooele, UT 84074.

Replacement semiconductors: Replacement transistors, ICs, and other semiconductors, marketed by Philips ECG, NTE, and Thomson (SK), are available through most parts dealers (including RadioShack on special order). The ECG, NTE, and SK lines contain a few hundred parts that substitute for many thousands of others; a directory (supplied as a large book and on diskette) tells you which one to use. NTE numbers usually match ECG; SK numbers are different.

Remember that the "2S" in a Japanese type number is usually omitted; a transistor marked D945 is actually a 2SD945.

Hamfests (swap meets) and local organizations: These can be located by writing to the American Radio Relay League, Newington, CT 06111; (<http://www.arrl.org>). A hamfest is an excellent place to pick up used test equipment, older parts, and other items at bargain prices, as well as to meet your fellow electronics enthusiasts—both amateur and professional.

jects that require large amounts of software to be written; projects that are not entirely electronic, such as automotive ignition systems; and large-scale housewiring and remote-control projects. For copyright reasons, we usually cannot troubleshoot projects from other magazines.

On the other hand, we'd be glad to have more questions about fundamental circuit designs, use of specific ICs, PC interfacing, and microcontrollers. Those are areas where the Q&A format works well, and there must be things you (the reader) are wondering about.

Some questions aren't chosen because we can't understand them, we can't read the handwriting, or essential information is left out. When writing to Q&A, please read over what you've written and get someone else to verify that it's complete and understandable.

Writing to Q&A

As always, we welcome your questions. The most interesting ones are answered in print. Please be sure to:

- (1) include plenty of background information (we'll shorten your letter for publication);
- (2) give your full name and address on your letter (not just the envelope);
- (3) type your letter if possible, or write very neatly; and
- (4) if you are asking about a circuit, include a complete diagram.

Questions can be sent to Q&A, **Electronics Now Magazine**, 500 Bi-County Blvd., Farmingdale, NY 11735, or e-mailed to q&a@gernsback.com, but please do not expect an immediate reply (because of our backlog) and please don't send graphics files larger than 100K. Due to the volume of mail, we regret that we cannot give personal replies. **EN**

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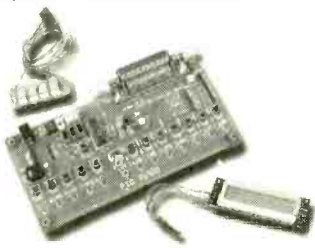
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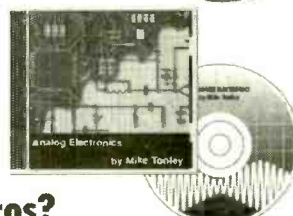
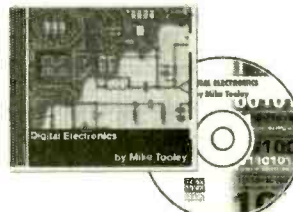
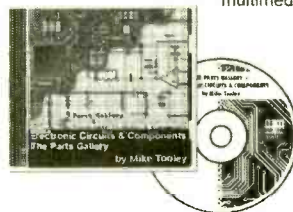
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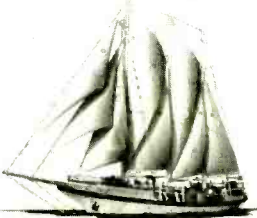


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LETTERS

SEND YOUR COMMENTS TO THE EDITORS
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BreadBlox Correction

We have recently been alerted to a slight error in the gain formulas presented in "The BreadBlox Prototyping System" that appeared in the June 1999 issue. On page 42, the formula for the inverting op-amp should be:

$$V_{OUT} = (-V_{IN}(R4/R5))$$

And for the non-inverting op-amp, the formula should be:

$$V_{OUT} = V_{IN} \times (1 + R7/R8)$$

We apologize for any confusion that might have arisen from this error.—
Editor

Firmware Change

When writing the firmware for "A Microcontroller-Based Precision Pulse Generator" (*Electronics Now*, December 1998), I had overlooked the fact that the PIC 16C55 starts executing at the last location in memory, not the first. Since the last instruction is a dummy return, the program may not start if the chip powers up with a non-zero return address. Programmed chips should be reprogrammed with a NOP (000) in address IFFH. An updated file is also available on the *Electronics Now* ftp site (<ftp.gernsback.com/pub/EN/pulsegen.cod>).

TOM NAPIER

Special Request

I have a special request for *Electronics Now* readers. I need someone who can do "etching and drilling" of printed circuit boards on a small scale. I will design the foil artwork pattern on

paper, and from there the reader will etch and drill the board.

The board is one of a kind (only one copy is needed), no larger than 4 by 6 in size and usually smaller.

I have no means to do the boardmaking myself as I live in an apartment. I will be happy to make a reasonable and fair payment for this service. If any reader can help me with this, it would be greatly appreciated.

CRAIG KENDRICK SELLEN
Mallard Meadows RHC
476 Belmont St.
Waymart, PA 18472

More April Fooled

To all those humorless souls who wrote to complain about the April Fool's article "The EC909-12 Analog Microprocessor" (*Electronics Now*, April 1999)....

Geez, guys, lighten up! IT WAS A JOKE!!!

I have in front of me the April 1952 edition of *Radio Electronics* open to the Mohammed Ulysses Fips article on "The Dead Beat Heterodyne Noise Neutralizer." I loved the gag then, and I still enjoy them. Keep 'em coming every April—the more far out the better.

A Gernsback reader for over 50 years,
BOB ZINCK
Halifax, NS, Canada

EN

Write To:
Letters,
Electronics Now Magazine,
500 Bi-County Blvd.,
Farmingdale, NY 11735

Due to the volume of mail we receive, not all letters can be answered personally. All letters are subject to editing for clarity and length.

Monitor Video Problems

THIS MONTH WE WRAP UP OUR DISCUSSION OF MONITOR-SUBSYSTEM-RELATED PROBLEMS WITH THOSE DIRECTLY AFFECTING THE VIDEO. FOR THE PURPOSES OF THE FOLLOWING DISCUSSION, THE POWER SUPPLIES AND DEFLECTION WILL BE

assumed to be functioning properly.

The schematic of the video circuitry of a typical monitor is shown in Fig. 1 and includes components on the main board as well as those on the little board on the neck of the CRT. In this design, a three-channel RGB video IC feeds the output transistors that drive the CRT. Others may use all discrete circuitry or put a lot more inside a chip. Common problems include bad connections, dried up electrolytic capacitors, blown transistors, defective ICs, problems with the G2 or focus voltage from the flyback, and shorts inside the CRT. Let's look at some symptoms, and how to troubleshoot and repair their causes.

Blank Picture, Power Light On, Digital Controls Active

First verify that your computer has not simply entered its power saving mode and blanked the screen or shut off the monitor video and power circuits entirely. Confirm that the video source is not defective or blank—substitute another video source or try a known good monitor.

Here are some questions:

1. Is there a raster on the screen at any settings of the brightness and contrast controls, and/or when switching modes? (A raster is the pattern of scan lines with or without a picture.)

2. Can you obtain a raster of any kind by adjusting the screen (G2) control (probably on the flyback) or master

background or brightness?

3. Looking in the back of the monitor, can you see the glow of the CRT filaments?

4. Do you get that static on the front of the tube that would indicate that there is high voltage present?

If the answer to all of these is no, then you have a power supply and/or deflection problem.

Some possible causes of no raster are:

- No or low high voltage (low voltage, deflection, or high voltage power supply failure).

- Fault with G1 or screen (G2) voltages.

- Filament to the CRT is not getting powered.

- Drive to CRT is bad/shut off as a result of a fault elsewhere resulting in protective shutdown.

Some possible causes of no video include a problem in the video input, video amplifiers, or video output, or cut-off due to some other fault.

The cause of the problem could be as simple as a bad connection—try gently prodding the boards with an insulated stick while watching the screen. Check for loose connectors and re-seat all internal connectors.

Dark Picture

A monitor with a picture that is too dark may have a fault or the CRT may just be near the end of its useful life. The first step is to confirm that your video

source—computer, camera, etc.—is producing a proper signal.

Is the brightness at all erratic? Does whacking the monitor have any effect? If so, then you may have bad connections on the CRT driver card or elsewhere. If the brightness tends to fade in and out over a 10 to 20 second period, a bad filament connection is likely. Check for the normal orange glow of the filaments in the neck of the CRT. There should be three orange glows. If they are excessively reddish, very dim, or fade in and out, you have located a problem.

One of the most common causes of brightness problems is a dirty CRT faceplate or safety glass. Don't laugh! It sounds obvious, but have you tried cleaning the screen with suitable screen cleaner? It is amazing how dirty screens can get after a few years—especially around smokers!

Other causes include:

1. An old CRT. The brightness of the CRT deteriorates with the filament over time. It doesn't matter much what you are doing or if you use a screen saver.

2. Bad component in the filament circuit or a bad connection reducing filament voltage.

3. The brightness control is faulty—a bad potentiometer, bad connections, or problem with its power supply. Depending on the specific problem, control may or may not have any effect. If digitally adjusted, there could be a problem with the logic or control chip. If the button or menu item has no effect at all, then a logic or control problem is likely.

4. Improperly set screen (G2) voltage (usually on flyback) or a faulty divider network.

5. Improperly set video bias (background) levels or a fault in video-drive

circuitry.

6. A fault in the video amplifiers. With all three colors affected equally, that would most likely be a power-supply problem. A video amplifier problem is likely if turning up the screen (G2) or master-brightness control results in a very bright raster before the retrace lines appear.

7. A fault in the beam or brightness limiter.

8. The high voltage is low. However, this would likely result in other symptoms (affecting focus, size, and geometry) as well.

Brightness Control Has No Effect

If the control is an analog knob, then it should be varying the control grid (G1) voltages relative to the cathodes (K) of the CRT. This is not likely to be a very complex circuit: check continuity and solder connections and the control itself for proper operation with an ohmmeter. A power supply going to one side of the control (negative probably) may be missing.

If brightness is a digital control, then you will need a schematic to troubleshoot it unless there is an obvious bad connection.

No Color—Black And White Picture

This is an extremely unlikely failure mode for a computer monitor unless you are using a composite video input. It is most likely due to a software driver or program problem. Sometimes the PC will think that the monitor you have connected is not capable of color and certain programs will then display in B/W no matter what. That might be due to an initialization problem—possibly a race condition during the boot process—especially likely if you are using an older video card with a new fast processor.

One Color Is Too Weak Or Too Strong

If the problem is slight and/or has gradually gotten worse, this may just require an adjustment of the color brightness/background/bias and/or color gain/drive controls inside the monitor.

- Too high an intensity for one of the color channels will result in a tint of one of the primaries: red, green, or blue.

- Too low an intensity for one of the

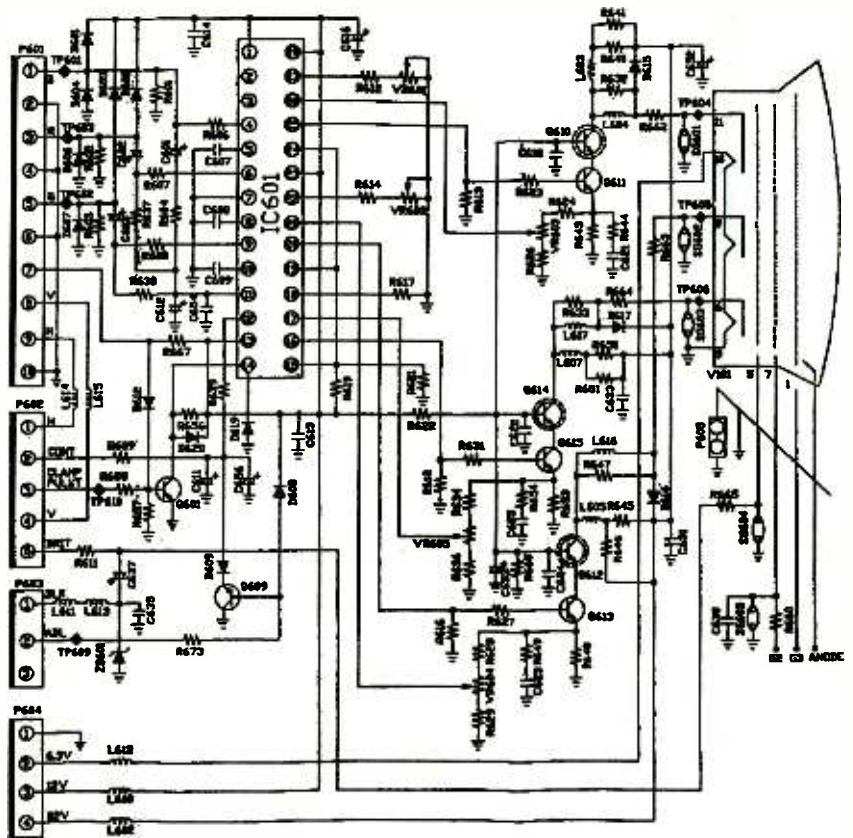


FIG. 1—THE VIDEO CIRCUITRY OF A TYPICAL MONITOR is shown here. The diagram includes components on the main board as well as those on the little board on the neck of the CRT.

color channels will result in a tint of the complement of one of the primaries: yellow, cyan, or magenta.

- Problems mainly in the shadows or dark areas of the picture usually represent a fault with brightness/bias/background.

- Problems mainly in the highlights or bright areas of the picture usually represent a fault with the gain/drive.

A color that is now suddenly brighter or darker than normal resulting in incorrect color balance or a tint in the background could be due to a number of causes:

- Bad cable or pin bent on cable connector.

- Bad connections or bad component in video amplifier or on CRT neck board for that color.

- Weak gun in CRT (reduced color).

- Bad video card or incorrect software color-map settings.

- For monitors with sync-on-green capability, the monitor may think you are using sync-on-green when in fact you have separate sync. In particular, this may result in a problem with excessive green.

Intermittent, Flickering, Or Missing Colors

This is a catch-all for some of the most common monitor problems. Most of the causes boil down to bad connections of one form or another. However, defective components like bias resistors on the CRT-driver board or in the video circuitry could also be at fault.

- Does whacking the monitor have any effect? If so, then bad connections are confirmed. If the color(s) come and go suddenly, then it is most likely *not* a CRT problem. The bad connections could be at the VGA cable, video driver board on the neck of the CRT, or elsewhere (see below).

- If a single color fades in and out with a delay of about 10-15 seconds, it is probably intermittent power to the CRT filament for that color and it probably means that the unit is bad since the three filaments are wired in parallel inside the CRT. One of the internal connections has come loose. To confirm, look in the neck of the CRT to make sure all three filaments are glowing orange. If one of them is going on and off, the CRT is bad.

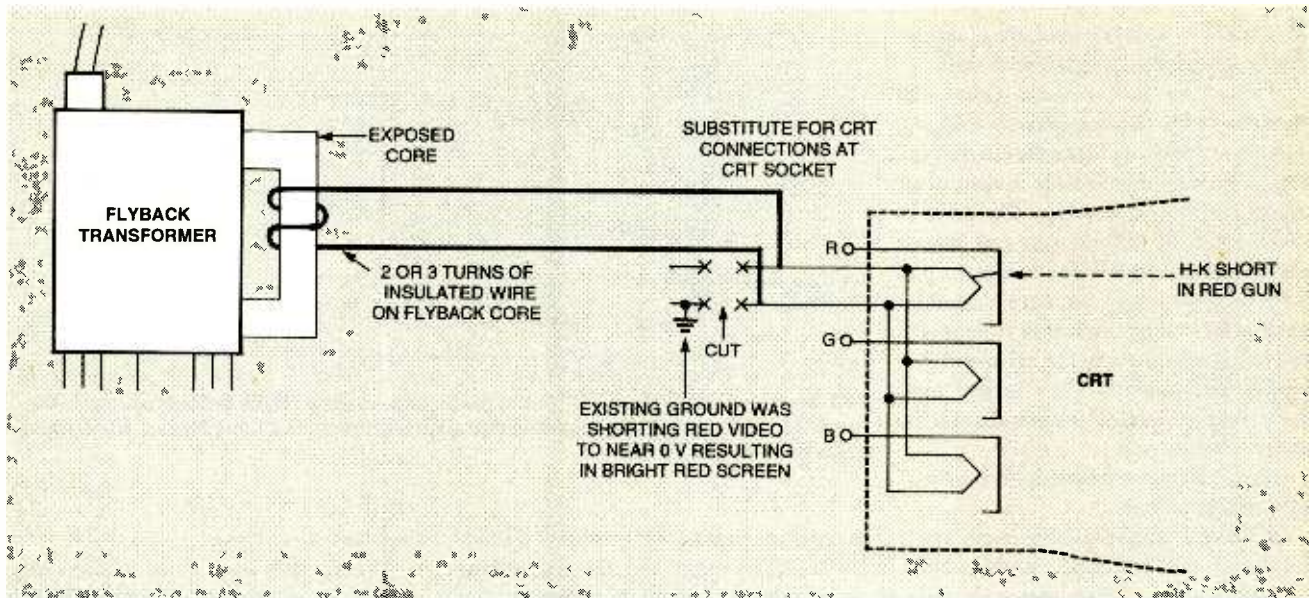


FIG. 2—TO PROVIDE ISOLATION FOR A CRT H-K SHORT, wrap two turns of well insulated wire around the core of the flyback and solder to the CRT filament pins after cutting the connections to the original filament source.

Possible Causes Of Intermittent Or Missing Colors

- The VGA or another video input cable is loose, has broken wires internally, or pins are not making solid contact. If this just happened after reconfiguring your system and reconnecting the monitor or installing a new monitor, check your video connector—you may have bent over or pushed in pins 1, 2, or 3—the R, G, and B video signals respectively. If you find a bent pin, *carefully* straighten it with a pair of needle nose pliers. If it is pushed in, try to grab onto it and pull it out—then put a drop of Epoxy or another adhesive at its base (don't get any on the part of the pin that makes contact) to prevent it from being pushed in again. There also might be cold solder joints on the VGA board itself at the VGA connector. These can be re-soldered.

- Cold solder joints on the printed-circuit board on the CRT neck.

- Cold solder joints elsewhere in the monitor, usually around the pins of large parts such as transformers, power transistors and resistors, and internal connectors.

- Internal connectors that need to be cleaned and re-seated. Remove, clean with contact cleaner, burnish, and replace.

- Bad filament connections inside the CRT (gradual fade in and out or one filament not lit). Replace the CRT or monitor.

To narrow down the problem:

- Locate the output for the bad color on the video driver board on the neck of the CRT. This will probably read a significantly higher voltage than the corresponding pins for the good colors. If so, a circuit problem is likely—probably on this board but it could be in other parts of the video circuitry.

- Test components on this board for the good and bad color channels. A shorted transistor or open resistor can kill one channel. Swap parts between good and bad colors to confirm.

- Gently pull the CRT neck board off of the CRT and replace it. This will tend to clean the contacts.

- Connect an output of the video circuit/chip that is working (*i.e.*, a color that appears on the screen) to all three color drivers on the CRT neck board. If you now get a more-or-less black and white picture (there may be a moderate color tint as the relative intensities of R,G,B may not be balanced), the problem is likely with the circuitry on the main board. If you still have missing or messed up colors, the problem is on the CRT neck board or with the CRT.

Ghosts, Shadows Or Streaks In Picture Adjacent To Vertical Edges

Complaints about these kinds of problems are very common, especially as the screen resolution and necessary video bandwidth keeps increasing. Most are due to cable- and video-termination deficiencies and not actual monitor

defects.

The video signals for red, green, and blue (or just a single signal for monochrome) are sent over cables that are generally 75-ohm transmission lines. Those are coaxial cables that may be combined inside a single sheath for VGA, SVGA, MACs, and many workstations, but could be separate coaxial cables with BNC (or other) connectors for other video applications.

Without going into transmission line theory, suffice it to say that to obtain good quality video, the following conditions must be met:

1. A good quality 75-ohm shielded cable must be used.

2. Where multiple BNC-terminated monitors are to be connected to a single video source, all wiring is done in a daisy chain fashion. (SVGA monitors cannot be daisy-chained without additional hardware.)

3. Only the last monitor in the chain should be terminated in 75 ohms. All of the others must be set to high impedance (Hi-Z).

Note that monitors for PCs, MACs, and many workstations usually have built in termination and do not offer the choice of high-impedance. That means that without a video distribution amplifier, it is not possible to connect multiple monitors of this type to a single video source with any expectation of a good-quality display.

Even adding a short extension cable or using an A-B monitor selector box

may result in unacceptable image degradation especially at higher scan rates.

Failure to follow these rules will result in video ringing, ghosts, shadows, and other unsightly blemishes in the picture. It is often not possible to control all aspects of the video setup. The cable is often a part of the monitor and cannot easily be substituted for a better one. The monitor may not have properly-designed circuitry such that it degrades the video regardless of the cable and display-board quality. The display card itself may not have proper drivers or source termination.

Some examples of common termination problems are:

- Overly bright picture with trails following vertical edges, perhaps with periodic ringing: Termination is missing, switched to Hi-Z, or there is bad soldering inside monitor.

- Bright ghost images adjacent to vertical lines: This may indicate that the terminating resistor is greater than the impedance of the cable. You may be using Ethernet Thinner cable by accident; that cable is most often RG58 with an impedance of 50 ohms.

- Dark picture and ghost images adjacent to vertical lines: This may indicate that the terminating resistor is too low—multiple monitors on a chain all set for 75 ohms instead of just the last one. Or, an improper type of cable such as audio patch cord.

- Fuzzy vertical edges: This may indicate a poor-quality cable or a run that is just too long. For high resolutions such as 1280 by 1024, the maximum cable length should be as short as 25 feet, or less for poor quality cable. Better cable or fiber-optic repeaters may be necessary.

For other similar problems check all cables for defective or improperly installed connectors. This is especially applicable to cables with BNC- or UHF-type connectors, which require a kind of artistic talent to assemble properly and consistently. Throw out those extension cables and switch boxes!

If only 1 or 2 colors (of the R, G, and B) are affected, then look for improper switch settings or bad connections (bad cable connectors are really common) on the problem color cables.

General Streaks Or Lines To The Right Of Bright Or Dark Areas

The problem is that on a white back-

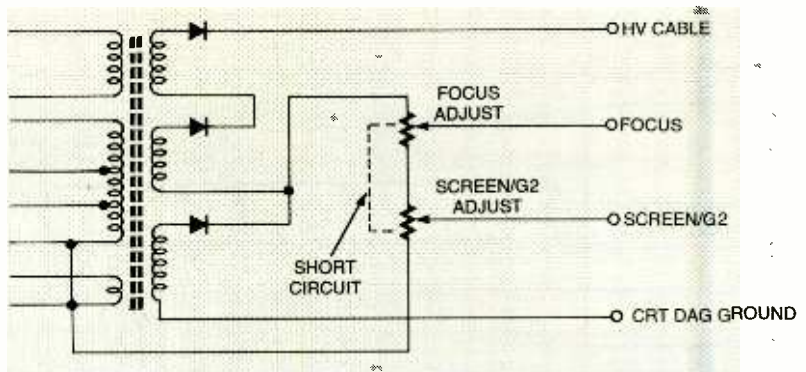


FIG. 3—IF THE FOCUS IS POOR and the picture is overly bright, suspect a short in the focus/G2 divider. Another symptom is that adjusting focus affects brightness, while adjusting brightness affects focus.

ground the various objects leave a shadow to their right. We are not talking about ghosts (duplicate images), but more like horizontal dark streaks on the white background. Also it seems that high intensity colors display very bright, but low intensity colors are overly dark (almost black). The contrast and brightness adjustments may make no difference.

This symptom could be caused by a number of things, but they are all in the video amplifier and probably not the CRT driver board, though this is possible.

First, check carefully for bad connections and other obvious failures. Dried-up filter capacitors could result in video-dependent ripple on the power-supply lines. Bad coupling capacitors could result in similar symptoms but probably for only one color, not all of them. It may be easiest to just replace any suspect electrolytic caps in the vicinity. This could also be a symptom of a bad CRT, but this would be unusual assuming you are dealing with a not-ancient monitor.

Retrace Lines In Picture

During the time the electron beam is returning from right to left at the end of a line and bottom to top (over the course of multiple lines), the beam should not be visible on the screen. However, a number of faults can result in visible retrace lines.

Where all colors are involved—the lines are essentially white or gray (or with a slight tint due to slight unequal settings of the color adjustments), look for something common like an incorrectly adjusted screen (G2) or master brightness/background/bias control (or a problem in one of those circuits), a defective power supply, or a problem in

the blanking circuitry.

Where only one color is showing, suspect an incorrectly adjusted individual background/bias control or bad part on the CRT neck board for that color. This could also indicate a short in the CRT.

Red, Green, Or Blue Full On—Fog Over Picture

This symptom could be a heater-cathode (H-K) short in the CRT or a failure of a component in the chroma circuits or video output (driver board).

Don't panic—heater-cathode shorts in CRTs can often be worked around.

Note: Before proceeding, it is a good idea to make sure that the screen is degaussed—otherwise you could be attempting to track down problems with the wrong color!

Some simple tests can confirm or rule out other possibilities.

- Compare the voltages for the video drive signals to the CRT on the little board on the neck of the CRT with the CRT both connected and unplugged. A schematic will help greatly in locating these signals. If there is a significant difference, especially on the bad color, then the CRT is a likely candidate. Try tapping the neck of the CRT *gently* (with it plugged in and while viewing a picture) to see if it is an intermittent problem. If there is no significant difference in the voltages, you may have a bad driver or a problem in the chroma circuits.

- Use an insulated stick to prod for bad connection/cold-solder joints, probably on the little board on the neck of the CRT. Look carefully for hairline cracks around the component leads.

- You can swap components between two colors and/or test with an ohmmeter on that driver board to determine

what is bad.

- Alternatively, interchange the outputs of the bad color with a good one by jumpering on the video-driver board (on the CRT neck). If the bad color changes, then the problem is in the circuitry and not the CRT.

- Disconnect the cathode for the full-on color from its drive. If it is still full-on, the current must be taking another path inside the CRT.

Shorts In a CRT

Occasionally, small conductive flakes or whiskers present since the day of manufacture manage to make their way into a location where they short out adjacent elements in the CRT electron guns. Symptoms may be intermittent or only show up when the TV or monitor is cold, warm, or in-between. Some possible locations are listed below:

Heater to cathode (H-K): The cathode for the affected gun will be pulled to the heater (filament) bias voltage—most often 0 V (signal ground). In this case, one color will be full on with retrace lines. Where the heater is biased at some other voltage, other symptoms are such as reduced brightness and/or contrast for that color are possible. This is probably the most common location for a short to occur.

Cathode to control grid (K-G1): Since the G1 electrodes for all the guns are connected together, this will affect not only the color of the guilty cathode but the others as well. The result may be a very bright overloaded *negative* picture with little, no, or messed-up colors.

Control grid to screen (G1-G2): Depending on circuitry this can result in any degree of washed out or dark picture.

Screen to focus (G2-F): The screen (G2) and focus voltage will be the same and the controls on the flyback will interact. The result will be a fuzzy white raster with retrace lines and little or a very-low contrast picture.

Focus to high voltage (F-HV): The high voltage will be pulled down—probably arcing at the focus spark gaps/other protective devices. The line fuse and/or HOT may blow.

Other locations between electron gun elements such as feed wires are also possible.

If you have an internal short, replacing the CRT might be required, but there are a variety of “techniques” that can often be used to salvage a TV that

would otherwise end up in the dump since replacing a CRT is rarely cost effective:

1. Isolation—this will usually work for H-K shorts as long as only one gun is involved.

2. Blowing out the short with a capacitor—depending on what is causing the short, this may be successful but will require some experimentation.

3. Gently tapping the neck to dislodge the contamination—depending on the location of the short, one side or the other might be better. Sometimes, this can be done in-place while watching the picture.

A combination of (2) and (3) may be required for intermittent shorts that don't appear until under power.

Providing Isolation For a CRT H-K Short

This procedure will substitute a winding of your own for the one that is built in to the flyback to isolate the shorted filament from the ground or voltage reference. (If you have a schematic and can determine where to disconnect the ground or voltage reference connection to the filament winding, try that instead.)

As shown in Fig. 2, wrap two turns of well insulated wire around the core of the flyback and solder to the CRT filament pins after cutting the connections to the original filament source (scribe the traces on the board to break them).

This winding should cause the filaments to glow at about the same brightness as before but now isolated from ground. If they are too dim, put another turn on the flyback to boost the voltage as low filament temperature will result in reduced emission, blooming, and possible damage to the cathodes after awhile. (Don't go overboard as you may blow the filament totally if you put too many turns on the core—you can then just toss the monitor.)

Route the wires so that there is no chance of them getting near the high voltage or any sharp metal edges, *etc.* Your picture quality may be a tad lower than it was before because of the added stray capacitance of the filament wiring being attached to the (formerly bad) video signal, but hey, something is better than nothing.

Picture Fades In and Out

If the picture faded away on the order of 10-20 seconds (and if it comes back,

also comes up to full brightness in same time frame—possibly with the persuasion of some careful whacking) and there are no other significant changes such as size, focus, *etc.*, then take a look in the back of the tube for the filaments to be lit. If the orange glow is coming and going as well, then you probably have a bad solder connection on the circuit board on the neck of the CRT. Since the filaments are usually wired in parallel and all would not go bad at the same time.

However, if only a single color fades in and out, then a bad connection inside the CRT is a distinct possibility—look for only one of the filament's glow to be coming and going. This is probably not worth fixing since it will require CRT replacement.

If the picture faded away with other symptoms, then there is probably a fault in the video amplifier/output or one of its power supplies—still probably a loose connection if you are able to get it back by whacking the unit.

Focus Problems

Slight deterioration in focus can be corrected by adjusting the focus control that is usually located on the flyback transformer. Sometimes, it is accessible externally, but usually not. On monochrome monitors, the focus control, if any, may be located on the main board.

Don't expect to have perfect focus everywhere on the screen. Usually there will be some degradation in the corners. A compromise can generally be struck between perfect focus in the center and acceptable focus in the corners.

If the focus adjustments have no effect, then there is probably a fault in the focus power supply. For most color TVs and monitors, the correct focus voltage will be in the 4-8 kV DC range, so you will need a meter that can go that high, some big resistors to extend its range, or a HV probe to test it. You must use a high-impedance meter as the current availability from the focus power supply is very low.

Try to measure the focus in-circuit. If the value you read is very low then disconnect the wire (from the PC board on the neck of the CRT or wherever) and measure again and observe any change in picture.

If still low, then almost certainly there is a problem with the potentiometer or the flyback. See if you can open it
(Continued on page 85)

Prototype

Ultra-Clean Back-Up Power For Critical Users

We all take electric power for granted and consider the loss of it an inconvenience, but in many situations, losing power is far more than that. Consider the following scenarios: The power goes out for a few seconds and critical data is lost at a computer data center. A momentary power glitch results in spoiled product in a manufacturing facility producing computer chips. Electricity goes off for a minute or so in a hospital operating room or intensive care unit imperiling the life of a patient.

It is obvious that high-quality uninterrupted electrical power is a must in those and many other situations since a momentary power interruption, even if only a heartbeat in duration, can mean disastrous results. While estimates vary amongst the experts, electric power-quality problems cost U.S. industry from \$15 billion to \$26 billion annually because of downtime, ruined product, and lost productivity alone.

Today, computer centers, high-tech manufacturing plants, military-communication centers, hospitals, and other facilities requiring uninterrupted, high-quality electricity rely on uninterruptible power supplies (UPS). Typically, UPS systems consist of roomfuls of lead-acid batteries, a standby generator powered by a gasoline, or a diesel engine and associated electronics to make the UPS work.

The main problem with these UPS system are the batteries, which are bulky, short-lived, and sometimes unreliable. Batteries require labor-intensive maintenance, periodic costly replacement and disposal, often require an air-conditioned environment, and are subject to a long list of EPA regulations because of the toxic materials they contain.

Fortunately, there might be a better

solution. Flywheels, sometimes called "mechanical batteries," are a promising alternative to electrochemical batteries as the energy storage device in UPS systems. Indeed, the Electric Power Research Institute (EPRI), the research and development agency for the utility industry, says that flywheels are well suited for preventing short-term power disruptions.

Flywheel Facts

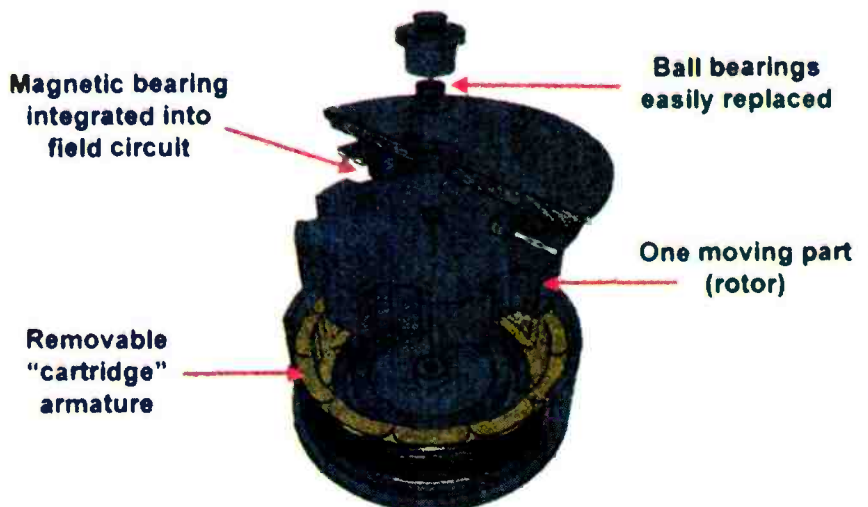
Flywheels store kinetic energy in the form of a spinning wheel. Then as the wheel slows down the energy is released in the form of the needed electric energy. A motor-generator is used to spin up the flywheel to store energy and then convert the kinetic energy into electrical energy. There are two basic types of flywheels: low-speed conventional flywheels that generally use steel and high-speed systems that use advanced composite materials such as fiberglass

and graphite.

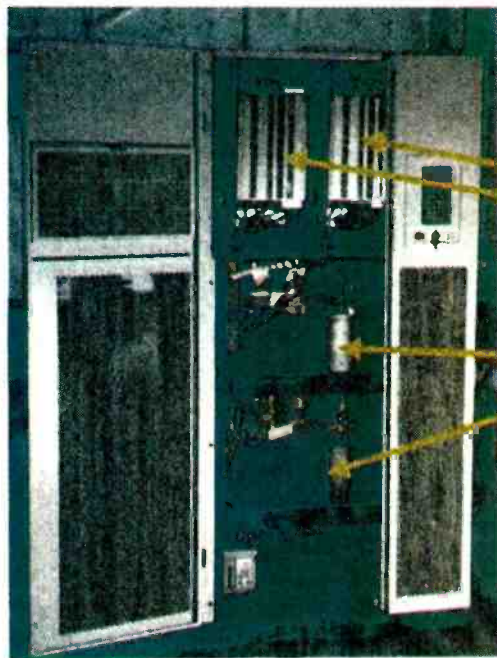
While steel flywheels are easy to manufacture and are relatively inexpensive, they are limited in rotating speed, meaning a fairly massive wheel is needed to store adequate energy. In contrast, high-speed flywheels are very compact. Over \$200 million has been spent over more than 25 years in research and development on advanced flywheel technology and still they are quite expensive and thus not readily available. The good news is that EPRI expects this to change dramatically in the next few years, and in fact it already has.

A Practical Flywheel

Active Power, Inc. in Austin, TX has developed the world's first fully integrated flywheel energy-storage system. The company's line of *CleanSource* flywheel storage systems is being marketed to electric utilities, data centers, industrial manufacturing companies, medical cam-



IN ACTIVE POWER'S CLEANSOURCE FLYWHEEL SYSTEM, the motor, generator and flywheel are integrated into a single, compact unit. The single moving part serves both as the high-speed flywheel and the rotor for the motor-generator.



Independent
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Flywheel Energy
Storage

THE CLEANSOURCE ENERGY STORAGE SYSTEM is contained in a refrigerator-like unit that takes up about 10 square feet.

pushes, and other organizations that require uninterrupted electrical power at affordable prices.

CleanSource uses a solid-steel flywheel rotating at 7000 rpm. While high-speed as steel flywheels go, it is quite safe. The motor, generator, and a flywheel rotor are integrated into one simple component, the only rotating part in the CleanSource system. A single CleanSource unit can deliver just under 500 kW of DC for a short period of time or less power for as much as two minutes. Since the vast majority of power interruptions in this country are less than a few seconds, this is plenty of time for an engine-generator to be started or for the power to return. Two or more units can be connected in parallel for greater power output.

A CleanSource flywheel power source is compact, non-toxic, low maintenance, and has low energy requirements. A CleanSource unit takes up about 10 square feet of space, or about 20% of the space for the same power as chemical batteries, and uses less power than a hair dryer in its standby mode. The overall cost of a CleanSource unit is less than a typical battery installation. With only one moving part, the manufacturer states that the unit should last for more than 20 years with minimal maintenance. To date, CleanSource sys-

tems are the only flywheel energy storage system certified by Underwriters Laboratories Inc. (UL).

Flywheel systems can be used in several ways. First, they can be used to completely replace lead acid batteries in UPS systems. For example, a CleanSource unit can replace hundreds of battery terminals with two corrosion-resistant connections. It is estimated that a single CleanSource system can replace 45 tons of toxic lead and sulfuric acid in a large commercial or industrial site over its lifetime.

Alternatively, flywheels can be used to augment UPS battery units. Used this way, they extend the life and run-time of lead-acid batteries by taking the "hits" that would normally occur during short outages or sags. The setup also provides redundant energy storage for added insurance and protects against outages when the battery might have been taken off-line for maintenance. Elimination of frequent batteries discharges also prolongs battery life.

Finally, flywheels can be used for "glitch" protection. In that application, they are used to supply a short burst of electrical energy to compensate for a momentary interruption or voltage sag.

Current Customers

To date, CleanSource units are in

FOR MORE INFORMATION

Electric Power Research Institute
3412 Hillview Ave.
Palo Alto, CA 94034-1395
Web: www.epri.com

Active Power, Inc.
11525 Stonehollow Dr., Suite 135
Austin, TX 78758
Web: www.activepower.com

operation in over 30 installations in the U.S. and one system in South Africa. The EPRI and Constellation Energy completed the first commercial retrofit of a flywheel energy storage system to extend battery life in the UPS system used by Comcast, one of the largest cable broadcasters in the U.S.. There, a CleanSource CS 200 flywheel energy storage was integrated into an existing UPS system in order to improve its overall reliability and to extend the life of its existing batteries by reserving them for emergency backup use. American Electric Power (AEP) has integrated a CleanSource unit with a UPS in order to protect all of its more than 600 computers at AEP's new office facility in Gahanna, OH. Smart Technologies in Austin, TX with more than 200 computer servers and associated routers, switches, and modem pools uses a CleanSource system to replace batteries in a system that also includes an UPS and diesel generator.

The Air Force Space Command at Peterson Air Force Base in Colorado Springs, CO has two systems attached to battery-based UPS systems. Fort Walton Machining in Florida, a precision machine shop, has eliminated frequent outages that reduced plant productivity. Since the CleanSource system was installed in Oct. 1997 it has performed over 300,000 discharges and even protected the facility against power outages during hurricane Earl in September 1998.—By Bill Siuru **PT**

Studying Stealth

The U.S. Air Force recently opened an upgraded test facility at Holloman Air Force Base in New Mexico. It is believed to be the only one of its kind in the world able to conduct wide bandwidth bistatic imaging and radar cross section (RCS) measurements



BICOMS, THE MOBILE RADAR UNIT—40 feet tall, 66 feet long, 37 feet wide, and weighing 90 tons—is shown here at Holloman Air Force Base, New Mexico.

of full-sized aircraft.

Bistatic measurements are essential to understanding the stealth characteristics of military targets that use shaping as the primary approach to radar cross section reduction (RCSR). The Bistatic Coherent Measurement System (BICOMS) was designed by researchers at the Georgia Tech Research Institute (GTRI) for the U.S. Air Force 46th Test Group, Radar Scattering Division (RATSCAT).

“The Air Force has upgraded its existing fixed-site capability to a state-of-the-art system and provided a mobile system that is almost identical to the fixed system,” explained Ted L. Lane, GTRI principal research scientist and the project’s principal investigator. The mobile system performs measurements not only at different angles but also at varying distances from the aircraft under study. Because BICOMS can be moved very close to the target, it can also measure near-field effects to understand how factors such as glint affect the radar signature.

The two radar systems, the fixed and the mobile, are coherent and linked together using fiber optics for bistatic measurements, but can also operate independently to provide high-speed simultaneous measurements of two separate targets under test. Operating together, the two systems can simultaneously produce bistatic and monostatic data from each radar unit.

The new mobile radar unit—40 feet tall, 66 feet long, 37 feet wide, and weighing 90 tons—was built at GTRI’s research facility near Atlanta and shipped to RATSCAT last summer. It is world’s largest mobile RCS measure-

ment system. GTRI researchers also designed the equipment connecting the two systems and the upgrades of the fixed unit.

The fixed radar system can continuously sweep turntable-mounted targets from 1 GHz to 18 GHz and 34 to 36 GHz as they are rotated. The mobile system operates from 2 to 18 GHz, though its capabilities can be expanded because all mechanical systems are in place to support Ka band.

On the mobile system, eight radar dishes ranging in diameter from 14 inches to 10 feet ensure uniform illumination of targets up to 80 feet in length at typical ranges of 5600 feet. On the fixed system, the mobile dishes are duplicated, along with an additional 16-foot dish provided for the 1–2 GHz band.

On both systems, the antenna positions are computer controlled and provide an automatic peaking feature to reduce test setup time. Automated calibration equipment improves the efficiency and the accuracy of the data—and performance of the military systems. Calibration must be repeated during the day as normal heating and changes in the sun alter conditions of both the fiber optics and the test range.

PT

Clouds From Both Sides

Properties of high-level cirrus clouds that may affect global warming were measured this spring off the Hawaiian island of Kauai, using specially designed instruments carried by remotely piloted aircraft flying at 50,000 feet.

The measurements are being compiled to develop a global picture of how solar energy enters the atmosphere and moves within and through clouds. Clouds are effective at both reflecting incoming solar energy back to space and absorbing longwave radiation from the Earth’s surface. But it’s not known exactly how these dual roles of clouds in reflecting and absorbing solar energy work. Data from the study will help scientists better understand these roles and build more accurate global climate models to predict climate changes.



THE ALTUS ROBOTIC AIRCRAFT measures solar energy that is transmitted and reflected by cirrus clouds in the Hawaiian islands.

The climate studies are being guided by Sandia National Laboratories for the DOE’s Atmospheric Radiation Measurement—Unmanned Aerospace Vehicle Program. The Altus’ aircraft being used as an aerial platform for the instruments was built by General Atomics Aeronautical Systems, Inc. for NASA. NASA’s Dryden Flight Research Center, Edwards, CA, provided the aircraft and funded the flight series under NASA’s Environmental Research Aircraft and Sensor Technology (ERAST) program.

The Altus has a two-stage turbocharged engine capable of taking the aircraft to 65,000 feet, above the tropopause where most clouds form. The aircraft carries a 340-lb. payload of radiometers, laser-based lidar detection devices, and similar instruments to collect and transmit information about clouds such as their optical properties and the size and concentration of particles they contain. A second aircraft, a DHC-6 Twin Otter, flies beneath the clouds in stacked formation with the Altus above, carrying radar from NASA that probes the ice and water content of the clouds.

NASA’s Dr. James Stewart, manager of the ERAST program at Dryden that produced the Altus and other high-flying, long-duration uninhabited aircraft for environmental research, said this series of flights by the Altus demonstrated the scientific and commercial potential of the remotely operated aircraft NASA is developing.

The long-range goal is to develop enough information to improve the accuracy of predictive models of climate

change. In the future, the climate researchers would like to conduct similar measurements in a deep tropical region, closer to the equator, where tropical storms are responsible for bringing moisture from the ocean into the atmosphere in a process that drives the dynamics of weather patterns far and wide. **PT**

Squids Are Us

Researchers at Los Alamos National Laboratory are using Superconducting QUantum Interference Device (SQUID) sensors to measure extremely small magnetic fields. SQUIDs are the most sensitive magnetic field detectors known. They detect and convert weak magnetic fields into electrical signals.

The research into SQUIDs includes magnetoencephalography, a method of measuring the tiny magnetic fields produced when groups of the brain's roughly 100 billion neurons are active, and magnetocardiography, a method for measuring the magnetic fields produced by cardiac activity. The work could help neurosurgeons pinpoint areas associated with brain injury or functional abnormalities such as epilepsy and help medical researchers study such brain-related disorders as Parkinson's disease, multiple sclerosis, and schizophrenia.

Other scientific applications of SQUIDs focus on the corrosion processes in metal containers that typically cause tiny electrical currents known as corrosion currents. These currents induce weak magnetic fields that can be detected by SQUIDs; Los Alamos scientists have developed a prototype device capable of detecting corrosion currents in storage containers. The technique can also be used to investigate corrosion and ablation in other metallic materials, including those in aircraft, sea vessels, and pipes.

In addition to corrosion current detection, SQUIDs are being used as sensitive gravity gradiometers to measure and map variations in gravitational fields. The process detects localized changes in the gravitational field caused by bodies of material that differ in density from their surroundings. Potential applications include the passive measurement of oil reserves and the location

and mapping of subterranean voids. **PT**

Smart Airplanes

NASA is developing new "smart" software that will enable aviators to control and safely land disabled airplanes. The goal is to reduce commercial-aircraft accident rates by a factor of five over the next ten years.

The intelligent flight control system employs experimental "neural network" software developed by computer scientists at NASA's Ames Research Center, Moffet Field, CA and the Boeing Company's Phantom Works division, St. Louis, MO. Neural network software is distinguished by its ability to "learn" by observing patterns in the data it receives and processes, and then perform different tasks in response to new patterns, according to Dr. Charles Jorgensen of Ames, principal investigator for the software program at NASA. Simple neural network software has been in use since the 60s, but not in such a complex safety-related environment.

Using a highly-modified F-15 aircraft, tests at NASA's Dryden Flight Research Center, Edwards, CA, demonstrated how the neural network software can correctly identify and respond to changes in aircraft stability and control characteristics, and immediately adjust the control system to maintain the best possible flight performance under both normal and simulated failure conditions. The tests involved about a dozen flights over a three-week period. **PT**

In its flight control application, the neural network software program takes data from the aircraft's air data sensors—airspeed, direction, pressure, force—and compares the pattern of how the aircraft is actually flying with the pattern of how it should fly. These patterns are based on a series of pre-programmed aeronautical equations or control laws that define how the airplane flies. If there is a mismatch due to equipment failure, combat damage, or other reasons, the aircraft's flight control computer uses the new neural network programming to "relearn" to fly the plane with a new pattern six times every second.

Using its on-line learning capability, the neural net software would identify that something has changed, then reconfigure the flight control computer system to adapt to those changes, making the failure or damage almost "transparent" to the pilot. To enable the pilot to maintain or regain control, it may change the way the remaining functional control surfaces and systems are used to compensate for the loss of the inoperative or damaged surfaces or equipment.

Jorgensen noted that neural net software being developed in this NASA project could have other applications. "Once we prove neural net software can rapidly learn to fly a crippled aircraft and help pilots land it safely, then engineers will be more likely to use the intelligent software in power plants, automobiles, and other less-complicated systems to avoid potential disasters after equipment failures," he said. **PT**



A HIGHLY-MODIFIED F-15 AIRCRAFT UNDERGOING TESTS at NASA's Dryden Flight Research Center, Edwards, CA, to evaluate how the neural network software will enable aviators to control and safely land disabled airplanes.



EQUIPMENT REPORT

GRAND ULTRAVIEW PRO PC-TO-TV CONVERTER WITH VIDEO OVERLAY

Combine your own text, graphics, and more with any composite or S-Video signal.

CIRCLE 15 ON FREE INFORMATION CARD



Grand UltraView Pro comes with a full-function remote control for presentation use and general convenience. The unit has a serial mouse output that can be connected to a PC for fully remote functionality, and for that you need to load a driver. But you don't have to get that complicated if you don't need to.

Hooking up Grand UltraView Pro is simple, and anyone familiar with video and computer gear will be able to do so without consulting the instructions. All of the inputs, outputs, controls, and potentially confusing cables are clearly labeled. The unit has a power input for the included adapter, and two video inputs—one composite and one S-Video.

Grand UltraView Pro also has a microphone input and a VGA input for connection to a notebook or desktop computer, PC or Mac. Included is a Y cable for connecting the device between a desktop computer and its monitor, but the Y part of the cable isn't used for notebook computers, which always have a VGA output to spare. So much for the inputs.

Videotape has been popular for so long now that many college students were born into households containing VCRs. Camcorders have been popular for nearly as long. What that means is that home videos have been piling up in closets for two decades because many would-be amateur film directors have put off editing those cherished, but drawn out moments into more palatable entertainment, often because of the lack of proper equipment.

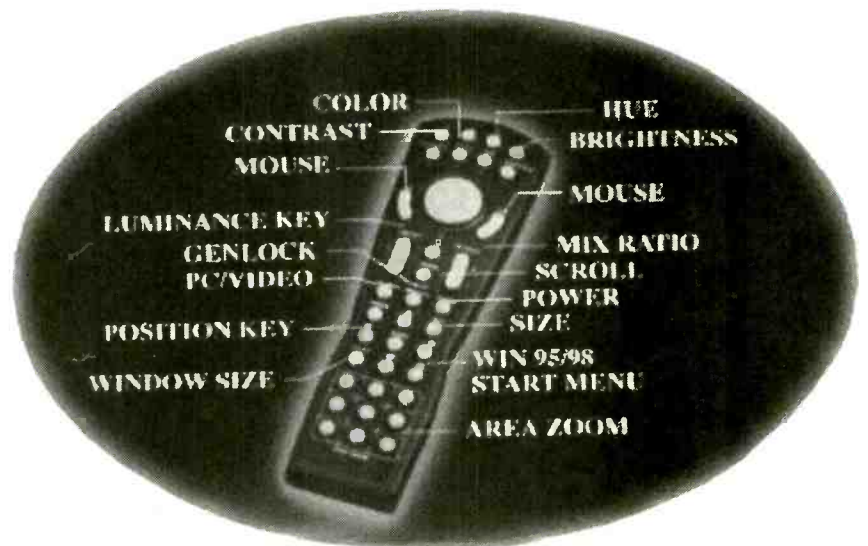
For years, editing video, adding subtitles and voice commentary, and adding other special effects required rather costly equipment. Fortunately the multimedia PC put an end to that, enabling anyone with a couple of grand to do some pretty impressive video editing—at least on the computer. Getting the stuff back onto videotape, or displaying the work on a large-screen monitor rather than a small computer screen, requires additional equipment. True there are fancy graphics cards that have video outputs, but an affordable all-in-one solution would be more ideal.

Enter the Grand UltraView Pro, a desktop PC-to-TV converter with video overlay capabilities that is perfect for professional or amateur video production on the small scale. It lets you output your edited material to videotape or an NTSC or PAL display. Grand UltraView Pro supports resolutions up to 1024 by 768 for NTSC or PAL and is supplied with a powerful remote control. The unit is bundled with *Astound 5.0*, a presentation program that lets you be as

creative as you want with video, graphics, images, text, and more. It has a list price of \$499.

Grand UltraView Pro

Not just a PC-to-TV converter, as mentioned above, Grand UltraView Pro also does video overlay so that computer generated text and graphics can be placed on top of existing video for viewing or recording. Though Grand UltraView Pro comes with the multimedia presentation software, no software or drivers are required for the unit to operate, and there are no cards to install in a computer, so setup is a no-brainer.



THE GRAND ULTRAVIEW PRO comes with a powerful remote that can be used to control both the unit and the attached computer.

Then there are the outputs. Three video outputs include RGB, composite, and S-Video. These can be connected to compatible inputs on NTSC or PAL video monitors or recorders. There's also an audio output for dubbing voice to tape with the included microphone. The mouse output can be connected to a computer's serial port to control the computer using Grand UltraView Pro's remote control as a mouse that works with an existing mouse. All necessary cables for inputs and outputs are included, such as S-Video, composite, audio, serial, and so on.

Though the instructions on how to hook up Grand UltraView Pro are clear enough but hardly necessary, understanding how to use the unit can only be learned by a few minutes of tinkering with the controls. But that is really all it takes, as the device is fairly simple to use. The selected video source (composite or S-Video) appears perfectly clear and full screen at the video outputs, with the VGA input overlaid on top of it. Controls on the unit let you adjust the size, position, color, and so on, of the VGA. The unit will convert VGA resolutions up to 1024 by 768.

You can easily adjust "how much" of either source is seen. It's hard to explain, but basically you can overlay the entire VGA image on top of video, or filter out only the windows you want to see or just the text portion of a presentation floating over the video—and whatever you can see you can record. If you happen to have video running on the PC, you can overlay video on top of video. Grand UltraView Pro has adjustable vertical and horizontal output positions, three settings of overscan/underscan, a screen-freeze function, and an area-zoom that lets you enlarge only certain parts of the screen.

The minimum requirements to use Grand UltraView Pro are meager. They include a PC-compatible 286 or faster with VGA output. A free serial port is required to use the remote as a mouse. You also need a TV or VCR with a composite or S-Video input and an audio input to use the microphone. Then you need an external video source, which can be another VCR, DVD player, video camera, or whatever, as long as it has a composite or S-Video output. To run *Astound 5.0*, however, requires a computer running Windows 95 or Windows

98, 40MB of hard disk space, 16MB RAM with 24 MB RAM recommended, a CD-ROM drive, VGA graphics, and sound for audio functionality. Of course performance might not be satisfactory on anything less than a Pentium.

Grand UltraView Pro makes it easy to add custom text and graphics to any video signal. You can create material with the bundled *Astound 5.0* or any other presentation program such as *Microsoft PowerPoint*. Its uses range from business, to professional, to just plain family fun. It's also affordable and easy to use. Grand UltraView Pro is just what you need to combine your computer-generated multimedia efforts with video on tape. For more information on the Grand UltraView Pro, contact the manufacturer directly (Dobbs-Stanford Corporation, 2715 Electronic Lane, Dallas, TX 75220; Tel: 214-350-4222; Web: www.dobbsstanford.com) or circle 15 on the Free Information Card. **EN**



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Digging Into the Model 70

IN THE JULY ISSUE, WE BEGAN RESTORING A PHILCO 70, ONE OF THE RADIO MODELS DEVELOPED TO COUNTERACT SLUMPING SALES DURING THE GREAT DEPRESSION. THE "70" WAS ONE OF A GROUP OF SETS HOUSED IN CABINETS CREATED BY INDUSTRIAL

designer Edward L. Combs. With their rounded tops and with speaker grilles resembling stained glass windows, these radios inevitably became known as "cathedrals."

Last month, we contented ourselves with a searching visual examination of the Model 70, noting that the chassis was very clean and showed no obvious signs of tampering. It was also reassuring that (except in one case), there were no signs of burned or overheated components. The exception was the power transformer, which had apparently oozed some potting compound around its base.

The transformer may have cooked for awhile because of a filter-capacitor short (both of these caps had been replaced). However we found that all tubes lit normally and that the voltage at the HV winding was correct. So it looks like we can give the transformer a clean bill of health, at least so far.

Removing the Capacitor Blocks

Up to now, we hadn't picked up a screwdriver or a soldering iron in connection with this project, but, since we've learned all we could by inspection, it was time to dig in. I decided to begin with the set's six Bakelite block capacitors. As you'll recall, most of the paper caps (and in one case a resistor) are potted inside these little Bakelite enclosures—their leads wired to external ter-

minal lugs for ease of connection to the other components.

The longevity of old-style wax-sealed paper caps being what it is, it would be foolhardy to fire up this almost 70-year-old radio without replacing all of them. That meant removing all six of the Bakelite units from the set and "unpotting" the components they contained. Two additional caps, mounted in individual tin enclosures, would also have to be removed and rebuilt.

I have to say that I've never before disconnected so many leads inside a radio at one time. When I change out multi-lead components, I much prefer to do them one at a time—completely replacing one component (while lead dress and connections are fresh in my

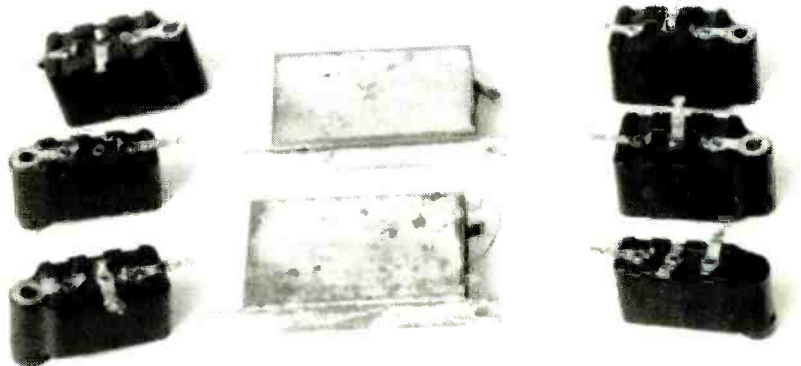
mind) before moving to another. But in this case, it made no sense to do the job piecemeal.

So I went ahead and drew a careful map of the location of each of the six blocks and the positions of the terminals on each one. Then, as I disconnected each lead from its terminal, I carefully noted its "destination" on the map. I'm not the world's best graphic artist, but I really took care to do this job clearly and correctly. Snarling up a connection would create problems that might not only be difficult to untangle later, but also lead to burnout and destruction of other components.

Finally, after using up about a mile of de-soldering braid, I finished the job of removing and mapping the leads. As each block was freed up, I removed the single screw holding it in, lifted it out, noted its part number on my map, and set it aside.

Unpotting the Blocks

This wasn't a job I was looking forward to, but it didn't turn out to be too difficult. Moving the project outside to



THE SIX BAKELITE BLOCK UNITS and two "tin" caps as removed from the Model 70. An additional capacitor, mounted on the tone control, will be changed out later.

avoid any potentially toxic fumes, I placed the block to be “unpotted” upside down in a portable vise and aimed a heat gun at the exposed compound. The black waxy material had a fairly low melting point, and it began to “run” at the surface very quickly.

As soon as this sign of softening appeared, I took the block out of the vise and began digging and scraping out the softened compound with a screwdriver. It was relatively easy to expose the tops of the components potted inside and, with that done, the block went back into the vise for another blast from the heat gun. Now the grip of the potting compound was loosened enough so that the components could be carefully pried out with a smaller screwdriver.

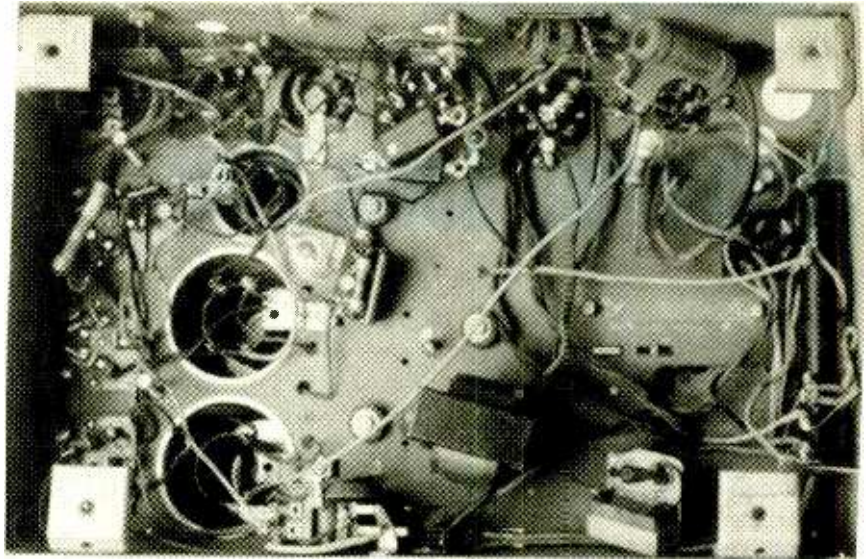
With the shell empty, it was easy to scrape out most of the residual compound using the larger screwdriver—leaving it clean for reinstallation of new modern caps. This technique worked out so well on the first block I tried, that I got a little too enthusiastic with the second one and pried a bit too hard when removing the components. I ended up breaking out part of the end of the Bakelite shell (luckily not the end involved in the “one hole” mount). It won't show too badly, but it *was* aggravating. After that, I was a lot more careful, and emptied out the remaining four blocks without further breakage.

When I was finished, the blades of a couple of favorite screwdrivers (not to mention my hands and the outsides of the Bakelite shells) were covered in the “goopy” black potting compound. But not to worry: mineral spirits turns out to be a perfect solvent for the stuff, and cleanup was as easy as a few wipes with a saturated rag.

Some of you may well wonder what that waxy black stuff is and if it has any health-threatening properties. I don't have the answer, but if someone else does, I'd be very pleased to hear from him or her.

Problems for Follow-Up

During my wholesale removal of the block capacitors, I noticed a couple of cases where wiring had been changed by a “service” person. The first change involved the volume control, which is a dual potentiometer. One section of the pot varies the cathode bias on the RF and IF tubes; the other section (connected as a voltage divider between the antenna and ground terminals) controls



THE UNDERSIDE OF THE MODEL 70 CHASSIS looks a little bare with all of the capacitor units removed. The power resistor near the upper right corner is not original (see text).

the strength of the RF input to the set's antenna coil. In my set, the antenna-coil input lug had been disconnected from the wiper arm of the pot and connected directly to the set's antenna terminal.

Why is anybody's guess. Perhaps the set lost sensitivity for some reason the “repairman” couldn't discover and this was his way of getting around the problem. Or maybe it had been used in a rural area where signal strength was very low. In any case, in a normally operating set without AVC, this strategy would certainly lead to overload and distortion on stronger stations. At some point before trying out the set for the first time, I'll return the antenna input circuit to the original configuration—then see what problems arise, if any.

The other area where something is amiss is in the rewired filter-cap circuit. Here, the two original individual caps had been replaced by a more modern war-surplus multi-section unit. At the same time, a 750-ohm power resistor that is definitely not original had been installed.

Sometimes, such a resistor is installed as a cheap replacement for a burned-out filter choke. However, the resistor does not appear to be wired that way and the set's filter choke tests OK on an ohmmeter. Further investigation of this problem will have to wait until I can disconnect and remove the replacement cap. (It's installed in such a position that I can't read its values and terminal lug codes.) I'll want to remove the unit anyway to replace it with a fresh one.

I'd just as soon not disconnect the electrolytic now and add to the confusion of loose leads under the chassis. Better to wait until the Bakelite blocks can be equipped with new caps and reinstalled!

One nice side effect to having all of the blocks removed is that virtually every resistor in the set ended up disconnected at one end—making it possible to conduct an out-of-circuit ohmmeter check. All the resistors checked out to be within at least a 20% tolerance range of their color coded values except for the two 240,000-ohm units (the grid-bias resistor for the type-47 output tube and the plate resistor for the type-24 detector). These had almost doubled in resistance and will be replaced with proper ones when the blocks are reinstalled.

From the Readers

I've received a few notes from **Electronics Now** readers who have begun to notice the column. The first one came from George Baldwin (Burlington, Ontario, Canada) who retired from Canadian Westinghouse in 1972 after 48 years of service. His collection includes the Westinghouse Aerola Jr. and Sr. models as well as a Radiola III and IIIA. (He indicates the latter are Westinghouse models also—which would make them rarities since these sets commonly carry the RCA brand).

Thomas Coates, in a recent e-mail, tells me he shares my interest in the minimally designed AC/DC sets that

(Continued on page 24)

Answering Some Mail

LETS CHECK THE MAIL AND ANSWER SOME QUESTIONS ABOUT SWLING EQUIPMENT, NEW AND USED.

JAMES BLACK OF SAN ANGELO, TX, E-MAILS A QUESTION ABOUT SW RECEIVERS:

"I have searched several issues of your magazine, and I have yet to find an advertisement for a manufacturer of shortwave receivers. When last I was interested in SW in the 1960s, the big names were Racal, Collins, and Drake. I hear they are moribund or gone now. Is that true, and could you give me some addresses, and preferably Websites, for today's manufacturers?"

Sure, Jim. Not surprisingly, given the state of world affairs, there seem to be a lot of readers interested in getting more information about the shortwave receiver market today. As you recalled, Drake made a number of popular SW radios back in the 1960s, and the good news is that the company is very much alive today, having returned to shortwave receiver manufacturing again after an absence from the market for a number of years. You can contact the company by writing R.L. Drake Co., 230 Industrial Drive, Franklin, OH 45005; Web: www.rldrake.com.

Other brands you may want to check out are:

AOR: AOR Manufacturing Ltd., 4E East Mill, Bridgefoot, Belper, Derbyshire DE56 2UA, England; Web: www.demon.co.uk/aor.

GRUNDIG: Lextronix Inc., 3520 Haven Ave. Unit L, Redwood City, CA 94063.

ICOM: ICOM America Inc., 2380 116th Ave. NE, Bellevue, WA 98004;

Web: www.icomamerica.com.

JRC: Japan Radio Co. Ltd., New York Branch Office, 430 Park Ave., 2nd Floor, New York, NY 10022; Web: www.jrc.co.jp.

LOWE: Lowe Electronics, England; Web: www.lowe.co.uk.

SANGEAN: Sangean America Inc., 2651 Troy Ave., South El Monte, CA 91733; Web: www.sangean.com.

SONY: Sony Electronics Inc., 1 Sony Drive, Park Ridge, NJ 07656; Web: www.sony.com.

TEN-TEC: Ten-Tec, 1185 Dolly Parton Parkway, Sevierville, TN 37862; Web: www.tentec.com.

YAESU: Yaesu USA, 17210 Edwards Road, Cerritos, CA 90703; Web: www.yaesu.com.

You can write these companies—or check their on-line sites where available—for information about their shortwave receivers. Or you can take a shortcut and write a major retail and mail order distributor such as Universal Radio Inc., 6830 Americana Parkway, Reynoldsburg OH 43068; e-mail: dx@universal-radio.com; Web: www.universal-radio.com. Universal's hefty catalog lists, with complete specs, most shortwave receivers available today. The 100-page catalog is available free by fourth class mail or for \$1 by first class mail.

And if you're looking for unbiased SW receiver reviews and recommenda-

tions, check out the annual *Passport To World Band Radio*, available through most major booksellers or direct from the publisher, International Broadcasting Services Ltd., Box 300, Penn's Park, PA 18943; e-mail: mwk@passport.com; Web: www.passport.com.

Used Receivers

Buying a new receiver is one way to go. But there is an alternative, suggests Ray Pommers of Redwood City, CA, who writes:

"I have a question about buying a second radio. I'd like to have two receivers in order to check parallel frequencies of the same station at the same time to see which is coming through with the best signal. But I'd just as soon not have to pay too much. How about a used SW receiver? How much should I pay? Which one should I choose? Where can I buy one?"

Hey, Ray, that's four questions, not one! But it's OK, since I've got a "four-fer-one" sale today. Seriously, though, they are good questions, and one that, from the mail I've been receiving, others are wondering about as well.

Happily, the new fourth edition of Fred Osterman's *Buying A Used Shortwave Receiver* came across my desk recently. And he confirms what you suspected, Ray, that you can get a real buy with a good used shortwave radio.

"Why purchase a used receiver?" Fred writes. "The answer is simple: savings! You can typically expect to pay 30 to 40 percent off the price of a current-model radio. On a discontinued model, the savings can be 50 percent or more."

The book gives specifications—and prices you may expect to pay—for more than a hundred solid-state receivers from the past 10 or 20 years. Not includ-

ed in the book are older tube-type sets, which Fred suggests are more for collectors than SWLs who want reliable receivers.

“Older receivers required far more maintenance than today’s solid-state digital radios. The performance of most solid-state (*i.e.* no vacuum tubes) radios does not diminish with time. A Yaesu FRG-100 that was built in 1992 will work as well as the one purchased last week.”

Some examples from Fred’s book: It should be possible to pick up a Drake R7 receiver, originally sold between 1978 and 1981, for around \$650 to \$750. I still use an R7 and think it is one of the best DXing receivers ever made, though a bit complicated to tune.

Or how about the portable Sony ICF-2003, from the late 1980s? Osterman rates it with 5 stars and a good buy if you can find it for about \$90.

For a real cheapie you might choose the Realistic DX-120, sold by Radio-Shack in the 1970s. It was a very basic set without a lot of bells and whistles and has the old fashioned slide rule tuning dial, rather than the digital frequency readout most listeners expect today. But for a back up receiver or for casual listening—or checking parallel frequencies—it might be what you’re looking for. This receiver gets a 2-star rating from Osterman, who suggests you might find a DX-120 (also known as the Star Patrol) for around \$30.

There are some down sides in purchasing a used set, he points out. If you don’t have the opportunity to tune before you buy, you might be disappointed in its performance. A seller will not generally be in a position to offer a warranty. But the book offers suggestions of things to watch out for.

OK, then, where can you buy a used receiver?

- Garage sales or through newspaper classified ads.

- Flea markets during local and regional “hamfests,” annual or periodic get-togethers for amateur-radio (ham) operators. Check one of the amateur-radio magazines for a calendar of these events.

- Electronics stores selling amateur-radio equipment usually have used receivers that they have taken in on trade for new gear for sale.

- Online sources include Usenet news groups such as rec.radio.amateur, shortwave and rec.radio.amateur.swap

Buying A Used Shortwave Receiver

A Market Guide to Modern Shortwave Radios



Fourth Edition

By Fred Osterman

THIS NEW BOOK *Buying a Used Shortwave Receiver*, by Fred Osterman, offers guidance to SWLs looking for a good used radio.

and Web sites such as www.antiqueradio.com, www.universal-radio.com, www.radiofinder.com, or www.torontosurplus.com.

Osterman’s book is available through Universal Radio (see address above).

High Wire Act

A receiver is never better than its antenna. And there are many options for the shortwave listener, from a simple short random length of wire to a super long “Beverage” type that might stretch out a quarter mile or so. You can also build your own or buy one ready-made,

and Jacob Naylor of Ponca City, OK, has a question about one of the latter:

“How about the Eavesdropper antenna?” he writes. “What do you think about it?”

The Eavesdropper, sold by Antenna Supermarket (P.O. Box 563, Palatine, IL 60078), is one of the ready-to-put-up commercial SW antennas on the market today. There may be others as good, but

CREDITS: Brian Alexander, PA; Richard D’Angelo, PA; David Krause, OH; William McGuire, MD; Ed Newbury, NE; David Ross, ONT; North American SW Association, 45 Wildflower Road, Levittown PA 19057.

ABBREVIATIONS

DX, DXing: Distant shortwave stations; listening to them as a hobby.

kHz: kilohertz, unit of frequency measurement

SW, SWL: Shortwave, shortwave listener.

UTC: Universal Coordinated Time, a time standard used by most major international broadcasters and listeners. It is equivalent to Eastern Daylight Time plus 4 hours; CDT+5 hours; MDT+6 hours, or PDT+7 hours.

this is one I could recommend to the SWL who wants a good all-band antenna with none—OK, little—of the work associated with stringing up a “skywire.”

It is a multi-band receiving antenna, covering all the SW bands from 11 to 75 meters, approximately 4000 to 26,000 kHz, with automatic bandswitching by trap circuits that match the antenna to the band you are tuning. It has gas-tube lightning protection that is so important to your solid-state SW receiver.

The Eavesdropper is only a bit over 40 feet long and is completely assembled, ready to use. The company suggests it can even be installed inside an attic. At about \$80, it is an antenna option that will be attractive to many SWLs.

Down The Dial

Looking for something interesting to tune? Try these:

AUSTRIA—7,325 kHz, Radio Austria International has English at 0030 UTC. Listen for its “News from Vienna” and “Report from Austria.”

CLANDESTINE—4,060 to 4,085 kHz, Voice of Iraqi Kurdistan isn’t going to top any SWLs list of “must hear” stations since programming is all in the Kurdish language. But since the conflict between Saddam’s Iraqi government and the country’s Kurdish minority continues to make headlines, this may make an intriguing log. The frequency varies. Listen around 0345 UTC for chanting and rousing patriotic music.

FRENCH GUIANA—13,700 kHz, Radio France International’s English programs are relayed from a transmitter in this South American country at around 2000 UTC.

LITHUANIA—6,120 kHz, Radio Vilnius should have its new 100-kilowatt US-made Continental Electronics SW transmitter operational as you read this. It is installed at a transmitter site at Sitkunai in Lithuania, and replaces

relays of the station’s Lithuanian- (0000-0030 UTC) and English- (0030-0100 UTC) language transmissions to North America, which had been aired by transmitters in Germany. This frequency may have changed when the new transmitter went on the air, however. Tune around at the times mentioned, if you don’t find Radio Vilnius on 6,120.

SOUTH AFRICA—17,870 kHz, Channel Africa is heard at 1810 UTC with its English “Newswatch” program, identifications, and drum signal.

SWEDEN—7,115 kHz, Radio Sweden is heard in English from 0330 to 0400 UTC with news and commentary, pop music, weather forecast for Scandinavia, and a regional feature program called “60 Degrees North.”

THAILAND—13,695 kHz, Radio Thailand’s English programming can be heard to 0029 UTC sign off, with Thai music, news, weather, time “pips,” and a distinctive 8-gong signal. EN

ANTIQUE RADIO

(continued from page 21)

originated during the Depression. He wonders who invented them and speculated that perhaps the Hazeltine Co. had something to do with it since their patent notices appeared on so many sets.

A reasonable, if brief, run-down on the origin of the classical AC/DC set will be found in my April **Popular Electronics** column and my June column in this magazine. But the short answer is that nobody invented it; it just evolved as various designers and engineers incorporated their innovations in response to the need for a very inexpensive receiver.

As far as the Hazeltine patents are concerned, Professor Hazeltine invented the famous Neutrodyne circuit popularly used in the TRF (tuned radio-frequency) radios whose heyday was in the mid to late 1920s. If a Hazeltine notice appears on an AC/DC set, it is because the set is a TRF, rather than a superheterodyne design that was much more common from the 1930s on.

Thomas Risher (11918 Greyford St., #3, Whittier, CA 90606) writes that he occasionally restores old sets and is now working on a Hallicrafters S38E. Though he didn’t request it, I’m sure Tom would appreciate a copy of the schematic for this radio if someone has

one handy and would be willing to copy and send it. What he did ask for is help in interpreting the color code bands on the tubular paper caps that are used in the unit.

These caps usually have a group of four color bands on one end and either one or two bands on the other. Place the cap in front of you with the group of four at the left. Reading left to right, the first two bands indicate the significant figures of the capacitance and the third band the decimal multiplier that will give you the value of the cap in pF. The fourth band represents the tolerance in percent. The band(s) on the right (read left to right if there are two) represent the significant figure(s) of the cap’s voltage rating. Their decimal multiplier is always 100.

Significant figures are indicated by the colors black, brown, red, orange, yellow, green, blue, violet, gray and white—which represent the digits zero through nine, respectively. Only the first seven colors (black through blue) are required for their decimal multiplier. These indicate, respectively, multipliers of 1, 10, 100, 1000, 10,000, 100,000 and 1,000,000.

Tolerance color codes are as follows: gold (sometimes green), 5%; silver (sometimes white), 10%, no color (sometimes black), 20%. You may also find that one end of the cap is painted black or has a dot of black paint. This indicates the end that is connected to the “outside foil” of the unit; it should be connected to the circuit point closest to ground for maximum shielding effect.

E-Mail Address Change

See you next month when we’ll continue the Philco 70 restoration. In the meantime, your comments and queries are always welcome. Write me *c/o Electronics Now*, 500 Bi-County Blvd., Farmingdale, NY 11735 or e-mail me at my **new** address: mfellis@enteract.com. The old interaccess address will still reach me for awhile, but will be phased out over the next few months. Personal answers are not always possible, but all correspondence will be acknowledged in the column. EN

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Flat-Panel Displays

ARE YOU GETTING SICK OF THAT HEAVY, WORKSPACE-HOGGING MONITOR YET? IF YOU'RE LIKE MOST COMPUTER USERS, YOU WANT A DISPLAY WITH A LARGE VIEWABLE AREA THAT DOESN'T TAKE UP A LOT OF SURFACE AREA.

A few years ago this problem didn't really exist. While 14-inch monitors weren't that great to look at, for quite some time they were the only option and, of course, they could fit just about anywhere. Now we're tempted by the 17- and 19-inch monitors that are a real treat on the eyes, yet which are inconvenient in many setups. Sure their footprints have been somewhat reduced with the introduction of various short-neck designs, but the fact remains: Cathode ray tube (CRT) displays will always be somewhat ... unwieldy.

What to do?

This month we'll take a look at a display option that's becoming more reasonable every month. With a few careful considerations, you might just be ready for the future of monitors.

Flat and Light

They've been in laptops for years, and are now appearing in many more devices—including monitors. We're of course talking about LCD panels, the thin, colorful wonders of the last decades of the millennium.

Unlike CRTs, which rely on a heavy vacuum chamber and electron gun, LCD panels consist of almost weightless components encased in a "sandwich" of reasonably light plates of glass. The components consist of liquid crystals—peculiar tiny molecules that can be influenced by magnetic fields—and the cells or microchambers that control them. In

an active-matrix display, each of these cells contains a thin-film transistor (TFT) that turns on and off to form an intermittent magnetic field. Passive matrix displays (which are rarely found in new products) use a transistor to control each row of cells.

The glass layers of an LCD contain polarizing filters. Light from a backlight shines through the filter and is influenced or twisted by individual liquid-crystal molecules. These molecules are turned by the magnetic fields influencing them (see Fig. 1). When in line with a polarizing filter, a molecule blocks light, causing a dark spot. When twisted

90 degrees out-of-phase with the filter, the molecule allows maximum light to pass through. Any angle in between will result in varying brightness of light.

Modern color LCDs use multiple liquid-crystal elements to produce a variety of colors. Each pixel or dot of the screen therefore contains three or more elements (bunched together on a microscopic level) that can combine to produce colors. These elements are each pressed up against a color filter. The varying light intensities combined in each bunched group of elements will be perceived by the human eye as a single color dot. For a simple example, 100-percent red, 100-percent blue, and zero-percent green elements would combine to make a purple pixel or dot.

Unlike CRTs, which are redrawn line by line thousands of times a second, each pixel in an active-matrix LCD can be turned on or off individually and simultaneously. This makes LCDs truly flick-

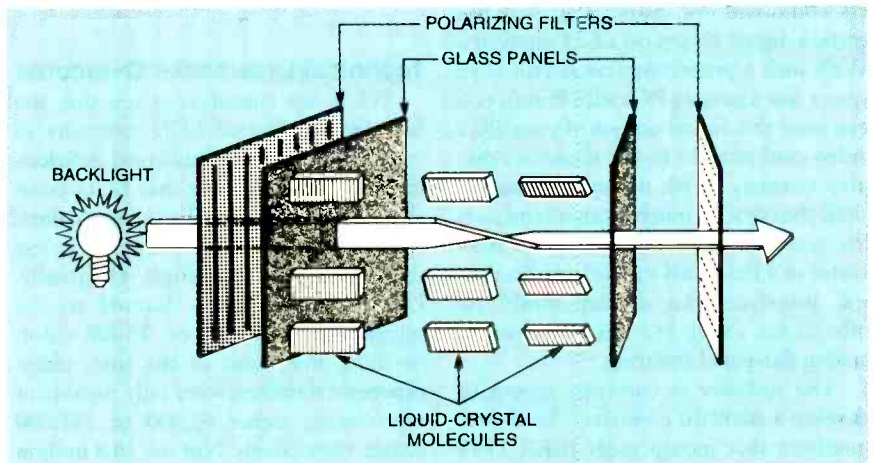


FIG. 1—PASSING POLARIZED LIGHT THROUGH LIQUID CRYSTALS makes it possible to control the intensity of light that makes it through a filter at the other end. When influenced by a magnetic field, liquid-crystal molecules can be made to twist the light to varying degrees in and out of phase.

er free and easy on the eyes. You almost feel as if you're looking at a brightly lit piece of paper after a while.

The low weight and high quality of LCDs has made them popular in many more products than just laptops. For example, the technology has also made it possible to have color Windows CE handheld computers or HPCs.

Why not take advantage of the benefits of LCD on your desktop? Initially, there have been pricing and quality issues to worry about, but read on to find out how these have been eradicated.

Price Drops

While some of the most impressive LCD monitors are out of the typical user's price range (18-inch models can cost \$3000!), typical 14.5- or 15-inch viewable units have come down drastically in price. Because of their increasing popularity and improved manufacturing methods, these average-size flat-panel monitors are available for about \$700-\$900. And they're only getting cheaper.

Granted, the viewable size on these displays is a bit smaller than that of a 17-inch monitor, but not by much. A 17-inch CRT usually has a 15.9-inch viewable area—an almost unnoticeable difference when compared with the typical 15-inch LCD. Of course, a 17-inch monitor can be had for less than half the price of a flat panel. You have to decide if the space-saving features and other benefits we discussed earlier are worth it.

The type of interface used in the display will affect price, too. Some computers come with an output that matches certain digital inputs on LCD monitors. With such a proprietary connector (I've seen a few Compaq PCs with them), you can send the digital output of your PC's video card straight to the monitor's display circuitry. With no analog conversion, the signal is much cleaner (and so is the picture). With no need for a converter in a flat-panel monitor with a digital interface, the display could be offered for about \$50 cheaper than an analog flat-panel monitor.

The industry is currently trying to develop a standard connector for digital monitors that incorporates IEEE 1394 also. That way your flat-panel display will also act as a hub for this 400-Mbps interface used in digital camcorders and other high-quality devices—all through one cable connection to the PC.



LIKE STANDARD CRT MONITORS, flat-panel displays are getting wider. This VPD180 from ViewSonic offers 18.1 inches of viewable area, though it is about as deep as a cereal box.

Technical Drawbacks Overcome

While few consumers knew this, the first few batches of LCD monitors to come out had an unpublicized deficiency. Because of the way that LCD color elements are combined to create colors, most panels were made to operate at less than true color settings. Originally, LCD technology was limited to the reproduction of 16- or 18-bit color, meaning that most of the first, ultra-expensive monitors were only capable of reproducing either 65,000 or 252,000 colors, respectively. Not the 16.8 million colors that computer users were becoming accustomed to using.

What does such a limitation do to a panel? To be honest, many people wouldn't notice the difference, especial-

VENDOR INFORMATION

Compaq
20555 State 249
Houston, TX 77070
Tel: 800-345-1518
Web: www.compaq.com

ViewSonic Corp.
381 Brea Canyon Road
Walnut, CA 91789
Tel: 909-869-7976
Web: www.viewsonic.com

ly if involved primarily in office-related tasks like letter writing or spreadsheet use. Those dealing with graphics and
(Continued on page 29)

NEW PRODUCTS

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Digital AC Power Meter/Logger

Designed to easily measure and record information about any electrical load that is connected to the AC line, the Model 21-1850CI Digital Power Meter provides valuable information about electrical consumption, cost, cycle characteristics, and more. It determines AC load characteristics for testing, alternative power system installations, troubleshooting, or educational purposes.

power meter is then connected to the AC line. All parameters are then shown either on the 1 by 16 alphanumeric display on the instrument or on the simulated display on the computer monitor.

The 21-1850CI Digital Power Meter has a suggested list price of \$349.99.

BRAND ELECTRONICS

421 Hilton Road
Whitefield, ME 04353



CIRCLE 20 ON FREE INFORMATION CARD

This power meter features accurate true RMS measurements of voltage up to 150VAC, current up to 15 amps, volt-amps up to 1850 VA, peak power, and power factor. The included easy-to-use RS-232 interface and PC software enables the user to control and monitor the instrument through a PC.

The 21-1850CI includes a real-time clock and calendar for precise data logging, power interruption immunity, and on-board memory for up to 8121 data entries. When used as a data logger, the instrument will record average power consumed by the load during user-set intervals ranging from 1 minute to 2 hours. Five-minute intervals result in data covering approximately one month.

Operation is very simple—the load to be monitored is connected to the receptacle on the back of the meter. The

Tel: 888-433-6600 (orders) or
207-549-3401
Fax: 207-549-4568
Web: www.brandelectronics.com

Magnifying Light

Ideal for production benches and workstations or longer length inspection and assembly applications, the fully rotational Omnivue "Max" magnification light offers a 43-inch extended reach arm. The magnifier uses three 9-watt compact fluorescent lamps, which provide two light levels: 27 watts of light from the top and both sides or 18 watts of side-to-side lighting. Either light level is available with a simple touch of a three-way switch.

One feature of the instrument is a three-diopter optical-quality glass mag-

nifying lens, which tilts independently of the light source for optimum positioning. This capability reduces glare from overhead lighting since the lens can be



CIRCLE 21 ON FREE INFORMATION CARD

precisely positioned where it's needed. The light includes an industrial-grade clamp for traditional worksurface mounting. Additional mounting options include a table base and portable stand for easy mobility or pin mount for production workstations. Two optional lenses are available that increase magnification up to 7 and 15 diopters. UV "black lights" are another option.

The Omnivue Max has a suggested retail price of \$331.

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Wireless Video Camera

Concealed in an everyday videotape is a high-resolution pinhole lipstick video camera along with a long-range, 2.4-GHz, FCC-approved video transmitter. This system is meant to provide security in a variety of applications, from keeping an eye on the baby-sitter to monitoring personal property.

Setting up video surveillance takes only minutes. Place the videotape anywhere that you want to watch. Then place the included receiver up to 300 feet away and connect it to your monitor or VCR. The system comes complete with camera/transmitter, receiver, and power supplies. The Wireless Videotape

Camera costs \$349.95.

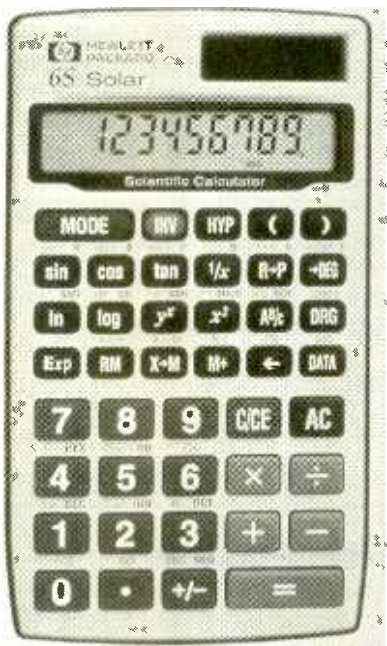
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CIRCLE 27 ON FREE INFORMATION CARD

Scientific Calculator

A compact scientific calculator, the HP 6S, which is available in blue and silver metallic finishes, is designed to appeal to students. The calculator comes with 67 built-in functions necessary to help solve math problems at the middle-school level. In addition to the basic math functions, the HP 6S has fraction calculation and single-variable statistics functions that allow the student to learn elementary statistics easily. To complement the HP 6S, Hewlett-Packard has developed an innovative math and science curriculum.



CIRCLE 22 ON FREE INFORMATION CARD

Among the calculator's high-performance features are fraction functions and display, standard trigonometric and hyperbolic functions, single-variable statistics, and algebraic entry-system logic. Its larger-than-standard 10+2-digit LCD display is easy to use, making equations and solutions easier to read. The tactile feedback keys have a solid feel, and a backspace key is provided to allow users to correct mis-entered infor-

mation. The calculator can be solar- or battery-powered.

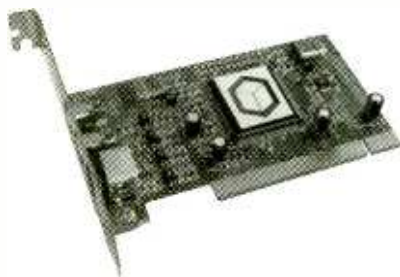
The HP 6S has a suggested retail price of \$16 for the dual-powered option and \$12 for the battery-powered option.

HEWLETT-PACKARD COMPANY

1155 SE 164th Avenue
Vancouver, WA 98613
Tel: 360-212-8353
Fax: 360-212-8401
Web: www.hp.com/calculators

Frame Grabber

The DFG/LCI frame grabber supports all the usual video standards, such as PAL, NTSC, and SECAM. (S-VHS can also be connected.) Images are either transferred to the VGA card or to the PC's RAM in video real time for further processing. Using the digital video data, various settings such as contrast and brightness, hue, and saturation can be adjusted.



CIRCLE 23 ON FREE INFORMATION CARD

Still video cameras, camcorders, VCRs, and industrial monochrome and color cameras with Y/C outputs all can be connected to the board. So that critical video sources can be grabbed, the DFG/LCI has a mode that compensates for critical synchronization behavior and allows images to be grabbed in a higher quality. The maximum possible resolution is 768 x 567 pixels at 50 Hz and 640 x 480 pixels at 60 Hz.

The DFG/LCI frame grabber, which comes complete with the PC card; software development kit, software Grab&View Light, and a TWAIN driver—all for Windows 95/NT; and documentation, costs \$339.

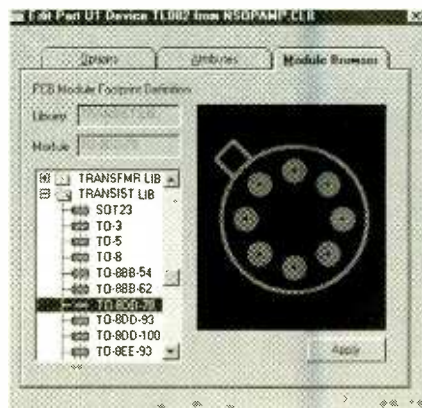
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Fax: 704-370-0906
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Schematic Capture Software

Version 3.0 of WinDraft Schematics features a completely revised Bill of Materials (BOM), starting with a new dialog box that is more intuitive to use. Designers can manipulate the data to their personal needs for part sorting, ordering materials, graphing, and compatibility with other software. The improved BOM also will perform its own sorting by quantity, value, or a user-defined attribute.

The new Module Footprint Browser allows designers to easily scan Win-Board PCB software for the desired footprint package and assign it to the selected schematic part. The expanded Net Properties set global defaults for the entire design as well as setting individual net properties. In addition, built-in netlist generation outputs formats for many popular board layout products, including Accel EDA, Pads PCB, Pads 2000, Protel, Pcad, and WinBoard.



CIRCLE 24 ON FREE INFORMATION CARD

The unlimited pin version of WinDraft 3.0 costs \$495, and the 650-pin version costs \$250. Registered customers will be notified as to the upgrade cost. A free evaluation version of WinDraft, a fully functional version with a 100-pin limitation, is available from the Web site listed below.

IVEX DESIGN INTERNATIONAL

15232 N.W. Greenbrier Parkway
Beaverton, OR 97006
Tel: 503-531-3555
Fax: 503-629-4907
Web: www.ivex.com

SWR Power Meter

The Grand Master series of SWR/Power Meters feature an SWR scale that expands the full view of the

meter, with 3:1 SWR centered at mid-scale for precision and wide-range measurements. The meters, which measure $7\frac{1}{2} \times 3\frac{1}{4} \times 4\frac{1}{4}$ inches, provide peak and average, forward and reflected power readings, and have selectable power ranges.



CIRCLE 25 ON FREE INFORMATION CARD

There is a large $3\frac{1}{4} \times 1\frac{1}{4}$ -inch precision illuminated meter for easy wide-angle viewing. A functional and simple front-panel layout allows users to intuitively select power ranges or bands or make SWR readings.

The MFJ-870 HF SWR/Power Meter, which covers 1.6 to 60 MHz and has 30, 300, and 3000-watt power ranges, costs \$134.95.

MFJ ENTERPRISES, INC.

P.O. Box 494

Mississippi State, MS 39762

Tel: 601-323-5869

Fax: 601-323-6551

Web: www.mfjenterprises.com

AC Current Clamps

Intended for use with any Fluke DMM or current measurement device equipped with banana inputs, the i200 is a single-range 200A clamp-on AC-current clamp with current output via safety-shrouded banana plugs. In addition, the i200, with a measuring range from 0.5 to 240A, has a 1 mA/A output signal.



CIRCLE 26 ON FREE INFORMATION CARD

The i200s is a dual-range 20A and 200A clamp-on AC current clamp. It is suitable for use with DMMs, oscilloscopes, and power analyzers, or ScopeMeter test tools that have BNC connectors and accept voltage inputs.

The i200s is equipped with voltage output via a safety-insulated BNC connector and has a dual banana-to-BNC adapter, allowing it to be connected to any multimeter with banana input.

Both the i200 and i200s clamps have a 40-Hz-10kHz frequency response. The i200 costs \$89 and the i200s costs \$149.

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EN

COMPUTER CONNECTIONS

(continued from page 26)

full-motion video, however, could often spot the deficiency in moments. I caught one manufacturer trying to lie about the color depth of a flat-panel monitor it was releasing in hopes that the prototype would eventually be replaced by a better panel (because the unit does have 24-bit color now, the vendor will remain nameless).

The truth is that those who work with video can spot the color dithering that occurs when a low color setting is used on a true-color image. It's most noticeable in color fields that are supposed to gradually change in hue (the subtle differences in a flower petal, for instance). What ends up happening is that the colors not available end up all converting to the closest available hue. The result is a blotchy, pixelated area that just doesn't look natural.

In short, make sure you purchase a panel that's capable of displaying true 24-bit color. Remember, you're replacing a desktop monitor—it only makes sense to do so with a device that lives up to the quality of what you're replacing. While 18-bit panels are fine for laptops, where you're not really going to be working too heavily with graphics, on a desktop you want the ultimate visual experience. (Incidentally, because of the growing popularity of DVD in portables, more and more laptops are coming with 24-bit panels these days.)

The good news is that there are plenty of 24-bit displays, in all sizes, to choose from on the current market. Take advantage of the state of the art.

Another drawback that many early flat-panel monitors had was the use of

poor wide-angle technology. While each manufacturer relied on a different technique for doing so, all had the goal of avoiding the problem LCDs have when viewed from an indirect angle. When you go as much as 45 degrees to either side of a typical screen, the image gets a washed-out look that makes it hard to read what's onscreen.

Most new panels do offer some kind of decent wide-angle design. That usually consists of enhancements to the back-lighting technique, as well as to the "grooves" of the polarizing filter on the front of the LCD panel. Ask if wide-angle enhancements have been made (and try to see a demo) before spending close to a grand on a flat-panel monitor.

While still more expensive than their CRT counterparts, LCD monitors are becoming a viable option. With prices dropping and technology getting better, maybe the time has come for you to go slim. Unless, of course, you plan on waiting for a bigger flat-panel display to come down in price. And the techie shopping game goes on....

That about does it for this month. If you'd like to get in touch with any comments or questions, feel free to send e-mail to connections@gernsback.com, or snail-mail to *Computer Connections, Electronics Now*, 500 Bi-County Blvd., Farmingdale, NY 11735.

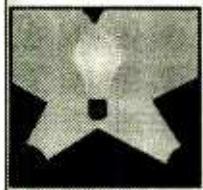
EN



An Introduction to Light in Electronics

An Introduction to Light in Electronics

F.A. WILSON



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Automate Your Home with an Expandable X-10 Controller

Control the lights and appliances in your home with the touch of a button!

CHRISTOPHER A. NIELSEN

How many times have you crawled into your bed and turned out the light only to realize that the glow in the hall is coming from the forgotten light in the kitchen? Would you like to ring your doorbell and have the lights set just right when you open the door without having to go to each one and dim it separately? Perhaps you would like most of the lights in your house to come on if a backyard detector senses an intruder.

If you're interested in controlling things around the house, the X-10 system of dimmers, switches, and controllers is a convenient method for most users. Using low-cost wall units or plug-in modules, virtually everything in the house can be controlled by sending signals over the power wiring already in your home. It's a wonderful technology that was developed in the late 1970s; the basic standard is still with us today. The use of X-10 technology in home automation is an obvious choice since it is widely available through many large retailers and mail-order outlets. Recently, the standard was extended to give greater control over X-10 devices. New devices have recently become available; for example, universal dimmers that can control loads up to 1000 watts, have the ability to handle inductive loads, have more dimming levels, and have new memory features.

With the X-10 system you can dim every light in the house individually. However, the problem of controlling those lights in a logical way soon becomes obvious as more



dimmers are added. Let's look at one example: an "evening" mode set with the ceiling light dimmed to 60%, the fireplace lamp at 80%, the desk lamp off, and the wall sconce at 30%. Many X-10 controllers are available, but with most it is not easy to automatically set different lamps to different levels in one step. Let's assume that the lights in the above example are plugged into controllers 1, 2, and 3. With most controllers, you must press "1" (the ceiling light), then press the "dim" button until it reaches 60%; then press "2" followed by the "dim" button until the fireplace lamp is at 80%; finally, press "3" then "off" to douse the desk lamp. As you can see, the process can become tedious quickly.

There are computer-controlled

X-10 interfaces available, but few provide a convenient way to control the system with inexpensive push buttons or other switch-type sensors located anywhere around the home; those that do tend to be expensive or limited in the types of accessories that they support. By using the Home Automation Controller presented here, however, home automation suddenly becomes a powerful and flexible tool that you have complete control over.

The Home Automation Controller has been designed with both flexibility and expandability in mind. Although it works with standard X-10 dimmers, relays, curtains, and other controllers through a local keypad, the "hooks" have been designed in to allow additional

interfaces. The result is an elaborate home-automation system that you can assemble easily.

Basic Home-Automation Protocols.

The magic of X-10 takes advantage of the fact that household wiring uses AC current. On a 60-cycle system, there are 120 times each second when the voltage drops to zero; that is called a "zero crossing." The X-10 protocol sends a "packet" of data by waiting for a zero-crossing moment and sending out a 120-kHz signal for one millisecond. That one-millisecond burst is a "one" bit; a zero bit is signified by the absence of the high-frequency signal. The zero-crossing moment is used because with little voltage on the line, it is easier for the receivers to hear the signal.

It's actually a little more complicated. The X-10 standard contains a specific transmission format to handle varying situations and for improved reliability. To accommodate 3-phase electrical systems, the "one" burst must actually be sent three times during the AC half-wave. Each bit (except for the start code) is sent twice—once normal, once inverted. For example, if "0100" is being sent, the actual transmission will be "01100101."

Each command transmission takes 11 AC cycles. All commands start with a start code (1110). Note that the code is sent as *without* the duplication and inversion so that it only needs two cycles to transmit; that makes the start code unique in the X-10 scheme. Next, a 4-bit "house code" is sent followed by a 5-bit function code.

The X-10 command structure allows for 16 controllers to be accessed by the function code; the remaining 16 available commands (of a total of 32) have to do with the various actions to be taken, such as "on" or "off." There are also several "global" commands that affect all of the controllers, such as "all on" or "all off." That might not seem like many controllers for a larger house, which is where the "house" code comes into play. There can be up to 16 "houses" in any one system, each of which can have up to 16 controllers assigned to it for a total of

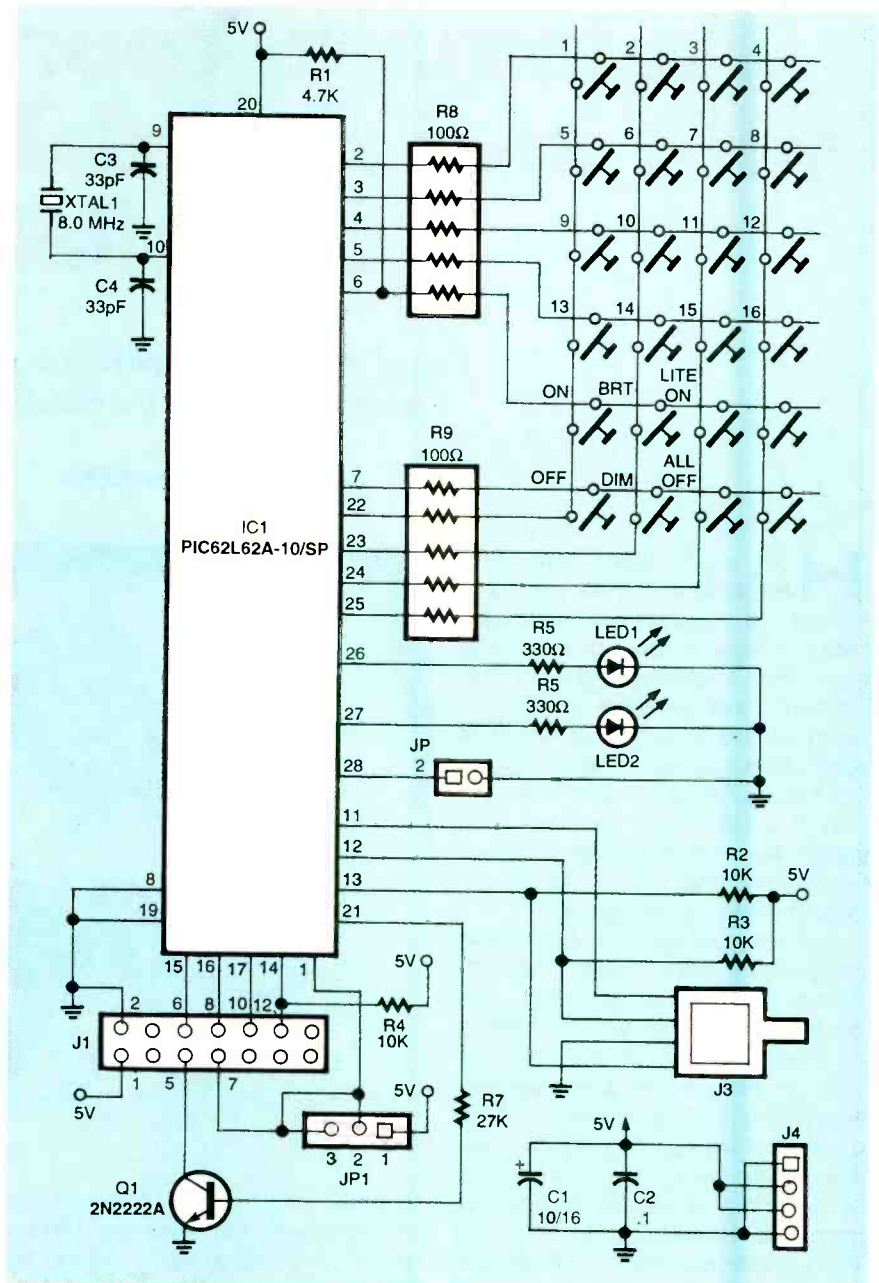


Fig. 1. The Home Automation Controller is built around a PIC microcontroller. The software in the PIC chip gives this seemingly simple circuit the ability to do some sophisticated home-automation tasks. An external interface gives the unit an unprecedented degree of flexibility and expandability.

256 controllers per system. For example, you could have all of the controllers in the living room assigned to "house A," all of the controllers in the bedroom to "house B," and so on. Another scheme might have certain lights around the house assigned to the "A" system, motorized curtains on the "B" system, and the like—the actual arrangement is up to you.

Following the transmission of the complete X-10 packet, there is a 3-cycle delay. If the command is not

a "dim" or "bright" command, the whole 11-byte transmission is repeated once. The dim and bright commands do not require the delay and are typically repeated many times to get to the desired dimming level.

As you can see, the transmission format has been designed to ensure reliable reception by the X-10 receivers plugged into the electrical system. The basic reliability has been proven by the fact that the system is still available after

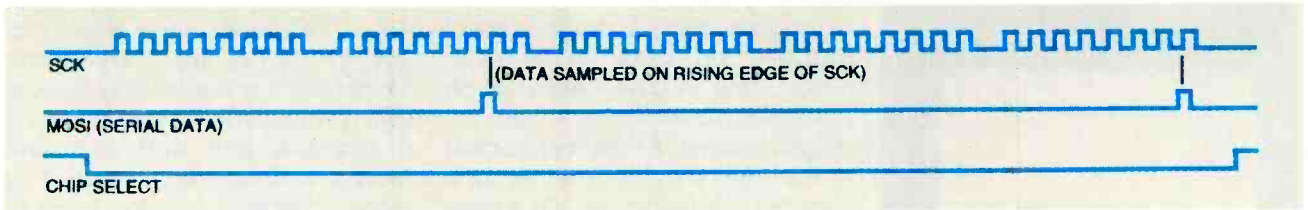


Fig. 2. When sending X-10 data over the SPI interface, information can be sent in both directions at the same time by using the same synchronization clock.

over 20 years on the market. Complete details of the actual X-10 transmissions are available in the Technical Note for the PL-513 and TW-523 X-10 line-interface modules. That information, as well as everything that is related to the entire X-10 product line (including an interesting history of the interface) is available at the company's Web site (www.x10.com).

How it Works. The heart of the Home Automation Controller, as shown in the schematic diagram in Fig. 1, is IC1, a PIC16C62A microcontroller running a special program. Most of the circuitry that surrounds IC1 handles the power, oscillator, and interconnection needs of IC1.

A "matrix-style" keypad is connected through J2 and resistor networks R8 and R9. Using a series resistance in that way provides electrostatic-discharge (ESD) protection for IC1. When reading the keypad, IC1 makes the six row lines cycle from high to low and back one at a time in a rotating sequence. At each step, the four column inputs are checked to see if any are low. That condition exists when a particular key is shorting the particular combination of row and column lines together.

Part of the flexibility built into the

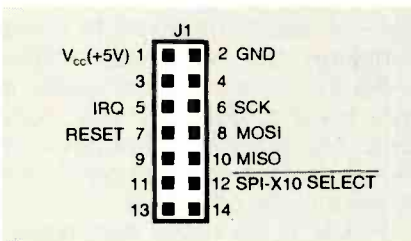


Fig. 3. The Home Automation Controller's SPI interface carries all of the standard signals plus a few additional controls that give the unit its flexibility. Not only can the controller tell an external device that it has data ready to be read, it can also be reset on demand.

Home Automation Controller is in its expandability. To that end, an external interface is provided by J1 so that external devices such as personal computers can control the Home Automation Controller directly. The type of interface used in the Home Automation Controller is the Serial Peripheral Interface (SPI) protocol. That type of interface uses four wires to carry information and synchronization signals between devices: chip select (CS), clock (SCK), master in/slave out (MISO), and master out/slave in (MOSI).

When an external device needs to send data to the Home Automation Controller, the chip

select line (pin 12 of J1) is brought to logic 0 and held there during the entire transmission of one or more bytes. The SCK signal (pin 6 of J1) acts as a clock signal while the MOSI (pin 8 of J1) line carries the data to the Home Automation Controller. The MISO line (pin 10 of J1) carries data from the Home Automation Controller to the external device. Figure 2 shows the timing of data being sent to the SPI X-10 interface.

The MISO line is held at logic 1 during X-10 transmissions to act as a "busy" indicator; an external controller will see a value of \$FF—or 255 decimal—being returned. In that case, the transfer should be tried

PARTS LIST FOR THE HOME AUTOMATION CONTROLLER

SEMICONDUCTORS

- IC1—PIC16C62A-10/SP
Microcontroller, integrated circuit
- LED1, LED2—Light-emitting diode, red
- Q1—2N2222A NPN transistor

RESISTORS

- (All resistors are 1/4 watt, 5% units)
- R1—4700-ohm
- R2—R4—10,000-ohm
- R5, R6—330-ohm
- R7—27,000-ohm
- R8, R9—100-ohm resistor network,
10-pin single-inline package, isolated elements

CAPACITORS

- C1—10- μ F, 16-WVDC, electrolytic
- C2—0.1- μ F, ceramic-disc
- C3—C4—33-pF, ceramic-disc

ADDITIONAL PARTS AND MATERIALS

- J1—14-pin dual-row header
- J2—10-pin single-row right-angle header, see text
- J3—4-pin RJ-11 connector, PC-mount

- J4—4-pin single-row header
- JP1—3-pin single-row header
- JP2—2-pin single-row header
- XTAL1—Crystal, 8MHz
- 5-volt DC wall-mounted transformer, modular telephone cable, enclosures, wire, hardware, etc.

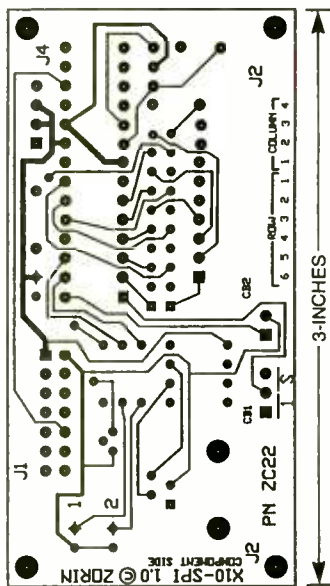
Note: The following items are available from Zorin, PO Box 9885, Seattle, WA 98109-0885; Tel: 206-282-6061; Web: <http://ZORINco.com>; E-mail: info@ZORINco.com; Printed circuit board (ZC22), \$15.00, Pre-programmed IC1 with data sheet (ZC25), \$23.00; Complete board kit (ZK25), \$47.00; Assembled and tested unit with assembly and operation manuals (ZA25), \$70.00; X-10 transmit-only line-interface model PL513 (ZC26), \$20.00; X-10 transmit-and-receive line-interface model TW523 (ZC27), \$30.00; 6-foot RJ-11 phone cord (ZC24), \$2.50. Please add \$5.00 postage/handling for US and Canada; \$25 for other destinations. WA residents must add appropriate sales tax. Visa/MC accepted.



Fig. 4. Command interfaces for the X-10 protocol are small, inexpensive, and reliable. This particular unit has the ability to receive feedback from the other modules and send it back to the main controller.

again after a few seconds.

Note that the pin assignments of J1 (shown in Fig. 3) have two additional signals beyond the SPI signals. One signal is an interrupt request provided by Q1. That signal is activated by IC1 when it finds a key pressed when scanning the keypad matrix. That signal can be used to alert an external controller that one of the keypad switches has been pressed.



Here's the foil pattern for the component side of the Home Automation Controller. Although double-sided boards are more difficult to etch, the result is a compact assembly.

The other signal is a reset control that lets an external controller restart the Home Automation Controller. Note that the schematic diagram shows JP1 also connected to the reset line. The reset signal is normally connected to IC1's reset line. If pins 1 and 2 are shorted with a jumper block on JP1, the Home Automation Controller can be used as a stand-alone system with no other external controllers or devices. With no jumper on JP1, an external controller is *required* to make the Home Automation Controller work. If you need to use the Home Automation Controller both ways, it would be best to cut the circuit trace that connects the reset pins between IC1 and J1. That way, it is a simple matter to move JP1's jumper block to switch between the two styles of control.

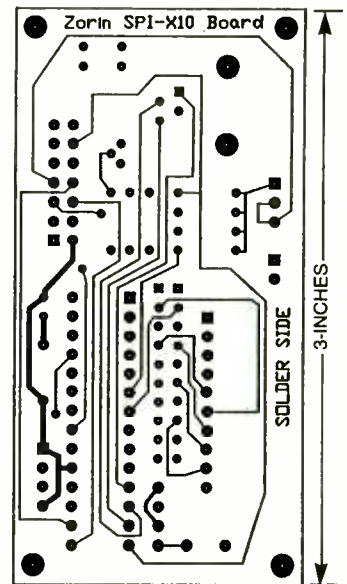
The other configuration header, JP2, is normally left open. That will let the keypad connected to J2 control X-10 devices directly without the need of a host controller connected to J1. If a jumper is installed on JP2, then the keypad does not trigger X-10 commands directly. Instead, the key codes are sent to a host controller using the SPI interface. With that arrangement, the keys can be redefined for other functions, separate from X-10 functions if desired. Using a host controller is beyond the scope of this article; that feature, however, is included to add to the Home Automation Controller's versatility.

Two LEDs are included for diagnostics of the SPI interface. One LED (LED1) indicates power up and SPI activity, while LED2 is an indicator that a key on the local keypad was pressed and that its key code is waiting for pickup by the host controller through the SPI interface.

The Home Automation Controller relies on a line-interface module made by X-10. The line-interface module generates the 120-kHz signal needed by the X-10 system. An advantage of using the line interface module is that it protects the hobbyist from working directly with line voltages. The unit is fully optoisolated and provides a safe way to work with X-10 signals. The interface modules also provide a square-wave signal that follows the AC sig-

nal—a necessary piece of information for timing the transmissions. Model PL513 is a send-only device, and model TW523, shown in Fig. 4, is a two-way unit that can also receive X-10 signals generated by other controllers, sending them to the Home Automation Controller. While either model can be used, future versions of the Home Automation Controller's software will take advantage of the receive functions of the TW523, so that model is recommended.

The line-interface module has a 4-pin telephone-type connector (RJ-11) for connecting it to the



Here's the foil pattern for the solder side of the Home Automation Controller.

Home Automation Controller; a standard telephone line cord can be used. Note that the wiring of standard telephone wall cords is reversed—pin 1 on one end is pin 4 on the other. The Home Automation Controller is designed to use that style of telephone cable to avoid problems that would come from using the wrong type of cable. If you have a cable in your "junk box," just make sure that pin 1 at one end of the cable is connected to pin 4 of the other end.

Power to the Home Automation Controller can be supplied through J1 or J4. A simple 5-volt DC wall transformer can be used. Note that J4 is wired so that a four-position header can be plugged in either way without worry that the circuit

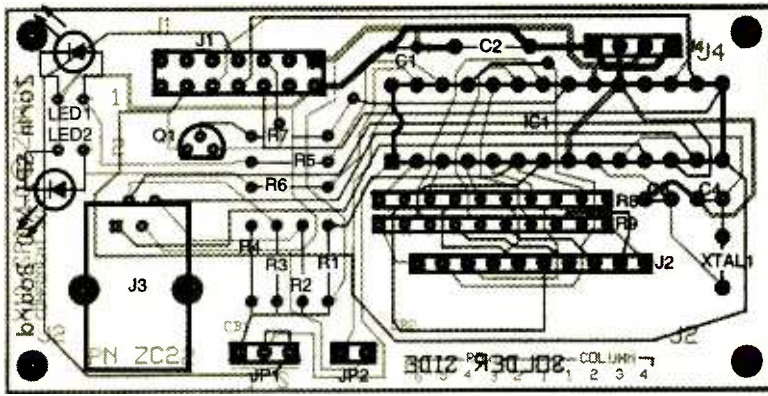


Fig. 5. The Home Automation Controller is small and compact in relation to its built-in functions and abilities.

might be damaged from connecting the power backwards by accident.

Software. The program that resides inside IC1 gives the Home Automation Controller its "personality." It is designed as a main loop that executes continuously. The two main functions of the main loop monitor the SPI chip-select line and periodically scan the keypad to check for any keys being pressed.

The method of scanning the keypad was discussed before. Before scanning, the variable that stores the last key value is cleared and then incremented as each key is tested. When a key is detected, the key number is saved. No further keys are scanned, and that value is

then sent to the SPI interface with the next transfer. Any external controller connected to J1 is signaled with Q1 so that it knows that a key was pressed and needs to be retrieved. In addition, LED2 is lit. If a jumper on JP2 is not installed, an SPI packet is also generated corresponding to the key pressed.

If the SPI chip-select line goes low, then one byte is expected from the MOSI line on the SPI interface. While that first byte is shifted in, the key code for the last key pressed is shifted out through the MISO line. If the first four bits of the input byte are 0001, then the SPI transfer routine returns, ending the SPI transfer. That code is used when the external controller only needs to get the most recent key code; it does not need to send a complete X-10-type packet of five bytes. If the first four bits of the first byte are 0000, then four additional bytes are expected; they should contain the data needed for an X-10 transmission.

The SPI packet format, as stated above, consists of 5 bytes. The high four bits of the first byte define the packet type as mentioned before, while the lower four bits define the house code. The 16 possible combinations correspond to house codes A through P. Byte two specifies the X-10 command (on, off, dim, etc.) as described in Table 1. Byte three is used for dim and bright commands, and specifies how many dim or bright commands to send. The last two bytes of the SPI transfer represent a bit field of all possible X-10 target units. A one bit is present if the corresponding unit is to

respond and zero if it is not. For example, bit 7 of byte 4 represents unit 16, while bit 0 of byte 5 represents unit 1. All of the units set to the same house code can all run the same command at the same time. X-10 devices that are set to a different house code than what is specified in the SPI packet will always ignore the commands that are sent through the power lines.

After the SPI transfer, the X-10 commands received are translated to the X-10 format and sent out over the power lines. Commands that are to be sent to multiple units are sent according to the bit pattern of the last 2 bytes of the SPI transfer. Finally, the command is repeated according to the X-10 specification, or in the case of the bright or dim command, the command will be sent the number of times specified in the third byte of the SPI packet.

Also note that older X-10 devices have only 16 levels of brightness, so that larger numbers are ignored. Newer devices have a greater number of brightness levels—the reason for the eight-bit value.

Construction. Although the Home Automation Controller can be built on a perfboard using standard construction techniques, a printed-circuit board makes for a neater project. Foil patterns have been provided should you wish to etch your own board. As an alternative, a pre-etched board is available from the source given in the Parts List.

If you are using a PC board purchased from the Parts List source or created from the foil patterns, follow the parts-placement diagram shown in Fig. 5 when assembling the board. Start by installing resistors R1 through R7. When installing the capacitors, make note of C1's polarity. Installation of polarized components continues with LED1 and LED2, followed by resistor networks R8 and R9. Before soldering the resistor networks, make sure that they are in the correct holes—they will fit into the holes for J2 as well.

Crystal XTAL1 is not polarized; it can be installed in either direction. A socket for IC1 is recommended;

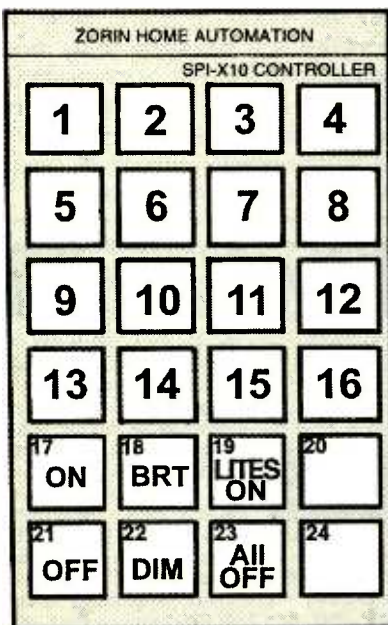


Fig. 6. The keypad layout for the Home Automation Controller is simple and logical.

being able to simply replace the microprocessor with a replacement makes upgrading the software a snap. Install the socket with the notched end facing the correct direction. Before installing J1, note that there is a small triangle on the outside of the connector. That mark indicates pin 1 and should be orientated to the square pad on the PC board. It is a good idea to first take a permanent marker and make that mark more visible.

Before installing the headers for JP1 and JP2, decide how you will want to use the expansion capabilities of the Home Automation Controller. If you want to use the unit in both a stand-alone and an externally-controlled arrangement as mentioned before, you will need to cut the trace under JP1 on the bottom of the PC board that is shorting pins 2 and 3. Remember, you only have to do that if you are going to use the Home Automation Controller in its stand-alone mode with an external controller connected to J1. Placing a jumper block over pins 1 and 2 of JP1 with an external controller connected to J1 will force the reset line to a 5-volt level. Depending on the nature of the external circuit, you might destroy the external controller's output circuit that is connected to the reset line of J1. Besides, the external controller would not be able to reset the Home Automation Controller with the reset line forced high. For now, install the jumper plug over the two pins marked "1" and "2." Finish up by installing the rest of the connectors. Note that the plastic posts on J3 should snap firmly into the holes in the board.

The software for IC1 must first be "burned" into the chip. The code is available on the Gernsback FTP site at ftp.gernsback.com/pub/EN. The

file to download is spi-x10.zip. Once IC1 is programmed, plug it into the socket, making sure that pin 1 is on the side next to the notch.

Any set of momentary-contact buttons or a matrix keypad can be used for the keypad. Note how the switches are to be wired. The order of the pins a particular keypad might not be the same as needed for the Home Automation Controller. The author's prototype used a Pactec HP-9VB keypad. When wiring up the keypad, you can either wire the unit directly to the board (as per the schematic, Fig. 1), or use an optional header that is labeled as J2 in Fig. 5, which is recommended. Note that the provided foil patterns have the row and column markings as a part of the etch pattern. If the connector from your keypad doesn't match the connections on J2, an adapter cable will be needed. Simply use connectors that match the receptacle on the keypad and J2; wire them together so that the pins are connected together in the right order. Even if your keypad matches the pinout of J2, you will probably need to build an "adapter cable" anyway; that's because the keypad will typically be mounted some distance from the Home Automation Controller, requiring longer wires.

A suggested labeling for the buttons is shown in Fig. 6. If you are using a flat membrane-style keypad, you could photocopy Fig. 6, reducing or enlarging as needed to match your keypad. Lay it over the keypad, fold the paper around the back, and tape it in place. You might want to coat the paper with a fixative to prevent the printing from wearing away.

As with any electronics assembly project, carefully inspect your work before applying power for the first time. Look closely since it is very easy to look right at a solder bridge and not see it; spend at least a couple minutes searching for errors.

Testing and Operation. Connect the various parts of the Home Automation Controller together. The keypad plugs into J2 and a 5-volt DC power source to J4. With a length of modular telephone

cable, connect J3 to the input of an X-10 interface. Plug the interface into a convenient wall socket and not into a filtered power strip; that will limit the ability of the X-10 signals to reach other modules. You will also need an X-10 lamp module and a table lamp. Plug the lamp into the lamp module and the lamp module into another wall socket. Set the lamp module to house code A, unit 1.

When the Home Automation Controller is powered up, LED1 should blink. That will indicate that the software in IC1 started correctly. If it does not, check all of the interconnections and solder joints. Double-check that there is a jumper on JP1 between pins 1 and 2.


Next, press the "1" key on the keypad. LED2 should light, indicating that a keycode is available for download from the SPI interface. Press the "ON" switch and the light connected to the lamp module should now come on. The "OFF" switch should turn the lamp off. Press and hold the "DIM" switch. The light should go back on and then start dimming until you release the "DIM" key.

Now that the Home Automation Controller is tested and functioning, the rest is up to your imagination. Interface modules are available from a wide variety of sources, as well as many different types of modules for different tasks from lamps to curtains to alarm systems. What better way to enter the Twenty-First Century than having an automated house that would make George Jetson jealous? ☺

TABLE 1
SPI Function Codes

0000	All units off
0001	Lights on
0010	Unit on
0011	Unit off
0100	Unit dim
0101	Unit bright
0110	All lights off

THE TRANSDUCER PROJECT BOOK



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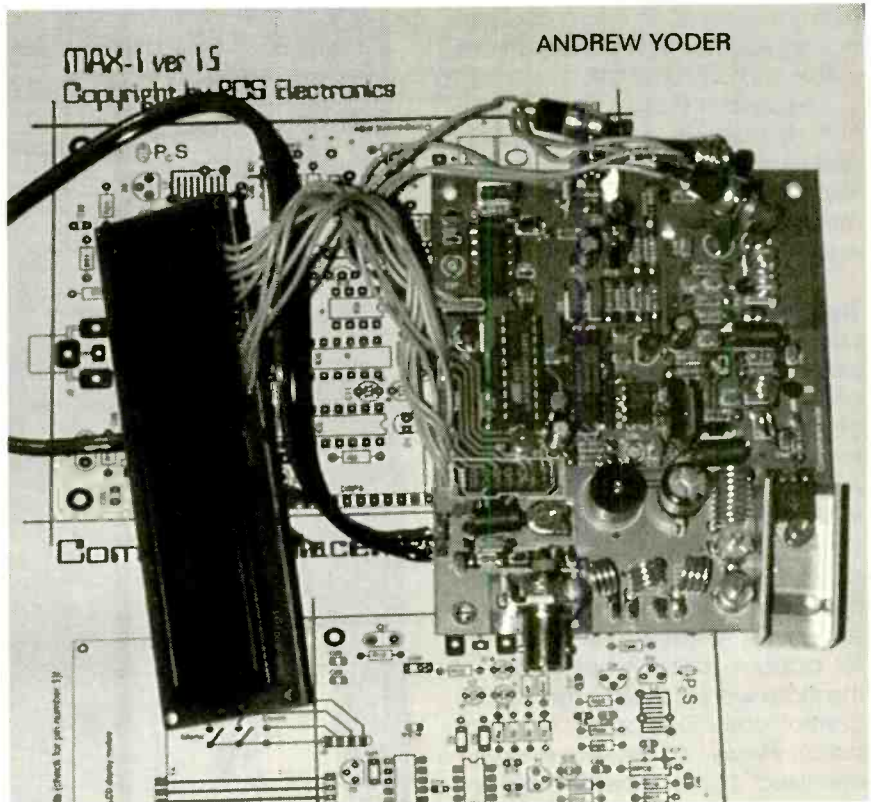
Low-Power FM Transmitters

Join the growing ranks of clandestine radio broadcasters, and perhaps stay in the good graces of the FCC as well.

For decades, the concept of low-power radio was held in check by technical barriers. Those favorable to the concept were told by those in commercial broadcasting that the transmitting and audio equipment were too expensive. End of story. Most of these radio enthusiasts had no technical background and were mesmerized simply by the notion of impressing their audio on the radio spectrum. To these and most other "normal" people, radio is still less a science than alchemy—using engineering voodoo to convert sound into radio signals.

During this time, most of the low-power or pirate stations that began broadcasting were operated by electronics hobbyists or radio-station engineers. The good thing about that is that it makes for less interference when radio transmitters are operated by those with a technical background. But, unfortunately, most radio engineers are more interested in signal quality than in the material that is actually being broadcast. As a result, until the mid- to late-1980s, most of these hobbyist stations offered little aside from the mainstream music that was already getting airplay on commercial stations. Rare was the station that combined capable engineering with creative on-air material.

A Change in the Air. In the mid-1980s, technological improvements finally helped bring about an awareness that owning a little broadcast station wasn't entirely out of the grasp of the common person. The key was the "stereo transmitter in a chip" ICs—such as the BA1404—that came on the market. By the late 1980s, not only were such ICs readily available, but they were manufactured and distributed in such quantity that they



were quite inexpensive.

The availability of relatively simple and inexpensive electronics soon translated into kits that were manufactured and sold by a variety of entrepreneurs. At first, nearly all of the kits sold were simple, inexpensive units, intended only for bugging and wireless-music applications. But hobbyists bought thousands of the transmitters, often modifying the equipment for improved audio response, frequency stability, and increased output

power. This desire for better, more powerful units did not go unnoticed by the manufacturers. The only hindrance was the Federal Communications Commission (FCC), which tended to confiscate and destroy equipment that could be used for pirate broadcasting or unlicensed two-way communications.

Some groups, most notably Free Radio Berkeley, decided that selling higher-powered transmitters and amplifiers was worth the risk. The fact that the FCC was already tied up in court with FRB also helped matters, providing a sort of buffer zone against possible equipment confiscation. Other electronics kits providers, such as Ramsey Electronics and Pan-Com International, played strictly by the book, offering high-quality, but legal-powered equipment.

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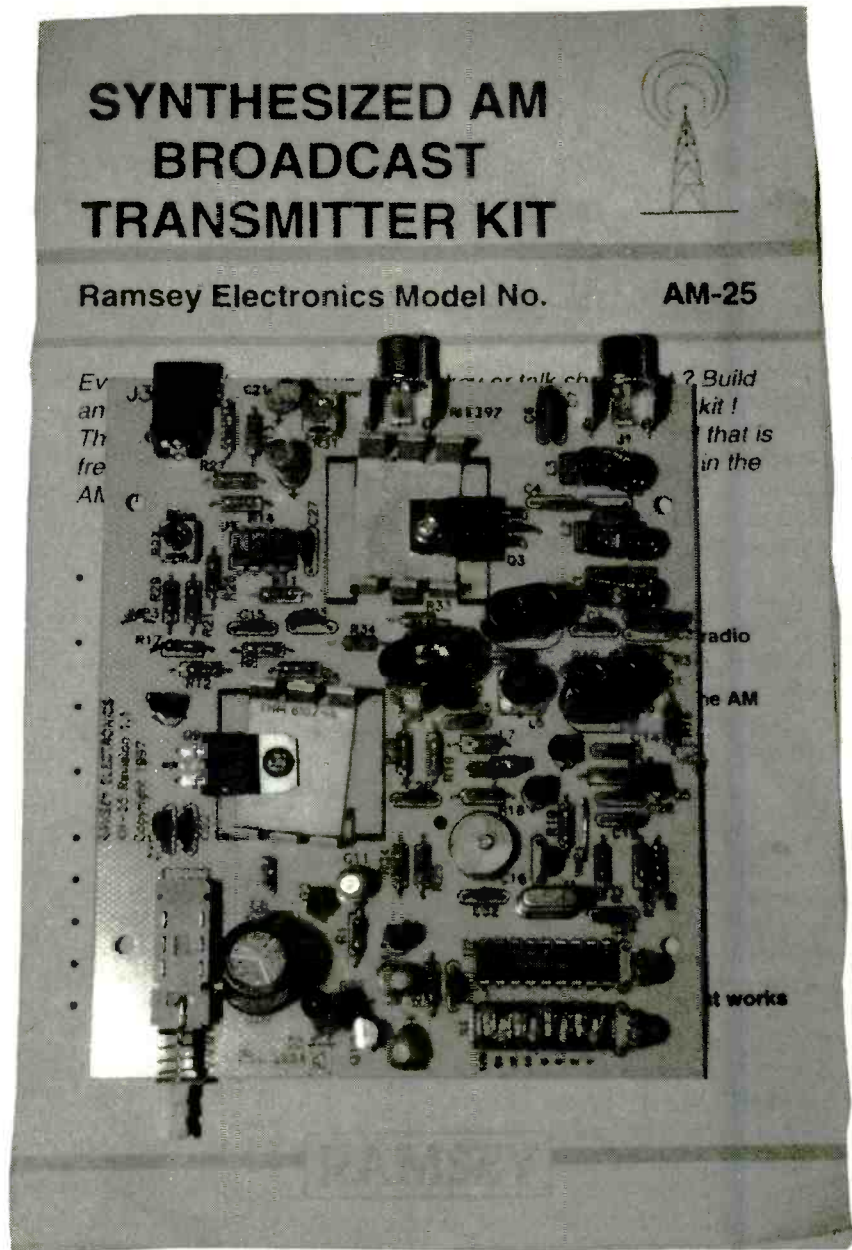
Although selling transmitters that operate above the Part-15 limits might cause unhealthy risks in the United States for retailers, those outside of the States do not have to face the FCC's wrath. That "loop-hole" allowed some companies such as Veronica Electronics and Broadcast Warehouse (United Kingdom) and PCS Electronics (Central Europe) to begin channeling high-quality, high-powered transmitter and amplifier kits.

Because of those factors, literally hundreds of low-power FM stations and pirates started broadcasting in the mid-1990s. And as more equipment sold, the demand for the equipment increased.

Transmitters, the FCC, and the Law. Ever since the beginning of radio, people have justified unlicensed broadcasting with a variety of excuses. Some have attempted to cloak themselves with the First Amendment. Others have stated that the FCC can only control interstate communications, not intrastate (within state) communications (this argument seems to have some validity, but the deciding factor appears to be whether or not the state wants to allow the FCC to control communications within its state). Finally, others have simply dismissed the concept that any organization has the right to control the airwaves.

Whatever justification was used to violate the rules, The Communications Act of 1996 eased the moral consciences of many who flipped the switch on unlicensed transmitters. That law relaxed ownership regulations to the point where few privately owned commercial stations currently exist in the United States—most are owned by corporations that have a grasp on other media outlets. The bland output across the radio spectrum combined with the gnawing realization that the media elite control the airwaves pushed many otherwise law-conscious citizens into the pirate camp.

Facing considerable criticisms from the public and private sector alike, the FCC began to look at proposals for legalized low-power FM broadcasting in 1998. In January



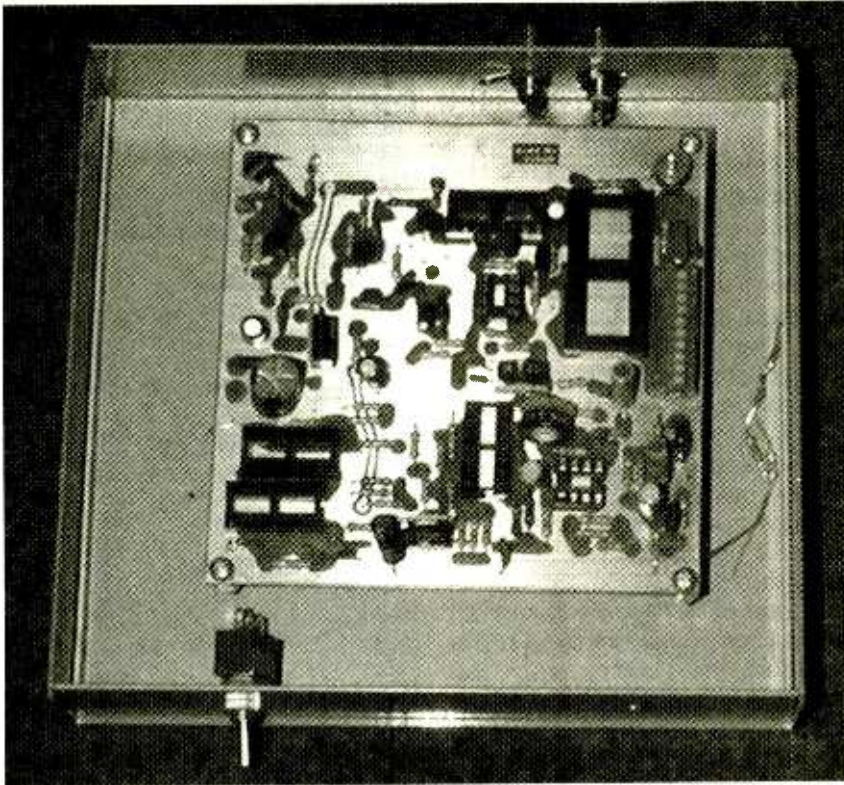
The Ramsey Electronics AM-25 is a low-power AM transmitter with a fully synthesized VFO; its output frequency can be controlled by a series of DIP switches.

1999, the FCC announced that they were interested in comments on a two-tiered low-powered FM plan. They also announced that those who had broadcast without a license would not be shown any favoritism—if anything, they would find the licensing struggle more difficult.

LPFM Transmitters and The Present. With the FCC considering a new low-power FM broadcasting band, current pirates and those who are up-and-coming are faced with a dilemma. If they stay off the

air to comply with the FCC, they could lose all momentum with their staff and audience. If the FCC never does ratify the low-power broadcasting band or spends more than a year approving legislation, the "station" might not have enough audience or staff to get back on the air. On the other hand, broadcasting at this time could jeopardize any chance at getting a license later on.

So, what are the other options? Aside from converting to Internet radio, the only way to stay on the air legally is to purchase a Part-15



The MPX96 from North Country Radio is a basic Part-15 transmitter, but it does offer a synthesized PLL for frequency control, on-board audio generator for testing, and RF output filters. A one-watt version is sold for export only.

compliant transmitter and operate with very low power. A number of these transmitters are available—especially from American kit companies, which are especially conscious of the Part-15 regulations. Another option is to purchase a higher-powered transmitter from one of the European companies and attenuate its output power to stay within Part-15 limits. The advantage here is that if the FCC creates some LPFM legislation, then the transmitter will be ready to go at higher power. But the nature of Part 15 makes that a very iffy proposition.

For example, one peculiarity of the FCC's Part-15 rules is that no specifications are given for output power. Part 15 relates only to unintended interference emitted from an electronic device. For example, the interference that your computer monitor can emit is limited by Part 15. Obviously, your monitor has no radio output, so the interference rating can't be given in output power. Instead, the rating is in millivolts-per-meter, which is the signal strength at a particular distance

away from whatever is emitting the signal.

While such a specification is fine for unintentional radiators, it makes life very difficult for anyone trying to comply with Part 15 with a broadcast station. The big problem is in making the measurements. It requires that you have specialized test equipment, an RF millivoltmeter, in particular. The least-expensive millivoltmeter that I've found to date is available from Ramsey Electronics and costs \$695. That's more than most personal broadcasters can afford.

Because of that and other Part-15 issues, most personal broadcasters in this country avoid the details and simply purchase Part-15 compliant transmitters and run them with the specified power input and antenna. One advantage of that approach is that the FCC has generally been more flexible with very low-powered FM broadcasters. Part-15 stations are very rarely visited by the FCC; most FM stations running higher power are typically warned, not immediately fined. On the other hand, this is not an invita-

tion to violate FCC rules—if the FCC believes that you are violating their rules (especially if you are believed to be doing so on purpose), they could choose to confiscate equipment, levy a fine, or take you to trial.

In short, operating within Part-15 limits depends entirely on the end results, not on the equipment that is used to achieve them. If you have any questions, contact the FCC before taking any actions.

Part-15 Transmitters. A number of companies produce "home broadcaster" and FM-bug or telephone-bug kits. Although these units might be capable of transmitting a signal, few are in stereo (let alone, offer good stereo separation) and will not be discussed here. Instead, we will focus on what we consider to be "broadcast-quality" transmitters. The term "broadcast quality" is used here to represent transmitters that are intended for amateur broadcasting and have better general specifications than other hobbyist kits. It is not used to convey FCC type acceptance for broadcasting on the FM-broadcast band.

One of the oldest existing electronics kit manufacturers in the United States is Ramsey Electronics, which offers hundreds of different kits for a wide variety of hobbyist and professional applications, including hobby broadcasting. The flagship transmitters of the Ramsey line are the FM-100 stereo FM transmitter and the AM-25 AM transmitter. The FM-100 is an FM transmitter packed with extra features: audio peak limiters, digital readout with up/down frequency buttons, audio-level meters, and a built-in mixer! The AM-25 is much more basic: a low-power AM transmitter with a fully synthesized VFO; its output frequency can be controlled by a series of DIP switches. Ramsey also offers other hobbyist equipment, such as an amplifier, receivers, two lesser FM transmitters, antennas, a mixer, and more.

Pan-Com International, a division of Panaxis Productions, has been advertising the concept of "your own radio station" longer than probably anyone. Their flagship transmitter is fairly basic, but for

an extra \$75 you can upgrade it with an LCD that displays the output frequency and station call letters! Panaxis also offers accessories, including filters, amplifiers, antennas, etc. Panaxis used to sell many of its own kits, but now it distributes equipment for a number of other companies.

North Country Radio is the "newcomer" on the American scene, although the company has been operating since 1986. NCR should be well known by **Electronics Now** readers because their two major hobby broadcasting transmitters, the MPX96 and the AM88, were both featured on our cover. MPX96 is a basic Part-15 transmitter, but it does offer a synthesized PLL for frequency control, on-board audio generator for testing, and RF output filters. A one-watt version is sold for export only. The AM88 is a frequency-synthesized transmitter for the AM band. It features an audio limiter to prevent overmodulation.

Higher-Powered FM Transmitters.

Hobbyists interested in domestic equipment can acquire it from Free Radio Berkeley. FRB is best known for its unlicensed broadcasting and subsequent court case in California. However, it also manufactures and sells a variety of broadcasting kits. Because of the higher power levels, FRB warns that the transmitters are "for educational purposes only" and that they must only be operated "into a dummy load." The mainstay of the FRB equipment is their digital PLL transmitter. FRB also manufactures amplifiers rated at approximately 1, 6, 15, 20, 25, and 35 watts. On alt.radio.pirate, some enthusiasts have complained about missing parts and slow service from FRB, so those interested in purchasing FRB equipment sometimes go through a third-party vendor.

Nearly all of the companies profiled in this article are general electronics-kit providers that began manufacturing transmitters once the need arose. Veronica Kits from the UK is the first company to dedicate itself entirely to low-power FM equipment. Veronica offers four different transmitter kits and seven

different assembled transmitters (ranging in power from 1- to 150-watts output). To round out the catalog, Veronica also sells limiters, power amplifiers, stereo encoders, antennas, and power supplies. Like Free Radio Berkeley, none of the Veronica equipment has names—it's all simply listed by power and/or function. Veronica equipment is designed to meet the more-stringent demands of professional applications, so it is highly regarded in the hobbyist arena.

From the end-user's perspective, Broadcast Warehouse is almost like a clone of Veronica; both companies are from England, both specialize in low-power FM kits and pre-assembled equipment, neither have names for their different models, and both companies are highly regarded. The flagship Broadcast Warehouse transmitter is their one-watt PLL unit. Like the Panaxis FMX transmitter, it also features an LCD display for frequency control. Broadcast Warehouse also sells an interesting variety of accessories, including a limiter, two stereo encoders, and even an RDS encoder so that stations can transmit digital messages that can be viewed on RDS-capable receivers while broadcasting programming.

PCS Electronics takes a different approach from all of the other transmitter manufacturers. Rather than stating that the equipment is for "educational" or for "professional" uses, the PCS Website touts their MAX series as "pirate-radio transmitters." The core of equipment from PCS Electronics is the MAX-1 FM transmitter, which is rated at three to five watts and includes an LCD readout. The readout does more than just show the frequency or call sign—it actually displays tuning errors for such problems as having too little shielding around the transmitter (RF feedback). The MAX-1 is available as a kit, tested, with two different power supplies, with a 20-watt amplifier, and with a variety of different enclosures. Interestingly, PCS makes no mention of its address, telephone or fax numbers, or even general location. Evidently, most of its business occurs through the Internet or distributor sales.

NAMES AND NUMBERS

Broadcast Warehouse

P.O. Box 697
Wallington
Surrey SM6 7ZR
UK
Tel: +44 181 2880192
Web: www.broadcast-warehouse.com/

Free Radio Berkeley

1442 A Walnut Street
Berkeley, CA 94709
Voice Mail: 510-464-3041
Web: www.freeradio.org/index.shtml

Hobby Broadcasting Magazine

P.O. Box 642
Mont Alto, PA 17237
Web: www.frn.net/rfi

North Country Radio

P.O. Box 53
Wykagyl Station
New Rochelle, NY 10804-0053
Tel: 914-235-6611
Fax: 914-576-6051
Web: www.northcountryradio.com/

Pan-Com International

PO Box 130
Paradise, CA 95967-0130
Tel: 530-534-0417
Web: www.panaxis.com/

PCS Electronics

Web: kiss.uni-lj.si/~k4mo0018

Ramsey Electronics

793 Canning Parkway
Victor, NY 14564
Tel: 800-446-2295
Fax: 716-924-4555
Web: www.ramseyelectronics.com/

Veronica Kits

Unit 5/6 1A Sandbeds/Albert Rd.
Queensbury, Bradford BD13 1AF
UK
Web: www.veronica.co.uk/

Choosing the Right Equipment.

Aside from making conclusions based simply on power levels and price, future purchasers of equipment should also consider the performance and special features that are included in the package. For example, the built-in mixer, limiter, and audio meters might sway the mobile broadcaster toward the Ramsey FM-100. Or the combination of built-in troubleshooting, power and low price might convince an enthusiast toward purchasing a PCS Electronics MAX-1.

(Continued on page 87)

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Vol. 1, No. 1 • July 1999

PURPOSE

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It is intended for the enlightenment, education and entertainment of the members of NESDA, ISCET, and NIAS, and other ethical professionals engaged in or connected with the appliance, computer, and electronics service industries.

With the exception of official announcements, the statements and opinions expressed herein are those of the authors and not necessarily those of the associations.

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Contents

Publisher's Information	2
Calendar of Events	2
NESDA/ISCET/NIAS Officers	3
NPSC '99 Registration Form	16

Articles

Service Summit Studies Warranty Payments and Industry Future by Vic Gerry	4
Talking to a Manufacturer Who Cares to Listen by Wayne Markman	7
Hitachi: Winding Up for Service Support by Walt Herrin, NSM, Hitachi	9
Manufacturer's Depot Service Has No Place in a Partnership by Wayne Markman	11
Thomson: Partnering for a Better Future by Steve Zell, Thomson	12
NPSC '99: Convention Site Offers Pleasant Memories by Amy Youngblood	14

Industry Calendar

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Georgia Electronic Service Dealers Assn. Convention '99 June 12-13, 1999 Helen GA Lane Norman (GA) 770-451-5057; Fax 770.455.8337; LaneN@aol.com
VPEA (VA) Convention/Mid-Atlantic Electronics Conference June 11-13, 1999 Virginia Beach Resort Hotel & Conference Center Virginia Beach VA Jim Teeters, Sr. (VA): 757-428-7317 JTeet@aol.com
CEO Summit June 23-25, 1999 The Broadmoor, Colorado Springs CO CEMA (VA): 703-907-7600; www.cemacity.org
Electronic Service Dealers Association of Illinois '99 Convention July 16-18, 1999 Ramada Inn, Bloomington IL George Weiss (IL) 773-282-9400; Fax 773.282.5700; Bell.TV@syslink.mcs.com

Calendar (cont'd.)

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Nebraska Electronic Service Assn.'s Fall Convention September 10-12, 1999 Holiday Inn @ Grand Island Exit (Hwy. 80) Jon Ludwig (NE) 402-464-9181 or Myron Sabs (NE) 402-291-0559
PCS '99 (Personal Communications Industry Association) September 22-24, 1999 Ernest Morial Convention Center, New Orleans LA PSIA (VA): 703-739-0300 817.921.3741; e-mail: ProServEd@aol.com
Audio Engineering Society (AES) Convention September 24-27, 1999 Jacob K. Javits Convention Center New York City NY Kathleen Mackay, Doug Cook 212-661-8528 E-mail: HQ@aes.org; www.aes.org
Handling Distressed Goods September 28, 1999 Omni Dallas Hotel at Park West, Dallas TX CEMA (VA): 703-907-7600; www.cemacity.org
AFSM International's 29th World Conference & Exposition October 17-19, 1999 Disney's Coronado Springs Resort, Convention Center Orlando FL Fax: 941-275-0794 John Vacirca, jvacirca@afsmi.org; www.afsmi.org
Electronics Industries Association's Fall Conference October 24-28, 1999 Palm Springs CA CEMA (VA): 703-907-7600; www.cemacity.org
Int'l. Consumer Electronics Show (CEMA) January 6-9, 2000 Las Vegas Convention Center & Hotels Las Vegas NV CEMA (VA): 703-907-7600; www.cemacity.org

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Service Summit Studies Warranty Payments and Industry Future

The second annual Product Service Summit meeting did not resolve any major servicing issues. But it did provide some useful information. And it did advance the potential of this new forum to mutually benefit servicers, manufacturers, and consumers in the future.

by Vic Gerry, Chairman, NESDA Industry Relations Committee

On Saturday January 9, 1999 NESDA hosted a "Product Service Summit" meeting between service industry leaders and the service representatives of major consumer electronics manufacturers.

This serious meeting about serious subjects was sandwiched between a continental breakfast and a luncheon provided by the NESDA Industry Relations Committee.

SETTING THE TONE

NESDA President Wayne Markman welcomed all participants, and expressed appreciation for their support of this communications concept. He explained the perceived need to examine many industry issues from the servicers' standpoint, and to try to find mutually acceptable solutions.

The meeting was chaired by the chairman of the NESDA Industry Relations Committee, Vic Gerry. (A complete roster of participants is at the conclusion of this report.)

Chairman Gerry outlined a few of the many concerns facing independent servicers today, and the need to find mutually beneficial solutions. He also distributed a packet of materials, which included a copy of the Consumer Electronics Warranty Claim Filing Requirements. It also contained a questionnaire designed to collect information from the manufacturers about warranty operations and procedures. He urged all manufacturing representatives to complete and return this questionnaire to the NESDA office.

Mr. Gerry said that he wanted to create an accurate set of records on all manufacturers' warranty policies and procedures, as well as a listing of all current administrative personnel (including titles,

mailing and e-mail addresses, and phone and fax numbers. He asked that this information be sent to him at his Long Island NY business address.

The presubmitted agenda listed the following topics:

1. Improving Customer Service:
 - (a) faster turnaround
 - (b) "soft services"
2. Warranty Procedures:
 - (a) standardization
 - (b) corroboration
3. Product and Parts Disposal:
 - (a) adopting procedures
 - (b) assigning responsibility
4. The Future
5. Parts Availability:
 - (a) new products
 - (b) older products

SERVICING SEARS

Prior to attacking the established agenda, industry concerns were relayed about the selling of branded products by Sears.

Servicers noted that, generally, these sets are sold to Sears without a manufacturer's warranty, and are not supposed to be serviced by any company but Sears. But in many instances, the consumers don't know this. It was alleged that some sales clerks added to the confusion by telling purchasers that the units could be taken to any authorized service center for repair. To add to the confusion, regular warranty information is packed and delivered with some sets, advising consumers to call the manufacturer's authorized service centers for services. So, when the units are taken to an independent servicer for service that is withheld, the consumers were understandably angry with all parties involved: Sears, the manufacturer, and the independent servicer. The independent servicer was the only entity that was not a part of the profit-producing sale. Yet, he is the one who must ex-

pend unreimbursable resources to try to placate and redirect a customer that might be lost because of the misunderstandings.

The attending manufacturing personnel were sympathetic to the plight. It was confirmed by most (except JVC) that the sale of their product to Sears was at a price that did not include warranty fulfillment. If they were to authorize their ASCs to perform the repair, they would incur a non-budgeted expense to assume the retailers obligations.

However, the consensus of opinion of those who sold product to Sears was that their number one priority was customer satisfaction. Rather than risk a lasting "black eye" for either themselves, or their partners in service, they would pay their ASC's for such service under certain circumstances. If the set-owner has not been solicited, and either demands service from the ASC, or finds it a major inconvenience to return to Sears, the servicer may request authorization to service the product. In such cases, these good-faith breaches of written policy will be authorized, and if so, paid at regular warranty rates.

The two exceptions to this general understanding were Yamaha, and JVC. Yamaha contends that, without exception, their products are sold to Sears without factory warranty, and are to be serviced only by Sears.

On the other hand, JVC sells its product to Sears with full factory warranty. So JVC treats all of its warranty claims alike, no matter where the products were purchased.

IMPROVING CUSTOMER SERVICE

As consumers and manufacturers demand quicker repair turnaround times, servicers expect — and are expected — to meet these needs. Yet, many factors that stymie faster service are beyond the servicer's control. To meet the demands, servicers need prompt access to parts and service information, plus more timely responses from manufacturers' technical support people. Clearly, we need to work together to assist each other in this area.

The group discussed the value of manufacturers' "hands-on" telephone technical assistance lines. It was also noted that some servicers pass out the tech-assist numbers to non-authorized service centers, and even to consumers.



Pictured above, seated clockwise from far left, are: Vic Gerry (NY), NESDA IRC Chair; Wayne Markman (CT), NESDA President; Peter Junger, Nintendo; Jack Zupko, Panasonic; Steve Camulli, Sony; Chuck Painter, Mitsubishi; Ed Nevins, JVC; Glen Yamashita, Mitsubishi; Wayne Nichols, Philips; Steve Zell, Thomson; Bob Masa (OH), NESDA; Howard Liberman, SFS; Paul Mierzwa, Pioneer; Bill Pugh (CA), NESDA; Bob Sawyer, Zenith; Ken Griffey, Zenith; Michael Snead, Hitachi; Charles Schaefer, Sharp; Larry Tinkler, Pioneer; John Suh, Daewoo; Car Brown (MA), NESDA; George Weiss (IL), NESDA; Leo Cloutier (CA), NESDA; Mike Webber (TX), NESDA; Walt Herrin, Hitachi; and Amy Stine, Affina (for Hitachi). Also participating but not pictured was Curt Sidles of Yamaha.

Some ASCs even sometimes use the service for routine problems that should be uncovered during routine troubleshooting. Obviously, this subverts the intended purpose of the lines, and dilutes the effectiveness.

Unfortunately, many servicers are not adequately prepared when requesting this type of service. Basic troubleshooting, at least, needs to be done before the call, and schematics and test equipment should be ready for immediate referral during the conversation. NESDA agrees to promote this responsible approach to hands-on tech-assist.

Manufacturers also are interested in determining the success of their tech-assist services. They want to know, of course, whether the assistance that was offered actually solved the problem. But, if it didn't, they also want to know what the servicer did to effect the repair. The Industry Relations Committee agreed to develop and promote a fax-back form to provide feedback on the technical assistance experience. Servicers should be willing to help the manufacturers determine the accuracy, and effectiveness of the information offered on the help-line.

SOFT SERVICES

As consumers acquire more high-tech, multi-featured products, they are facing ever-increasing problems in installing them, and connecting them together. Servicers did not participate in, and thus did not profit from, the sale or purchase of the product. Though servicers are most qualified to provide this in-

structional assistance, they cannot assume this responsibility without reimbursement. Since consumers are demanding more instructional service, but neither the consumer, retailer, nor manufacturer are willing to pay for services without a documented parts failure, how will this important niche be filled?

Manufacturers seem to recognize that these types of issues will increase as technologies proliferate.

Thomson's Steve Zell described his company's new "Get Connected" program, where customers are referred through an 800 number to ASCs for installation assistance. Thomson advises customers that there will be a fee for this service.

Bob Sawyer of Zenith noted that Zenith also refers customers to independent servicers for these types of services on projection installation, also with information that a fee is required.

REDUCING RED TAPE

Manufacturer warranty concessions pose a major problem for authorized servicers who perform in-warranty service. When consumers contact servicers with an out-of-warranty product, and are refused prompt service, they vent their anger on the servicer. Then, after the consumer contacts the manufacturer, and is granted a financial concession toward the repair, the servicer appears even more to be the "bad guy." Then, not only does the service center lose potential profits on the full cost of the repair or parts, but they sometimes also lose a customer.

The Industry Relations Committee recommended that special authorizations for such accommodations be faxed to servicers prior to the client requesting service. The fax should spell out clearly what the concession involves and what is, and is not covered. This will show clients that servicers are not making these concessions, but are honoring the manufacturers decisions in these matters. This will speed up the process and insure proper reimbursement. Most of the manufacturers indicated they will consider this type of procedure.

WEB-BASED TECH SUPPORT

Servicers who need to prepare themselves to service digital circuitry, HDTV, and other high-tech, multi-featured consumer products, must look to the manufacturers for assistance. Most of the manufacturers recognize this need for more prompt availability of service manuals, technical information, and training. Many meeting participants anticipate that web-based services will be the answer in the near future.

Most manufacturers are or will be providing technical support via the Internet on the World Wide Web. NESDA and the Industry Relations Committee recognizes the value of these web-based services. Almost certainly, servicers who want to be factory authorized in the future, will have to upgrade their computer systems. Their systems must be capable of handling large files containing images for download, including schematics, parts lists, repair databases, etc.

(cont'd. on next page)

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It is imperative that the service community gear up for these new services. This committee strongly recommends the integration of hot-links on the members-only sections of the NESDA web page (www.nesda.com), to connect to all manufacturers' sites containing service-related information. NESDA.com can thus provide a "door" to the technical services world for all manufacturers, and can be a powerful tool for servicers in getting important service information, fast. Cultivation of these types of services will be imperative to the success of many in the service business.

Steve Camulli of Sony reminded attendees that the Consumer Electronics Manufacturers Association (CEMA) has developed standards for electronic service data. Servicers eagerly await the implementation of these standards so there will be a universal format for all manufacturers' electronic service data.

AUTOMATIC WARRANTY CORROBORATION

Servicers are often forced into the unpopular (and unprofitable) role of being warranty "police." If they reject a consumer who has no proof-of-purchase, they stand to irritate and lose a customer. And, if they accept a fraudulently contrived bill-of-sale, or unknowingly accept a set that was sold more than once by the retailer, they stand to lose payment for the repair.

To combat this, Thomson introduced the imbedded "warranty clock" into consumer products. This has been a tremendous help in verifying first-use dates, and thus consumers' warranties. Many servicers believe that this warranty clock, or some equally effective system, should be adopted as an industry standard. Mr. Zell, of Thomson, wishes to send information on the operation of the "warranty clock" to all the other manufacturer participants

of this meeting.

Otherwise, this topic did not produce any tangible solutions at this time.

PRODUCT AND PARTS DISPOSAL

Servicers are beginning to feel the brunt of the responsibility for legally disposing of products they do not manufacture, sell, purchase, or consume. When a servicer exchanges a defective picture tube, even one that is still in warranty, or is left with an abandoned chassis, the disposal problem is becoming an increasingly expensive headache.

What role will the manufacturers play in the mandated and costly disposal of abandoned products, and/or their components? Should the disposal of chassis, picture tubes, batteries, lead, etc., be the responsibility of the consumer, servicer, or manufacturer of the product? If it's the servicer, how will he be adequately reimbursed for the many expenses involved?

Some manufacturers do have CRT-return procedures in effect, which do not impose undue costs on the servicer. But not enough manufacturers have them, and the programs aren't as inclusive as they should be. CEMA is collecting data about laws in individual states regarding environmental regulations.

This important, and extremely costly issue was mostly left unresolved.

FUTURE OF THE INDUSTRY

With the convergence of consumer electronics and computer products, we must raise the competencies of our service centers. A+ certification will be a requirement for many service opportunities. New products will require a new set of competencies. As servicers, we need to find a way to let the manufacturers — and the rest of the consuming public — know that we are qualified to service these new-technology items. A

discussion of how best to market ourselves indicated that the term, "TV serviceman" may not be as attractive to the consumer of services as, possibly, "Digital Systems Specialist." Charles Shaefer of Sharp indicated the importance of "perception." The title of the technician must reflect the service center's willingness, and ability, to embrace the service of leading-edge products. This would include the use of leading-edge products, like computers, and state-of-the-art test equipment.

TO BE CONTINUED . . .

Unfortunately, the meeting was limited to just three hours. A lot of information was covered in the compressed timeframe. But there are so many more questions begging to be understood, while the topics actually discussed are in need of more amplification — and more resolution. But, it was a welcome and refreshing opportunity to express some of the service industry's concerns to the people who can positively influence the results.

A consensus of the participants seemed to indicate that these types of discussions are beneficial to all involved, and that this dialog should be continued. It was suggested that the next two meetings be scheduled for late spring, and again during the NESDA convention this August in Dallas TX.

ROSTER OF PARTICIPANTS

Following is a listing of the participants at the Manufacturer/Service Summit Meeting, Jan. 9, 1999, Las Vegas NV. The manufacturing company service representatives were as follows (listed alphabetically by company):

Daewoo Electronics Corp., Lyndhurst NJ, John Suh, Senior Service Mgr.

Hitachi Home Electronics (America), San Diego CA, Walt Herrin, NSM; Kazuaki Nemoto, Senior Engineer, Service; Michael Snead, Technical Services Mgr.; Amy Stine, Account Mgr., Technology Industries Group, Affina, Peoria IL (Hitachi consumer relations company)

JVC Service & Engineering Co. of America, Edward Nevins, General Mgr. Service Division, Fairfield NJ

Mitsubishi Consumer Electronics America, Chuck Painter, Technical Support Mgr., Braselton GA; Glenn Yamashita, Consumer Relations Mgr., Irvine CA

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Nintendo of America, Redmond WA,
Peter Junger, VP Field Services

Panasonic Services Co., Secaucus NJ,
Jack Zupko, VP/IGM, Consumer Service Sector

Philips Consumer Electronics Co.,
Jefferson City TN, Wayne Nichols, Mgr. Field Service Operations

Pioneer Electronics Service, Long Beach CA,
Larry Tinkler, VP Service Operations Div.; Paul Mierzwa, Mgr. Warranty and Service Operations Administration

Sanyo Fisher Service Co., Lamont IL,
Howard Liberman, Field Service Representative

Sharp Electronics Corp., Romeoville IL,
Charles Schaefer, VP Service & Parts Group

Sony Electronics Inc., Oradell NJ,
Stephen Camulli, Zone Mgr., Field Service Operations, Consumer Audio/Video Products Group

Thomson Consumer Electronics, Indianapolis IN,
Steve Zell, Mgr. Consumer & Product Services, Marketing & Sales, Americas

Yamaha Electronics Corp. USA, Buena Park CA,
Curt Sidles, NSM

Zenith Electronics Corp., Glenview IL,
Robert Sawyer, Director Technical Services; (Huntsville AL); Arlen (Ken) Griffey, Dir. Consumer Services Sales & Marketing (Huntsville AL)

The service representatives were:

Wayne Markman, President, NESDA,
Markman TV, Hamden CT

Mike Webber CSM, NESDA Vice President,
Rucker's TV, Fort Worth TX

Vic Gerry, Chairman, NESDA Industry Relations Committee,
Page TV, Bethpage NY

Carl Brown, Audio Metrics, New Bedford MA

Leo Cloutier CSM, Electronic Service Center,
Los Angeles CA

Robert Masa CSM, Electra Sound,
Parma OH

Bill Pugh, High Tech Video Service,
Sacramento CA

George Weiss CSM, Bell TV,
Chicago IL

Wallace Harrison, NESDA Publications Editor,
Fort Worth TX

About the Author: Besides chairing NESDA's Industry Relations Committee, Vic Gerry is owner of Page TV in Bethpage (Long Island) NY. He is a past president of his local and state trade associations, and a former NESDA Region 2 director. He may be reached at 516-931-7617, or via e-mail at: NESDAirc@aol.com. ✦

Re. The Manufacturer

Talking to a Manufacturer Who Cares to Listen

At one time, the product service industry was regarded by most manufacturers as "a necessary evil." But more and more, the smarter people in manufacturing are implementing a "partnership" atmosphere between themselves, and the servicers who come in direct contact with - and influence - their customers.

by *Wayne Markman,*
President, NESDA

At the 1998 National Professional Service Convention, held in Orlando last August, Thomson Consumer Electronics Corp. won a major NESDA award. The company was named as the National Friend of Service for the 1997-'98 year. The FOS award is presented annually to the company that made the most outstanding contributions to the product service industry during the preceding year. Like most of the prior winners of this prestigious award, Thomson achieved this honor for some old-fashioned reasons: they earned it.

INVITATIONS TO SHARE

Last October, Thomson CEC held its second Service Industry Partnership Conference. Servicers from various parts of the country were invited to participate in frank discussions regarding the relationship between independent servicers and Thomson. The purpose of the meeting was to provide Thomson personnel with direct insights to the issues affecting the service industry. Thomson personnel also wanted to know how they and their service network could better help each other in this ever-changing, ever-challenging business.

Servicers in attendance were: **Leon Kleinschmit CSM, Millard Electronics, Omaha, NE;** **Harry Boguch, Harry's Electronic Service, Bellevue, WA;** **Mike Webber CSM, Rucker's TV, Fort Worth, TX;** **Steve Kaplan, Sterling Electronics, Lincoln Park, MI;** **Jim Mcnees, H.H. Gregg Service, Indianapolis, IN;** **Bill Simms, Bayard Electronics, Dallas, TX;** **Andy MacPherson, Lakes Electronics, Ft. Lauderdale, FL;** **Jerry Raines CET/CSM, Ford Electronics, North Little Rock, AR;** **Pete**

Partain CSM, Modern Appliance, Homewood, AL; **Richard Mildenberg CET, Entertainment Electronics, Oceanside, NY;** **Randy Whitehead CSM, Service West, Salt Lake City, UT;** and **Wayne Markman, Markman TV, Hamden, CT.**

We were welcomed by Steve Zell, Mgr. of Consumer and Product Services, and Charlie Jost, Mgr., Warranty and Technical Services, along with the heads of each service-related department.

MAJOR CONCERNS

Prior to the meeting, servicers were asked to submit suggestions on topics to be addressed. A listing of these topics, submitted by both the servicers, and Thomson personnel, was then distributed to each attendee. These items were:

- **Warranty Clock:** (1) Do Service Centers understand how it works? (2) How will it benefit the Service Industry?
- **Technical Training:** (1) What medium is most desired: video tape, computer-based, paper manuals, etc.? (2) What is the best way to handle digital training?
- **Quality Of Service Program:** (1) Should there be a bonus for in-home service? (2) Is everyone getting their money's worth with the current bonus program? (3) Is there a way we can do it better?
- According to NESDA, we lost 22% of our servicer base last year. What can be done to reverse this trend?
- One comment was made that there should be more "teamwork" between servicers and manufacturers. Are there any suggestions?
- **Increasing servicer compensation:** (1) Mark-up on warranty parts; (2) Pay for 'soft failures'; (3) COD rates for concession repairs; (4) Pay more for ex-

(cont'd. on next page) ☛

tended contract service.

- Serviceability issues: (1) VLS and PTV product; (2) HDTV/Digital; (3) What happened to the chassis exchange? (4) What warranty claim problems are being encountered, and what can TCE do to fix?
- How does our industry develop a mutually beneficial relationship between the manufacturer, the retailer, and the service center?
- How can service centers reduce or eliminate product returns?
- What should be the functions of the Premier Service Center?
- Disposal of defective CRTs: is it a problem for the service industry?
- What problems are servicers having with TCE service contract service?
- How can TCE improve communications with the service centers, both outgoing and incoming?
- The term 'Home Service': does it cause problems with consumers? If so, how can we better communicate what we all mean by 'home service'?
- Do we have any parts issues? Is Thomson properly communicating order-status to our service centers?
- How can manufacturers help servicers to recruit qualified technicians?
- Electronic Service Information (ESI): (1) How best to format? (2) What are best methods to distribute it? (3) Any other issues/problems with ESI?

IN-DEPTH DISCUSSIONS

The meeting began with the moderator asking the servicers present to prioritize the issues presented.

Not surprisingly, the number one priority among servicers were the payment issues. The parts-markup issue, and the need to increase rates were discussed in-depth. Servicers stated that increasing the reimbursement for in home service was the most important, due to the high cost of delivering service in the field.

Thomson, and many other manufacturers, are increasingly concerned about the high cost of product-returns. Servicers pointed out that we are in a position to help reduce the unnecessary return of products.

Serviceability issues were also explored by all. Servicers explained the value of the removable light box in projection television. Servicers also explained the need to be able to remove the chassis assemblies, and to utilize test fixtures to reduce the removal of heavy

televisions and picture tubes.

Servicers explained that, due to changes in our industry, service centers have had to become extremely efficient in order to survive. This increased efficiency demands that service facilities not spend an inordinate amount of time with red tape. Requests that TCE streamline procedures involving customer relations were explored, and TCE agreed to make changes in this area.

Another discussion item was the accessibility of the access port when chipper check is needed. Servicers would like easier access, possibly an infrared port.

Servicers would like to see Internet-access to many servicer aids. TCE people said the company is working to be on the Internet for servicers. Information such as warranty eligibility, claim-status, and possibly the ability to correct claims online, would be good for everyone.

The empowerment of servicers to make key decisions quickly was discussed by all. TCE is looking to expand on the limited program that is in place.

An auto fax system will be in effect soon, and more information about it will be forthcoming.

We discussed the new technology that is on the horizon. TCE is well aware of the growing need for 'soft services,' i.e., payment to servicers to solve non-failure-related customer problems such as sophisticated installations, customer product-education, and interfacing-problems with other equipment.

Standardization is considered a vital issue for servicers. The group thought that NESDA should take the lead in calling for these badly needed all-industry standards.

Many thought that Thomson's warranty clock should become an industry standard for warranty corroboration. The servicers expressed a need to support this concept, and try to get other manufacturers involved with this technology. All agreed that the clock will be beneficial to both servicers and manufacturers.

CRT disposal problems exist in some areas of the country, but not in others. TCE requested that servicers inform them of any laws or local ordinances affecting such disposal.

Servicers expressed opinions that they are in a good position to assist consumers in getting the best out of their equipment through the use of related accessories. The sale of accessories is good for everyone, manufacturers, ser-

vicers, and consumers.

HIGH EXPECTATIONS

In closing, I offer my sincere appreciation to Steve Zell and Charlie Jost of Thomson. They are taking very welcome bold steps to make our industry better for servicers, manufacturers, retailers, and consumers. I also issue a special thanks to Cathy Spratt at Thomson who organized the event, and worked tirelessly to make it a huge success.

These industry partnering meetings by Thomson are the best industry events that I have ever attended. The reason for this was the attitude of everyone involved. This was not just lip-service to a "necessary evil." I got the strong impression that Thomson officials not only desire servicers' input, but they also put a high value on it. When we were talking, this "Friend of Service" was really listening.

Of course, the real proof will be if Thomson implements the ideas and concepts discussed. If the results of last year's meeting is any guide, we will be a better industry after this year's meeting.

I fervently hope that other manufacturers will see how effective it can be for manufacturers and servicers to honestly and openly discuss issues that affect our respective segments of the industry, as we serve our mutual customers.

Editor's note: Wayne Markman, in addition to being president of the National Electronics Service Dealers Association, headquartered in Fort Worth TX, is also the owner/manager of Markman TV/Electronics in Hamden CT. ✦

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There is no "winding down" for a company that is dedicated to customer support. Hitachi's new NSM is dedicated to remembering his roots, and working together for mutual success. What else would you expect from a "country boy" who still winds his watch?

by *Walt Herrin, National Service Manager, Hitachi Home Electronics (America) Inc.*

Editor's note: The following is edited from a speech delivered during the Hitachi-sponsored breakfast, NPSC '98, Orlando FL, Aug. 15, 1998.

As some of you know, there have been many changes in the Hitachi service organization over the past year or so. For one thing, our company has relocated from Atlanta to San Diego. During the early parts of the move, I frequently tested Murphy's Law (whatever can go wrong, usually does). However, I'm pleased to report that, finally, all is well.

Lately, though, I've come to the conclusion that being a national service manager is a lot like getting married: it's great for the first two weeks. But even beyond that, there is a reward to meeting the challenges, and the commitments you've made.

PROUD TO SERVE

With very few exceptions, Hitachi's National Service Division is brand new. You might say we've rebuilt, from the ground up. Most of our service division management staff has also changed. With the possible occasional exception of Yours Truly, we are a strong and energetic management team.

I love being able to participate in the annual National Professional Service Conventions. It gives me an opportunity to see how much the members' babies have grown. It also lets me visit with many of my old and new friends who I don't get to see any other time. It also stirs many fond memories, such as the one I share with you now.

A PERSONAL RECOLLECTION

I was saddened to learn that Mr. E. H. Norman, of Norman's Electronics in Atlanta GA, passed away during the past year.

When I was 22 years old, a young pup not yet dry behind the ears (or between them) I took my first job with a manufacturer in Atlanta. At the time, I had never driven on a 4-lane highway, and had never seen a building taller than three stories. Also, at least in my life, indoor plumbing was a relatively new concept.

I was a country boy in the big city. But I was a "field engineer," and part of my job was to visit service centers. I was supposed to help the owners and technicians with their technical problems, administrative difficulties, or whatever.

Finally, when I couldn't put it off any longer, I paid a nervous visit to Norman's Electronics, the largest service center in the area.

Now, it was easy for a country boy to be intimidated at that young age. Many seasoned veterans of the business had already taken a certain amount of perverse delight in practicing their skills on me. I feel that I personally trained some of the best intimidators in the business.

Except for Mr. Norman. From my first visit to my last, he welcomed me openly, warmly, and without malice. He spoke to me as an equal, and treated me with a respect that was certainly not earned yet, though it was warmly received. He talked and I listened; he taught and I learned.

Few people, if any, know the tremendous influence this gentle man had on my life and my career. Mr. Norman didn't even know it. Interestingly, I never even knew his first name. I knew him as "Mr. Norman" when I was 22, and he remained "Mr. Norman" to me throughout his lifetime.

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It is said that a man never stands so tall as when he stoops to help a child. So I'd like to take this opportunity to say, "Thank you for standing so tall, Mr. Norman." Thank you for taking a 22-year-old boy under your wing and pointing him in the right direction.

REMEMBER YOUR ROOTS

It's said that, "To remember is to understand." A good judge remembers what it was like to be a lawyer. A good editor remembers being a writer. A good parent remembers what it was like to be a child.

I was a technician for many, many years, and the owner of a service company at one time. I remember the frustration of spending hours, and sometimes days, trying to fix a particularly difficult problem. I also remember the sense of satisfaction and achievement when I finally succeeded.

I remember the delicate balance between late receivables, and early payables. And I remember justifying to customers, on behalf of the manufacturer, why a part is on backorder, or why their product broke again 3 weeks, or 3 months, or sometimes 3 years later.

I remember because these are the fundamental building blocks, the basics of life in the service community. I remember, and I understand. Back then, it was my job to fix things that were broken, whether it was a customer, or a television set. That's still my job.

SIMPLICITY WORKS

That's why I'm not trying to wow you with rhetoric. And I'm not talking about any dreams, or visions of re-shaping the industry. I think that sometimes we get so caught up in such things, that we forget what brought us here.

I'm a simple man, with a simple objective. I want to get back to the basics, and address the fundamental services we provide as a service support organization. These essentials are: prompt, efficient warranty payments; increased order-fill, and reduced parts backorders; sensible, servicer-friendly customer-relations; efficient field-support; and a technical training and support organization second to none.

Most importantly, I want to keep honesty and openness as the foundation of the Hitachi National Service Division. That's my simple dream, and that's my simple vision.

INDEPENDENT TRUST

We believe in the independent parts and service system. That's why we strengthened our ties with our independent parts distributors. That's why we provided all the quick-fixes and symptom-cause information we've developed over the years to NESDA's web page, www.nesda.com. That's why we eliminated the "900" technical support for non-authorized servicers. All professional servicers need this information, and it's our job to see that you get it — and without any hassle. We're not here to dream about it, we're here to roll up our sleeves and do it.

Our people answer the phone with, "How can I help you?" That's not an empty statement; that's our philosophy. I'm remembering, and I'm putting myself back into your shoes — as technicians, and owners of service companies. We're not focused on the politically correct thing to do. We're focused on the right thing to do.

EXTERNAL MOTIVATION

Mark Twain pointed out that, "A watch doesn't wind itself, and doesn't regulate itself. These things are done exteriorly. And like the watch, outside influences and outside circumstances wind the man, and regulate him. Left to himself, neither the man, nor the watch would get regulated at all, and the sort of time he would keep would not be valuable."

We, and our industry, are a lot like a watch in this respect. As a manufacturer, we — along with the people who buy our products — hope that the products we build won't break. On the other hand, most of you hope that they do. When you think about it, we are in two industries that appear to be at cross purposes with one another. But we're both wound and regulated by common outside influences, and circumstances: our customers, and each other.

WORKING TOGETHER

Fred Allen (whoever he is) once said that, "A committee is simply a group of important individuals, who singly can do nothing, but who can together agree that nothing can be done." That might have been true for a long time. We've all seen committees come and go, with absolutely nothing accomplished as a result of their being. And the old watch

(cont'd. on next page)

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kept ticking away, slower and slower, losing more time each and every day.

But all of a sudden, within the last couple of years, we've come out of all the committees with real progress being made. Within NESDA and ISCET, that includes NESDAnet, the PRIDE program; national certification of appliance and electronics technicians; standardization of electronic service literature; and on, and on. And you, the professionals in the product service industry, through your leaders in NESDA and ISCET, made it happen.

So now I think Mr. Allen (whoever he is) should redefine "committee." Now, it should read much like the description of servicers uniting into your trade association: "a group of important individuals who, singly, can do nothing, but who can put aside their differences and, together, do anything."

WINDING UP

I reaffirm my pledge to continue my support, and the support of Hitachi's Service Division, to helping you succeed at helping our mutual customers. I personally commit to keep winding this old-but-important watch, so that the time it keeps is always valuable. ❀

Servicing Issues

Manufacturers' Depot Service Has No Place in a Partnership With Consumers or Servicers

Generally, manufacturers earn discounts off servicers' normal rates. They pay less because they recommend that servicer for all of that manufacturer's warranty service — and for out-of-warranty service on all those products, too. In modern times, however, out-of-warranty repairs are not assured. And an increasing number of manufacturers are sending more-and-more of their faulty products to depot service centers. Considering these conditions — plus the claims-filing red tape, the long wait for payments, the rejected claims, etc. — do they still rate that deep discount?

by *Wayne Markman,*
President, NESDA

Is "depot service" an oxymoron? Should "cherry pickers" pay more?

As the owner of a service center, you know how expensive it is to do business nowadays. You know about the costs of service data, test equipment, parts inventory, technician salaries, ongoing training, etc., in addition to all your other overhead costs. You know how tough it is to make a profit.

If you set up as an authorized camcorder warranty service center, you know that it's much tougher. You have the extra costs of specialized test equipment, more service data, and more training. You need income from a certain amount of units, on a regular basis, to maintain the required skills, amortize your investments in parts stock, equipment, training, etc., and to cover an applicable portion of your overhead.

DWINDLING CATEGORIES

Many of us are experiencing a decline in the carry-in units that we service. We know that this is due to several factors. Newer units are more reliable. The costs of replacement products are artificially low, and replacement becomes a viable option over repair. Some manufacturers, and some service contract companies are funneling repairs to centrally located repair centers. This is unfair to both the authorized service center, and the consumer.

THE UNREASONABLE REASON

Depot service center owners may claim that depot service is a benefit to

the consumers. Some depot service advocates claim they can provide a competent and economical alternative to a local, authorized service center. They contend that local servicers are not properly prepared to service these units, and that the repairs are sometimes performed inadequately.

Yet, it seems strange to me that a company that is deemed competent for certain repairs, is suddenly found to be incompetent for others.

For instance, it's OK to send your trained and equipped tech fifty miles to service a complex projection TV set, or a 35-inch unit that was too big to fit into a Mailboxes, Etc. package. But, according to them, your tech can't be trusted to do the same thing in your service center that the person at the depot will do to a malfunctioning camcorder.

What about the consumer? Would the customers prefer to take their camcorders back to the dealers they bought them from, or to their local service center? Or do they feel greater peace of mind in repackaging the unit and shipping it half-way across the country?

Let's consider the typical camcorder user. The camcorder is not an everyday-use item. It is used primarily for special events: Baptisms, Bar Mitzvahs, birthdays, weddings, European vacations, the long-awaited cruise, etc. Maybe a week (or less) before the event, a family member uncrates the camcorder from its storage box to charge the battery and check it out. If he finds it doesn't work, he calls the store he bought it from, or the manufacturer's

(cont'd. on next page) 

800-number.

Unfortunately, the person at "customer service" says that the unit has to be sent to a remote depot facility for repair.

It doesn't matter that the repair might have been effected locally within a couple of days. It doesn't matter if the problem was a bad tape, or a tape inserted incorrectly, or a battery charger that wouldn't work. It doesn't matter whether the cure might have been just a head-cleaning, or a battery replacement, or a myriad of customer-education situations.

Maybe it has an actual failure that could be easily repairable at a local service center — before the big event. What matters now is that this product has to be sent somewhere else, and it won't be back in time. The real reason for purchasing the camcorder has been defeated.

IN THEIR SHOES

Would the customer have bought that brand of camcorder if he had been told in advance that, "if you have trouble, you just send it off to another city so you can get service that's better for you than doing it locally?" Would the customer have purchased the service contract if they had been told up-front that, in the event of a problem, the camcorder would have to be packed up and shipped out of state?

But by not being told, might he consider the manufacturer and/or the retailer guilty of a "deceptive sales practice"? In either event, is he now likely to purchase another camcorder (or other equipment) from that manufacturer again?

When he learns that a local authorized service center with a great reputation was available — but not for him — how will he feel about the product, or the warranty? The consumer should at least have the option of competent, local service.

DESIGNATING "PARTNERS"

Manufacturers often bestow designations of various degrees of excellence upon their authorized service centers that meet certain requirements (SES, Premiere, etc.). Perhaps it is now time for servicers to assign similar degrees of excellence to manufacturers and contract companies.

Such designations from servicers could consider whether they allow qualified local servicers to service the entire product line, not just what isn't shippable. Other criteria could be: prompt claims processing, negotiated warranty reim-

Thomson: Partnering for a Better Future

Looking toward the future, Thomson has formed some strategic alliances, and strengthened its partnership with its authorized service centers. Here is Thomson's vision for itself, and its ASCs.

by Steve Zell, Manager,
Consumer Product Services,
Thomson Consumer Electronics Co.

Editor's Note: The following is edited from a speech delivered during the Thomson-sponsored luncheon at NPSC '98 in Orlando FL, August 14, 1998. At that function, Steve Zell accepted NESDA's award, bestowed upon Thomson as the 1997-98 Friend of Service.

Thomson Consumer Electronics (TCE) was again proud to be a part of the annual National Professional Service Convention. Personally, I want to acknowledge the contributions to the industry by NESDA's outgoing president and vice president. At the same time, we congratulate the new leaders who will take NESDA into the new millennium. They — and NESDA — have Thomson's best wishes for continued success.

Many of the fortunate servicers who attended the convention also visited our booths at the ProService Trade Show. And we were pleased to continue our

annual sponsorship of the Friday luncheon at NPSC. Personally, this was my first opportunity to address the service industry through this medium.

"FUTURE" ON OUR MIND

The theme of our exhibit at the '98 trade show was "the past...the present...the future...and the future is here today." Our exhibit offered a taste of the present and future in terms of electronic servicing aids. At the core of this was the computer, which was certainly no surprise. Our message was, "Be prepared for the future."

So what is the future?

Well, HDTV and other digital products are emerging, and are going to be coming at us like a runaway freight train. Are you ready? It's certainly no surprise to any of you that HDTV will be introduced this year, although in very small numbers, and a slow roll-out. Many of you are preparing, and are asking the right questions in preparing to service these great new products. More
(cont'd. on next page)

bursement, parts profit and handling costs, competent technical assistance, and reasonable parts pricing.

In return, "premium" companies could receive consideration when negotiating rates. Or owners of their products could get free loaner units. At the very least, those customers could get priority treatment from the service center, on both in- and out-of-warranty products.

These are just some thoughts that come to mind on how a servicer could repay a company's trust and respect for their service centers through a "total commitment."

Conversely, servicers need to put those who don't measure-up into a different category. We might entice them to consider the benefits of "total commitment." The servicer of high-tech products cannot produce a profit on

warranty work that is provided sporadically. Whatever increased expenses are incurred, those increased business costs must be passed on to the user of the service. Cherry-pickers must pay a correspondingly premium rate.

SELECT PARTNERS CAREFULLY

It is not in our best interests to be hostile to any manufacturer. But we must emulate them in making decisions in a businesslike manner, based solely on economic considerations. That means setting our rates on a profit-based system, and partnering with those that really want to mutually partner.

About the Author: Wayne Markman is the owner of Markman TV service center in Hamden CT. He was elected president of NESDA in August 1998. He may be reached care of NESDA, or by phone at 203-776-9123, or via e-mail at waynemt@compuserve.com.

importantly, you will take advantage of the new business opportunities they will provide.

I'm sure that many servicers wonder about the future of Thomson, and of these new emerging digital products. You want to know where Thomson is now, where are we going, and about our long-term strategy. More importantly, what about you as a servicer? What is your future?

THOMSON'S STRATEGY

In response to those questions, and as part of TCE's long term strategy, let me repeat a recent major announcement that Thomson released on July 30th. The outcome of this announcement will help secure *our* future, in terms of bringing together video products (hardware), the telecommunications world, computers, and related software.

On July 30, 1998, the French Government and TCE announced a 30% partnership arrangement with four well-known and respected companies that were chosen by Thomson. These partnerships reinforce the strategic development, and the profitability of the company. They provide Thomson with technical, commercial, and industrial resources complementary to our existing strengths. These four companies are:

- Alcatel, a French company and global leader of the telecommunications infrastructure. This partnership will aid in the development of technologies for future digital home networks linking home electronic appliances (which is the heart of convergence between consumer electronics and telecommunications).
- Microsoft, world leader in software. This partnership will significantly aid in the development and operation of digital and analog interactive television products and services. This covers built-in electronic guides, as well as the development and marketing of Internet television products.
- NEC, the world's second largest components supplier. They will provide flat panel displays, DVD ROM drives, and much more.
- DirecTV, world leader in Digital DBS Satellite Television. They are developing a new generation of interactive digital receivers and advanced interactive services. They are also engaged in joint activities designed to accelerate the transition to terrestrial digital television in the U.S.

THE SERVICE OUTLOOK

Now you can begin to see the picture of where Thomson is going with these emerging technologies and services. And guess what? They all center around television. That's where you come in.

Who's going to service these high-end products of the future? You are — if you're taking the steps now to prepare.

All of this change at Thomson does not come without some risk. However, we are deeply committed to making all of this happen in the coming months.

We are still defining much of this, and still do not have all the answers. But we are prepared to ride the digital train into the future, and we want you to be aboard. Here is what we *do* know that *you'll* need to do now. Of course, many of you are already prepared, and doing these things as a normal part of your business.

By the way, those of you who got out of the antenna business may need to reconsider. With the coming of HDTV, the outdoor antenna business will surely get a shot in the arm.

In the coming years, customers of these new emerging products will expect nothing less than top-notch service. Your preparation requires continued investment in, and upgrading of, electronic tools and servicing aids, and to diversify where possible. In-home service will be imperative. You should make it a priority to attend manufacturers' training when it is offered. Attend local community colleges for business courses to help you fine-tune your business skills. Take advantage of NESDA and ISCET's own Certified Service Manager and Certified Electronics Technician opportunities.

Thomson supports technician and service center certification, and lauds NESDA's efforts in these areas. Our tech-line operation in Indianapolis is fully certified. As we develop and introduce new service programs, we will seriously be looking toward technician, and service center certification programs.

SIGNIFICANT CHANGES

In the meantime, what has TCE been doing, and what will we be doing in the future to help strengthen the service industry for this digital train?

- We are enforcing stricter new-product return-policies, designed to significantly reduce returns on Color TVs. Since July, 1998, our new program has forced this business back to servicers. This means that more products will be

field-serviced by TCE-authorized service centers (ASCs).

- We have significantly expanded our premier service network.
- We are currently testing a program that empowers service centers to make concessions, right in their place of business, without contacting TCE. This will greatly improve customer satisfaction.
- We introduced electronic service information (ESI) allowing us to reduce annual subscription costs. It also allows us to combine schematics, parts list alignment instruction, bulletins, etc., into a handy electronic CD-ROM format. This CD is easy to navigate and use, and has great schematic print-out features.
- We are publishing ESI monthly, which includes Parts Finder II, Chipper Check, and its enhancements, and an easier-to-reference electronic service center manual.
- We launched computer-based training this year.
- We have reduced claim-processing red tape in terms of 10th digit, CRT claims, and exception claims-handling, via improved pre-approval process.
- We listen to an annual Service Advisory Council.
- We are more aggressively pursuing modular service opportunities for high-end televisions to help promote in-home service, and customer satisfaction.
- We continue to support QOS payment programs.
- In March of 1989, we canceled the toll-based 900-number technical-support line for our ASCs. You spoke, and we listened.
- And last but not least, we added Thomson's warranty clock feature to our products. This is designed to aid you in determining the warranty eligibility of products.

These are a few of the steps we've taken this past year to make life better for you, and to prepare you for the future.

THANKS FOR THE HELP

In conclusion, I extend a big thanks to the independents, as well as the ASCs who keep our customers' products working. Thanks to you and NESDA for your continued support of Thomson — through the good times, and the sometimes-not-so-good times. Together we have survived the past and the present. Together, we will succeed into the future. ❀

NPSC '99 in Dallas: Knowledge and Fun at a Site to Behold

Just because you come to the convention for the learning opportunities doesn't mean you can't have fun, too. Cosmopolitan/Western Dallas/Ft. Worth offers many reasons to bring the family for lots of lasting memories.

by Amy Youngblood

When you spend your time and money attending a convention, you want it to be memorable for a variety of reasons. You expect superior education, and you want memories of good times. For most participants, the annual National Professional Service Convention (NPSC) has never disappointed in either regard. This year will be no exception.

NPSC '99 will be held August 2-7 at the Hotel Inter-Continental in Addison, Texas.

Each National Professional Service Convention is wealth of opportunities for everyone engaged in the product service industry. Whether you are a technician, owner, manager, or support employees. And it's also good for electronics instructors, and people engaged in distributing and manufacturing. Every NPSC is an unparalleled opportunity to learn.

EDUCATION AND NETWORKING

Normally, there are more than a dozen technical seminars — on the latest technology — presented by the top trainers at the major manufacturers. Management seminars range from business basics, to the newest methods. (Those seeking to certify their technical or management skills may take either the CET or CSM exams.) There are structured-but-friendly forums where professional servicers can share their best ideas with each other. For most participants, the best part is the many opportunities to meet and share thoughts with other members from across the country, one-on-one.

MEETING MFRS. & SUPPLIERS

The two-day Annual ProService Trade Show (APTS) showcases products and services that can save, or help servicers make money, or function bet-

ter professionally. Here you can meet representatives of manufacturers, distributors, service contract companies, and other suppliers to the product service industry. (You can also win valuable door prizes, donated by the exhibitors, and dispensed by members of the Greater New York association who serve as masters of ceremonies.)

Even more manufacturers, and some other suppliers, provide representatives to the Service Information Symposiums. These forums are designed to let servicers meet high-level service representatives of these companies to learn from each other's perspective, and try to resolve any lingering communications problems.

FOOD AND FUN

Normally, there are many sponsored fun and food functions at each NPSC. This often includes a golf outing (also great for networking), frequent coffee breaks (also great for networking), breakfasts, lunches, and dinners (also great for networking).

On Tuesday and Thursday, August 3 and 5, Sharp and Philips, respectively, will host sumptuous dinner banquets. On Friday evening, August 6, the host Texas Electronics Association will sponsor a function to honor NESDA's many associated local, state, and regional associations. Saturday, August 7, NESDA and ISCET will conclude with their annual Awards and Officer Installation Banquet (which is partially funded by Gernsback Publications and *Electronics Now*).

On Wednesday, August 4, all convention registrants will be transported to Southfork Ranch, the TV home of the Ewing family of "Dallas." You can relive the "who shot J.R.?" days during the Sony-sponsored dinner gala. After a tour of the mansion, a trained gun-

fighter will let guests try their skill at a quick-draw. You can also try your hand at being a cowboy by roping a mechanical calf. Later, the Tex-Mex buffet will include a strolling Mariachi band, followed by a Mexican dance group. Round out the evening on the dance floor with your favorite partner.

EXPERIENCE NPSC AND TEXAS

Addison, situated on the northeastern tip of the Dallas/Fort Worth Metroplex, is a dynamic part of the Dallas community, and a place that can grab your attention and hold it forever. The facilities and amenities of the Hotel Inter-Continental will assure you of a luxurious vacation even if you never leave the property. And the friendly members of the Texas Electronics Association will serve as your hospitable convention hosts.

Following is a rundown of what you can expect to see, and experience in this renowned and exciting part of the Lone Star State.

HOTEL INTER-CONTINENTAL

The Inter-Continental carries on the tradition of its posh predecessor, the Hotel Grand Kempinsky. It tailors itself to the upscale convention crowd, and it shows in the detail, from the complimentary morning coffee, to the turn-down service at night.

Choose from three restaurants: Le Cafe for breakfast and lunch a la carte; Monte Carlo for dinner with French and Italian Riviera influences; and The Rotisserie for snacks and light meals. Room service is available 24 hours a day. Stay for the Champagne Sunday Brunch, which starts at 11 a.m. in the Malachite Room. Cost is \$32 per person. After-hours you are welcome to visit the Bristol Lounge with its piano bar and free hors d'oeuvres, or dance at Kemp's, the hotel nightclub.

Those dedicated to exercise can work out in the Health Club, which features free weights, exercise bikes, and



high-performance equipment. The cost is only \$5 per visit. Nearby are saunas and steam baths, lighted roof-top tennis courts, and indoor racquetball courts. Both the indoor and the outdoor pools include spas, too. And when you overdo, call the health club for an appointment for a massage. Joggers and golfers can learn directions to the nearest courses from the concierge.

And if business, not leisure, is on your mind, the Executive Express service is available for copying, faxing, secretarial work, computer access, lots of design services, and even a notary public.

The Inter-Continental also offers a travel agency, car rental agency, limousine service, florist, gift and sundry shop, jewelry store, mens store, hair salon and video checkout service.

Last, on Aug. 6 and 7, you can take in "Deadman a-Go-Go!", a murder mystery dinner in Le Cafe. Sponsored by Murder Mystery Weekend, diners join in an evening of staged "murder" and sleuthing for clues, accompanied by professional actors. Everyone's encouraged to dress up in '60s costumes for the night. Tickets for the dinner and mystery cost \$39 each, the show only costs \$19. Call 817-572-2212 for advance reservations.

CITY OF ADDISON

Note: The Inter-Continental's concierge can provide information and make arrangements for visiting most of these attractions in Addison, Dallas and beyond.

The town of Addison encompasses only 4.5 square miles, and holds 11,500 residents. Yet, it boasts more than 130 restaurants — more restaurants per capita than any city west of the Mississippi.

It is near several major Interstate arteries, and close to some great shopping. Within a 5-mile radius sit 17 hotels, the upscale Galleria mall, Prestonwood Mall and Valley View Mall. These shopping meccas feature such renowned stores as Macy's, Gianni Versace, Louis Vuitton, Saks Fifth Avenue, Marshall Fields, Tiffany's, and Neiman Marcus.

Also nearby is the Cavanaugh Flight Museum, home to more than 30 historic warbirds restored to their original flying condition. The Watertower Theater, inside the Convention Center, features performances year-round. There's a comedy club, and Addison sponsors the Summer Theatre Festival series. Call 1-800-

ADDISON for shows and schedules.

Or, if you miss the Thursday dinner at NPSC, head east to visit the Southfork Ranch of "Dallas" TV fame.



SEEING BIG-D

Just south of Addison, the million-plus-resident city of Dallas beckons with a host of attractions, events, sights and sounds. The Convention & Visitors Bureau claims that, on any given night, 110 live performances are presented in Dallas. To help bewildered visitors, the bureau has set up a Special Events Hotline: 214-746-6679. To organize the city a bit more, think in terms of districts:

North Dallas: Closest to Addison, a restaurant, entertainment and shopping extravaganza, and home to the big malls such as The Galleria.

Downtown: The business and historical center of the city, with links to the Zoo and lots of cultural attractions. Here you can find Dealey Plaza and the Sixth Floor Museum, remembering the day President Kennedy was assassinated; There's also the Dallas Museum of Art, and the Morton H. Meyerson Symphony Center. The Reunion Tower (that lighted ball so prominent in the Dallas skyline) is downtown, and it's open for dinner and cocktails.

Deep Ellum/Fair Park: Deep Ellum is home for Dallas' avant-garde and the best place to find funky shops, cutting-edge music, and imaginative cuisine. Nearby is Fair Park, a collection of Art Deco-style buildings housing The Science Place, the Aquarium, the Coca-Cola Starplex Amphitheatre, the African American Museum, and the Museum of Natural History, among others.

McKinney Avenue: Lovers of antiques and old architecture flock to McKinney Avenue, just north of the central business district.

West End: Restored turn-of-the-century warehouses now house more than 100 shops, restaurants and nightclubs, with strolling street performers and horse-drawn carriages, too.

Greenville Avenue: One-of-a-kind shops, restaurants, pubs and clubs appeal to Dallas' young professionals.

ALSO NEARBY

Like to bet on horses? The Lone Star Park at Grand Prairie features races year round. Or "bet on the bull" at the Mesquite Championship Rodeo in Mesquite, east of Dallas, on weekend evenings.

The Texas Rangers baseball team will play evening home games in The Ballpark in Arlington during most of your stay. On Aug. 1 they take on the Kansas City Royals. On Aug. 2-4 they play the Minnesota Twins. (Aug. 4 is Group Half-Price Night.) On Aug. 6-8, they host the Toronto Blue Jays.

Right next to The Ballpark is Six Flags Over Texas, an amusement park bigger than Disneyland, with rides and thrills, games and shows, food and fun. Tickets run \$37.70 for an adult day pass, \$18.86 for children under 48" tall.

Across the freeway is Six Flags Hurricane Harbor, a huge water park that can quench your August-parched soul. Take the kids and shoot the Roaring Rapids, or relax in the Lazy River, two of the many slippery rides available. Tickets run \$25.85 for adults and \$12.92 for children.

If outlet shopping is your bag, try Grapevine Mills, Texas's first outlet megamall, west of D/FW Airport, near the picturesque town of Grapevine.

WHERE THE WEST BEGINS

Wrap up your vacation with a visit to Fort Worth, home of NESDA and, to our unbiased eyes, the best the Metroplex has to offer. While firmly anchoring the west side of the Metroplex with big-city attractions, Fort Worth still radiates an old-fashioned Cowtown charm that appeals to first-time tourist and longtime resident.

For more information, call the Fort Worth Convention & Visitors Bureau at 817-336-8791. The Stockyards bureau is at 817-624-4741. The recorded events line is 817-332-2000.

BRING THE SPOUSE AND KIDS

Whether you do Dallas, Fort Worth, or any of the attractions in between, you can experience world-class modernism, or revel in old-west shenanigans. NPSC '99 is surely the thing to do in August, and the Texas D/FW Metroplex is the place to be. And it's a great place for the whole family. ❀



1999 National Professional Service Convention and Professional Service Trade Show

Hotel Inter-Continental • Dallas, Texas

CONVENTION - August 2-7, 1999 TRADE SHOW - August 4-5, 1999

Register for the Full Convention, Any Three Consecutive Days, or Daily

Sponsored by:

National Electronics Service Dealers Association (NESDA),
International Society of Certified Electronics Technicians (ISCET),
National Independent Appliance Servicers (NIAS);
and National Association of Service Dealers (NASD).

Complete this form, detach and mail to: NPSC '99, 2708 W. Berry Street, Fort Worth, TX 76109; 817/921-9061; Fax 817.921.3741

Full convention registration includes all programmed meals, banquets, door prize drawings, trade show, dealer/manufacturer meetings, seminars and workshops, golf and tennis, and participation in basic spousal functions. Activities may be scheduled for optional participation at extra cost. There is no convention youth program.

NOTE: Special Registration rates are valid ONLY on registrations completed and fully paid before the deadlines listed. "Three-Day Special" registration is available for any three consecutive days. Convention fee schedule:

Name _____
Firm Name _____
Address _____
City _____ State _____ Zip _____
Phone _____ Fax _____

If registered and fully paid by ...	First Registered (fully paid) Full	Each add'l. person from same family or business: Full	3-day Special	Totals:
ADULTS:				
July 15, 1999	\$270	\$240	\$180	\$ _____
After July 15, 1999	\$300	\$300	\$200	\$ _____
Daily Rate	\$90	\$90	\$90	\$ _____
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July 15, 1999	-	\$130	\$90	\$ _____
After July 15, 1999	-	\$150	\$100	\$ _____
Daily Rate	-	\$40	-	\$ _____

Member of (please check the appropriate boxes below):
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If registering for a 3-day special, please check for which 3 days you are registering:
 Mon.-Wed. Tues.-Thurs. Wed.-Fri. Thurs.-Sat.

Below, please print legibly your name, and the names of all other registrants (including nicknames) as they are to appear on the registration badges:

Check box if first NPSC	Name	Badge Name	Youth Ages
<input type="checkbox"/>	Your Full Name _____	The one name you want in large letters on your badge (first name, nickname, etc.) _____	_____
<input type="checkbox"/>	_____	_____	_____
<input type="checkbox"/>	_____	_____	_____
<input type="checkbox"/>	_____	_____	_____
<input type="checkbox"/>	_____	_____	_____
<input type="checkbox"/>	_____	_____	_____

Numbers of Participants/Length of Registration

# Adults Full _____	# Adults 3-Day _____	# Adults Daily: _____	Total No. of Days: _____
# Children Full _____	# Children 3-Day _____	# Children Daily: _____	Total No. of Days: _____

Make your check payable to NESDA

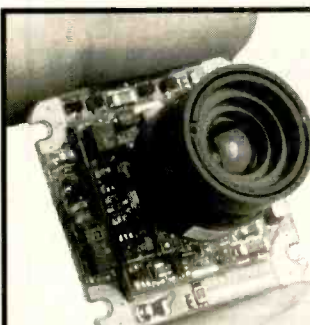
Visa ; MasterCard; No. _____ Exp. _____ Signature: _____

Special Room Rates: Deluxe room rates at the Hotel Inter-Continental are \$99 single or double, \$109 triple, and \$119 quad. Children 17 and under stay free with parents. Rates do not include room tax, currently 13%. Rooms are subject to availability. Room reservations will be handled solely by the hotel, but through NESDA. When we receive your convention registration, we will send you a form for making your special rate reservations directly with the host hotel. To guarantee a room at the Hotel Inter-Continental, reservations MUST be made by June 30.

REFUND POLICY: If you register in advance and later find that you have to cancel --- any time prior to convention --- all money prepaid will be refunded except for a \$10 processing fee per registered person.

Electronic SHOPPER

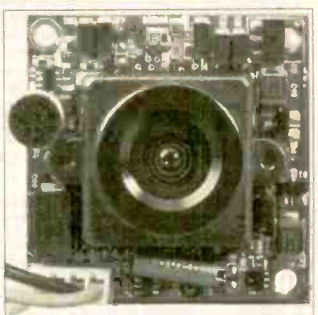
Micro Video Camera Sale



MB-45cB
Color Video Camera
2.8mm Lens
45° Angle of View
\$99.95
Size: 1.25" sq.



MB-650Ua
Black & White Video
Camera with Built-In
Audio & 4.3 mm Lens.
\$89.95
Size: 1.18" sq.



Wireless Cameras

Wireless Camera Package Deals, include: one camera, one receiver and power supplies. (Receiver holds up to 4 cameras)

Wireless 4-Channel A/V Black/White & Color Cameras



Built-in Mic
(on All models)
Cameras are shipped with 4.3mm lens.
(Camera shown with optional lens.)

GFS-1001 (900MHz)
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Worlds Smallest Video Camera

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Pinhole Camera Available:
CM-550P - \$69.95

240 Line Horizontal Resolution
Size: 1.12"(L) .5"(W)



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* Power Jack - 2.1 Female Barrel Jack.

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Up to 15 frames per second or VHS-quality resolution.

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Stand Alone System
No PC Needed.



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\$139.95



Length: 1.37"
Diameter: .87"

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LP-850i
\$129.95



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Diameter: .91"



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LIQUID CRYSTAL DISPLAYS

240x64 dot LCD with built-in controller.
 AND 4021ST-EO. Unit is EL back-lit. \$59.⁰⁰ or 2 for \$109.⁰⁰ or OPTREX. DMF5005 (non back-lit) \$49.⁰⁰ or 2 for \$89.⁰⁰
 20 character x 8 line 7/16" x 2 1/8" The built-in controller allows you to do text and graphics.

Alphanumeric—parallel interface

16x1	\$7.00	20x2	\$10.00	32x2	\$8.00
16x1 (lg. char.)	\$10.00	20x4	\$15.00	40x1	\$8.00
16x2	\$7.00	20x4 (lg. char.)	\$10.00	40x2	2 for \$20.00
16x2 (lg. char.)	\$10.00	24x2	\$10.00	40x4	\$20.00
16x4	\$15.00	32x4	\$10.00	4x2	\$5.00

5V power required • Built-in C-MOS LCD driver & controller • Easy "microprocessor" interface • 98 ASCII character generator • Certain models are backlit, call for more info.

Graphics and alphanumeric—serial interface

size	Mfr.	price	size	Mfr.	price
640x480 (backlit)	Epson	\$25.00	480x128	Hitachi	\$10.00
640x400 (backlit)	Panasonic	\$20.00	256x128	Epson	\$20.00
640x200	Toshiba	\$15.00	240x128 (backlit)	Optrex	\$20.00
480x128 (backlit)	ALPS	\$10.00	240x64	Epson	\$15.00
			160x128	Optrex	\$15.00

6" VGA LCD 640X480, Sanyo LMDK55-22 \$25⁰⁰

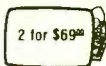
MONITORS

Non-Enclosed TTL

Comes with pinout. 12V at 1.4 Amp input • Horizontal frequency 15KHz • Ability to do 40 and 80 column.
5 inch Amber \$25.00 • 7 inch Amber \$25.00
9 inch Amber or Green \$25.00

5" COLOR MONITOR \$39.⁰⁰

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



9" COLOR SVGA MONITOR \$179.⁰⁰ Fully Enclosed - Tilt and swivel type.

POS & BAR CODE

MAGNETIC CARD READER \$25.⁰⁰

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

HP bar code wand (HBCS 2300) \$19.00

HACKER CORNER

EMBEDDED 486 COMPUTER \$99.⁰⁰

Complete enhanced Intel 486SX-33 based computer in ultra small (9-7/8" x 6-5/8" x 3-1/8") case. Ideal for embedded operations or as a second computer. Features include: • One 16 bit ISA slot • 3 serial ports plus dedicated printer port • Parallel optical coupled adapter port • Built in IBM PC/AT keyboard port • On board VGA video and port • Uses standard SIMM up to 32 MB • BIOS is PC/AT compatible

Unit has a backup Ni-Cd battery system in case of power failure (5 min. backup time) and lockable front cover to prevent floppy drive access. Mounting / interface provisions for standard 3.5" laptop floppy and 2.5 inch hard drives. Comes with very comprehensive manual.

SONY Miniature Color LCD Display (LCX005BKB) \$29⁰⁰

• 1.4 CM (0.55 inch) Diagonal Full Color Display • Built in Horizontal and Vertical Drivers • Delta Dot Pattern for High Picture Quality - 537 dots (H) x 222 dots (V) • Compatible with NTSC & PAL Format and Sync Inputs • 12 VDC Operation with -10 to +17 V RGB Signal and Driver Input Voltage • Excellent Display for Virtual Reality Projects, Viewfinders, and Miniature Test Equipment Displays • Pin Out and Specification Included • Unit Requires Clock, Synchronization and Video

CELL SITE TRANSCEIVER \$49.⁰⁰ 2 for \$89.⁰⁰

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

Encased Spread Spectrum RF Modem \$99.⁰⁰

The ProxLink Radio Module is a small communication device which replaces cables between RS-232 devices with wireless RF (Radio Frequency) technology. Attaching a pair of ProxLinks to any two devices with three wire asynchronous RS-232 ports allows wireless data transmission at rates up to 19.2 Kbaud (full duplex) over a range of 500 - 800 feet. Modules use 300 MZ spread spectrum radio for communication which does not require an FCC site license. A variety of configuration information (radio channel, baud rate, serial port configuration, etc.) can be programmed into module's non-volatile memory by host PC to provide compatibility and avoid overlapping systems. Configuration changes are supported by menu driven, on-board software. Commonly used Terminal Emulation software and transfer protocols can be used for configuring modules and transferring data between computers. ProxLinks require only 6-9 VDC (350 mA), RS-232 (9 pin sub-D) interface, and small (~4") whip antenna for operation. Unit size is 4.0" x 6.5" x 0.75". Installation schematics and application details available. These are 100 Mw power.

COLOR CCD CAMERA \$89.⁰⁰

Small fully enclosed color CCD camera ideally suited for video conference and mobile operations. No separate power supply or batteries needed - single 5 VDC power requirement can be obtained from PC keyboard interface or directly from the computer using the included adapter plugs. Standard NTSC composite output from 1/4" color CCD sensor with 250,000 pixels and automatic white balance.

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ALLIGATOR LEADS

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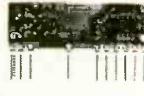
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- Up to 400ft. range
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- User data packetizing
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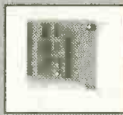


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- 2 ANALOG OUTPUTS
- 2 COUNTERS-24 BIT

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- 24 DIGITAL I/O

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- 28 LINES DIGITAL I/O
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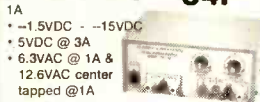


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Elenco Model F-1300

- Frequency: .05Hz - 1.3GHz 3 Ranges
- Period - Can read 60Hz to 60 000000 F=1/T
- Totalize - Counts to 199,999,999
- RPM - 3 to 2099994 RPM
- Duty Cycle
- Max. Ramp/AVG with Time
- Stop-watch set .2 sec. to 100 hrs.
- Math Functions
- Timer - 2 sec. to 99 days
- Pulse Width - 0.1ms to 6-666.6ms



\$225

Multifunction Counter
B&K Model



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1875
10Hz - 2.5GHz
 Ultra sensitive synchronous detector bargraph and RF strength. 3 Channels

Elenco Handheld Universal Counter
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Model F-2800



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Features 10 digit display, 16 segment and RF signal strength bargraph.

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Elenco RF Generator with Counter
 (100kHz - 150kHz) **Model SG-9500**



Features internal AM mod. of 1kHz, RF output 100MV - 35MHz. Audio output 1kHz @ 1V RMS. **\$225**

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 (analog, w/o counter)

B&K 20MHz Sweep/Function Generator with Frequency Counter
Model 4040

- 0.2Hz to 20MHz
- AM & FM modulation
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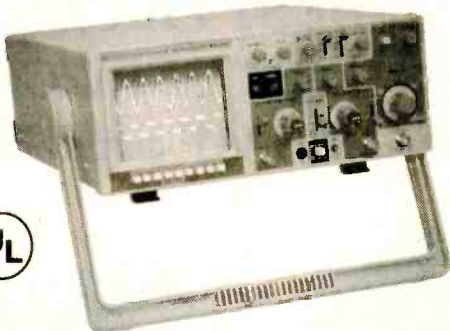
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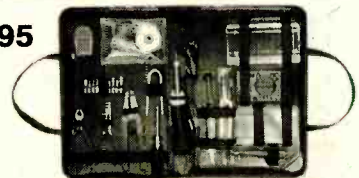
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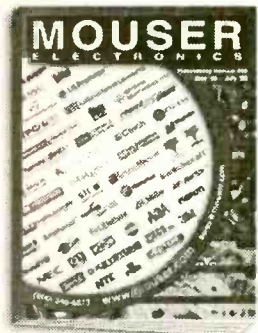


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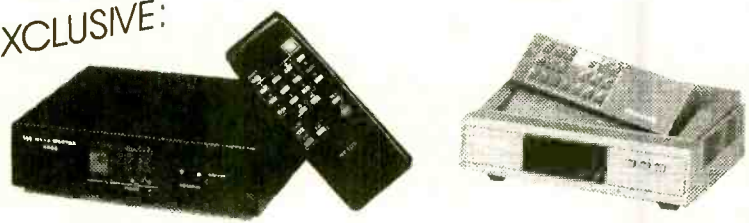
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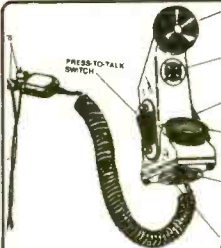
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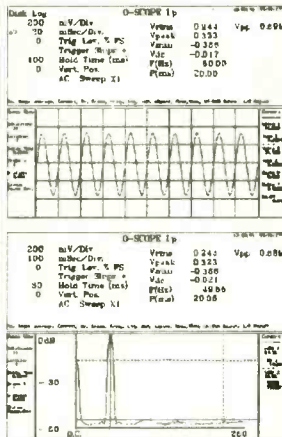
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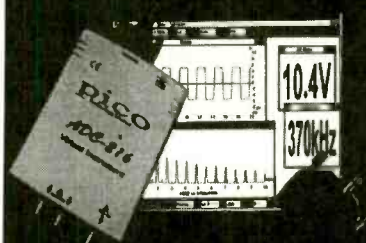
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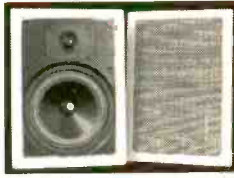
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These quality speaker stands are perfect for mini or rear surround speakers. The heavy die cast base provides stability. Textured black satin finish blends in well with any decor. The height is adjustable from 26-1/2" to 47-1/2" and the speaker wire can be run inside the pole for a better appearance. The top base is adjustable from 4-1/8" to 7-1/2" to accommodate most mini speakers. Includes foam pads to prevent marring of speaker cabinet. Sold in pairs. Net weight: 12 lbs.



#240-762 \$39.80 (1-3 PRS) \$35.50 (4 PRS-UP)

5 Function Remote

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#180-806 \$29.95 (1-3) \$26.95 (4-UP)

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#350-052 75¢ (1-9) 59¢ (10-UP)

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Part #	Length	Price (1-9)	Price (10-UP)
180-120	3 ft.	\$4.25	\$3.95
180-118	6 ft.	4.90	4.50
180-121	12 ft.	8.95	7.95
180-124	20 ft.	12.75	11.50

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Specifications: ♦Impedance: 8 ohms ♦Frequency response: 60-20,000 Hz ♦Power handling capability: 30 watts RMS/45 watts max. ♦Sensitivity: 89 dB 1W/1m ♦Dimensions: 9" round x 2-7/8" deep. ♦Net weight: 5 lbs. per pair.

#300-408 \$69.95 (1-3 PRS) \$62.75 (4 PRS-UP)

3 Amp Power Supply

This fully regulated power supply is perfect for powering CBs, car radios, and other 12 VDC devices that draw up to 3 amps. Heavy duty steel housing with front mounted switch and binding posts. Short circuit and overload protection!



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#120-530 \$19.95 (1-3) \$18.50 (4-UP)

DMM and LCR Meter

In addition to functions found in regular DMM's, this meter can also measure inductance in 5 ranges (4mH, 40mH, 400mH, 4H, 40H), capacitance in 5 ranges (4nF, 40nF, 400nF, 4uF, 40uF), frequency in 4 ranges (4KHz, 40KHz, 400KHz, 4MHz), TTL logic test, diode test and transistor hFE test. 5 AC/DC ranges up to 1000V (AC750V), 3 AC/DC current ranges up to 20A and 7 resistance ranges up to 4000 M ohms. Includes test leads, battery, spare fuse, and manual. Net weight: 1 lb.



#390-513 \$85.90 EACH

2.5W Mini Audio Amplifier

This amp contains both pre-amplifier and power amplifier on a super small board measuring only 1-5/8" x 1-1/4". Maximum output power is 2.5W into 4 ohms with 12VDC input power. No adjustments required. Short circuit protected.



#320-215 \$9.95 EACH

Weller WLC100 Soldering Station

The Weller WLC100 solder station is ideal for the professional, serious hobbyist, or kit builder who demands higher performance than usual of a standard iron, but without the high cost of an industrial unit. Power is adjustable from 5 to 40 watts. Includes 40 watt pencil iron. UL approved. Net weight: 1-3/4 lbs. Replacement sponge #372-119.



#372-120 \$39.95 EACH

"44" Solder

Kester "44" rosin core solder is designed for electronic and electrical work. It uses a fast acting, instant wetting, non-corrosive, and non-conductive flux for faster soldering and a strong, long lasting bond.



Part #	Alloy	Lead/Tin	Spool	Dia.	Price (1-3)	Price (4-UP)
370-080	60/40	1 lb.	.031"		\$8.50	\$7.95
370-090	60/40	1 lb.	.050"		8.50	7.95
370-098	60/40	4 lb.	.031"		33.90	31.80
370-088	60/40	1/2 lb.	.020"		6.95	5.75
370-072	63/37	1 lb.	.020"		14.90	13.50
370-086	63/37	1/2 lb.	.031"		9.95	8.50
370-074	63/37	1 lb.	.031"		12.50	11.50
370-087	36/37	1/2 lb.	.031"		7.95	6.75

Pro Wick

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Part #	TS #	Size	Length	Price (1-9)	Price (10-UP)
341-415	1802-5	.06"	5'	\$1.40	\$1.25
341-416	1803-5	.08"	5'	1.45	1.30
341-417	1804-5	.10"	5'	1.60	1.45
341-424	1802-10	.06"	10'	2.70	2.55
341-425	1803-10	.08"	10'	2.80	2.55
341-426	1804-10	.10"	10'	2.95	2.70
341-440	1802-25F	.06"	25'	6.80	6.30
341-441	1803-25F	.08"	25'	6.85	6.35
341-442	1804-25F	.10"	25'	7.60	7.00
341-418	1802-100	.06"	100'	21.90	20.50
341-419	1803-100	.08"	100'	21.90	20.50
341-423	1804-100	.10"	100'	23.90	22.50

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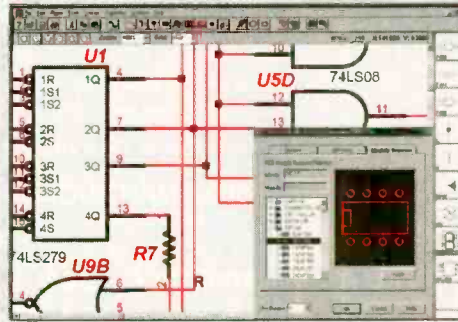
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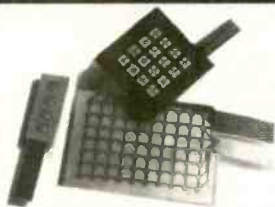
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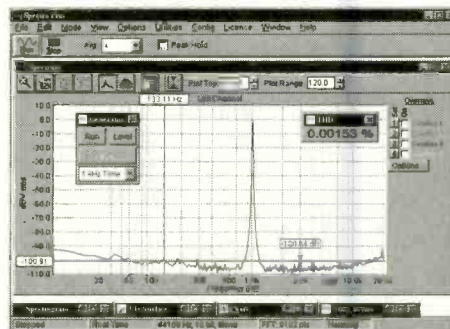
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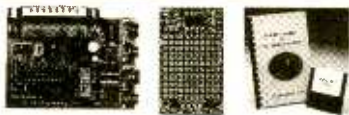
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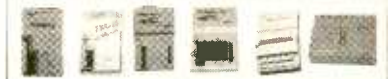
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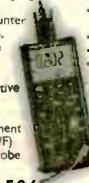


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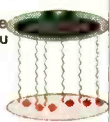
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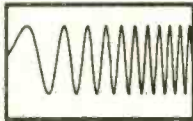


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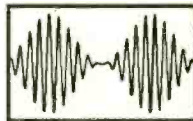


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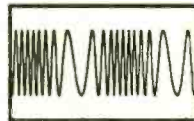
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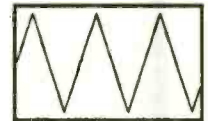
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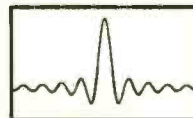
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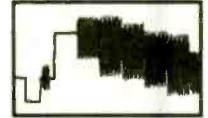
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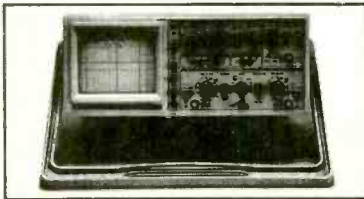
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- FM-4MC, High Power FM Transmitter Kit..... \$17.95
- FM-5, World's Smallest FM Transmitter Kit..... \$19.95
- FM-6, Crystal Controlled 2M FM Transmitter Kit..... \$39.95
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- FM-100, Pro FM Stereo Transmitter Kit..... \$249.95
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FM Stereo Radio Transmitters

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- AM-1, Entry level AM Radio Transmitter Kit..... \$29.95
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Everyone who sees one of these babies says they just gotta have one! Super cute tiny FM radios have automatic scan/search tuning, comfortable ear bud earphones and we even include the battery. The pager style unit looks like a shrunken pager and even has an LCD clock built-in. You will be amazed at the crystal clear amazing sound! That's a quarter in the picture for size comparison - pretty tiny, huh?



- MFMT-1, World's Smallest FM Radio..... \$11.95
- PFMR-1, Pager Style LCD Clock & FM Radio..... \$12.95

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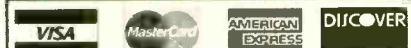
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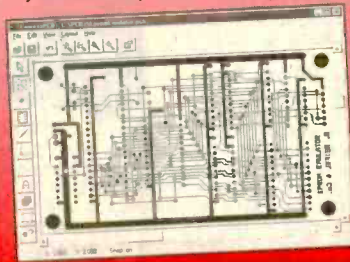


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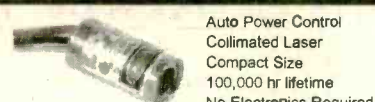
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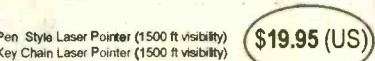
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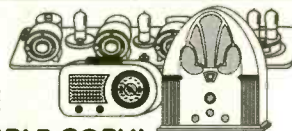
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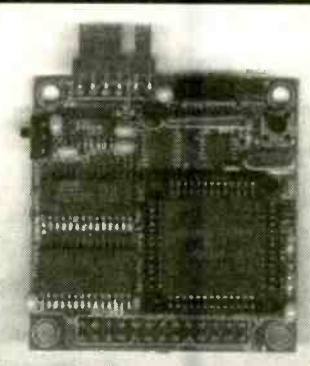
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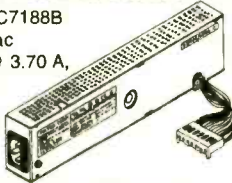
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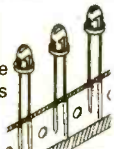
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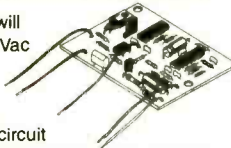
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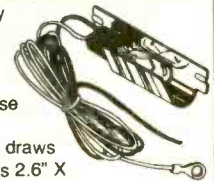
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Controlling Servos from a Computer

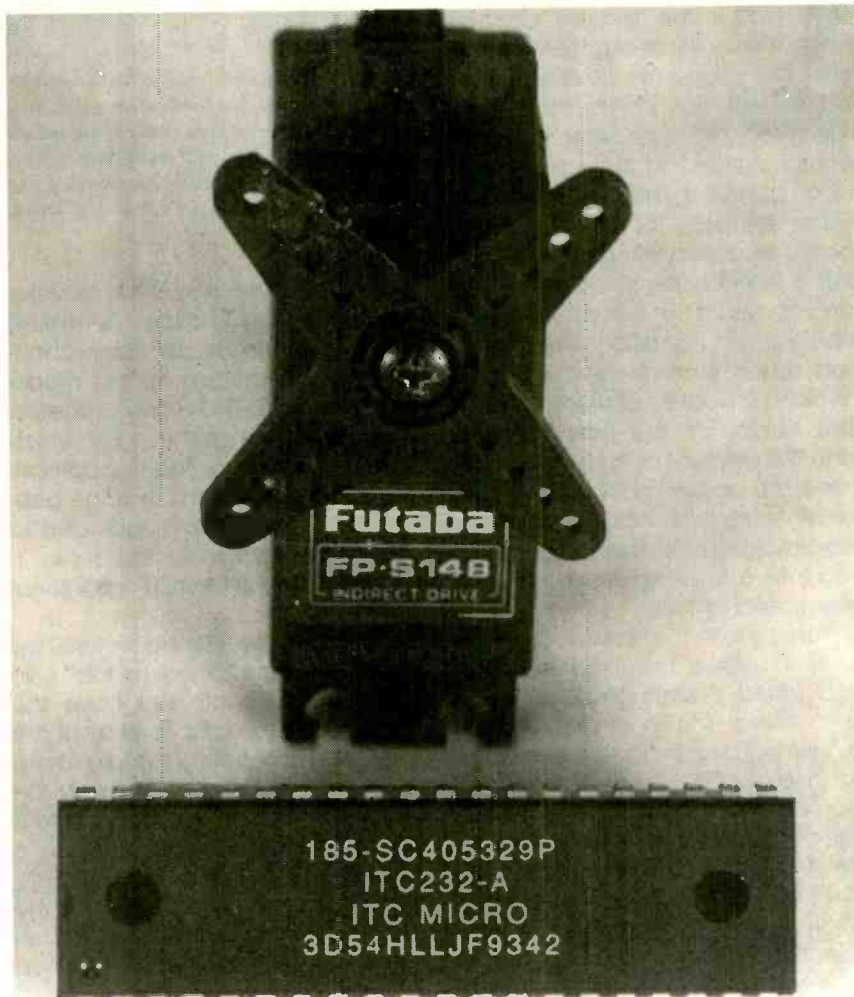
Here's a different type of motor-control project: Using any computer with a serial port to control radio-control-airplane servos.

RICARDO MORO-VIDAL

We are all familiar with the "recurrent idea syndrome:" a terrific idea that usually starts with "If only I could..." followed by a technical "impossibility" statement. Such a situation occurred a while ago when the author wanted to use a computer to control the motion of a small video camera. Although the project seemed daunting at first, it became a simple and fun project once the solution was found: a couple of remote-control model-plane servos, a simple hardware interface, and a few lines of code in QBasic.

Since moving servos from a computer is a very general application, let's explore how servos work. With that knowledge, we can devise the hardware necessary to interface them to a computer and the program that makes it all happen. Incidentally, this project will work with any computer with a standard serial port, be it a PC, Macintosh, or even an Apple III!

How Servos Work. Model-airplane servos are attractive to the experimenter because of their considerable torque, high reliability, ruggedness, reasonably accurate angular positioning (usually within 1-2%), and low cost. Standard servos have three wires: two are used for power and ground (color-coded red and black) and a white signal wire that carries a train of pulses referenced to the black wire. The width of the pulses varies between 0.5 and 1.5 milliseconds; that pulse width determines the position of the axis. The servo's output crank will be in mid-position with a 1-ms pulse width. The pulses are repeated at a



rate of about 25 per second, although higher rates can be used. Depending on the brand of servo that you are using, higher repetition rates might be needed. For example, it has been found that a 40-pulse-per-second rate works well with Futaba servos—a very popular brand.

Inside a servo is a highly-g geared DC motor attached to an output

shaft. Attached to that shaft (on the inside of the case, of course) is a potentiometer. That potentiometer is used for position feedback to the internal circuit; it controls the pulse duration of a retriggerable one-shot timer. The incoming pulse train triggers that timer. Since the timer pulse starts at the same time as the position pulse, the length of the two pulses can easily be com-

pared. If the signal pulse is longer than the timer pulse, the comparator circuit turns the motor in one direction. If it is shorter, the motor is turned in the other direction. Turning the motor moves the shaft, which moves the potentiometer and therefore changes the width of the timer pulse. The motion stops when both pulses have the same duration within a "window" of acceptable closeness. That window, called *hysteresis*, prevents the motor from "hunting" back and forth about the desired position. Since the motor and potentiometer are mechanical devices, their movement has inertia that keeps them moving a bit after the electronics command them to stop. As long as the hysteresis window is wide enough for the motor to come to a stop without overshooting, it won't have to reverse direction to return to the desired position. Such a condition would draw too much current—a situation to avoid in a battery-powered model. The quality of the potentiometer and the amount of hysteresis determine the accuracy of the servo. In order to reduce cost, most of the electronics inside the servo are fitted into a single custom-designed integrated circuit.

Armed with that knowledge and a few surplus mechanical parts, you could design and build your own servo. The only difficult part would be designing the comparator and control circuit—especially if compactness is a goal. Signetics used to manufacture a servo-amplifier chip that was perfect for such a situation. In fact, one of the example applications in that chip's specification sheet was the design of a model-airplane servo. Unfortunately, the NE544 is no longer being made and is becoming increasingly difficult to find on the surplus market.

Controlling a Servo. In a remote-control model-airplane system, the transmitter has a pulse generator for each channel. The pulse width for each channel is controlled by a separate potentiometer. Many times, two channels whose controls are usually combined into a two-axis joystick. An example for a remote-

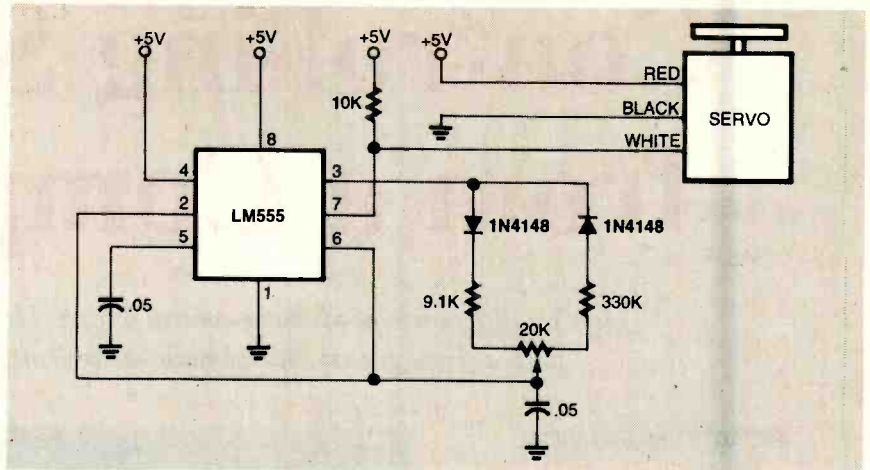


Fig. 1. A standard servo used in radio-controlled model airplanes uses three wires; two are used for power and ground. The third carries a pulse-width-modulated signal that is proportional to the position that the servo's output crank should move to. The pulse should vary from 0.5 ms to 1.5 ms with a repetition rate between 25 and 40 pulses per second. This simple circuit can be used to test a servo. By varying the potentiometer, the charging and discharging path of the timing components change the ratio between the output's on and off time without disturbing the overall pulse rate.

control model plane is the elevator (up/down) and rudder (left/right) controls. The pulses for each channel are transmitted to the model plane in order. The plane's receiver sorts out which pulse is for which servo, distributing them appropriately. The end result is that the position of the joystick is reproduced rather accurately by the servo in what is called a Digital Proportional System.

As we've mentioned before, we need a source of pulses that can be varied in width but have the same repetition rate. To test out the theory on a bench, a sample circuit is shown in Fig. 1. Although an LM555 timer can control a single servo, you can use an LM556 to control two servos or an LM558 to control up to four. In the circuit, the LM555 is wired as an oscillator, so that it generates pulses continuously. Note that the two diodes "steer" the charging/discharging current to or from the capacitor through resistors of different values. If the two "legs" had the same value, the charging and discharging times would be the same; the result is an output pulse with a 50% duty cycle. With the inclusion of a potentiometer in the charge/discharge path, the amount of resistance in the two legs can be varied, resulting in a simple way to set the width of the pulse. Because of the way that the potentiometer is wired into the cir-

cuit, any increase in the amount of resistance in one leg is balanced by a decrease of the same amount of resistance in the other leg. That arrangement keeps the overall repetition rate the same no matter how much the potentiometer is varied. If you decide to experiment with that circuit, you might have to adjust the value of the potentiometer and the capacitor in the RC network to get the best results for any particular servo.

Computer Control. While that circuit is simple enough, controlling a 555 from a computer is rather difficult. An alternative is to use a counter/timer chip that has a microprocessor interface built into it. Fortunately, such a chip is available from several designers. The one that we'll be working with is the 8254 from Intel. That IC was used as the timer in older IBM and IBM-compatible computers. Designed to be an enhanced version (not a replacement) of the older 8253 interval-timer chip, it is inexpensive and easy to find. Since it has three internal counters, it can be used to control more than one servo. Incidentally, the 8253 is pin-compatible with the 8254 and will work just as well in our servo-controlling circuit.

Finally, we need to connect the 8254 to a PC. With IBM-compatible systems so readily available today,

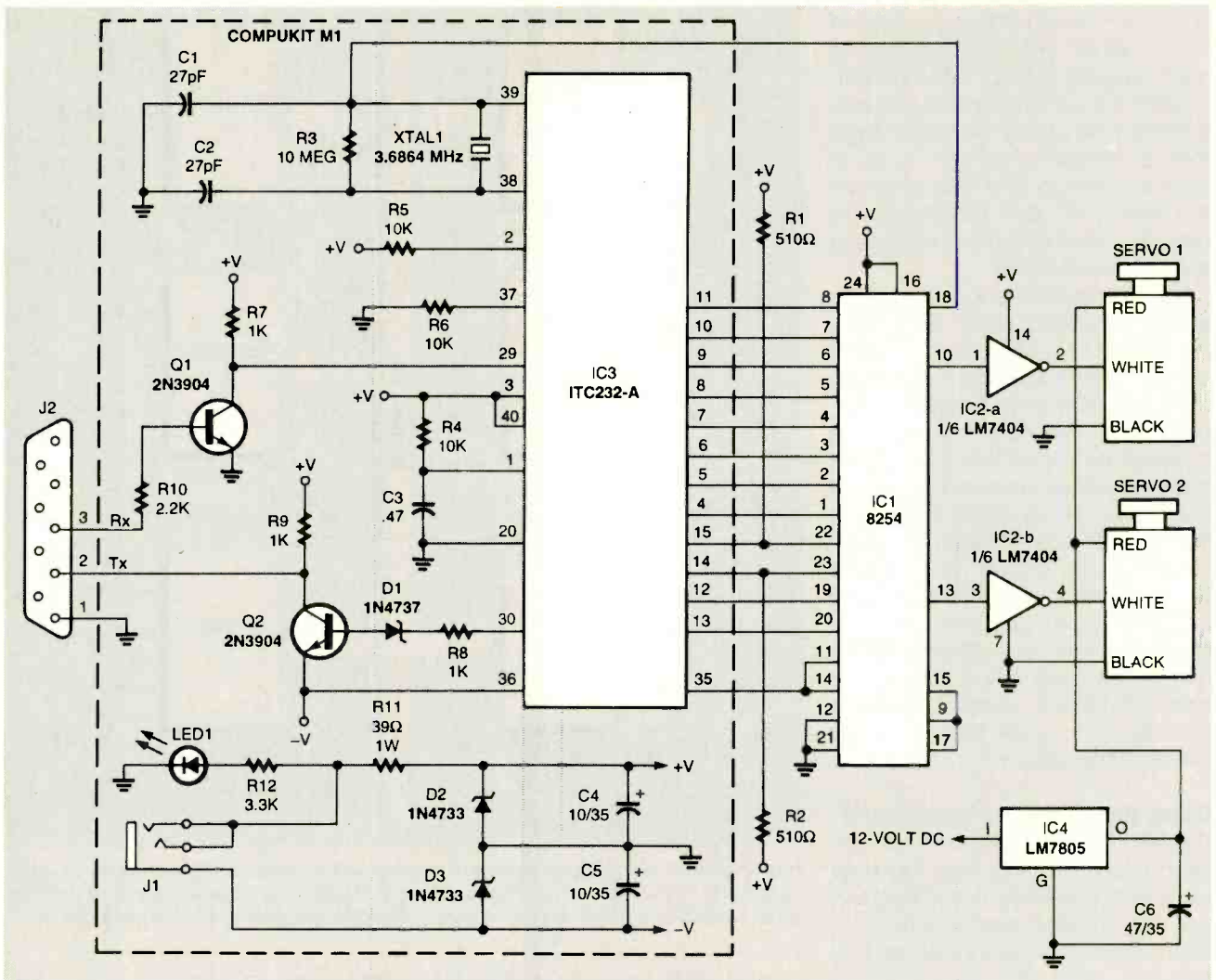


Fig. 2. Connecting model-airplane servos to a computer is simple and straightforward with the use of an ITC232-A interface chip. Most of the circuitry shown here (in the dashed-line box) is available on an inexpensive evaluation board.

it would be very tempting to target that type of PC as the controller. However, there are plenty of older systems that are probably sitting in closets and under benches collecting dust from disuse. Those systems can be used to control servos just as well; the trick is to find a universal method. For that, we don't have to look any further than the RS-232 serial port that is probably a part of any system that was designed for expandability. Using the RS-232 standard has an additional advantage in that the servos can be placed a distance from the computer; the RS-232 standard allows for cable lengths of up to 15 meters.

Traditionally, interfacing hardware to a computer via the serial port used to be difficult, but with

the availability of easy-to-use interface chips, such a barrier is a thing of the past. One of the more recent chips is the ITC232-A from ITC Microcomponents. That chip is a simple conduit between an RS-232 interface and several parallel ports. All commands, conversions, and translations are done automatically with a simple command syntax.

A serious down side to the ITC232-A is the difficulty in locating a hobbyist-friendly source. To that end, an experimenter's module is readily available from several mail-order sources. The CompuKit M1 includes an ITC232-A, a tiny power supply, and RS-232 hardware. The module works like a big IC since all of the ITC232-A's pins are available from a pair of inline connectors that are mounted on the bottom of

the printed-circuit board.

About the Circuit. The schematic in Fig. 2 shows, on the left side in a box, the CompuKit M1 circuit. We'll discuss that portion first. As you can see, the CompuKit is built around IC3, which is the ITC232-A. A serial-port interface is made from Q1, Q2, and their associated components. Those transistors translate the signals between the voltage levels needed by the RS-232 interface and IC3. Although it seems simplistic, baud rates of up to 115,200 can be handled with ease. Finally, a small power supply using Zener diodes D2 and D3 for regulation powers the board and produces the negative voltage necessary for the serial port. A 12-volt DC wall-mounted transformer (which is not

a part of the M1 kit) is connected to J1. While the floating-ground method used cannot deliver much current, it is sufficient for our needs. What's more, it has the advantage that a negative voltage is available, something that can often be a blessing since it eliminates the need to resort to a more expensive dual-supply scheme.

One bidirectional port on IC3 is used for passing data and commands to IC1, while a portion of another port is used for control signals such as READ and WRITE. The outputs from the timers in IC1 are buffered by the gates in IC2. Those buffered signals are used to control the servos. Since there is no way that the M1 power supply can provide enough power to move a servo, another power supply and regulator (IC4) are needed. It is important that two different transformers be used; trying to use only one will almost certainly destroy something in your circuit in the event of a problem.

Using the 8254. The specification sheet for the 8254 will be most helpful in understanding how the chip works and is used for controlling servos. The register descriptions from Intel are reproduced in Tables 1, 2, and 3; a block diagram is shown in Fig. 3.

The 8254 contains three down counters; they are called down counters because they count from a preset value down to zero. Each counter is connected to three pins. Pulses are input through a clock pin (CLK). The GATE pin, when held high, enables the corresponding counter. The OUT pin goes low when the counter reaches zero. The counters can be configured as 8-bit or 16-bit counters. Since all operations are done eight bits at a time, each counter has two internal registers to hold the count value. There is an additional 8-bit register, the control register, which can be programmed to select the working mode for each counter separately. The register being accessed is selected by address pins A0 and A1. The data to be transferred to and from the registers travels on the data bus pins (D0-D7). The direction of the data is selected with

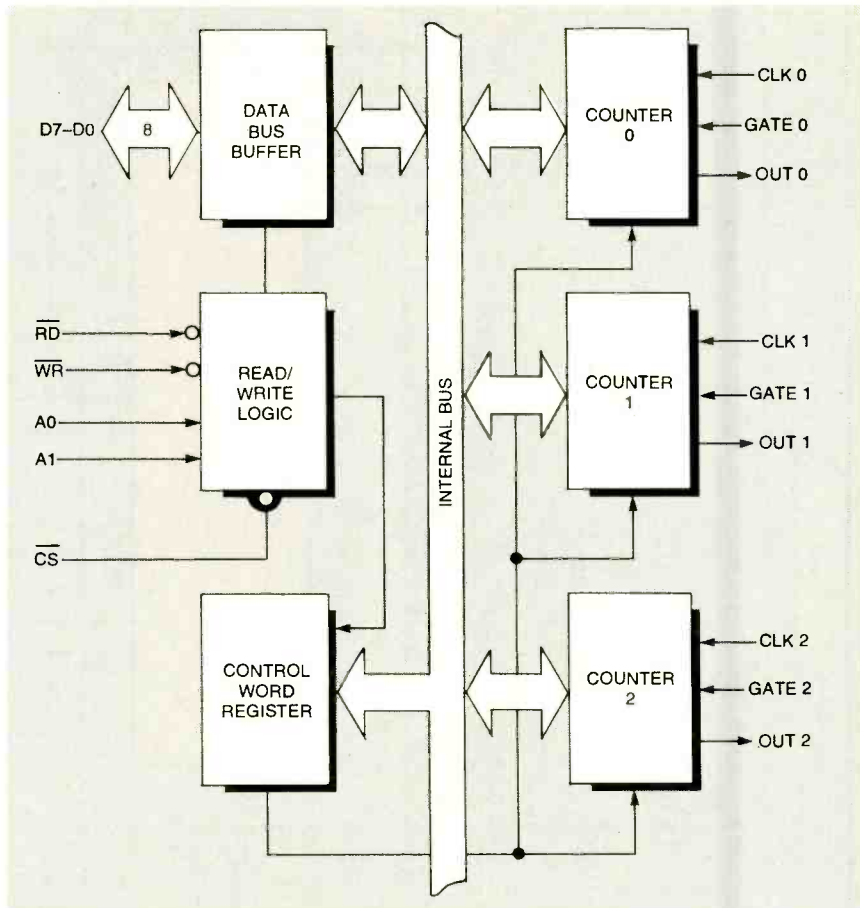


Fig. 3. The 8254 interval timer/counter is a complete microcomputer subsystem that can be easily interfaced to any microprocessor. The three internal counters can be set to a variety of different modes independently. It was this chip that was used as the timer/counter in the original IBM PC.

pins WR (data are to be written into the selected register) and RD (data are being read from the register). The control register cannot be read, only written. Finally, cs (chip select) enables the 8254. The WRITE, READ, and cs pins are active when grounded. Since we are only using one 8254, the cs pin (pin 21) is grounded so that IC1 is selected all of the time.

If you want, you can have several 8254s connected in parallel. In

that case, you would connect the chip-select lines (including the chip-select line of the first 8254) to separate unused data lines on IC3, and set those pins low (one at a time) to select among the additional 8254s. That way, you could keep adding servos to your system. Since three counters are available in an 8254, each additional chip can control up to 3 additional servos—the 10-microsecond pulses are already available from the first

TABLE 1
8254 PINS

CS	RD	WR	A1	A0	Function
0	1	0	0	0	Data to counter #0, Writing
0	1	0	0	1	Data to counter #1, Writing
0	1	0	1	0	Data to counter #2, Writing
0	1	0	1	1	Data to Control register, Writing
0	0	1	0	0	Data from counter #0, Reading
0	0	1	0	1	Data from counter #1, Reading
0	0	1	1	0	Data from counter #2, Reading
0	0	1	1	1	Data bus in high impedance
1	X	X	X	X	Data bus in high impedance
0	1	1	X	X	Data bus in high impedance

8254. That second set of counters would all be configured as retriggerable one-shots in the same way as with the counters that are connected to the servos. When sending data to the counters, you would need to activate the correct 8254 with its chip-select pin. Note that all of the chip-select lines will need to have a 510-ohm resistor connected between them and the positive power supply to act as a pull-up resistor in the same manner that R1 and R2 are connected to IC1's read and write control lines. That will prevent any conflicts between the chips when power is first applied; that will be discussed later in the software section. A large number of servos may be attached in that way for some interesting robotic effects.

A clock signal available at pin 39 of IC3 is fed to pin 18 (the clock

input of counter 2) of IC1. That counter is set as an 8-bit divide-by-40 counter. The resulting pulses are about 10 microseconds long. That signal clocks the other two counters, which are set as one-time retriggerable timers. A value based on the pulse length for the servo is stored in the counter register. That value is remembered until it is overwritten with new data or power is turned off. Every time the GATE pin goes high, the out pin goes low, the counter value is loaded into the counter, and the countdown starts. Each 10-microsecond clock pulse decreases the counter value by one. When the counter value reaches zero, the out pin goes high and the counting stops. Because servos need to see a positive-going pulse, IC2 inverts the pulse to the correct polarity.

Based on a 10-microsecond

clock pulse, counting 50 pulses will create the 0.5-millisecond pulse needed to move the servo to one end of travel and 150 pulses for the other end (1.5-ms pulse). Note that the 10-microsecond pulses are not exactly 10 microseconds long but rather 10.9-microseconds. That is due to the odd crystal frequency that is needed for IC3 to create all of the standard baud rates. The position of the servo can be set with a digital precision of 1 unit in 100 (150 pulses-50 pulses). A 1% accuracy is good enough for most applications and probably better than the mechanical precision of the servos used. If you need to increase the precision, divide the crystal frequency by 20; the pulses will be about 5 microseconds long. The counts for the servo pulse widths would then be 100 for 0.5 milliseconds and 300 for 1.5 milliseconds. That will increase the resolution to 1 in 200.

The length of that pulse can be set to a new value at any time; the new value will not be transferred to the counter until the next cycle. What's needed is to trigger the GATE pin at the repetition rate needed by the servos. In order to keep the cycle happening 25 times a second, a squarewave must be applied to the GATE pin. That is done with pin 35 of IC3. That pin is the output of a pulse-width modulator that is built into IC3. When IC3 is initialized, it is set to generate a squarewave of 25 to 40 Hz, depending on the needs of the servos that you will be using. A full manual on the use of the ITC232-A as well as examples, application notes, and software drivers for use with Visual Basic are available for download at www.rmv.com.

The Program. An example program written in QBasic is available for download from the Gernsback Web site at ftp.gernsback.com/pub/EN/itc232.txt. Examining the program is also a good way to learn how to use the command structure of the ITC232-A. The software was written in QBasic for two main reasons: it is very popular and it comes included in DOS and Windows. It can also be easily translated for other dialects of Basic

PARTS LIST FOR THE SERVO CONTROL SYSTEM

SEMICONDUCTORS

- IC1—8254 Programmable interval timer, integrated circuit
- IC2—LM7404 Hex inverter, integrated circuit
- *IC3—ITC232-A Serial-to-parallel interface, integrated circuit
- IC4—LM7805 5-volt regulator, integrated circuit
- *Q1, Q2—2N3904 NPN transistor
- *D1—1N4737 Zener diode
- *D2, D3—1N4733 Zener diode
- *LED1—Light-emitting diode, red

RESISTORS

- (All resistors are 1/4-watt, 5% units unless otherwise noted.)
- R1, R2—510-ohm
 - *R3—10-megohm
 - *R4-R6—10,000-ohm
 - *R7-R9—1000-ohm
 - *R10—2200-ohm
 - *R11—39-ohm, 1-watt
 - *R12—3300-ohm

CAPACITORS

- *C1, C2—27-pF, ceramic-disc
- *C3—0.47-μF, ceramic-disc
- *C4, C5—10μF, 35-WVDC, electrolytic
- C6—47-μF, 35-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

- *J1—Miniature jack
- J2—9-pin subminiature jack

- *XTAL1—3.6864-MHz crystal
- 12-16-volt DC wall-mounted transformers, model-airplane servos, wire, hardware, etc.

*Part of Compukit M1, see text

Note: The Compukit M1 is available from Jameco Electronics, 1355 Shoreway Rd. Belmont, CA 94002; Tel: 800-831-4242 or 415-592-8097; Fax: 800-237-6948 or 415-592-2503; E-mail: info@jameco.com; Web: www.jameco.com; catalog no. 127204, \$49.95.

Note: The following items are available from Ricardo Moro-Vidal, 2475 Queens Ave, West Vancouver, BC V7V 2Y9, Canada; Fax: 604-925-9247; e-mail: moro@compuserve.com; Kit of all ICs, Compukit M1, and 3 1/2-inch diskette with software including additional program to use a joystick, \$95; Kit with two standard servos, \$139. Solderless breadboard and transformers are not included. Prices are in US funds and include shipping and handling charges for delivery within North America. VISA and MasterCard are accepted. No COD orders outside Canada. Canadian residents must add appropriate PST and GST.

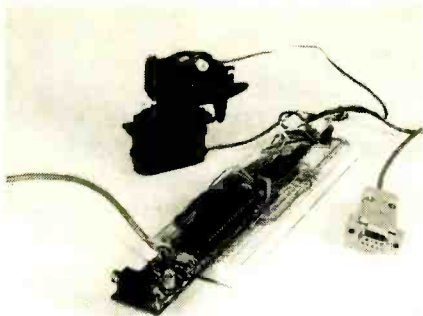


Fig. 4. The author's prototype, shown here, was built on a solderless breadboard. Pin-style headers on the Compukit M1 allow for easy experimentation. The circuit can be easily transferred to a permanent breadboard.

including Macintosh computers. Note that over half of the code consists of explanatory comments (preceded by a ` symbol) that are not needed for the program to work. The program is divided into blocks that are labeled as such in order to better understand the following explanation.

The first section, labeled BLOCK #1, contains constant definitions and program initialization. Note that there are two lines that open a serial port. You should choose which line to remove based on which serial port the servos are hooked up to.

The constant values for MaxH, MaxV, MinH, and MinV are set depending on your hardware. Those constants set the limits beyond which the program will not

TABLE 2
8254 CONTROL REGISTER

D7	D6	D5	D4	D3	D2	D1	D0
SC1	SC0	RL1	RL0	M2	M1	M0	BCD
Select Counter				Read/Load		Mode	BCD

try to move the servo. The easiest way to find those values is to set MinV and MinH to 0 and MaxV and MaxH to 255. Run the program and start changing the servo positions by pressing r, l, u, and d. Be sure to use lower-case keys; upper-case keys will move the servos by the number of steps defined by the constants LargeStepH and LargeStepV. When the servo stops moving, write down the values shown on the screen. Stop the program and edit the constants, replacing the 255 and 0 values with the ones that were just found.

The next block (BLOCK #2) initializes the ITC232-A. The W40 command sets pin 35 (PWM) to a frequency of 40 Hz. Since no duty cycle is specified, the hardware sets it to 50% by default. As mentioned before, the 40-Hz value was found to work well with Futaba servos. If your servos do not work or perform poorly, you might need to change that value to 25 or to an intermediate value. Experimentation is the best way to find the best setting.

Note that a subroutine called WRITESERIAL is used to do the actual communicating with the ITC232-A.

Since we'll be sending a lot of commands and reading as many result codes, "inventing the wheel once" is a sensible way to go. Some might wonder why the gosub statement is used rather than the more up-to-date SUB and FUNCTION method. With the more traditional method, the lines can be numbered, making the program easier to translate to any other Basic dialect.

In BLOCK #3, the ITC232-A chip is "readied for business." After a reset, all of the I/O pins on IC3 are in a high-impedance state; that is why R1 and R2 are in the circuit. Those resistors maintain a valid logic level on IC1's read and write controls when power is first applied. While the resistors are maintaining control over IC1, the initial control settings are sent to IC3's port B and then the port is configured as an output port. If we enabled the port first, the read and write pins on IC1 would both be activated—a condition that is not allowed.

The other port (port A) that is used is also configured as an output port; that port is connected to IC1's data lines and the software does not need to read any of IC1's registers. Since IC1's read control is controlled by software rather than hard-wired, software can be written in the future to do just that if needed.

The fourth block sets up the counters in IC1. We must write data into the 8254 registers often, so that is done in a subroutine called wr. Two variables are used for passing the register information: DATA\$ for the actual data and CONTROL\$ for the control-line pattern. In the 8254, counter 2 is used as a squarewave generator and the other two counters are set up as one-shot retriggerables.

If you are interested in adding additional servos as discussed before, keep in mind that the bit pattern stored in CONTROL\$ will need to account for the additional servos. With a larger number of servos,

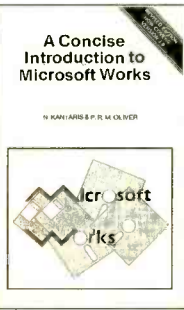
(Continued on page 79)

TABLE 3
8254 REGISTER DEFINITIONS

SC1	SC0	Definition	
0	0	Counter 0 selection	
0	1	Counter 1 selection	
1	0	Counter 2 selection	
1	1	READ BACK COMMAND	
RL1	RL0	Definition	
0	0	Counter latch	
0	1	Read/Load of LSB	
1	0	Read/Load of MSB	
1	1	Read/Load of LSB followed by MSB	
M2	M1	M0	Definition
0	0	0	Mode 0 (Interrupt on Terminal Count)
0	0	1	Mode 1 (Programmable one shot)
X	1	0	Mode 2 (Rate Generator)
X	1	1	Mode 3 (Square Wave Generator)
1	0	0	Mode 4 (Software Triggered Strobe)
1	0	1	Mode 5 (Hardware Triggered Strobe)
BCD	Definition		
0	Binary Count (16-bits binary)		
1	BCD Count (4-decades Binary Coded Decimal)		

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BP346-Programming in Visual Basic for Windows \$7.99. This book is a guide to programming. The reader is not expected to have any familiarity with the language as both the environment and statements are introduced and explained with the help of simple programs. The user is encouraged to build these, save them, and keep improving them as more complex language statements and commands are encountered.

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PCP112-Digital Electronics Projects \$10.99. Contains 12 digital electronics projects suitable for the beginner to build with the minimum of equipment — from instrumentation to home security, and a few "fun" projects too. With one exception, all projects are battery powered, and therefore, are completely safe for the beginner or young constructor.

PCP107-Digital Logic Gates and Flip-Flops \$10.99. Intended for enthusiasts, students and technicians, this book seeks to establish a firm foundation in digital electronics. It is for the user who wants to design and troubleshoot digital circuitry with full understanding of the principles. No background other than a basic knowledge of electronics is assumed.

BP76-Power Supply Projects \$3.99. Presents a number of power-supply designs including simple unbiased types, fixed voltage-regulated types and variable voltage stabilized designs. All are low-voltage types intended for use with semiconductor circuits. Apart from presenting a variety of designs that will satisfy most applications, the data in this book should help the reader to design his own power supplies. An essential addition to the experimenters electronics library.

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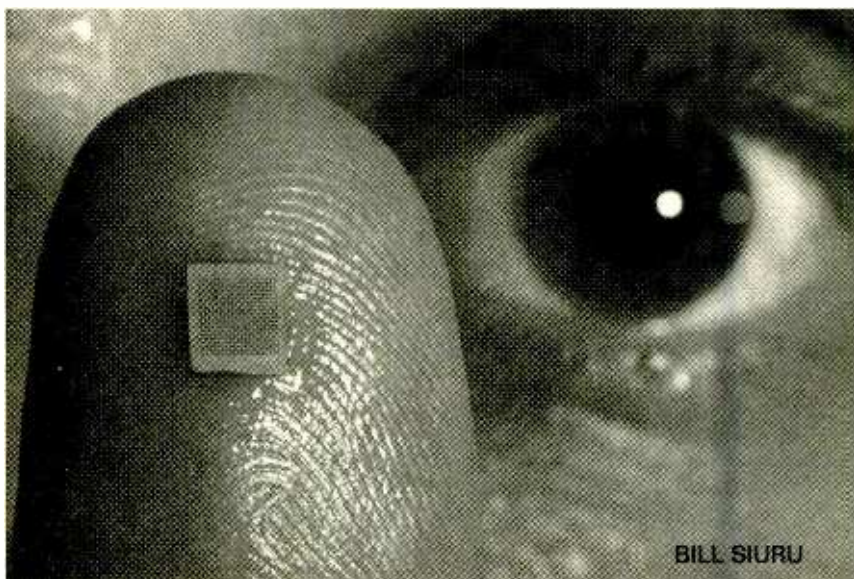
TAKING THE "OUCH" OUT OF DRUG INJECTIONS

*A new drug-injection technique that could
someday replace hypodermic needles*

Most drugs are either delivered orally or through injections with hypodermic needles. Both methods, however, have drawbacks. Taken orally, drugs must resist decomposition in the body's gastrointestinal tract, be readily absorbed through the intestinal walls, and survive attacks by the liver's enzymes. Delivery via hypodermic needles does put drugs directly into the bloodstream, but can cause pain, increase the possibility of infection, and requires some training to do properly.

Researchers at the Georgia Institute of Technology are developing another promising alternative, "microneedles" that are much thinner than the diameter of a human hair. The technology uses reactive-ion etching microfabrication techniques that were originally developed for producing integrated circuits. Tiny needles avoid causing pain because they penetrate only the outermost layer of skin that contains no nerve endings. Once the microneedles penetrate the *stratum corneum*, that is the outer layer of skin, the medications are carried into deeper areas of the skin where the compounds diffuse, are absorbed by the capillaries, and carried into the bloodstream.

So far the researchers have made solid silicon microneedle arrays that are 10-millimeters square. The needles are 150-microns long and leave holes about one micron in diameter when removed from the skin. Further development will reduce the length and diameter of the



THIS EXPERIMENTAL MICRONEEDLE array contains 400 individual needles. (Stanley Leary, Georgia Tech Communications Division)

microneedles, make them hollow to increase the rate of drug delivery, and permit mass fabrication of arrays at least a centimeter square. If the diameter of the microneedles can be reduced, the holes they produce could be small enough to exclude bacteria, eliminating a potential source of infection.

The goal of the research is a "user-friendly" technique for patients that is similar to the transdermal patches that are currently in common use. They would be very easy to use. Users would simply peel off a liner and stick the microneedle array onto the skin. When produced in mass volume, the microneedle arrays should be competitive in cost with existing disposable drug-delivery devices.

Other Advantages. Besides being a painless way to administer small quantities of high-potency medications, the technology could have other advantages. The microneedles would be especially useful with large protein-based molecules, such as those produced through new biotechnology processes. Such drugs often cannot be taken orally, but must be administered frequently enough to make traditional needle injection impractical or unpleasant. Microneedle arrays

FOR MORE INFORMATION

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would give drug developers more freedom to select compounds since they no longer would be constrained by the delivery method.

It is interesting to note that only a limited number of compounds, such as nicotine, can be readily absorbed by the skin. And while techniques are being developed for improving transdermal drug administration using chemicals, electricity, and ultrasound to make the skin more permeable, micro-needles could be both simpler and more effective for delivering drugs through the skin. In laboratory testing, the researchers have demonstrated microneedles can significantly increase absorption of a drug compound through the skin by as much as 25,000 times. Also preliminary testing on humans has shown that insertion of microneedles into the skin does not cause pain.

One interesting application is as part of microprocessor-based systems for delivering drugs continuously or in response to body needs. Here the arrays could be left attached to the skin to provide continuous administration of medication under the control of microprocessor-based equipment. The system could provide constant communication between the drug reservoir and what is happening inside the body. The microprocessor-based equipment could automatically administer drugs based on the body's need. A microprocessor-controlled pump could allow the device to be programmed to deliver a drug at variable rates. Microneedle arrays could also be used to withdraw bodily fluid for analysis. Such a feedback system, for example, could be used to regulate the blood sugar levels of persons suffering from diabetes.

Remaining Challenges. The major challenge ahead will be to demonstrate in a clinical setting that this approach can effectively deliver therapeutic quantities of various drugs safely and economically. For example, will high levels of drug under the skin cause local inflammation or will the body will react to the needle material itself? Also, if

the tips of a very small number of the needles can break off in the skin, will the minute amount of silicon left behind cause problems? Researchers will also determine if other materials or improved needle designs can eliminate this potential problem. As with most new medical techniques, the researchers must demonstrate the safety and effectiveness through extensive animal and human testing before they are put on the market. Ω

CONTROLLING SERVOS

(continued from page 76)

it might be a good idea to change the baud rate to a higher value. The ITC232-A can handle rates as high as 115,200, but the upper limit for QBasic is 19,200. While that might seem to be a bit of a bottleneck, it should be enough for most applications—the servo is always the slowest part of the system.

Now that all of the hardware is set up, BLOCK #5 is where the action takes place. The horizontal- and vertical-position variables (PosV and PosH) are initialized in the middle position—half way between the minimum and maximum position constants for the servos. Then a SELECT CASE statement determines which key has been pressed and sends out the corresponding commands. A capital R will produce a large turn to the right in the horizontal servo and a small r will produce a small turn. The same applies to capital L and lower case l to turn left. For the vertical servo, the U and D keys are used (for up and down). If you need to customize the number of steps taken for the various keystrokes, change the values of the constants LargeStepV, LargeStepH, SmallStepV, and SmallStepH; they are located at the beginning of the program.

The loop contained here is mostly for demonstration purposes. In your particular application, you will probably want to send your move commands directly to the MoveServoV and MoveServoH subroutines. Those subroutines (as their names imply) do the actual work of

sending the move commands to the servos. They also check to see if the servo is already at its travel limit as set by the limit constants at the beginning of the program.

Construction and Use. With most of the parts needed contained in the CompuKit M1, it is a simple task to build the entire circuit on a breadboard using standard construction techniques. In fact, the author's prototype shown in Fig. 4 was built on a solderless breadboard. Using that technique, it is a simple matter to change the circuit around, adding and removing components to achieve your goal. Once you have a circuit that is working well, it would then be a simple task to transfer all of the components and jumper wires to a printed-circuit-based breadboard. Boards to do just that are available from several sources including RadioShack; they carry a solderless breadboard (276-174) as well as a matching PC board (276-170).

As mentioned before, the original goal of this project was to control a small video camera. By attaching one servo to the crank of the other, it was an easy matter to create a motion unit that could both pan and tilt a small "golf-ball" camera that can be attached to a computer. With the QBasic program running in one window and the camera's view in another, you have the makings of a small security surveillance station. Once you become familiar with the workings of the basic hardware and software, your imagination is the only limit to the different uses for an inexpensive motion system. Ω

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Looking at "Miracle" Antennas, and More

ANY "MIRACLE" ANTENNA THAT IS QUITE SMALL YET STILL EFFICIENT WOULD SURE BE A WINNER. AM RADIO STATIONS COULD GET RID OF THEIR LARGE TOWERS. HAMS COULD EASILY MEET THE MOST RESTRICTIVE OF HOMEOWNER'S

covenants. Portable gear would get even more so. Broadcast band AM DX or FM DX would be a breeze, especially in cars and trucks. And "the next big thing" of pulse radio we recently looked at (see MUSE135.PDF on www.tinaja.com) would certainly benefit.

Sadly, Maxwell's Equations and a few related obnoxiously depressing physical laws tend to get in the road. While some new "miracle antennas" are now being highly touted, I found the ones I looked at did not stand up very well to close scrutiny. There's a bunch of real-world disappointments, hype, and wishful thinking here.

Hard data is often not there. And, most conspicuously, nobody seems to be stealing the plans for an obvious zillion-dollar opportunity.

It turns out that any traditional antenna has to be somewhere near a quarter wavelength or larger in size to end up being efficient, and significantly larger if it is also to end up being highly directional. And nothing beats sheer line-of-sight height at high frequencies.

Yet the time is ripe for genuine antenna breakthroughs. That's thanks to our new abilities to analyze and model complex electromagnetics, the new ease in integrating antennas with their driver or sensing electronics, the switch to very broadband communications, potent new techniques for effectively dealing with complex antenna arrays, and new digital coding schemes that give lower signal-

to-noise ratios.

Some Antenna Fundamentals

Maxwell's equations tell us that a time-varying current can radiate as a free-space electromagnetic field. The purpose of any antenna is to act as a launching means between guided and free-space electromagnetic waves or *vice versa*. The "guiding" might be in the form of a wire, a coaxial cable, a stripline, or an actual waveguide.

Let us look at a few fundamental antenna properties:

Duality—Most antennas work equally well in both directions, being able to transmit or receive. The math works equally well either way, subject to power and overload limits.

Regions—Most antennas have two regions, called the near field and the far field. These are sometimes called the Fraunhofer and Fresnel regions. In the near field, behavior is highly complex and most energy drops off with the cube

of distance. In the far field, properties are more orderly and most energy falls off as the square of the distance. The crossover between near field and far field takes place at $2L^2/\lambda$, or around a wavelength for a normal antenna. Figure 1 shows us how the field strength drops with distance on most typical antennas.

Pattern—Any antenna that can radiate equally well in all directions is called an isotropic antenna. Usually, you'll want an antenna to send or gather in energy in a desired direction. Thus creating a special antenna radiation pattern. Patterns are created by the arrangement and size of the antenna elements. The more, the merrier.

For instance, a TV satellite antenna must have a very narrow beamwidth, because the desired bird has a weak signal in a fixed position. But a GPS navigation antenna usually has to follow six wandering birds at once, so it should have a half-hemispherical pattern that looks equally well at the entire sky. Terrestrial TV transmitters create a "bagel" pattern since there's no point in blasting excess energy up or down. Multi-tower AM broadcast antennas purposely "throw nulls" at the nearest neighbor stations for lower nighttime interference.

Gain—The gain of any antenna is a comparison of how good it appears in a given direction compared to some reference antenna. The reference will often be an isotropic radiator or a dipole. In its best direction, a good dipole gives you a gain of 1.64 over isotropic. A TV transmitting antenna having a gain of five will create the illusion of a 50-kilowatt transmitter (ERP, or effective radiated power) in its prime reception area with only 10 kW or so of actual RF input.

Very small antennas traditionally

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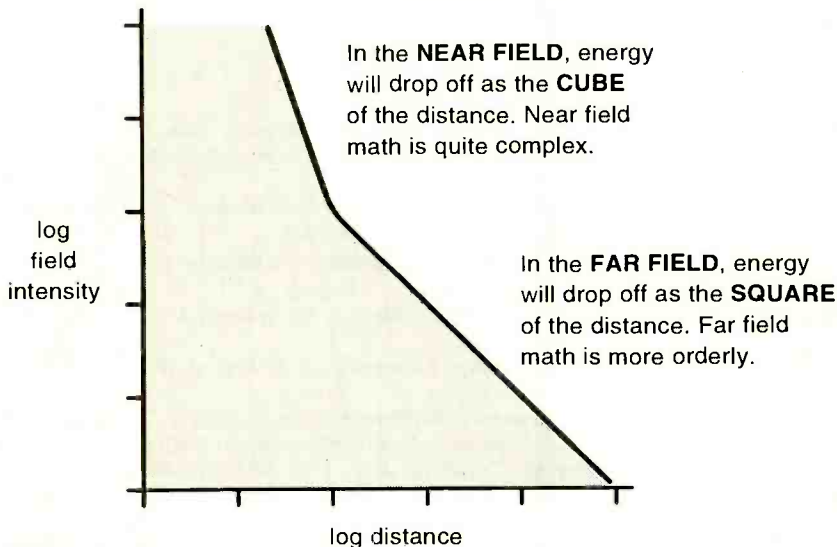
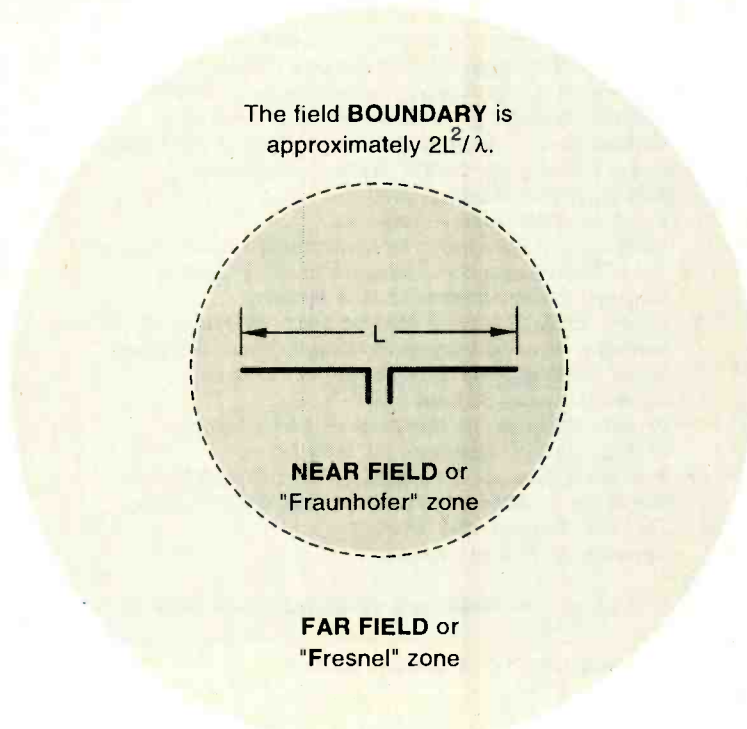


FIG. 1—TYPICAL ANTENNAS HAVE a "near" and a "far" field. Behavior of the two regions is radically different.

have had uselessly low gain values.

Radiation Resistance—If you replaced an antenna with a dummy load that corresponds to the energy outflow, you'd have a resistor equivalent to its radiation resistance. The radiation resistance of free space is 377 ohms. Small antennas tend to have uselessly low radiation resistances. Trying to drive into these creates monumental losses (and often outright burnout) of the matching networks used.

Matching—Transmission-line theo-

ry tells us that an antenna will reflect or kick back energy that's not properly coupled. A standing wave ratio, or SWR, is a way to measure how much incoming energy actually will make it out the antenna. An SWR of unity (1) is ideal. For proper matching, the incoming line impedance must be transformed to the radiation resistance. Also, most antennas are "tuned" to eliminate as much L or C reactance as possible at frequencies of interest. Physically small antennas tend to have a very low radiation resistance

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and strong reactances. These can be exceptionally hard to properly match, especially at higher power levels or over a wider bandwidth.

Effective Height and Area—The effective height of an antenna is the comparison of how it performs compared against a single quarter-wave element. The effective area can measure how much energy is actually gathered in. For instance, placing a large resonant loop near an AM radio dramatically improves its sensitivity. Most small antennas have small effective heights and effective areas. This severely limits both their efficiency and error rate.

The key paper in this subject area is Wheeler's "Fundamental Limitations upon Small Antennas," published years back in the *Proceedings of the IRE*, #35, 1947 pp. 1479-1484. In it, you'll find that the big problems include low gain, lower radiation resistance, poor bandwidth, very difficult matching, and dramatic differences between theory and real world patterns.

Some useful antenna books appear in Fig. 2. You can check into my www.tinaja.com/amlik01.html Web page to get more information on these titles.

Anyway, here are three "miracle" antenna concepts that might not end up being all that they seem:

The Crossed Field Antenna

Did the NAB (National Association of Broadcasters) recently get sucked into an old pseudoscience scam, or has a revolutionary antenna design finally been given the credence that it rightfully deserves? The presentation in question here is Brian Stewart's and Fathi Kabbary's MW Broadcast Cross Field Antennas session presented April 19, 1999 at the NAB99 Las Vegas Convention. In it, a commercial Egyptian AM-broadcast antenna was described that supposedly is barrel shaped and a scant 1/50th of a wavelength, yet gives a claimed efficiency much higher than a conventional design.

The concept is based upon a 1992 patent (#5,155,495). When you look at Maxwell's equations, it turns out that a radiating electromagnetic field can be created by one of two terms. One term is the usual current change. The second term tells us that electromagnetic radiation can occur from any pair of capacitor plates driven in quadrature.

Conventional theory and practice has

- Treatise on Electricity & Magnetism* (James Clerk Maxwell)
- AM Broadcast Station Antenna Systems* (Patrick M. Griffith)
- Antenna Design : A Practical Guide* (George J. Monser)
- Antenna Engineering Handbook* (Richard C. Johnson)
- Antenna Theory : Analysis and Design* (Constantine A. Balanis)
- Antenna Theory and Design* (Warren L. Stutzman)
- Antenna Toolkit* (Joseph J. Carr)
- Antennas* (John Daniel Kraus)
- Antennas and Waveguides for Nonsinusoidal Waves* (Harmuth)
- The ARRL Antenna Book* (Amer Radio Relay League)
- Integrated Active Antennas* (Julio A. Navarro)
- Limited Space Shortwave Antenna Solutions* (Frank Hughes)
- Microstrip Antenna Analysis and Design* (Daniel Schaubert)
- Mobile Antenna Systems Handbook* (K. Fujimoto)
- Modern Antennas* (A. Papiernik)
- Phased Array Antenna Handbook* (Robert J. Mailloux)
- Practical Antenna Handbook* (Joseph J. Carr)
- Practical Wireless Communication Antennas* (Leo Setian)
- The Radio Amateur Antenna Handbook* (William I. Orr)
- The Right Antenna* (Alvis Evans)
- Yagi Antenna Design* (Lawson)

For more details, see www.tinaja.com/amlik01.html

FIG. 2—SOME RECOMMENDED antenna books.

SOME CFA ANTENNA REFERENCES

Papers—

- "CFA—No Tricks," M. Hatley *Electronics World/Wireless World*, Dec 92, p1007.
- "CFA—RIP?" Colin Davis, *Electronics World/Wireless World*, May 93 p405-407.
- "A Conventional Explanation for the Crossed Field Antenna," M. Smith, *Electronics Letters* #28, 13 Feb 92, p360-361.
- "Fundamental Limitations of Small Antennas," H.A. Wheeler, *Proceedings of the IRE*, #35, 1947 p1479-1484.
- "Is This Antenna For Real?" Chris Anderson, *Radio World*, March 31, 99, p26-29.
- "Misguided CFA," K. Donaldson, *Electronics World/Wireless World*, May 93, p837-838
- "An Operational MF Antenna using Poynting Vector Synthesis," M. Hatley, Antenna Propagation Conference 7 part 2 #333 April 91 p645-648.
- "Three MW Egyptian MW Broadcast Cross Field Antennas," Brian Stewart & Fathi Kabbary, NAB Convention NAB99, Las Vegas, April 19, 99.

Critique—

- Electronics World/Wireless World*: Mar 1989, page 216; Nov 1989, page 1109; March 1990, page 253; Dec 1990, page 1094; June 1991, page 476; July 1992, letters; May 1993, page 405; Sept 1993, page 747; Dec 1993, letters.

Patents—

- US# 5,155,495 View through the link at www.tinaja.com/patnt01.html

Construction Plans—

- AntennaX* online magazine at www.antennax.com

Newsgroups—

- rec.radio.amateur.antenna
- sci.physics.electromag
- uk.radio.amateur

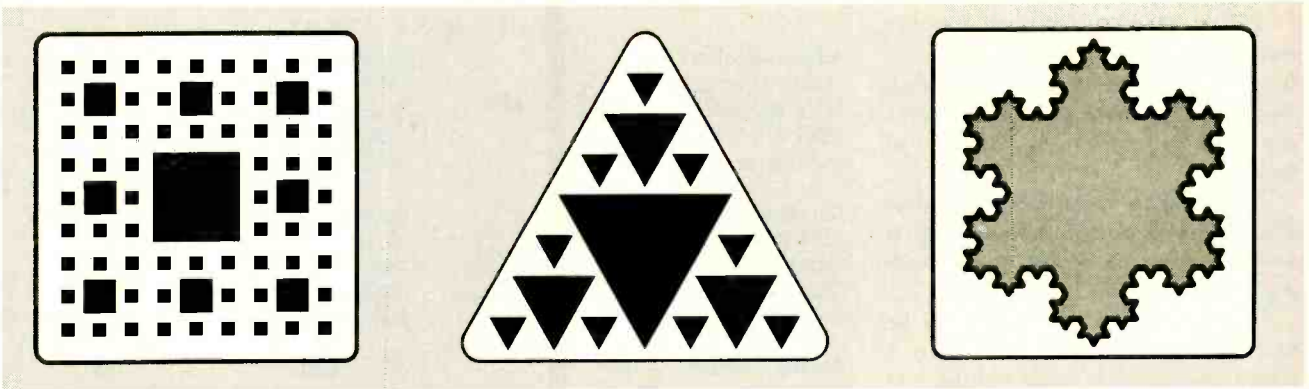


FIG. 3—SOME POSSIBLE 2-D FRACTAL antenna designs.

strictly limited this alternative to the near field only. In ten years, hams experimenting with a painfully obvious need have yet to come up with any CFA that was even remotely useful. Problems include matching networks blowing up when they try to drive a very low radiation resistance and a lack of field strength and sensitivity.

Theoreticians seem to have found and published explanations that seem to demolish the CFA concept, and I've been unable to find any credible peer-

reviewed papers published in any of the expected journals despite all the obvious benefits of such a stunning breakthrough. Critics who visited the Egyptian site felt that sand and exceptionally poor grounds severely degraded the original vertical antenna; that their still-in-place older antenna somehow acted as a resonator; and that line currents were not allowed for. They also felt the station test equipment to be out of calibration.

Lots of ongoing lively newsgroup

discussions on the CFA are found in rec.radio.amateur.antenna. The usual searching at www.dejanews.com also gives you lots of CFA stuff to study. So does punching CFA and antenna into www.hotbot.com. More on the NAB is at www.nab.org. A few construction projects on cross field antennas can be found at www.antennax.com.

I've gathered together some CFA references for you as our resource sidebar. You can view them and form your own conclusions.

Two Other Contenders

A second small "miracle" antenna is the CTHA, short for contrawound toroidal helical antenna. In it, a pair of radiating wires is wound in opposite directions around a toroidal (doughnut) shaped form. This one starts off looking good theoretically, but seems to pick up problems when it's actually applied in the real world, especially near a ground plane where the pattern tends to downgrade. Gain values also tend to be quite low.

Integral Technologies, found at www.itechfin.com, is one information source. A Contrawound Toroidal Helical Antenna paper by the West Virginia University's CIRA research center is a useful reference; you can get it at www.cira.wvu.edu. US patent number #5,734,353 might be of interest here, and can be easily viewed by way of my www.tinaja.com/patnt01.html.

As with the CFA, visit DejaNews, Hotbot, rec.radio.amateur.antenna or www.antennax.com for more.

A third new option is the fractal antenna, which could be any pattern-repeating or self-similar design such as a classic log periodic. What's new here is that it tends to use fractal math patterns, otherwise known as wiggly wires or big bunches of holes.

```
% REFERRAL LOG EXTRACTOR

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% (520) 428-4073 don@tinaja.com www.tinaja.com All rights reserved.
% Consulting services available per http://www.tinaja.com/info01.html

% Fully annotated version appears in http://www.tinaja.com/acrob01.html
% Use TWO reverse slashes when ONE is wanted in a filename PS string!

/sourcefilename (C:\medocs\logfile.txt) def % log file to be read
/targetfilename (C:\medocs\xtinfile.txt) def % referral file to be made
/searchphrase (tinaja) def % exclusion term to filter on

/workstring 20000 string def % start service procs

/checkline {dup searchphrase search addtooutfile1}
(pop pop pop) ifelse} def

/addtooutfile1 {(http://) search {pop pop dup (?) search not {addtooutfile1}
if}if} def

/ws {writefile exch writestring} def

/startoutfile {targetfilename (w+) file /writefile exch def (\n\nLines NOT
containing ) ws searchphrase ws (in document ) ws sourcefilename
ws (\n\n) ws} def

/addtooutfile {ws (\n) ws} def

/endoutfile {(\n\n) ws writefile closefile} def

/grabphrase {sourcefilename (r) file /workfile exch def startoutfile {mark
workfile workstring readline {checkline}{exit} ifelse clearoutmark}loop
endoutfile pop} def

grabphrase % this actually does it
```

FIG. 4—A WEB REFERRAL-LOG READER written in PostScript.

Fractal antennas do seem to offer somewhat smaller sizes and moderately broader bandwidths than traditional designs. They make nice student projects, but big time uses have yet to appear.

One leading researcher is Nathan Cohen. Fractal Antenna Systems up at www.fractenna.com appears to be a leading commercial site.

The fractals used apparently can be two- or three-dimensional. Figure 3 shows some possible small and flat 2-D fractal antenna designs. Several 3-D fractal antenna student projects appear at www.antlab.ee.ucla.edu/~johng/fractal.html. The classic fractal shapes include Sierpinski, the Koch curve, the Koch Island, and the Mandelbrot tree.

Additional antenna analysis can be found at www.tinaja.com/info01.html.

Reading Web Referral Files

I sure like to apply PostScript as a general purpose computer language. PS is really superb at reading most any file in nearly any format. Easily written PostScript code can be sent to Acrobat Distiller, or else to its Ghostscript alternative, creating your choices of a screen or a printable page, a displayed and recorded log message, an actual I/O control, or a new disk file—the latter written in any format you like.

Much more on all this appears on www.tinaja.com/acrob01.html and at www.tinaja.com/post01.html. Start off with file DISTLANG.HTML. That PostScript Reference Manual or red book from Adobe is essential reading. You can find it through www.tinaja.com/amlink01.html

How are people reaching your Web site? Which of the banners and links are effective? Your answers to those questions are found in the log files that your ISP should be giving you. Two problems though. The files can be long and difficult to read.

WebTrends or other reporting apps often report the amazingly useless discovery that “your site” or “none” are the most popular referrals. And thus are the only ones reported on. Wowie gee!

Log file details appeared back in MUSE124.PDF and in similar files on my Web site. Figure 4 shows us a simple PostScript log file reader.

Rather than extracting all of those individual fields, we simply note that a <http://> string normally appears only at the beginning of the referral informa-

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(800) 833-6687
www.adobe.com

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www.sciplus.com

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www.analog.com

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www.antennex.com

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www.fractenna.com

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www.linear-tech.com

National Association of Broadcasters

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Washington, DC 20036
(202) 429-5300
www.nab.org

Pivot Point

225 N Highland St.
Hustisford, WI 53034
(800) 222-2231
www.pivotpins.com

Radio World

5827 Columbia Pk. #310
Falls Church, VA 22041
(703) 998-7600
www.imaspub.com/rw.html

RF Design

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(303) 793-0448
www.rfdesign.com

SGS-Thomson

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www.st.com

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Technical Works

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www.technicalworks.com

Time Domain

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(256) 922-9229
www.time-domain.com

WebTrends

621 SW Morrison #1025
Portland, OR 97205
(502) 294-7025
www.webtrends.com

tion. And that a “?” anywhere in the string probably comes from a search engine rather than another site.

This PS code reads your log file a line at a time. It searches each line for the <http://> magic marker. If it is found, the rest of the referral will be tested for

the absence of your host site name or for any search engine. If useful, it writes the valid remainder of the referral to a new disk file. This file is easily viewed or modified to HTML code for web access.

Note that you should rename your log file as logfile.txt and remove any

ending nulls from it for this code to work as shown. And always use two file-name reverse slashes inside a PS string for every one you want.

Watch that detail!

For a simple modification, remove the not after the “?” search. This time, you get a list of only your search engine queries. Thus telling you what people are looking for when they find your site, which can be very handy information.

Fancier PostScript-as-Language examples let you extract all reference url's in your Acrobat files and then semi-automatically test all of them for valid links. Find this one as my file PDFLINK.PS that I have uploaded to www.tinaja.com/blat01.html.

Lots of great opportunities here. Also try [comp.text.pdf](#).

An Update

In our recent pulse radio tutorial of MUSE135.PDF, I purposely omitted any mention of government lab work. As someone with a strong aerospace-radar background, I felt their whole program seemed highly questionable from the get-go. For real eye-openers on tax dollars at work, view www.house.gov/science_democrats/archive/mirrpt99.htm plus all the information up at www.time-domain.com/news.html.

Pulse radio does offer incredible potential. Don't miss out keeping up to date on this emerging topic.

New Tech Lit

From Hitachi, there's a new CD ROM on their H8 Embedded Controllers. From Linear Technology, comes a LT1328 IRDA infrared receiver.

From Analog Devices comes a single chip 7175A digital-to-NTSC encoder. From SGS, check out the new series of Class-D audio amplifiers such as their nice 18-watt TDA7481. We saw more on similar amps in MUSE128.PDF.

Your quickest and easiest ways to get free data sheets on most anything electronic is to click on either of the DATA or QUEST links on my Guru's Lair homepage at www.tinaja.com.

“Understanding Range Limitations of Low-frequency Unlicensed Transmissions” is found in *RF Design* for April of 1999, pages 36 to 50. We may look at this in a future column.

Dark Life is an outstanding new book by Michael Taylor. Evidence is fast mounting that the most common life form on earth is life as we don't know it:

For example, rock eating subminiature cave bugs who would consider the inside of your car battery “cool but cuddly,” and whose lifestyles are based on a sulfur reduction that is done in total darkness. This has big-time implications for everything from SETI explorations to cancer cures. Taylor's book is also a highly readable “like it is” glimpse into cavers. I have personally been underground with quite a few of the researchers he mentions.

A new line of accurate low-cost power meters are now available from Brand Electronics. And Brad Mock's Technical Works has his new line of fast and low-cost prototyping aides, PIC and otherwise. Click through on my Web banners to reach these.

A broad variety of quick release pins and similar fastener solutions is available from Pivot Point. I'd sure like to use them on Nissan Pathfinder rear seats. Please let me know if you know of any ready-to-go aftermarket products that solve this obvious need; there seems to be a big-time product being missed out on here.

My favorite two surplus stores are American Science and Surplus and C&H Sales. Both offer free catalogs. Lots more surplus bargains are up at www.tinaja.com/barg01.html, which is newly spruced up with photos and online ordering. Among what you'll find there is a 60-kilowatt triple-load bank, a quality CO2 incubator, and a printed-circuit plate-thru lab.

For all the fundamentals of digital integrated circuits, check into my *CMOS* or *TTL Cookbooks*, either by themselves or as part of my bargain-priced *Lancaster Classics Library* as per my nearby Synergetics ad.

My latest Web site additions up at www.tinaja.com include greatly expanded content for my three Tech Musings, Blatant Opportunist, and Resource Bin e-zines.

As usual, mentioned items should appear in our Names & Numbers or CFA References sidebars. Be sure to look there first. A reminder that free answers to easy tech questions can be gotten by phoning or e-mailing me per the Need Help? box. Please be sure to include your e-mail address if you expect a personal reply.

More detailed solutions are found through my InfoPack service. Details at www.tinaja.com/info01.html. Or you could try our consultant's net at www.tinaja.com/consul01.html.

Let's hear from you.

SERVICE CLINIC

(continued from page 13)

enough to measure and/or disconnect the potentiometer. If the problem is inside the potted part of the flyback, the only alternative is a new flyback or an external divider if you are so inclined. However, once the focus network goes bad inside the flyback, there is an increased chance that other parts will fail at some point in the future.

If the voltages check out with the CRT disconnected, there is a chance of a bad CRT or of a shorted component on the PC board on the neck of the CRT. Look for shorted capacitors or burnt or damaged traces.

Measure the voltage on the focus pin of the CRT, **but be very careful:** If there is an internal short, you could have the full 25 kV+ at this location! If you get a reading, this would be an indication of an internal short in the CRT.

Bad Focus and Adjustment Changes Brightness

This is the classic symptom of a short between the focus and screen supplies—probably in the focus/screen divider, which is part of the flyback or tripler; see Fig. 3. However, it could also be in the CRT. If you have a high-voltage meter, measuring the focus voltage will show that (1) it is low and (2) it is affected by the screen control. Similarly, the screen voltage will be affected by the focus control (which is what is changing the brightness).

To determine if the problem is in the CRT, measure the focus and screen voltage with a high-voltage meter. If they are identical, pull the plug on the CRT. If they are now their normal values, then a shorted CRT is a distinct possibility.

Wrap Up

That's it for now. Next time we will continue our discussion of monitor problems and other related items of interest. Until then, check out my Web site, www.repairfaq.org. I welcome comments (via email please at sam@stdavids.picker.com) of all types and will reply promptly to requests for information.

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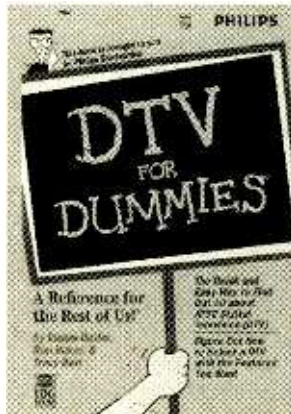
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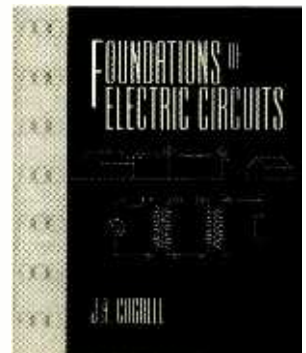
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and end with summaries that review how those objectives have been met. Key terms are highlighted and emphasized by a note in the margin when they are first introduced and defined. Each chapter ends with a glossary that defines many key terms and refers to the context where the words first appear. Problems sets accompany each chapter.

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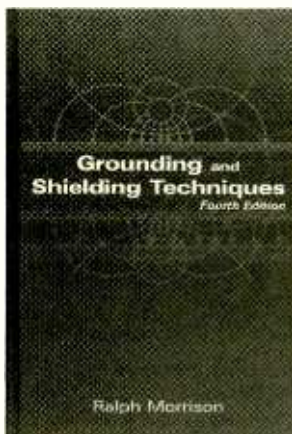
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problems created when analog designs are buried in the middle of hardware that must meet radiation and susceptibility standards.

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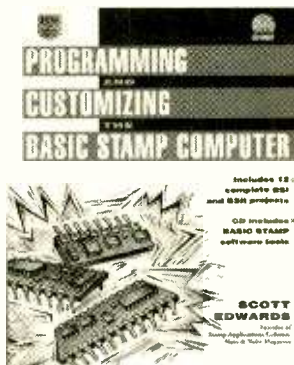
practical explanations of the physics of fields, numerous illustrations, and a clear, readable text.

Programming and Customizing the Basic Stamp Computer

by Scott Edwards
McGraw Hill
1221 Avenue of the Americas
New York, NY 10020
Tel: 800-2MCGRAW
Web: www.ee.mcgraw-hill.com

\$34.95

This guide provides a comprehensive tutorial on the easy-to-use BASIC Stamp single-board computer, which runs a PIC microcontroller and doesn't require any assembly language programming. Starting with a primer on basic electronics, including reading schematics, identifying components, and constructing prototypes, the author goes on to a thorough coverage of both BASIC Stamp I and II—from reading and



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understanding BASIC programs to PBASIC toolboxes to detailed applications. There is also a BASIC Stamp Quick Reference Guide.

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Ideal for a wide range of readers (from the less experienced users to those who want to get more out of their computers), this book offers an introduction to Windows 98. It covers all aspects of the operating system, accessories, and utilities. The use of DOS from Windows is explained, along with the diagnostic and error-correcting tools of Windows 98.

EN

LOW-POWER TRANSMITTERS

(continued from page 40)

Or, do the quality of the Veronica and Broadcast Warehouse transmitters make their choice a necessity?

So, where do you turn for help? One place is *Hobby Broadcasting* magazine, which regularly publishes FM transmitter reviews. The FRN Grapevine (www.frn.net/vines) features an FM bulletin board and chat room, with plenty of enthusiasts who are more than happy to voice their opinions concerning transmitters. Also, the Usenet group alt.radio.pirate is frequented by many active participants—both legal Part-15 station operators and those who choose to broadcast above the legal limits.

Those with the greatest impact on choosing a transmitter and putting it on the air, ironically, have no interest in broadcasting. The FCC, who has complete control over the broadcasting bands, consists of appointed officials, not radio hobbyists or even elected candidates. The FCC could open a new broadcasting band or change the low-power specifications at any time. To keep abreast of the current news in low-power broadcasting, see any of the information sources mentioned above or visit the FCC Web page at: www.fcc.gov.

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Free Information Number	Page	Free Information Number	Page
— "A" tech Video Solutions	68	142 Jameco Electronics	CV3
— Abacom Technology	44	— James Electronics	48
— ABC Electronics	52	— KNS Instruments	52
— AES	54	— Lynxmotion	66
214 All Electronics	67	— M ² L Electronics	52
— Allison Technology	50	327 MCM Electronics	43
— Amazon Electronics	64	306 Merrimack Valley Systems	54
— Andromeda Research	50	133 MicroCode Engineering	CV2
— Antique Radio Classified	65	— microEngineering Labs	57
— Arrow Technologies	48	— Modern Electronics	52
— Bsoft Software, Inc.	56	318 Mouser Electronics	48
322 C&S Sales, Inc.	46	— MSC Electronics	64
332 Circuit Specialists	59	262 Parts Express Inc.	51
— CLAGGK, Inc.	7, 68	— Pioneer Hill Software	56
— Cleveland Inst. of Electronics	3	222 Polaris Industries	41
— Command Productions	44	315 Prairie Digital	44
— Connecticut microComputer	57	264 Print (Pace)	61
— Decade Engineering	64	266 Ramsey Electronics	63
— EDE - Spy Outlet	52	283 Resources Unlimited	49
— Electronic Tech. Today	30, 77	— Saelig Co. LLC	50
323 Electronix Express	42	— Securetek	65
— Emac Inc.	57	— Sil Walker	56
— Engineering Express	64	— Square 1 Electronics	58
335 Foley-Belsaw	53	— Super Circuits	48
— General Device Instruments	57	— Tech Systems	66
160 Global Specialties	19	— Techniks	64
— Grantham Col. of Engineering	8	— Technological Arts	66
— Home Automation	56	312 Telulex	62
— Howard Electronics	69	333 Test Equipment Depot	62
331 Howard Electronics	45	217 Test Equipment Sales	58
— ICS	65	275 Timeline	42
— Information Unlimited	60	— Unbound Tech	58
— Intec Automation	65	— U.S. Cyberlab	54
138 Interactive Image Technologies	CV4	132 Windjammer Barefoot Cruises	8
319 IVEX Design	55	— World Star Technologies	64
— J&M Microtek, Inc.	65	— World Wyde	64, 65
— J-Tron Inc.	64		

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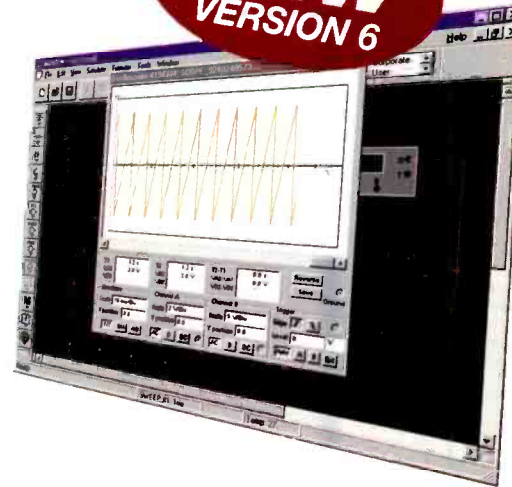
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