NUTS & VOLTS MAGAZINE

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VOL. 18 NO. 11
NOVEMBER 1997

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- Includes driver disks, photocopied book
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- 102-key keyboard has standard QWERTY layout with additional French characters
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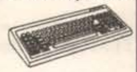

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- Sold in pairs, choose AC operation, mobile, or one of each.
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- Unit has DB-9 connectors, you will need to fabricate an adapter cable set (DB-9 male & female to mini-modular connectors, diagram provided, ask about parts kit for land-line unit)
- Both styles are identical except for power adapter and one jumper.
- Units are new in box, 90-day warranty - exchange

HSC# 16909 Land-Line Phone Scrambler
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Tired of the cheesy sound coming from those give-away speakers in your multimedia kit? Try upgrading to these sonic wonders...you'll have to hear them to appreciate the difference these will make without blowing your budget!

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- 3.25" woofer, 1" piezo tweeter, ported enclosure
- 15W built-in amplifiers, 80W peak, 5.4W RMS
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- AC adaptor, audio cables included
- On-off switch, 3-D switch, bass, treble & volume controls
- Attractive off-white finish with grey grille-cloth

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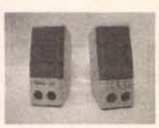

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  - Mac software included
  - SCSI Controller & software required for IBM use
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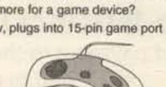

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Nuts & Volts Magazine encourages article submissions and queries. Send a SASE for a copy of our writer's guidelines.

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

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

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reader FeedBack

Correction for "Build the LAB" (Oct '97) by Larry Ball

Between the time "Build the LAB" was written and the time it appeared in the Oct. '97 issue, the variable capacitor mentioned in the article (Mouser and DC Electronics Part #24TR218) was discontinued by the manufacturer. I apologize for any problems this may have caused the readers of *Nuts & Volts Magazine*. Fortunately, there are alternatives.

Fair Radio Sales (1016 E. Eureka St., P.O. Box 1105, Lima, OH 45802, **419-223-2196**) sells a 12 pF to 475 pF variable capacitor which will work as a replacement. It's part #C123/URM25. The correct leads for this capacitor are the top solder terminal and the case.

Antique Electronic Supply (6221 S. Maple Ave., Tempe, AZ 85283, **602-820-5411**) sells a 15 pF to 500 pF (three section) variable capacitor which will also work. Their part number is #C-V500-X3. When connecting this capacitor, use any one of the six circular loops as one lead, and the case as the other lead. All of these capacitors are much larger than the original capacitor, and will require a larger enclosure than the LAB prototype. Their price is around $10.00 plus shipping.

Again, I apologize for any problems this may have caused.

Larry Ball

Corrections for "Digital Voltmeter Capacitance Adapter" (Sept '97) by Fred Blechman

Several words in the final paragraph were left out. It should read:

The two switch knobs fit through round holes in one end of the box, and the unknown capacitor terminal mounts on the top.

Also, the paragraph at the top of page 62 should read:

Capacitors are inherently AC devices, since they block DC current flow once they are charged, and the amount of AC current they pass "increases as AC frequency increases."

Due to unforeseen circumstances, Part 3 of "Encyclopedia of Electronic Circuits" by TJ Byers, had to be rescheduled until next month. Sorry for any inconvenience this may cause.

Editor

Continued on page 93

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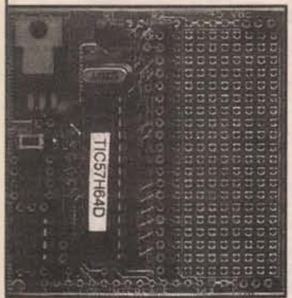

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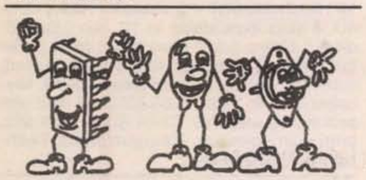

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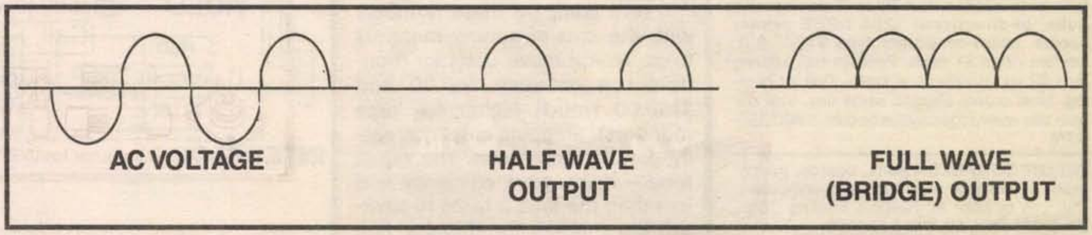
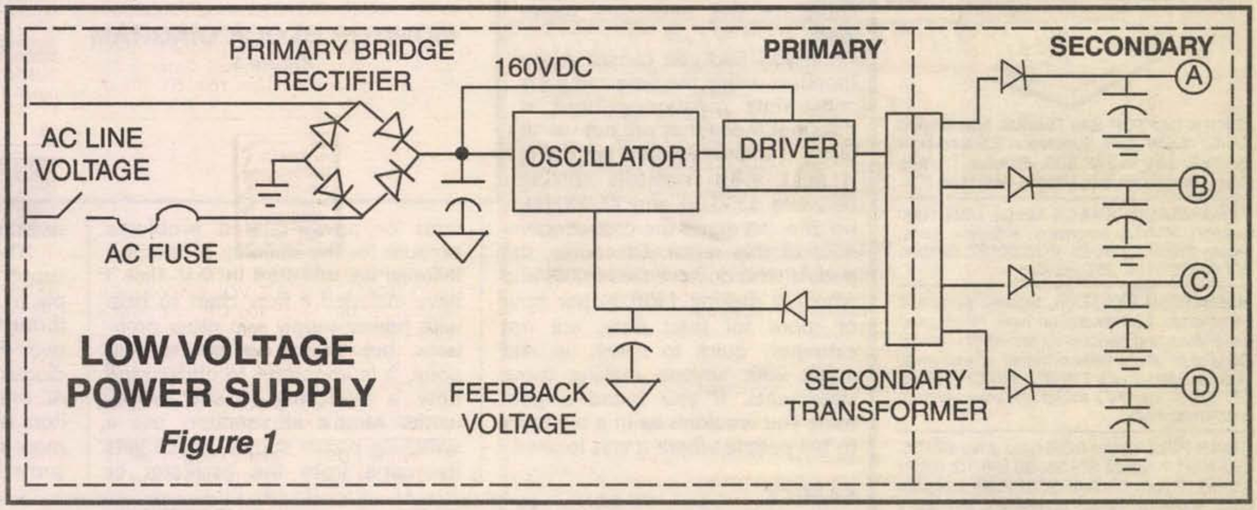
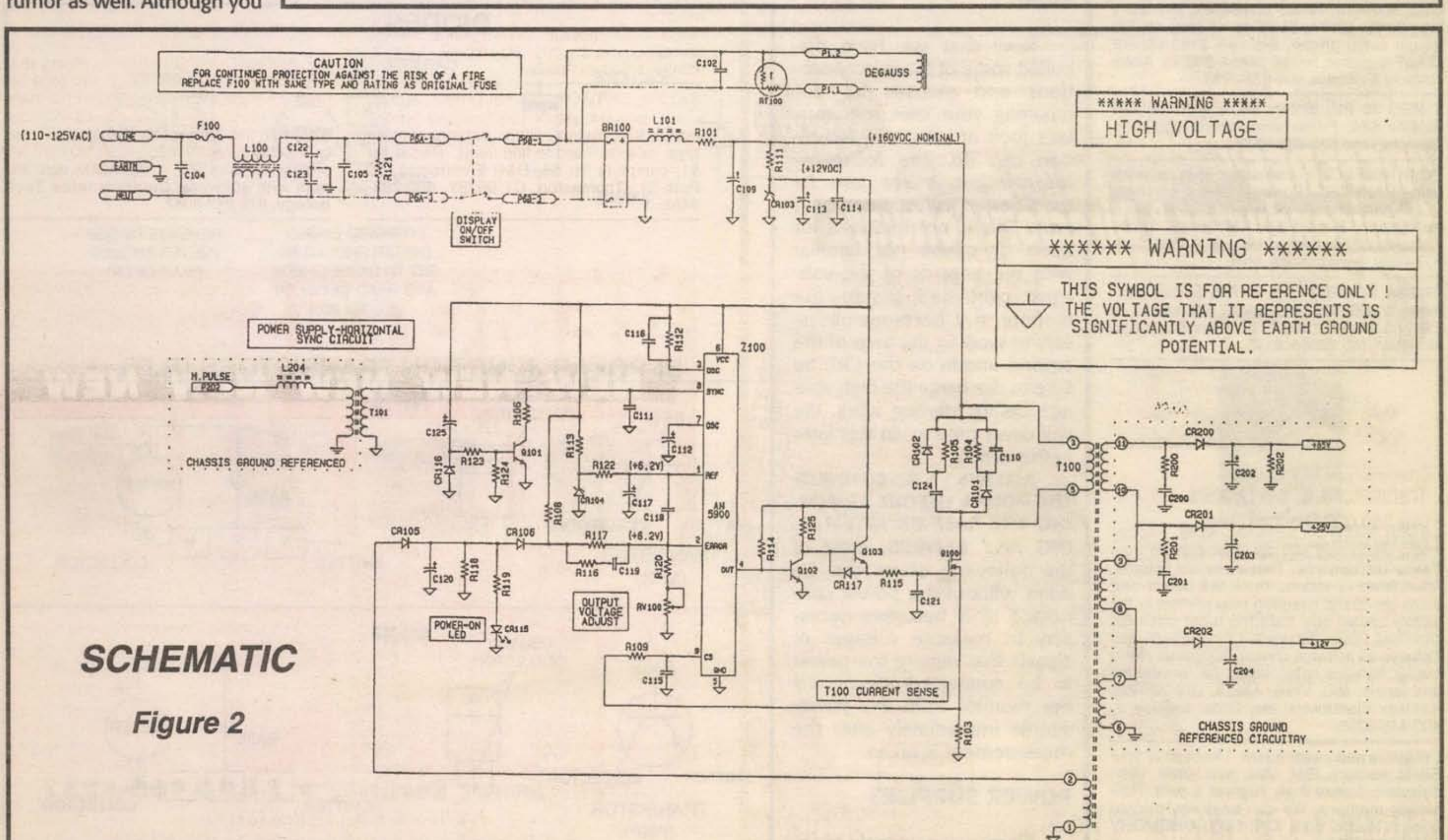




LOW VOLTAGE POWER SUPPLY

Figure 1



SCHEMATIC

Figure 2

COMPUTER HARDWARE *cont.*

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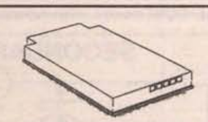

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could spend thousands on fancy test equipment, the most efficient equipment is also the least expensive. For example, starting from scratch, you can buy everything you need at a cost of under $700.00, and you would be well equipped (see list of equipment at the end of this article). If you wanted to cut some corners, you could get started for about half that number.

Let's compare these numbers with the cost of getting monitors fixed. Typical repair costs for monitors run between $65.00 and $150.00 (much higher for large monitors). Shipping costs can easily double these costs. The repair time — if you work efficiently — is less than the time it takes to package the monitor for shipping and complete the necessary paper work.

If you find you cannot repair monitors within the time and parts constraints mentioned here, it does not mean they are not worth fixing, it means you are not doing it right. With monitors costing between $200.00 and $3,000.00, no one can argue the cost-effectiveness of this repair. Of course, the people who do have these skills and who are making $300.00 per hour or more for their time, are not extremely quick to speak up and argue with anyone making these statements. If you found a gold mine you wouldn't be in a big hurry to tell people where it was located.

SAFETY

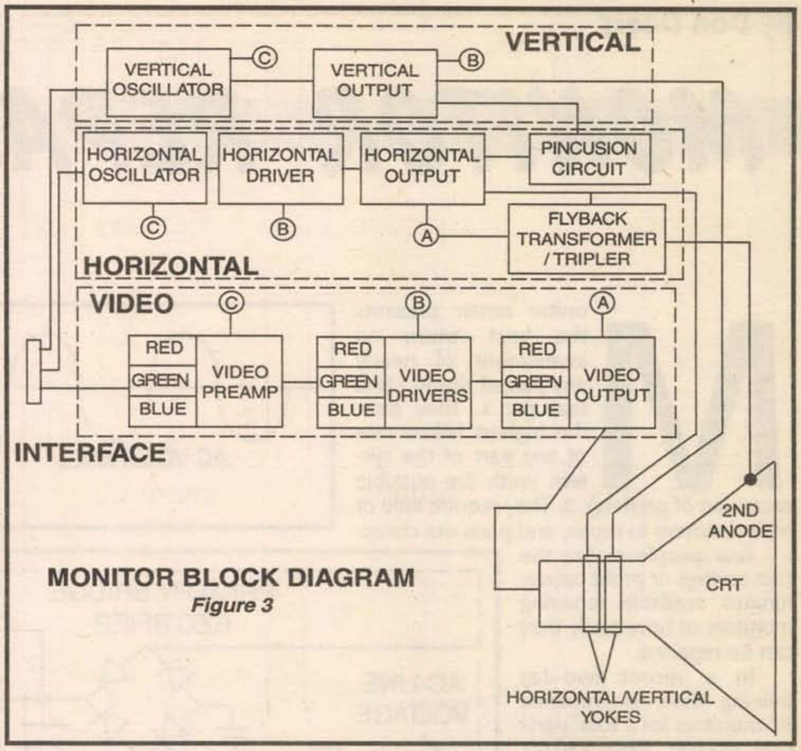
Now that we have dispelled some of the misconceptions and excuses for not repairing your own monitors, let's look at what the technician can do. ***The following information is for use by qualified service personnel only.*** This is not intended for users or others not familiar with the hazards of the voltages contained inside the monitor. If it becomes necessary to work in the area of the second anode on the CRT, be sure to discharge the high voltage before starting work. We will cover how to do this later in this article.

ALWAYS DISCONNECT THE POWER BEFORE REMOVING THE CASE OR ATTEMPTING ANY REPAIRS. Most of the following steps can be done without the power connected. If it becomes necessary to measure voltages or signals that require the power to be connected, disconnect the monitor from the power source immediately after the measurement is taken.

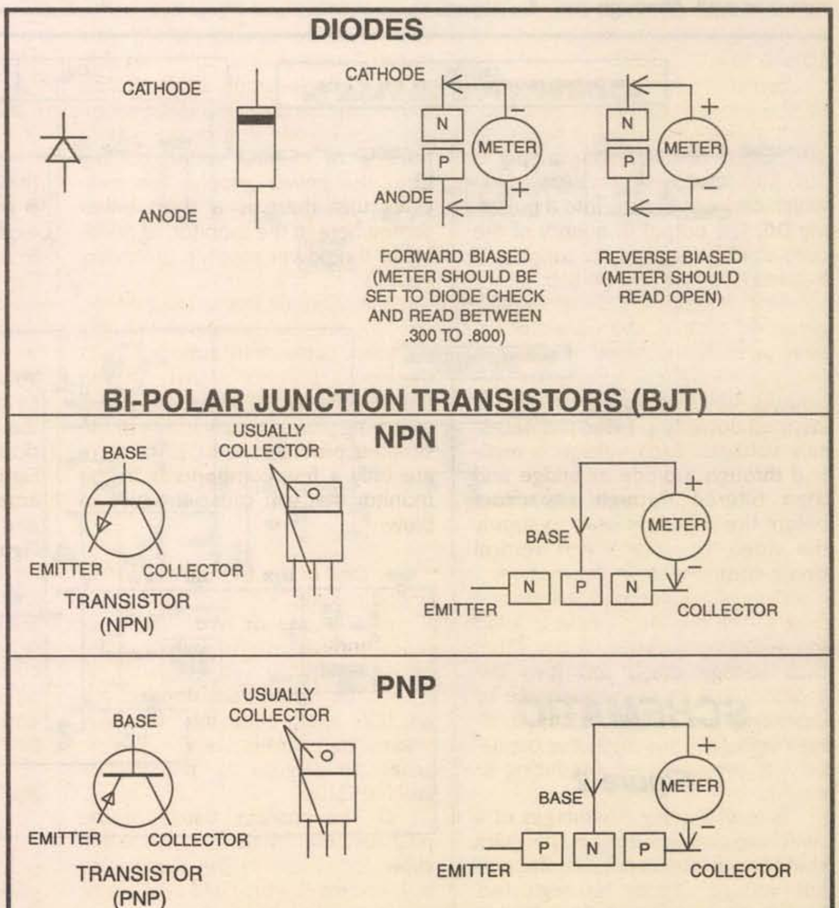
POWER SUPPLIES

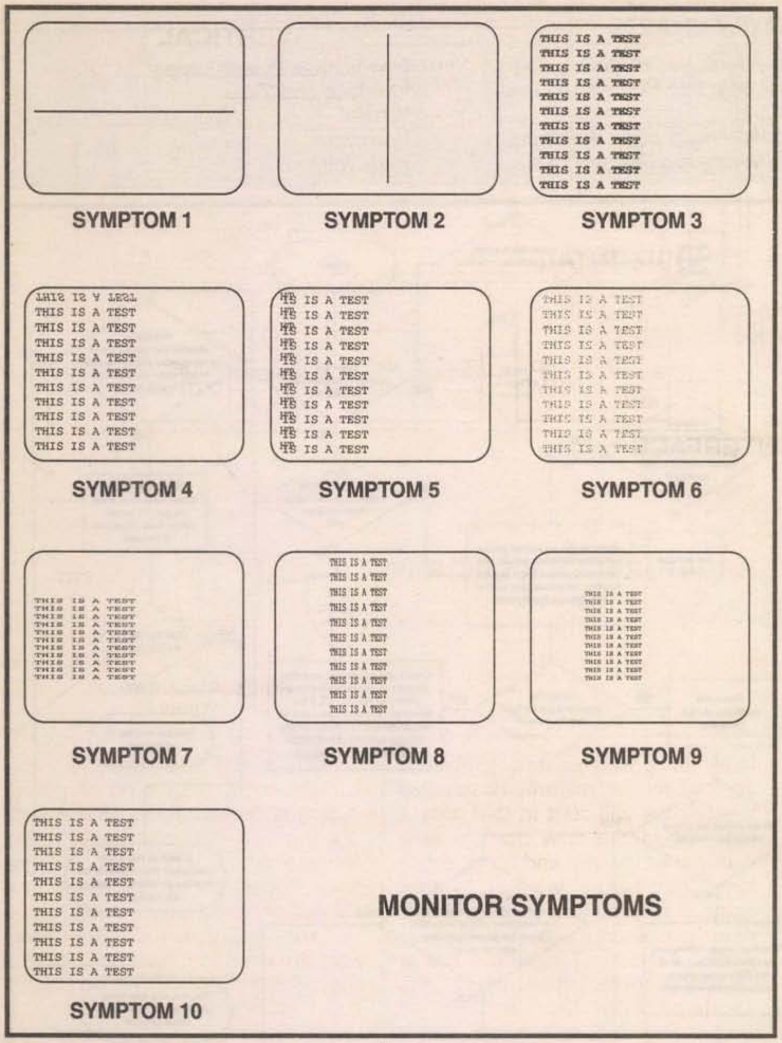
Since power supply problems or power-related problems account for the majority of monitor failures, we will start in that area. I have included a flow chart to help with power supply and other problems, but before we get to that point, it is important to understand how a switching power supply works. Almost all monitors use a switching power supply, which gets its name from the oscillator or switcher circuit (see Figure 1).

The most basic type of power supply is called a linear power supply. In a linear supply, the AC is fed through either a halfwave (one or two diodes) or a fullwave (four diodes) rectifier, which converts the AC into a pulsating DC. Filter capacitors are used to make the voltage a more steady DC voltage, and usually some type of silicon regulator will



MONITOR BLOCK DIAGRAM
Figure 3





be used to keep the voltage regulated at a constant level.

Switching power supplies start off the same as a linear power supply, but instead of using a regulator, the output of the power supply is fed into the oscillator (switcher) which converts the DC into a pulsating DC. The output frequency of the oscillator for most power supplies is between 20 KHz and 60 KHz.

This pulsating DC is usually amplified by a bipolar transistor (or pair) or an FET (labeled as driver in Figure 1). It is then fed into the secondary transformer where it is stepped down to provide the necessary voltages. Each voltage is rectified through a diode or bridge and then filtered through capacitors before the voltage is used to supply the video, horizontal, and vertical circuit components in the monitor.

One of the voltages will be fed back to the oscillator circuit to keep the voltage regulated. If the feedback voltage drops too low, the oscillator will try to compensate by increasing the output. If the feedback voltage is too high, the oscillator will compensate by reducing its output.

One of the big advantages of a switching power supply is the quick shutdown in the event that the output voltage cannot be regulated. Such is the case if there is a short in the monitor pulling down the power. The oscillator, not being able to compensate simply shuts off. This is why, in the case of a dead monitor, you should listen carefully for a buzzing or clicking sound coming from the power supply. This indicates that there is a short either somewhere in the monitor, or possibly in the power supply's secondary section.

If a monitor has a blown fuse, you can count on the problem being a shorted component somewhere in the power supply's primary section (see Figure 1). A blown fuse in a switching power supply is one of the simplest problems to fix, since there are only a few components in the monitor that can cause the fuse to blow:

A. One of the four diodes in the bridge rectifier.

B. The one or two large filter caps connected to the output of the bridge rectifier.

C. The driver transistor (usually an FET) that feeds into the secondary transformer. In the sample schematic (Figure 2), this part is labeled Q100.

D. The posistor. Usually if the posistor (the small black or white cube connected to the degaussing coil) shorts, the fuse will take about one second to blow. If the shorted part is anything else listed above, the fuse will blow instantly.

CURRENT SENSING

In the schematic labeled Figure 2, it is easy to see how the current sensing works. The FET at Q100 (driver) is being switched on and off by the IC at location Z100. As Q100 switches on, it supplies a ground potential to the T100 primary, whose other side is connected to the 160V DC line. When Q100 is off, the potential on the top of R103 (labeled T100 CURRENT SENSE) is at ground. The harder Q100 is switched on, the closer to the 160V potential will be reached at this point.

If the voltage at this point reaches too high a level, it is sensed by the oscillator chip (Z100) and it will shutdown the oscillations, which shuts down the power supply's output. Most power supplies will try to come back up, but will shutdown again if the current reaches an excessive level. This explains the clicking sound usually heard from a power supply when a short occurs.

TYPICAL POWER SUPPLY OUTPUTS

Most monitors will have three or four different voltages generated by the low-voltage power supply. In Figure 1, you will see three output voltages. The outputs will usually be as follows:

80V to 115V (labeled A)
20V to 40V (labeled B)
12V to 16V (labeled C)
5V (labeled D)

These voltages can be seen in the schematic in Figure 2: A = 85V, B = 25V, and C = 12V (with the exception of D = 5V, that is not used in this monitor).

Voltage A in Figure 1 would be used by the high voltage/horizontal output and video output (red, green, blue) sections of the monitor. Voltage B in Figure 1 would be used by the driver or pre-output stage of the horizontal, video (RGB), and vertical output sections. Voltage C in Figure 1 would be used in the preamp section of the video, vertical, and horizontal section (also see Figure 3, Monitor Block Diagram).

The 5V line only applies to monitors that use TTL circuitry. Such is the case for monitors that use digital or on-screen adjustments. Of course, some monitors will vary as far as the number of voltages used and what voltage levels are used, but this applies to most monitors.

BLOCK DIAGRAM

The block diagram (Figure 3) helps to show how the different parts of the monitor interact. All but the earliest monochrome monitors

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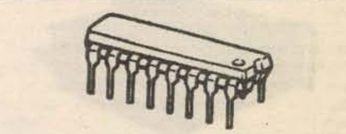

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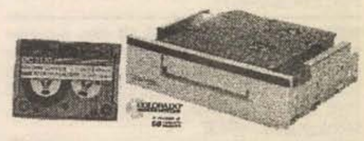

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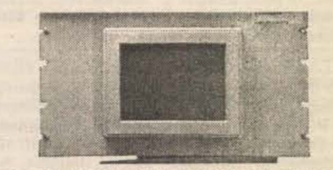

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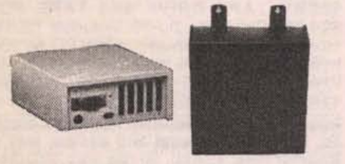

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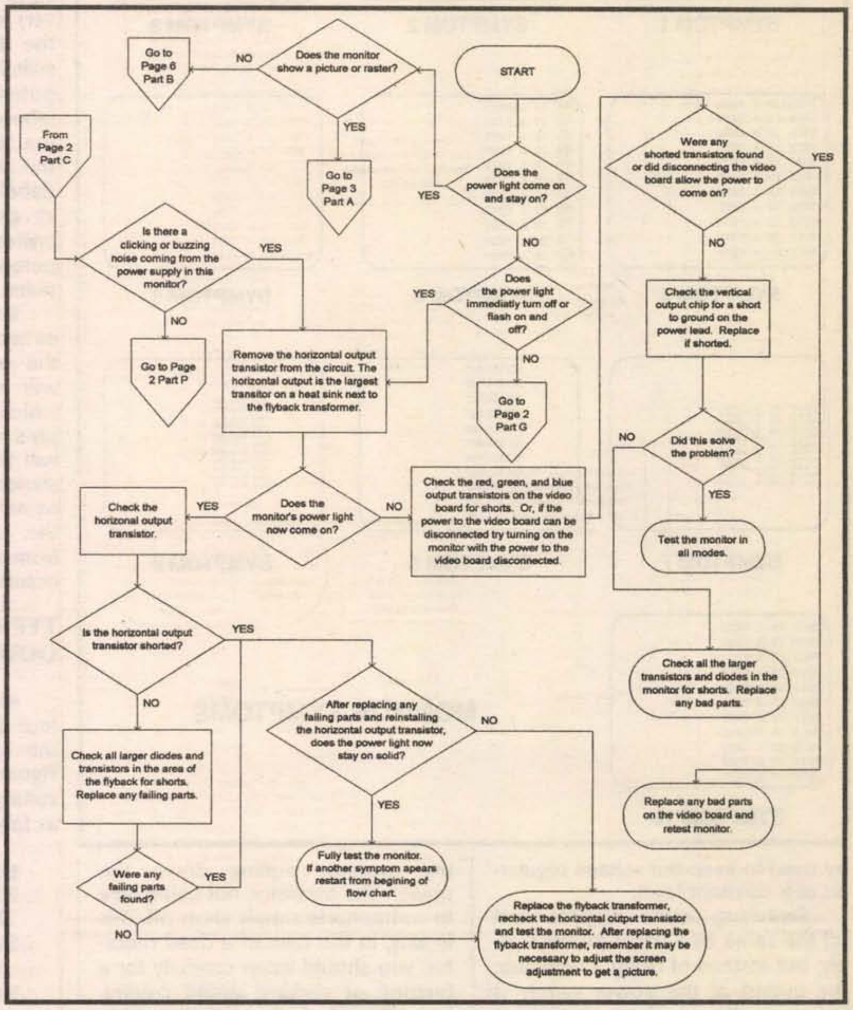
FLOW CHARTS

The following pages contain a flow chart that will help you fix monitors in a minimum of time.

The complete eight-page flowchart covers the following monitor sections:

Low-Voltage Power Supply
Interface and Video
Vertical
Horizontal
High Voltage



have an internal vertical and horizontal oscillator. The vertical and horizontal signals from the system are used to sync up the display with the incoming signals. Most newer monitors have energy-saving modes called a standby mode.

If the monitor does not sense a horizontal signal on the signal cable, they will shutdownown the high voltage and the CRT heater voltages in order to save energy. This is why you must always use an input signal when testing monitors.

In Figure 3, it becomes obvious that most of the circuits in the monitor are simply used to amplify the signals from the system in order to supply the necessary drive required by the CRT.

INTERFACE AND VIDEO

The most common problems that could be associated with either of these sections would be, for example, incorrect colors due to a bad cable, bad video driver chip/transistor, or a bad connection. Other common problems relating to bad interface cables include no display, monitor errors (2401) on POST, inability of the monitor to properly sync vertically or horizontally, or a dim screen. For any of these problems, first check for bent or broken pins on the connector. Next check for a bad cable by wiggling the cable and watching for changes on the screen, and then use an ohmmeter to prove continuity on all connections. Check for bad connections on the board located on the back of the CRT, before looking for failing transistors or capacitors in this circuit.

HORIZONTAL AND VERTICAL

Many of the following problems that can occur with the horizontal and vertical circuits can be corrected with the adjustments either on the front or back of the monitor. For some monitors, the case will have to be removed to get to these adjustments. Always mark the adjustment position before attempting any corrections and do not go crazy trying all the adjustments to solve these problems. Usually, these symptoms are indicative of a bad part. Adjusting all the pots will only create more work later, once the bad part has been replaced. The following is a list of failures associated with the vertical or horizontal circuits:

1. Vertical screen shrinkage (see symptom 7 in the Monitor Symptoms chart on the previous page). Vertical shrinkage indicates a problem with either the vertical output IC, or a bad capacitor in the vertical deflection circuit.

2. Horizontal screen shrinkage (see symptom 8). Horizontal shrinkage indicates a problem with the horizontal oscillator circuit, or deflection circuitry (usually a failing capacitor).

3. Vertical and horizontal screen shrinkage (see symptom 9). If both are shrunken, the problem is probably low-output voltage from the power supply.

4. Wrapping of image vertically (see symptom 4). Usually caused by a failing capacitor in the vertical circuit.

5. Wrapping of image horizontally (see symptom 5). Usually caused by a failing capacitor in the horizontal circuit.

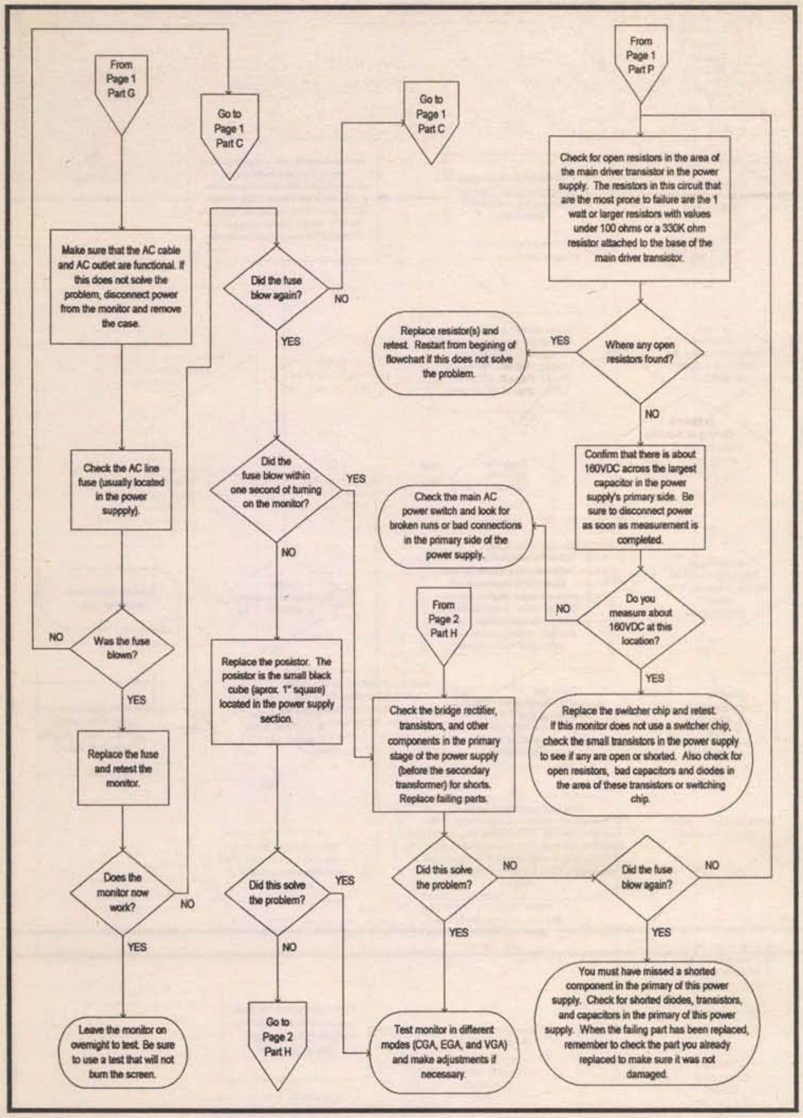
6. No vertical deflection (a line from side to side, see symptom 1). This is usually caused by a failing vertical output IC (in most cases a TDA1170, TDA1670, or TDA1675). This part will sometimes cause a resistor to open that supplies voltage to the chip. If replacing the chip does not solve the problem, look for an open resistor with a value between 10 ohms and 20 ohms.

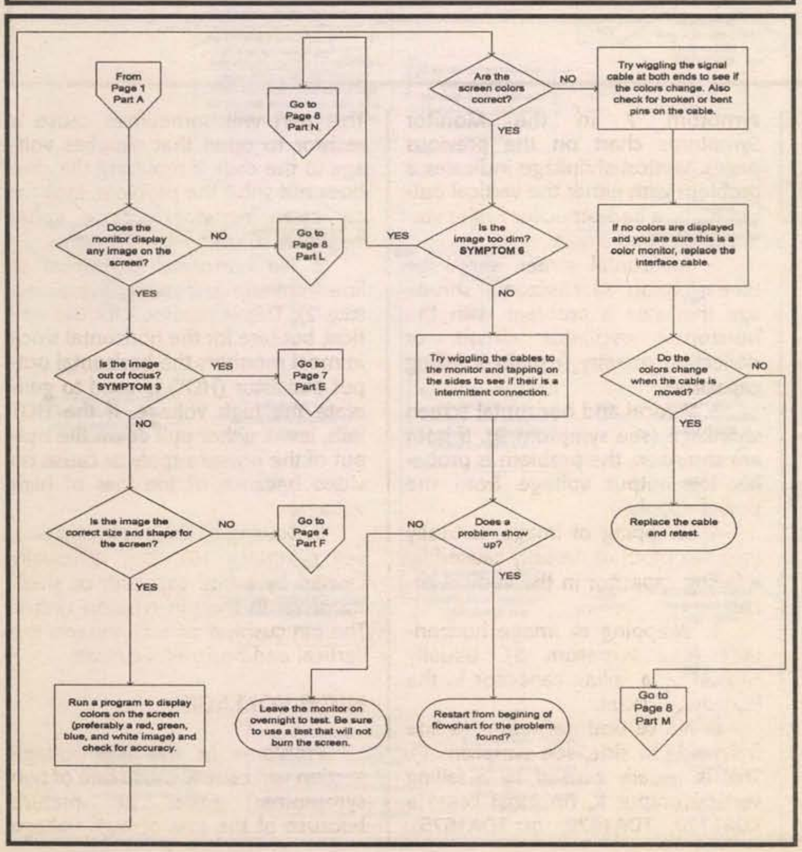
7. No horizontal deflection (a line from top to bottom, see symptom 2). This is common for the vertical, but rare for the horizontal since in most monitors the horizontal output transistor (HOT) is used to generate the high voltage. If the HOT fails, it will either pull down the output of the power supply or cause no video because of the loss of high voltage.

8. Bowing of sides (pin cushion, see symptom 10). This is usually caused by a bad capacitor or small transistor in the pin cushion circuit. The pin cushion circuit connects the vertical and horizontal circuits.

HIGH VOLTAGE

Problems in the high-voltage section will usually cause one of two symptoms: either no picture because of the loss of high voltage





to the CRT, or a dead monitor, due to a short in the high-voltage circuit, with the previous symptom being more likely to occur. Due to the higher current in the horizontal output stage that feeds into the flyback transformer to generate the high voltage, this section generates more heat than most parts in the monitor and is most prone to failures.

This information is for use by qualified service personnel only. This is not intended for users or others not familiar with the hazards of the voltages contained inside the monitor. Much is said about the dangers of the high voltage (for most monitors about 25,000V), but this voltage contains very low current and does not pose a threat unless you wear a pace maker. Most injuries from the high voltage occur *after* a shock from the high voltage, when reflexes take over causing the technician to pull away from the monitor, scraping themselves on a sharp object inside.

If it becomes necessary to work in the area of the second anode on the CRT (this includes replacing a flyback transformer), be sure to discharge the high voltage before starting work. Even if a CRT has never been connected to a voltage source, it can still carry a charge. Most monitors currently being sold have bleeder resistors in the flyback to dissipate the high voltage when the monitor is turned off. But it is best to play it safe by discharging the CRT before working in the high voltage area of the monitor.

To discharge the second anode (with the power disconnected), use an insulated screw driver or lead with one side connected to chassis ground; use the other end to lift up the rubber suction cup covering the second anode and make contact with the lead underneath.

Remember, if the CRT has been sitting around for more than a few minutes, even if it is not connected to the flyback transformer it is still possible for the CRT to pick up a charge from static in the air. It is recommended that it be discharged again before work commences.

When a monitor is dead (no power), it is easy to test the high-voltage circuit as a possible cause. Remove the horizontal output transistor (this transistor is fairly easy to find as it will usually be the largest transistor in the area of the flyback and on a heatsink) from the circuit and see if the power light will now come on when power is reapplied. If the monitor is still dead, you may have a short elsewhere in the monitor or, most likely, you have a problem in the power supply. Most shorts that are hard enough to pull down the power supply are

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in the high voltage or horizontal output circuit.

If pulling the horizontal output transistor does allow the power supply to come up, then test the transistor (replace if bad). If the horizontal output is not bad or replacing it does not solve the problem, it will be necessary to replace the flyback transformer (after confirming no other shorted transistors or diodes in this area).

For monitors that have power but no picture, a high-voltage probe can be used to test the high-voltage output. **WARNING: DO NOT USE A STANDARD VOLTMETER WITHOUT A HIGH-VOLTAGE PROBE TO TEST THE HIGH VOLTAGE.** If the high voltage is not there or is too low, check the horizontal output transistor. If it is good or replacing it does not solve the problem, it will be necessary to replace the flyback transformer.

All of this is assuming that you have already ruled out the horizontal oscillator and driver stages. Occasionally this problem can also be caused by a bad component in the high-voltage shutdownown circuit (designed to protect against over-voltage). Recently, we have seen a high number of NEC monitors with dirty relay contacts causing these same symptoms.

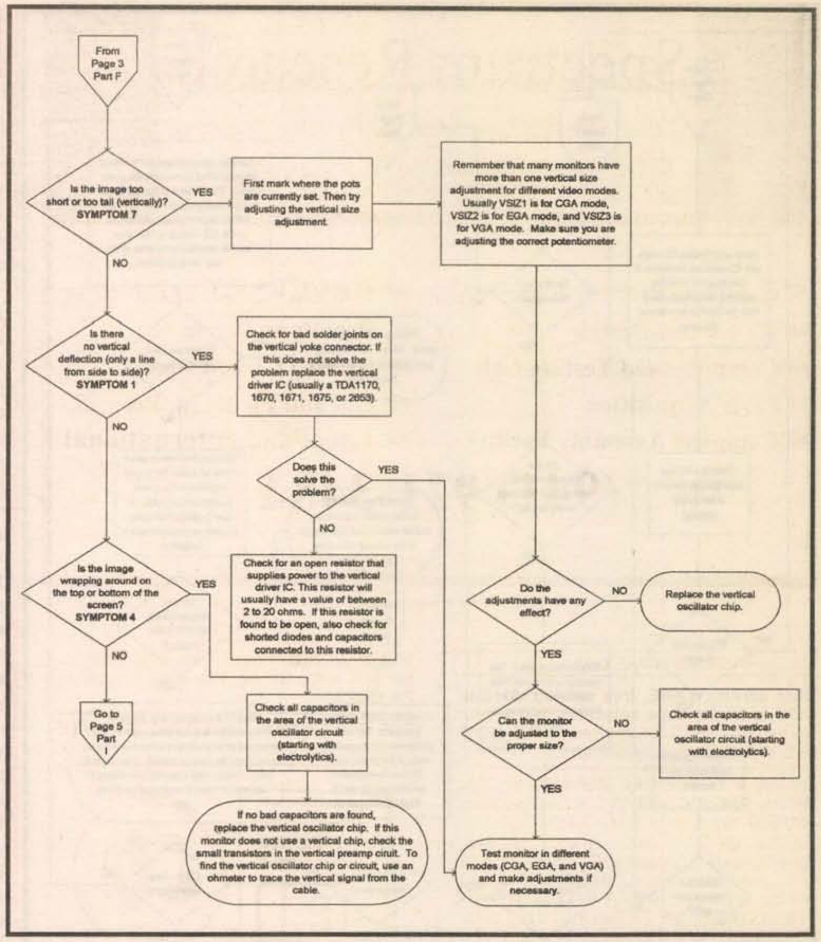
TESTING COMPONENTS

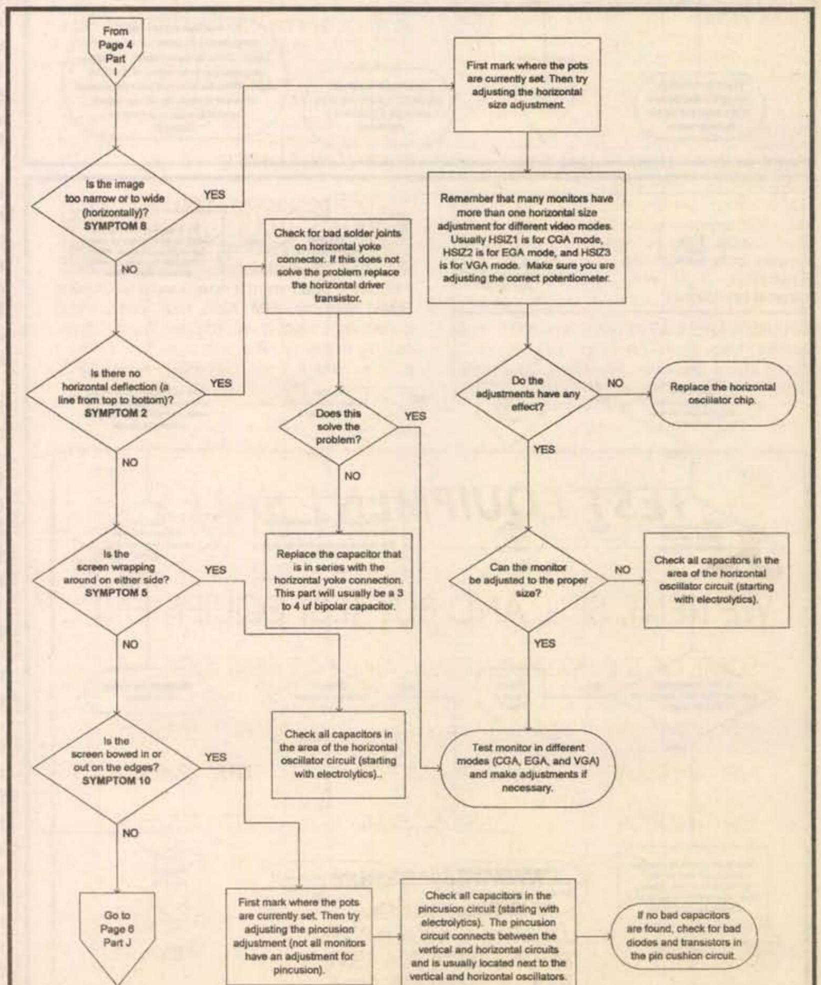
An ohmmeter is one of the most cost-effective tools available. Many of the newer DVMs have transistor testers built in. But almost all meters have a semiconductor test setting (indicated by the diode schematic symbol) used for testing diodes and transistors.

All semiconductor junctions have a forward (should yield a measurement of .3 to .8 on a DVM) and reverse bias condition (should measure as open on most DVMs), depending on which direction the power is applied. Using an ohmmeter on a good diode, you should measure .3 to .8 in one direction and open in the other direction.

Using two meter leads (positive and negative), and considering a transistor has three leads (emitter, base, and collector), there are six different measurements that can be done. A good transistor should give a forward (.3 to .8) reading on two of those six measurements and open on the other four measurements. The exception on some transistors is that they have a shunting diode that will cause them to measure forward bias on three connections, and reverse on the other three.

When transistors fail, they will either open one or more





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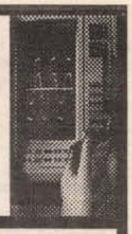

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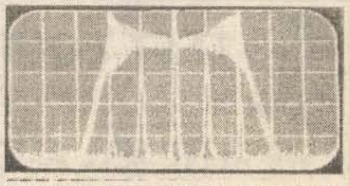

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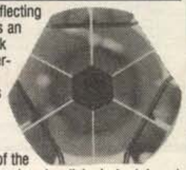

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Recovering Components of Disposable Cameras, and Basics of Flash Tube Circuits

by Brian J. Mork

I think it's a waste to discard disposable cameras. It's very easy to extract your film from a disposable camera, send it off to get developed, and keep all the electronic and mechanical parts for free. By unsnapping plastic catches, the entire camera can be disassembled. This article tells you how. Once inside, the oscillator circuit to charge the flash provides an excellent chance to review or learn a super low-cost oscillator flash circuit.

INTRODUCTION

The way a disposable camera is suppose to work is that you buy a cheap plastic camera with film already embedded inside. After taking all the pictures, you mail the entire package – film and camera – away to be processed. I thought it would be much better if I could mail away just the film, and keep the rest.

The idea works!

I've had experience only with the Kodak brand, but I imagine others are similar. Nonetheless, the specific instructions I give deal with the Kodak model.

After taking the pictures, the film inside one of the disposable cameras is wound up inside a light-tight 35 mm metal canister, just like the ones you use in your more expensive camera. This metal canister can be removed and sent away for processing.

It seemed goofy to me to send away the rest of the camera to arrive in some land fill somewhere. Aren't these components better used in the hands of creative experimentors? You bet they are!

The last third of the article uses the circuit on the inside to learn about charge oscillators – the basic building block of all switched power supplies.

STEP-BY-STEP DISASSEMBLY

To get your film out and to take apart the other pieces, you have to first rip off the cardboard outer coating. When you do this, different cracks and crevices will be revealed.

Don't go poking around inside yet because there is a very real risk of shock unless you know what you're doing.

Photo 1 shows my camera just after removing the cardboard casing. If you look carefully, you can see a cavity across the front bottom where I've removed the 1.5V AA cell that powered the flash circuitry. My battery still tested into the good range with one of those polymer heating strip testers that turn color when pressed onto both ends of the battery. Salvage number one.

From here on out in the dissassembly, don't touch any metal on or inside the camera. Potentially hazardous voltages could be present. Use a screw-driver-ish tool that is not metal – not conductive. For some of the catches, a toothpick might be the best tool. If you have to use a screwdriver, use one with an insulated handle.

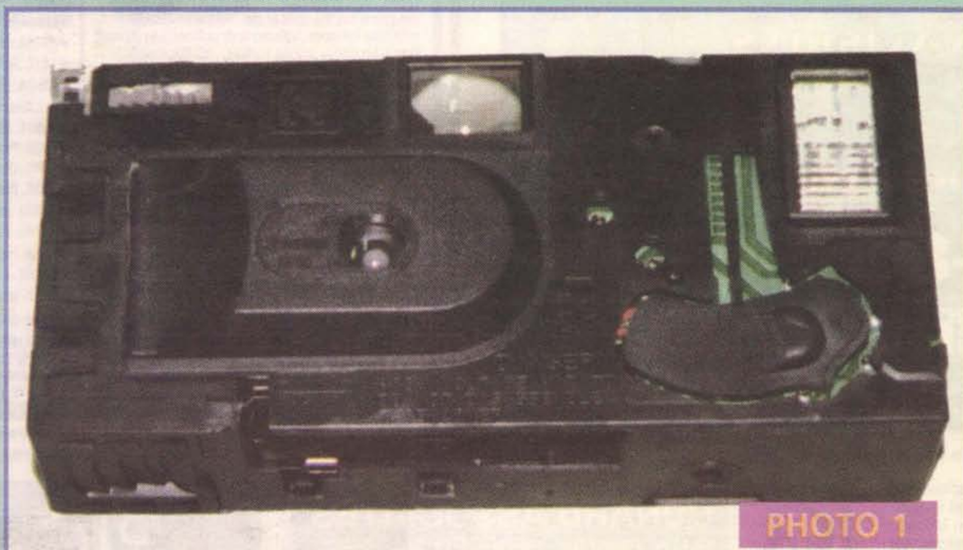
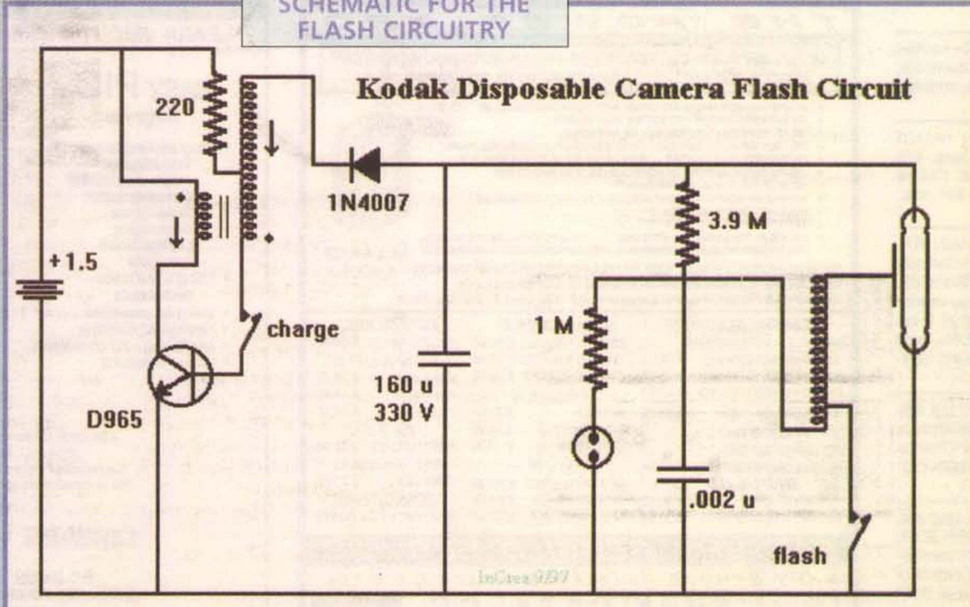


PHOTO 1

SCHEMATIC FOR THE FLASH CIRCUITRY



There is a side panel that covers up the exposed film, which is rolled up in a light-tight 35 mm canister just under the winding knob. To allow the side panel to slide away from the body of the camera, you need to lift up four catches, two on the front and two on the back of the camera.

There was a molded piece of plastic covering the front two catches on my camera. I think the cover piece is there just for cosmetics, or to provide a finger grip while originally using the camera. It has no structural value, so I used a razor blade to slice into it and then bent it off. Release all four catches and slide the cover off.

Photo 2 shows the film cartridge visible just after removing the side panel. Reach inside with a fingernail and pop the film cartridge out. Set it aside for future processing.

The back of the camera is the next panel to remove. It has two catches along the top, which are accessible from the back. Reach inside with your tool and push the catches sideways, away from the winder, toward the view finder window.

There are also two bottom catches that are accessible from the bottom of the camera. Poke into the hole and push straight inward (upward into the camera body) to release these bottom catches.

Reach in the hole or recess and gently bend the plastic tab to release, keeping a little "pull away" tension on the clear piece. Once a catch is free, block it apart with a toothpick before going onto the other catches.

Next remove the top clear piece: two catches along the top rear edge, three along the top front edge. Save the piece. It has a concave, about ~1 cm² lens. Remove four mechanical plastic pieces around the metal trigger mechanism for the shutter and the flash.

The metal pieces around the shutter, including the shutter itself, are part of the electrical discharge circuit. Assume they have several hundred volts on them unless you've measured otherwise.

Next remove the front plate. One catch is along the top front, one is along the left side rear, one is on the front face between the trigger mechanism and where the winding knob was. The last one is down inside, almost in the exact center of the front of the camera; you'll have to reach it with a small bladed screwdriver.

The front lens will pop off. Save it. It is a concave, ~3/8" diameter lens with a focal length of about 1.3".

STOP! *Read the next few paragraphs before touching anything inside the camera.*

Photo 3 shows what you'll be looking at. The two larger through-the-board solder connections on the lower side of the visible circuit board are the main charging capacitor connections. The camera I disassembled had a 160 uF capacitor, rated to 300 VDC. Shorting the two leads together made a LOUD pop and nearly welded the insulated-handle screwdriver I used to do so.

Check the voltage across these leads with a voltmeter before getting your fingers on the circuit board and before further disassembly. If you'd rather not get a loud pop and arcing, position a 1 Kohm resistor across the two solder connections (without touching the contacts or the resistor leads as you do this).

Initially, a current flow of up to 250 mA may flow, but the RC time constant is about 0.16 seconds. Give it 10 seconds and you should be okay.

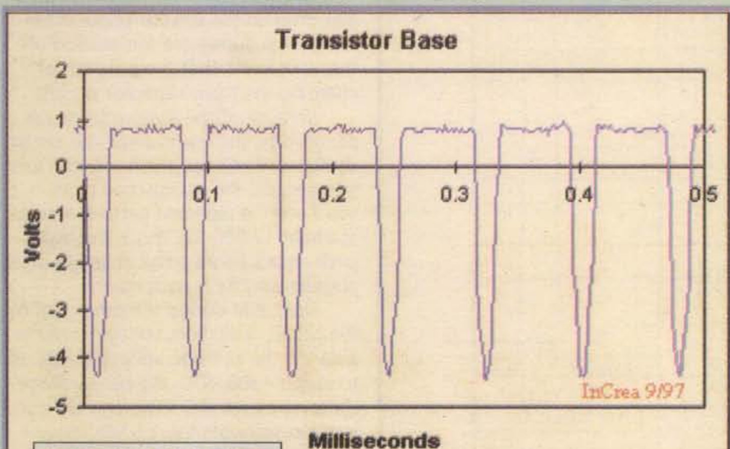
Two red wires go from the circuit board to the shutter. The shutter itself is the "FIRE" button on the schematic. When they touch, the flash will trigger. Don't play with this carelessly!! When I held down the charge contact, the metal of the shutter developed 250 VDC across them. The leaf metal charging contact developed a similar voltage.

Several minutes after popping the flash and removing the battery, I still measured more than 100 volts on the contacts, due to residual charge retained on the main capacitor after the flash tube extinguished.

Two catches will let the circuit board come out. Before totally removing the board, mark the metal battery clip with a permanent marker, so you'll know which way to put the battery in. I left my circuit board in the plastic shell for stability.

CIRCUIT ANALYSIS

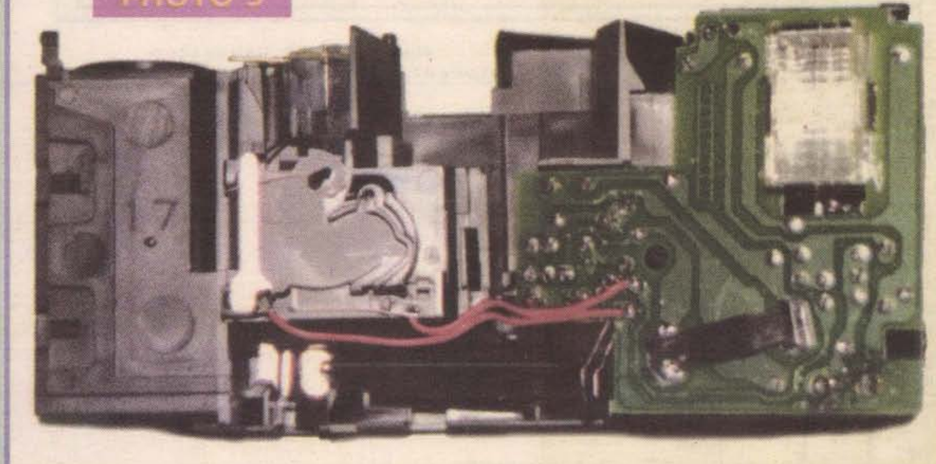
Figure 1 shows a reverse-engineered schematic for the flash circuitry. There are three major sections, each operable independently from the others: a charging oscillator, a blinking full-charge indicator, and a trigger.



BASEWAVE FORM

PHOTO 2

PHOTO 3

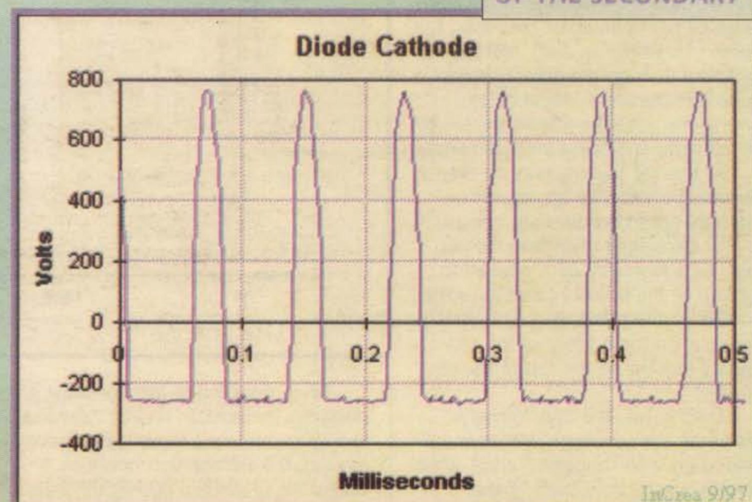


The Charging Oscillator

The charging oscillator consists of everything left of the 160 uF main charge capacitor. When a battery is in place, but the charge switch is not engaged, the collector sits at about 1.5 VDC, and the base sits at about zero volts.

When the charging switch is closed, current is pulled through the 220-ohm resistor and the last few coils of the transformer secondary. The transistor turns a little bit

VOLTAGE AT THE TOP OF THE SECONDARY



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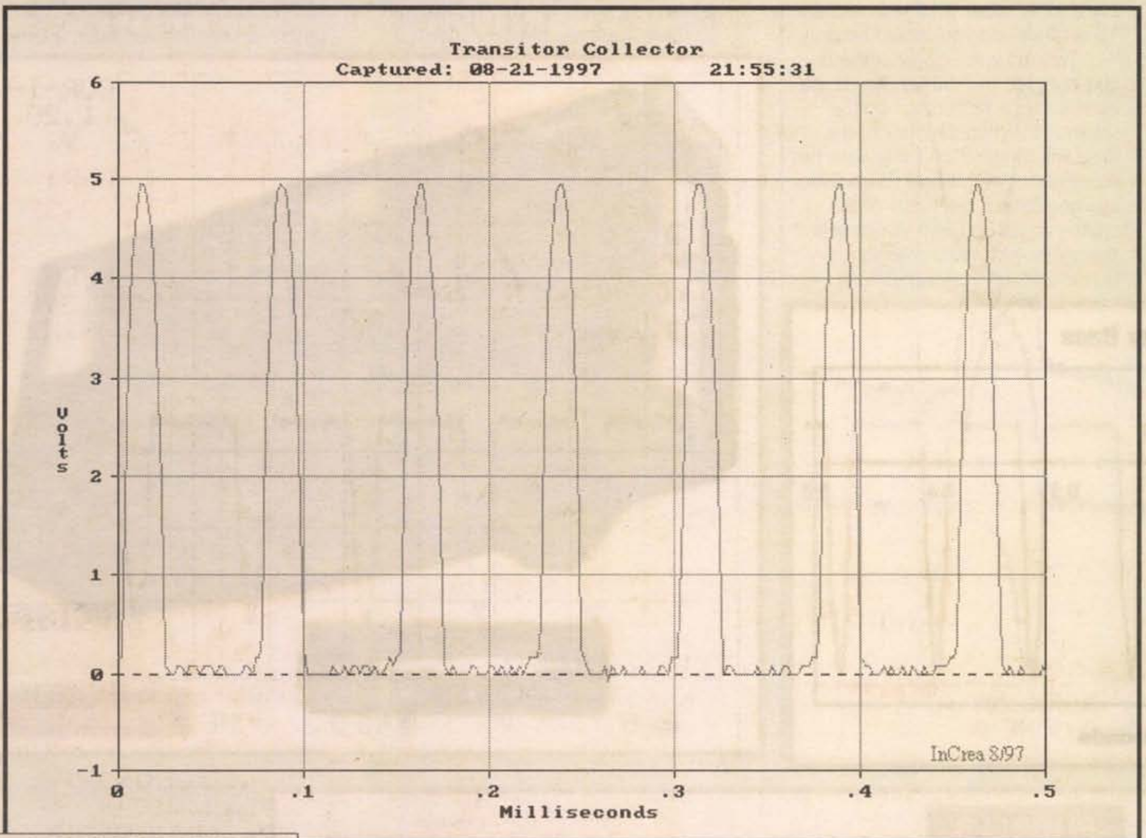
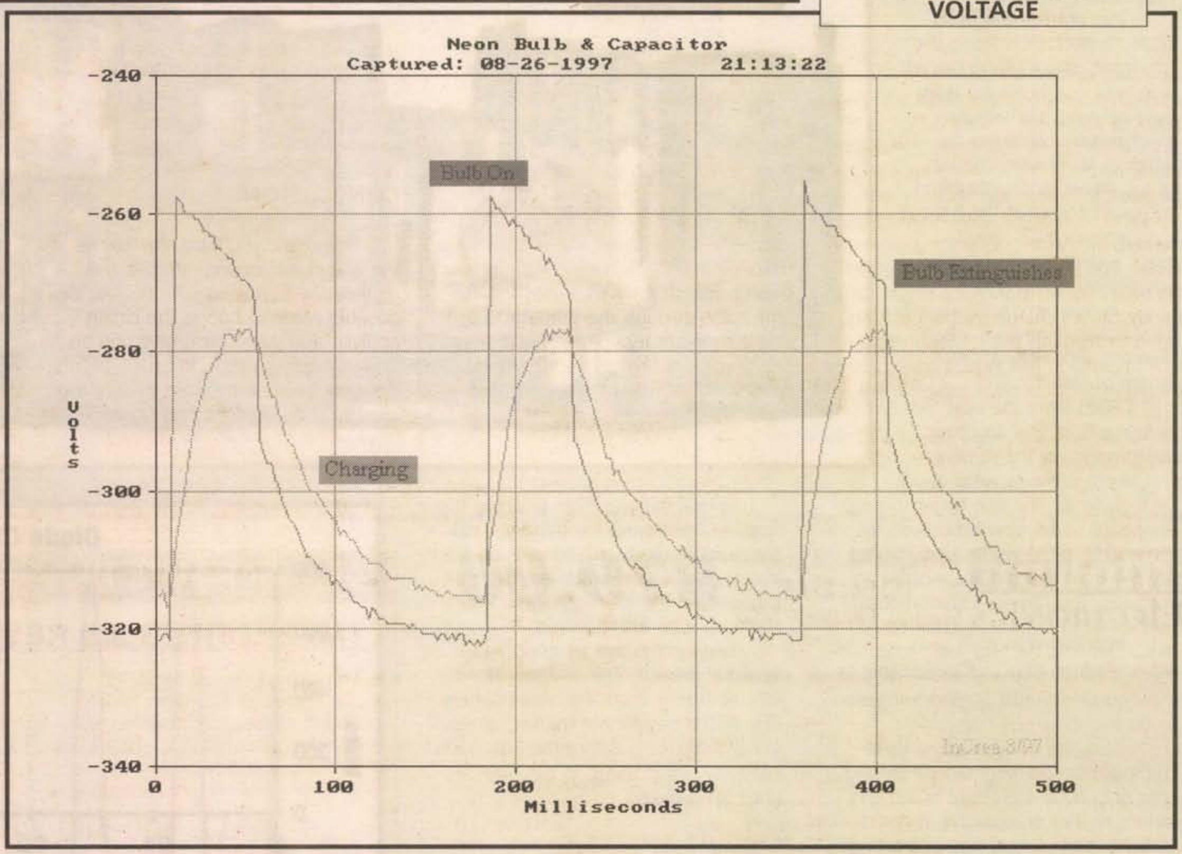


VOLTAGE AT THE COLLECTOR



OSCILLATING THE VOLTAGE

on, pulling the collector toward ground. Current in the primary of the transformer builds up. This is signified by the arrow on the schematic.

This positive feedback induces more current in the secondary, which pumps positive charge toward the bottom of the inductor (as shown on the schematic). VB rises to an even higher voltage. When VB tries to swing up above about 0.7 volts, the transistor turns hard on, as seen on the base waveform. Any attempt to go higher is "shorted" to ground by the base-emitter diode inside the transistor.

When the transistor is full on, the collector is essentially shorted to ground (notice the voltage at the collector hits a minimum of zero volts, but doesn't go below ground), and the current flow through the primary builds up to a maximum. It might help to take a look at all the relative phases of all transistor and transformer terminals.

Notice the polarity dots on the switching tranformer are shown on opposite ends because they indicate in-phase voltage rather than the current. As a high voltage is applied to the top of the primary (relative to the bottom of the primary), a high voltage develops on the bottom of the secondary (relative to the top of the secondary).

For the way the transformer is drawn on the schematic, voltages are associated with "opposite" ends, while current is associated with "same" ends.

Since the base of the transistor is clamping the bottom end of the transformer secondary a diode drop above ground, the voltage that develops across the secondary pushes the resistor tap and the cathode of the diode by about a volt, proportional to its tap position on the secondary coil. This is negative, significantly below ground.

The voltage on the bottom side of the 220-ohm resistor is driven negative about 2.3 volts below the power supply, implying a maximum current of 2.3/0.22 => 10.5 milliamps going through the resistor.

The voltage at the top of the secondary drops precipitously toward -300 VDC. The pull of current in the top side of the secondary is conducted by the forward biased diode, and charge is pulled off the top of the capacitor. (*Yes, once more, I'll note that really electronics are going through the diode and being deposited on the top of the capacitor.*) The + charge depletion on the top of the 160 uF main capacitor causes a voltage drop. In the relative phase waveforms, it is during the flat portion of the waveforms that the business of charging the main capacitor occurs.

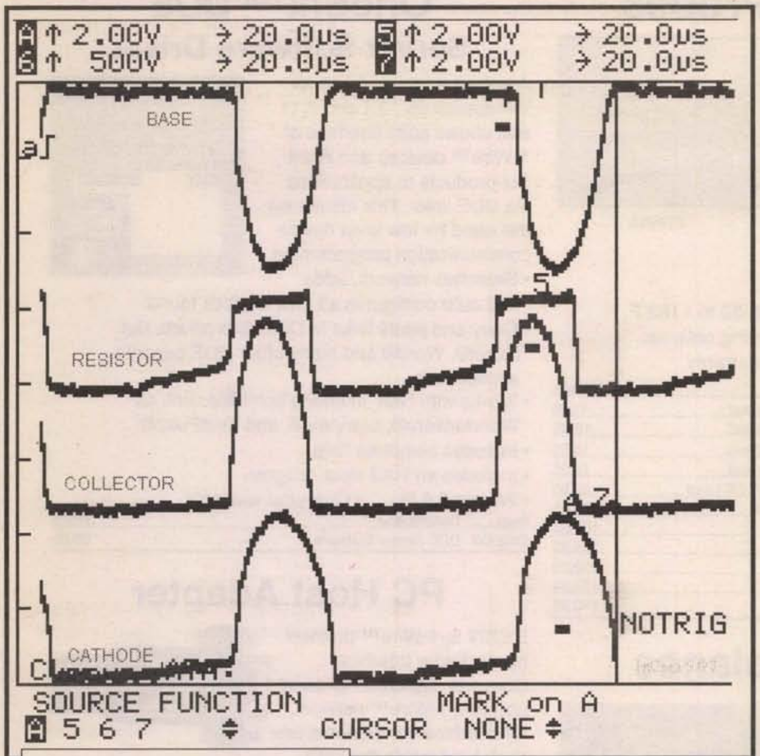
Because of the positive feedback provided by the transformer, the circuit oscillates. If you use the horizontal axis numbers off the oscilloscope plots, you'll see the repeated pattern occurs at about 12,000 Hz. This is the high-pitch squeal heard when charging most photography flash equipment.

Note that during the other half of the circuit oscillation, voltages reverse polarity: the cathode voltage builds up to about +300 VDC; the base voltage drops to about -4.5 VDC; and the collector overshoots the 1.5 VDC power supply, eventually getting to about 5 volts.

The Blinking Indicator

With voltage building on the main

[redacted]



RELATIVE PHASE OF ALL TRANSISTOR AND TRANSFORMER TERMINALS

capacitor, current leaks through the 3.9 Mohm resistor and charges up the 0.002 uF capacitor. As the 0.002 uF capacitor is charged, the voltage magnitude across the 1 Mohm resistor and the neon bulb increases in magnitude.

When it reaches about 300 volts, the bulb arcs across its internal electrodes. The ionized cloud of neon gas has near-zero resistance, so the bulb quickly causes charge to drain off the capacitor through the 1 Mohm resistor. The voltage magnitude drops toward 20% of its peak value (1/4.9 voltage divider).

Eventually, it reaches a level where the ionization of the neon gas cannot be maintained. The light goes off.

With the bulb's resistance returned to essentially infinity, charge builds up again on the 0.002 uF capacitor. The cycle repeats over and over again, oscillating the voltage.

The Trigger

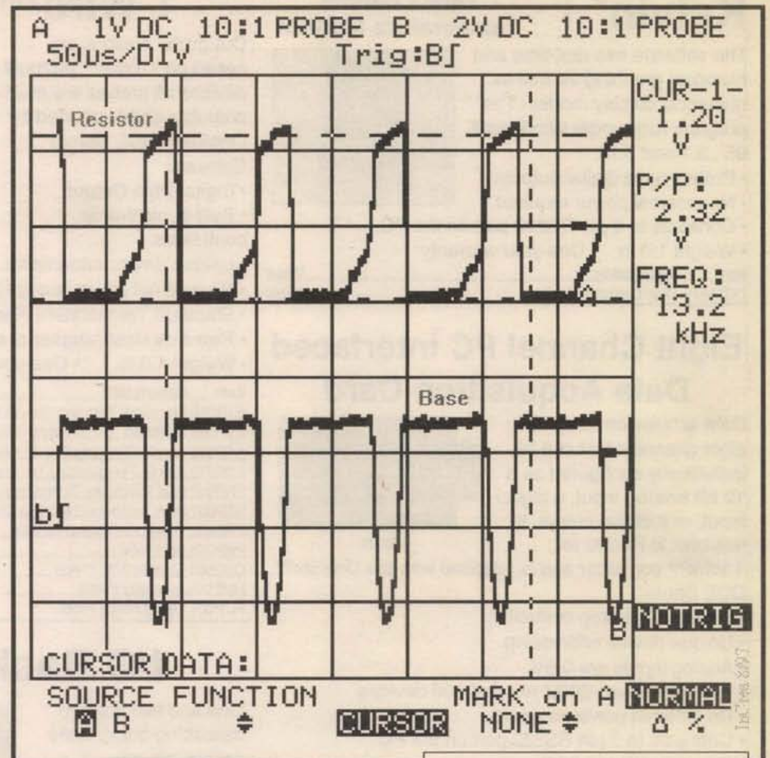
If you close the "flash" contact, the entire voltage of the main capacitor is shorted to ground through the 3.9 Mohm resistor and the primary of the flash transformer. The flash transformer is a very high ratio voltage step-up transformer that uses the current pulse through the primary to provide a momentary voltage pulse over 1,000 volts. A few of the gas molecules in the strobe bulb are ionized, and immediately attracted to the electrodes, which have just less than 300 volts across them.

As the ions go screaming toward an electrode, they collide with other gas molecules, knocking electrons out of them. Very quickly, there is huge number of atoms ramming into each other, releasing Bremsstrahlung radiation – i.e., a flash of white light. When the voltage on the main capacitor is too low in magnitude to sustain the ionized discharge, the flash extinguishes.

CONCLUSION

Hopefully, you'll be able to use the above instructions to gain the confidence to not dispose of your disposable camera. I hope the circuit analysis and waveforms give you an understanding you didn't have before. I'm particularly interested in how the photos and diagrams and figures worked for you. Let me know what did and didn't work.

For additional reading on the topic of disposable camera salvage, check out how others have documented a more formal educational exercise to dissect disposable cameras, from the marketing point of view. I've looked at a few web pages, but I'm not sure of the extent of what's available. Some of it appears to be specifically about the innards, including a lab exercise for students to do marketing studies about the electrical parts. **NV**



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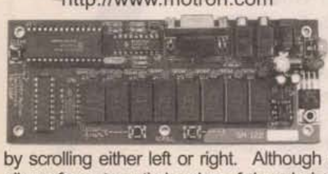

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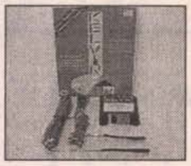

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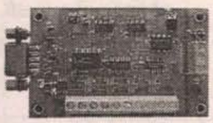

T8AH

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Item	Description	Price
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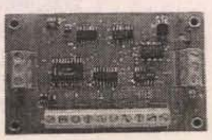
T8AH	Analog Only Card	99.95
T8DH	Digital Only Card	89.95

Eight Channel Data Acquisition Card



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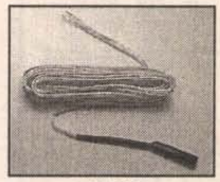

STP010

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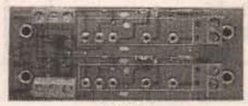
I/O Backplanes



T2SSM

T1SS

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T2SSM	Digital I/O Card	39.95
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OAC5	AC Output Module	9.00
IDC5	DC Input Module	9.00
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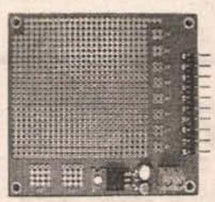
T8 Design Prototyping Card



The prototyping card connects to any T8ADH, T8AH, T8AD, or T8A to allow easy prototyping of I/O and analog conditioning circuits.

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- Size 3.375W X 3.375L
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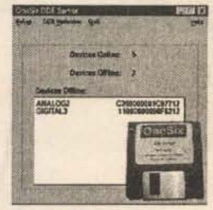

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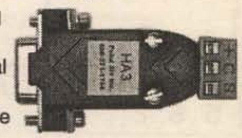

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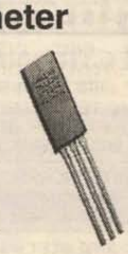

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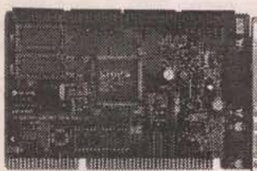
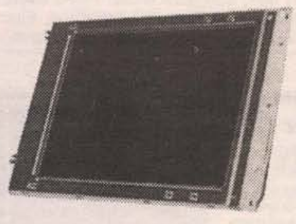

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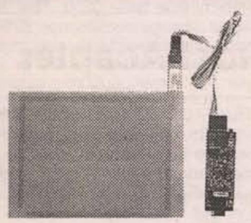


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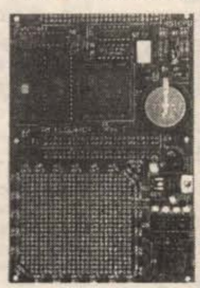

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HP 180A SCOPE (MIL SPEC AN/USM-281A) includes vertical plug-in 1801A (PL1186), horizontal plug-in 1821A (PL1187). Tested: $195. Manual reproduction: $15. Davilyn Corp. 1-800-235-6222.

SELL: HP 141T, 8552A, 8553B, SPEC. ANA., $1,300; HP 141T, 8552B, 8554B, $1,800. HP 141T, 8552B, 8555A, $2,000; HP 8690B, $200; PLUG-INS CALL FOR LOW COST PLUG-INS; HP 5340A, $1,200; EIP 371 source locking counter, $1,200; HP 8683B signal generator, $2,500; HP 432A, 8478A, power meter, $450; Bird 4430, Thru-line wattmeter and six slugs, $500; Clarostat 240C decade power resistor, $200; Cabletron TDR 5000 time domain reflectometer, $800; HP 11729B carrier noise test set; HP 1725A 265MHz dual ch. scope, $500; HP 7475A six pen plotter, $250; HP 7550A, 8 pen graphics plotter, $400, Matrix 3000 color graphics recorder, $1,000; HP 5423A structural dynamics analyzer, $4,000; HP 3575A phase meter, $800, HP 3437A system voltmeter, $400; A-Comm Electronics 303-290-8012 Sales@A-comm.com

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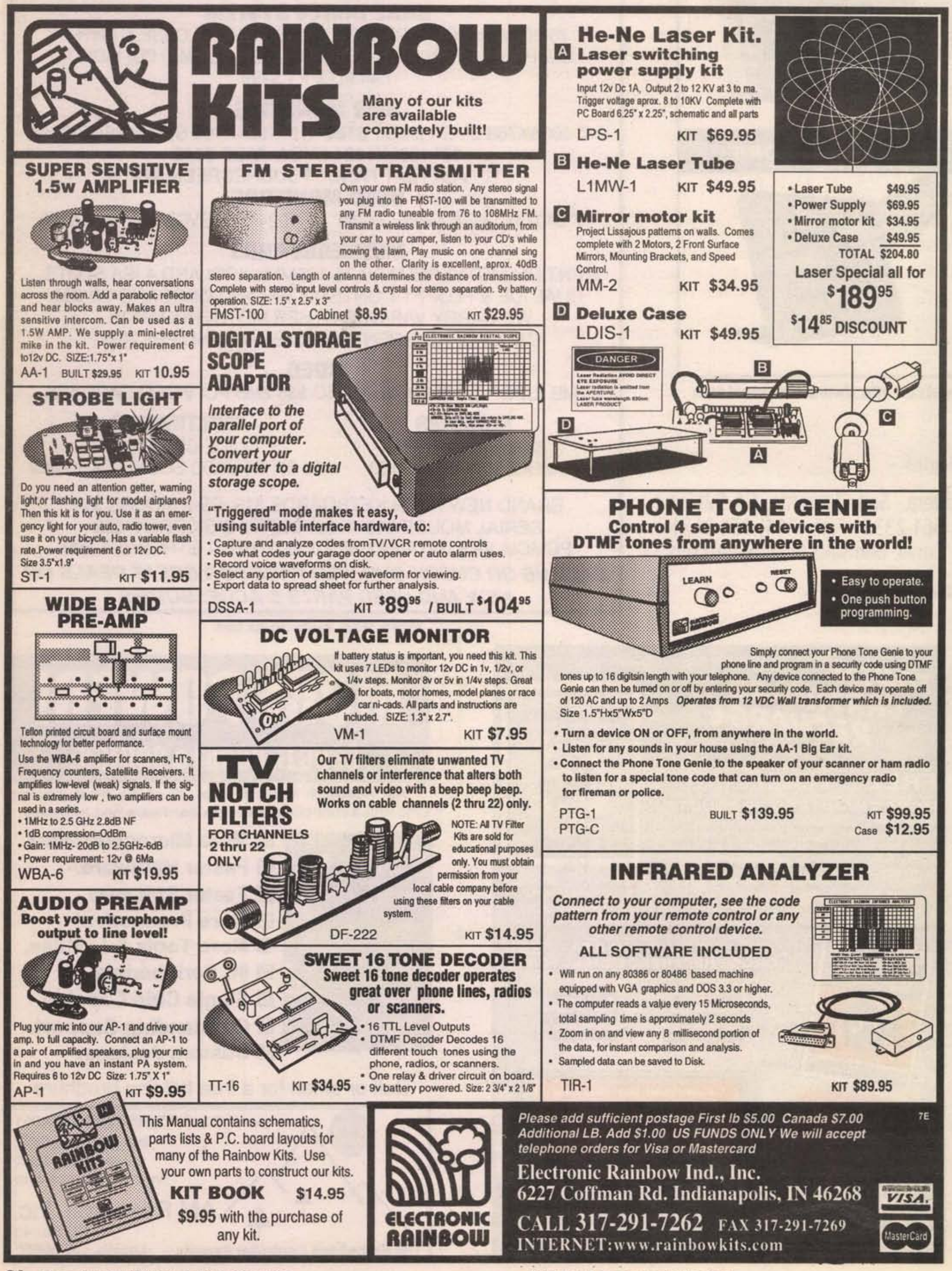

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Stamp Applications

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

by Jon Williams

Have you ever stopped to consider how much of our life is governed by clocks? A bunch. We get up at a given time. We go to work at a given time. We finish work at a given time. Our favorite television and radio programs start and stop at a given time. Wow! Just think how out of sync our society would be without clocks.

It's Time To Get Real Using the Dallas Semiconductor DS1302 RTC

A software real-time clock is not a practical exercise when it comes to the BASIC Stamp. Even if one succeeded in implementing the clock function, without interrupts, it's not likely that the Stamp could handle any additional control. It would be too difficult to keep the software clock in sync. It's on occasions like these — when software really isn't the answer — that we turn to external hardware. Thankfully, there are choices. And PBASIC makes them easy to use.

Before we get to hardware specifics, let's talk about time and how to deal with it in a microcontroller. When we refer to time, we're concerned with the hours, minutes, and the appropriate side of noon (AM or PM). This can be a headache to deal with in software. For example, if the time was 11:45 AM and we wanted to add 20 minutes, we'd have to add the 20 to the 45, notice that we went passed 60, carry to the hours variable, check that we went from AM to PM, blah, blah, blah. What a hassle! There is an easier way.

Just a minute, please ....

I once worked for a large irrigation company, and was involved with many teams that designed and built sprinkler timers. Sprinkler timers deal with time on two levels: 1) when to start the sprinklers, and 2) how long the sprinklers should run. It's interesting to note that no matter what the scope of the irrigation controller — from those you can buy at garden centers for residential use, to the big, computerized irrigation systems used on golf courses — time was always dealt with as a single variable. Conversion routines are used to interface with people.

Life for the Stamp would be quite a lot easier if it only had to deal with one variable for the time instead of three. We move from three variables to one by converting the hours, minutes, and AM/PM to minutes. Now you let the Stamp deal with time as a value between zero (12:00 AM) and 1439 (11:59 PM). It's a reasonably simple matter to convert between this raw time format and something we humans can live with.

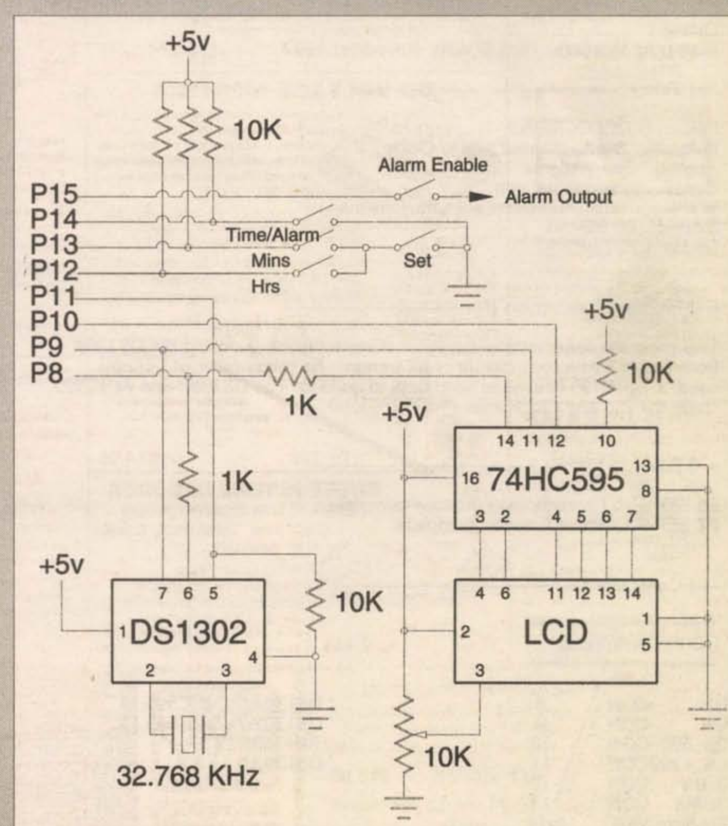
This month, we're going to demonstrate how to deal with real-time by building something that most of us use every day: an alarm clock. We'll use an external RTC chip and take advantage of the LCD interface we covered last month. This project should give you a firm grounding in time-based control, and teach you a math trick or two along the way.

The Dallas Semiconductor DS1302

For our alarm clock, we'll be using the DS1302 from Dallas Semiconductor. This eight-pin DIP keeps track of seconds, minutes, hours (with an AM/PM indicator, if running in 12-hour mode), date of month, month, day of week, and year with leap year compensation valid up to 2100. As a bonus, the DS1302 contains 31 bytes of RAM that we can use as we please. And for projects that use main's power, the DS1302 also contains a trickle-charging circuit that can charge a back-up battery.

Connecting to the Stamp is very straightforward. The DS1302 uses the same three-wire interface as the DS1620 thermometer (Apr. '95) and the DS1267 digital pot (Aug. '96). This allows us to take advantage of the BS2's SHIFTOUT and SHIFTIN commands. To write a value to the DS1302, we'll send (SHIFTOUT) the register address first, then the data for that register. The LSB of the address determines whether the operation is a write (0) or a read (1). To read from the DS1302, we send the address, then immediately read back (SHIFTIN) the register value.

For our project, we'll share the clock and data lines with a 74HC595 shift register. This cuts down the number of Stamp pins required to implement the alarm clock. For details on using the 74HC595 with an LCD, please refer to the Oct. '97 issue (More LCDs ...).



Time format conversion

In order to keep our interface with the DS1302 simple, we'll use it in the 24-hour mode. In this mode, we don't have to fuss with the AM/PM indicator. (If you want to know how, download DS1302.BS2 from my FTP directory.) For a 12-hour display, we'll deduce AM/PM mathematically.

Another compelling reason to use our raw time format is that the DS1302 stores its registers in BCD (binary coded decimal). In case you haven't dealt with BCD before, here it is in a nutshell: BCD is a method of storing a value between zero and 99 in a byte-sized variable. The ones digit occupies the lower nibble, the tens digit the upper. Neither nibble of a BCD byte is allowed to have a value greater than nine. Thankfully, the BS2 allows nibble-sized variables and, more importantly, it allows variables to be overlaid. We discussed this technique back in the Aug. '97 issue (PBASIC Programming With Style) and now we're going to use it.

If you study the variables section of Listing 1, you'll see that we've defined each time element as a byte, then overlaid the tens and ones nibbles. These overlaid nibble definitions do not occupy any more memory in the Stamp. With these definitions, converting the time from the DS1302 to our raw format takes just one line of code:

```
rawTime = (hr10 * 600) + (hr01 * 60) + (mn10 * 10) + mn01
```

Get a pencil and paper, and do it longhand. What you'll find is that the result is always a value between zero and 1439. Keep in mind that we're using 24-hour mode, so the hours value is always between zero and 23.

Converting back is just a bit trickier but, once you get the hang of it, you'll find the technique very useful. The key to this conversion routine is the modulus operator (//). The modulus operator returns the remainder of a division. For example, 5 // 2 (read "five mod two") returns one.

Here's the code to convert from our raw (minutes) format to the BCD values required by the DS1302:

```
hr10 = rawTime / 600
hr01 = rawTime // 600 / 60
mn10 = rawTime // 60 / 10
mn01 = rawTime // 10
```

This first line is easy. Since there are 600 minutes in 10 hours, we simply divide by 600 to get the tens value. Remember that the Stamp uses integer mathematics — the result of a division will always be a whole number. Getting the ones digit of the hours means dividing by 60 since there are 60 minutes in one hour. But first, we've got to get rid of the tens. This is where the modulus operator helps us. Since the Stamp does math from left to right, we first mod the raw value by 600. This step gets rid of the tens of hours. Now we can divide by 60 to get the ones.

Getting the minutes works in the same fashion. First, we mod the raw time by 60 to get rid of all the hours, then we divide by 10 to get the tens digit. The final step is getting to the ones minutes, so we mod the raw time by 10. You'll notice that this technique does not modify the value of the rawTime variable.

Since the nibble variables are overlaid with the time register variables, our BCD bytes are ready to SHIFTOUT to the DS1302. Pretty nifty, isn't it? Unless you've used this technique before, you may not be entirely comfortable with the modulus operator. That's okay, everything gets easier with time (no pun intended). Again, I suggest that you work through the steps with a pencil and paper so that you have a firm grasp of the technique.

Setting the clock

The modulus operator exhibits a behavior that can be very useful: keeping a variable within a range. The result of x // y will always fall between zero and y-1. And, unlike the MIN and MAX operators, the modulus operator causes the result to wrap around. This table will give you a quick idea of how it works:

```
0 // 3 = 0
1 // 3 = 1
2 // 3 = 2
3 // 3 = 0    ß Notice the wrap around
4 // 3 = 1
```

We'll take advantage of this behavior in our time setting routine. Based on the user input, we'll either add one or 60 (an hour) to our raw time and then mod by 1440. This will keep the time between 0 and 1439 and handle the rollover for us. Without the modulus operator, we'd be forced to use a convoluted IF-THEN construct and test for values. No, thank you.

There is one last modulus trick I'd like to share with you before we move on to our clock circuit and software. In the description above, and in the clock we present here, we're simply adding time and rolling over. But what if we wanted to add another input to this project that told the Stamp to subtract time? How would we handle that?

Hang on, this gets a bit gory .... What you'll do to subtract from the raw time is to add the modulus value (1440) minus the amount you want to subtract. So, to subtract a minute, you'll actually add 1439 to the raw time and then apply the modulus of 1440. For example, to subtract an hour

Sources

For more information on the BASIC Stamp, contact:

Parallax, Inc.
3805 Atherton Road, #102, Rocklin, CA 95765
phone **(916) 624-8333**
Internet **http://www.parallaxinc.com**

Scott Edwards Electronics
P.O. Box 160, Sierra Vista, AZ 85636-0160
phone **520-459-4802**; fax **520-459-0623**
Internet archive *(catalog, user manuals, samples)* located at **ftp.nutsvolts.com** in directory **/pub/nutsvolts/scott**
E-Mail: **72037.2612@compuserve.com**

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1505 Grande Blvd, #1602
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ftp://members.aol.com/jonwms/stamps

Dallas Semiconductor
1-800-336-6933 (for orders less than 20 pieces)**http://www.dalsemi.com/**

```
' Listing 1
' Stamp Applications: Nuts & Volts, November 1997

' —[ Title ]————————————————
'
' File...... BS2CLOCK.BS2
' Purpose... Stamp II-based Alarm Clock
' Author.... Jon Williams
' E-mail.... jonwms@aol.com
' WWW....... http://members.aol.com/jonwms
' Started... 20 SEP 97
' Updated... 27 SEP 97


' —[ Program Description ]————————————————
'
' This program demonstrates basic timekeeping functions using the DS1302
' from Dallas Semiconductor. In order to minimize the number of I/O pins
' used, a 74HC595 is used to send data to an LCD. The DS1302 and 74HC595
' share the Dio and Clock lines.


' —[ Revision History ]————————————————
'
' 26 SEP 97 : Timekeeping functions complete
' 27 SEP 97 : Alarm function complete


' —[ Constants ]————————————————
'
' ================
' I/O Pin Definitions
' ================
'
Dio       CON     8             ' DS1302.6, 74HC595.14
Clk       CON     9             ' DS1302.7, 74HC595.11
CS_595    CON     10            ' 74HC595.12
CS_1302CON        11            ' DS1302.5
SetHr     CON     12
SetMn     CON     13
TmAlrm    VAR     In14
Alarm     VAR     Out15

' ================
' DS1302 Registers
' ================
'
WrSc      CON     $80           ' write seconds
RdSc      CON     $81           ' read seconds
WrMn      CON     $82
RdMn      CON     $83
WrHr      CON     $84
RdHr      CON     $85

CWPr      CON     $8E           ' write protect register
WPr1      CON     $80           ' set write protect
WPr0      CON     $00           ' clear write protect

WrBrst    CON     $BE           ' write burst of data
RdBrst    CON     $BF           ' read burst of data

WrRam     CON     $C0           ' RAM address control
RdRam     CON     $C1

T24hr     CON     0             ' 24 hour clock mode
T12hr     CON     1             ' 12 hour clock mode
AM        CON     0
PM        CON     1

AlrmLen CON       1             ' length of alarm (in minutes)


' ==================
' LCD control characters
' ==================
'
ClrLCD  CON     $01             ' clear the LCD
CrsrHm  CON     $02             ' move cursor to home position
CrsrLf  CON     $10             ' move cursor left
CrsrRt  CON     $14             ' move cursor right
DispLf  CON     $18             ' shift displayed chars left
DispRt  CON     $1C             ' shift displayed chars right
DDRam   CON     $80             ' Display Data RAM control
```

from the raw time, you'll add 1380, then apply the modulus of 1440. This technique takes advantage of the wrap-around behavior of the modulus operator. To perform a subtraction, we simply wrap around something less than a full "turn." Let's go through one to see how this works:

- 8:00 PM (20:00) has a raw time value of 1200
- Subtract one minute:
  - 1200 + (1440 - 1) = 2639
  - 2639 // 1440 = 1199
  - {1200 - 1 = 1199}
- Subtract an hour:
  - 1200 + (1440 - 60) = 2580
  - 2580 // 1440 = 1140
  - {1200 - 60 = 1140}

At first, this may look like a lot of work. Please trust me when I tell you that it isn't. These modulus operator tricks will streamline your programs, saving valuable EEPROM space for other code. And it's always a good idea to write efficient code, even when the program is "small." Save yourself a possible rewrite — you never know when a small program will grow into a monster.

Our alarm clock

Now that we've introduced the DS1302 and thoroughly covered the modulus operator, the rest of our alarm clock project is a breeze. My design goal was to use no more than eight of the BS2's I/O pins for the time-keeping and display elements. Four of these pins are used to communicate with the DS1302 and the 74HC595. The rest are used for time-setting buttons and the alarm enable.

To set the clock, press and hold the SET button, then press either the MINUTES or HOURS button to change the time. The BUTTON command debounces the inputs and, with the auto-repeat feature, allows us to change the time quickly by holding either of the time-set buttons. The state of the Time/Alarm input determines which value is displayed and changed. The software is simplified by using an array to hold the raw time values and using the Time/Alarm input as a pointer into the array. When we send the new time to the clock, the seconds value is always reset to zero.

You'll notice that I cheated a bit with the alarm. From a software standpoint, the alarm is always active. This keeps the program simple. The alarm is disabled by opening a switch connected to the alarm pin. We check for an alarm by comparing the current time with the alarm time. This comparison is done inside a loop so that we can activate the alarm pin for any number of minutes we choose (AlrmOut constant) without worrying about crossing midnight. For alarm outputs shorter than one minute, you can modify the code and use the seconds value returned from the DS1302.

Okay, it's up to you now. Download the DS1302 documentation from Dallas Semiconductor, get out your breadboards, and build the clock. Once you've got it working, you might want to challenge yourself with adding features. How about a second alarm? How about adding everyone's favorite: a snooze button? And why not add another switch to determine the direction (add or subtract) of the hours and minutes time-set buttons? Next month, we'll talk about some possible solutions to these problems.

Time for the BS1?

I can imagine that some BS1 users are feeling just a bit slighted, and I certainly understand. While it is possible to connect the DS1302 to the Stamp 1, the process uses up a lot of code space and doesn't make room for many features. But don't give up, there is another solution. Tune in next month and I'll show you how to build a BS1-based alarm clock with a couple of serial modules. Until then, feel free to download DS1302.BAS from my FTP directory if you'd like to experiment with the DS1302. **NV**

```
CGRam   CON     $40                     ' Char Gen RAM control

' ---[ Variables ]---------------------
'
addr    VAR     Byte                    ' DS1302 address to read/write
ioByte  VAR     Byte

secs    VAR     Byte
sc10    VAR     secs.HIGHNIB
sc01    VAR     secs.LOWNIB
mins    VAR     Byte
mn10    VAR     mins.HIGHNIB
mn01    VAR     mins.LOWNIB
hrs     VAR     Byte
hr10    VAR     hrs.HIGHNIB
hr01    VAR     hrs.LOWNIB

ampm    VAR     hrs.Bit5                ' 0 = AM, 1 = PM
tMode   VAR     hrs.Bit7                ' 0 = 24, 1 = 12

rawTime VAR     Word(2)                 ' raw storage of time values
work    VAR     Word                    ' work variable for display output
oldSc   VAR     Byte                    ' previous seconds value
apChar  VAR     Byte                    ' "A" (65) or "P" (80)

char    VAR     Byte                    ' character to send to LCD
temp    VAR     Byte                    ' work variable for LCD routine
lcd_E   VAR     temp.Bit2               ' LCD Enable pin
lcd_RS  VAR     temp.Bit3               ' Register Select (1 = char)

butn    VAR     Byte                    ' BUTTON workspace variable
alrmX   VAR     Bit

' ---[ EEPROM Data ]-------------------
'

' ---[ Initialization ]----------------
'
Init:   DirH = %10001110

        addr = CWPr                     ' clear write protect register
        ioByte = WPr0
        GOSUB RTCout

        oldSc = $99                     ' set the display flag
        tMode = T24Hr                   ' put clock in 24-hour mode
        rawTime(0) = 360                ' preset alarm to 6:00 AM
        GOSUB SetRTm                    ' set time to 12:00 AM

' Initialize the LCD (Hitachi HD44780 controller)
'
LCDini: PAUSE 500                       ' let the LCD settle
        char = %0011                    ' 8-bit mode
        GOSUB LCDcmd
        PAUSE 5
        GOSUB LCDcmd
        GOSUB LCDcmd
        char = %0010                    ' put in 4-bit mode
        GOSUB LCDcmd
        char = %00001100                ' disp on, crsr off, blink off
        GOSUB LCDcmd
        char = %00000110                ' inc crsr, no disp shift
        GOSUB LCDcmd
        char = ClrLCD
        GOSUB LCDcmd

' ---[ Main Code ]---------------------
'
Start:  GOSUB GetTm
        IF secs = oldSc THEN ChkHr
        GOSUB ShowTm

ChkHr:  BUTTON SetHr,0,150,10,butn,0,ChkMn      ' is Set Hours pressed?
        GOSUB GetTm                             ' yes, get the clock
        rawTime(TmAlrm) = rawTime(TmAlrm)+60//1440
        IF TmAlrm = 0 THEN NoSet1               ' skip 1302 set for alarm
        GOSUB SetRTm                            ' set new time
NoSet1: GOSUB ShowTm                            ' display the change
        PAUSE 100                               ' pause between changes
        GOTO ChkHr                              ' still pressed?

ChkMn:  BUTTON SetMn,0,150,10,butn,0,ChAlrm     ' is Set Mins pressed?
        GOSUB GetTm
        rawTime(TmAlrm) = rawTime(TmAlrm)+1//1440
        IF TmAlrm = 0 THEN NoSet2
        GOSUB SetRTm
NoSet2: GOSUB ShowTm
        PAUSE 100
        GOTO ChkMn

ChAlrm: IF AlrmLen = 0 THEN Start               ' skip if no alarm length
        alrmX = 0                               ' assume no alarm
        FOR temp = 0 TO (AlrmLen-1)             ' check for length of alarm
          work = rawTime(0)+temp//1440          ' calculate alarm range
          IF rawTime(1) <> work THEN NoAlrm     ' is time in range?
          alrmX = 1                             ' yes
NoAlrm: NEXT
        Alarm = alrmX                           ' output the alarm state

        GOTO Start                              ' start all over

' ---[ Subroutines ]-------------------
'
' send a byte (ioByte) to the DS1302 location specified by addr
'
RTCout: HIGH CS_1302
        SHIFTOUT Dio,Clk,LSBFIRST,[addr,ioByte]
```

```
        LOW CS_1302
        RETURN

' get a byte (ioByte) from the DS1302 location specified by addr
'
RTCin:  HIGH CS_1302
        SHIFTOUT Dio,Clk,LSBFIRST,[addr]
        SHIFTIN Dio,Clk,LSBPRE,[ioByte]
        LOW CS_1302
        RETURN

' convert raw time format to BCD bytes for DS1302
'
SetRTm: hr10 = rawTime(1) / 600
        hr01 = rawTime(1) // 600 / 60
        mn10 = rawTime(1) // 60 / 10
        mn01 = rawTime(1) // 10
        secs = $00

' use burst mode to set the clock and calendar
' - do not remove the third SHIFTOUT line
' - you must send 8 bytes for data to be written in burst mode
'
SetTm:  HIGH CS_1302
        addr = WrBrst
        temp = 0
        SHIFTOUT Dio,Clk,LSBFIRST,[addr]
        SHIFTOUT Dio,Clk,LSBFIRST,[secs,mins,hrs]
        SHIFTOUT Dio,Clk,LSBFIRST,[temp,temp,temp,temp,temp]
        LOW CS_1302
        RETURN

' use burst mode to the grab time (hrs, mins & secs)
'
GetTm:  HIGH CS_1302
        addr = RdBrst
        SHIFTOUT Dio,Clk,LSBFIRST,[addr]
        SHIFTIN Dio,Clk,LSBPRE,[secs,mins,hrs]
        LOW CS_1302
        rawTime(1) = ((hr10 & %11)*600)+(hr01*60)+(mn10*10)+mn01
        RETURN

' Send command to the LCD
'
LCDcmd: lcd_RS = 0                        ' command mode
        GOTO LCDout

' Write ASCII char to LCD
'
LCDwr:  lcd_RS = 1                        ' character mode

LCDout: temp.HIGHNIB = char.HIGHNIB       ' get high nibble
        lcd_E = 1
        SHIFTOUT Dio, Clk, MSBFIRST, [temp]
        PULSOUT CS_595, 1
        lcd_E = 0                         ' drop Enable line low
        SHIFTOUT Dio, Clk, MSBFIRST, [temp]
        PULSOUT CS_595, 1
        temp.HIGHNIB = char.LOWNIB        ' get low nibble
        lcd_E = 1
        SHIFTOUT Dio, Clk, MSBFIRST, [temp]
        PULSOUT CS_595, 1
        lcd_E = 0
        SHIFTOUT Dio, Clk, MSBFIRST, [temp]
        PULSOUT CS_595, 1
        RETURN

' Show time in LCD
' - the time displayed is controlled by the position
' - of the TmAlrm switch input

ShowTm: char = DDRam+$02                  ' move to third position in LCD
        GOSUB LCDcmd

        work = rawTime(TmAlrm)            ' get the raw time
        hrs = work / 60                   ' extract (decimal) hours
        mins = work // 60                 ' extract (decimal) minutes
        IF TmAlrm = 1 THEN ST0
        secs = 0                          ' show zero seconds if alarm

ST0:    apChar = "A"
        IF hrs > 0 THEN ST1
        hrs = 12                          ' zero hours -> 12 AM
        GOTO ST3

ST1:    IF hrs > 11 THEN ST2
        GOTO ST3

ST2:    apChar = "P"
        IF hrs = 12 THEN ST3
        hrs = hrs-12                      ' 13 - 23 -> 1 - 11 PM

ST3:    char = hrs DIG 1+48               ' get hours, convert to ASCII
        IF char <> "0" THEN ST4
        char = " "                        ' remove leading zero

ST4:    GOSUB LCDwr                       ' write hours.tens
        char = hrs DIG 0+48
        GOSUB LCDwr                       ' write hours.ones
        char = ":"
        GOSUB LCDwr
        char = mins DIG 1+48
        GOSUB LCDwr
        char = mins DIG 0+48
        GOSUB LCDwr
        char = ":"
        GOSUB LCDwr
        char = sc10+48
        GOSUB LCDwr
        char = sc01+48
        GOSUB LCDwr
        char = " "
        GOSUB LCDwr
        char = apChar
        GOSUB LCDwr
        char = "M"
        GOSUB LCDwr

        oldSc = secs                      ' reset check value
EndST:  RETURN
```


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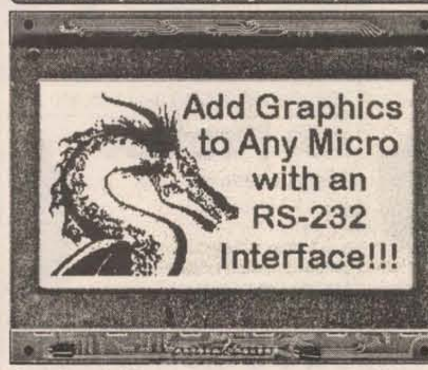

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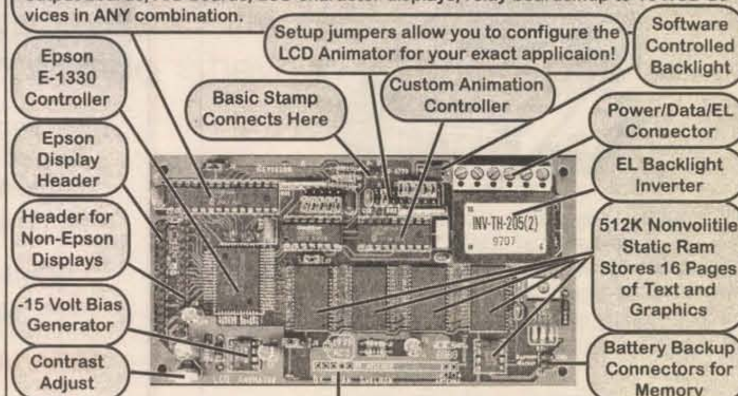

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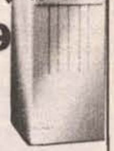

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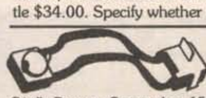

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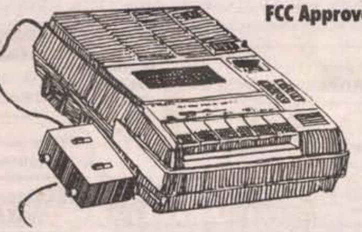

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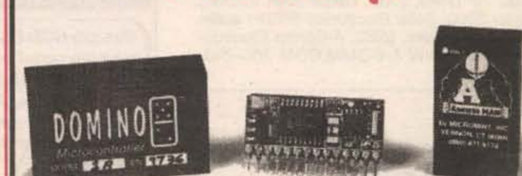

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RF EQUIPMENT: HP 8761B coaxial switch (18GHz, SMA) $65. **HP 5342A/001** counter (18GHz, oven option) $1,950. **HP 11869A** adapter for 8350B $350. **HP 436A, 8481A** power meter, sensor $1,650. **HP 8555A, 8552B, 141T** (.01-18GHz spectrum analyzer) $1,600. **HP 8502A/H26** transmission/reflection test set $950. Excellent condition, with warranty. Pepper Systems, 214-353-0257.

PORTABLE SCOPES: Tek 222A (10MHz) digital storage/readout, handheld battery-operated $1,250 (many accessories available). **Tek 475A** (250MHz) $650. **Tek 475A/DM44** (250MHz, multimeter) $725. **Tek 466** (100MHz, storage) $600. All with bright CRTs; excellent condition, warranty. Pepper Systems, 214-353-0257.

POWER SUPPLIES, ETC.: HP 6237B triple output: 0-18V, 1A; 0-20V, .5A dual tracking $375. **HP 6253A** 0-20V, 3A dual tracking $325. **HP 6255A** 0-40V, 1.5A dual tracking $325. **HP 6443B** 0-120V, 2.5A $350. **Tek PS 503A** triple output $175. **Xentek** extreme isolation transformers for clean power: 5 KVA, 2.5 KVA, etc., starting at $150. Excellent condition, warranty. Pepper Systems, 214-353-0257 Fax 214-902-9511.

TEKTRONIX PLUG-INS: AM 502, 7A22 high-sensitivity differential amplifiers $350, $290. **AM 503 & A6302** current probe & amplifier $850. **FG 504** 40MHz function generator $675. **TR 503** tracking generator $850. **5D10** waveform digitizer with readout $295. **7CT1N** curve tracer $350. **7D20** digital storage $650. **7S12, S-6, S-52** time domain reflectometer $1,350. **7S14** 1GHz sampler $575. Excellent condition! Mainframes and many other plug-ins available too. All with warranty. Pepper Systems, 214-353-0257.

NETWORK ANALYZER HP 8505A, HP 8503A, HP 8501A - complete RF network analyzer system in perfect working condition, $3,975. ISA, PO Box 6955, Laguna Niguel, CA 92607. 714-488-0010, Fax: 714-488-0299, E-Mail: sklar@cerfnet.com

WATTMETERS URM-120, 2-1000 MHz, 10-1000W, three couplers, meter, case, manual, 10 lbs. $140. Add shipping. Tartan Electronics, Box 36841, Tucson, AZ 85740-6841, 520-577-1022.

SECURITY

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

PROFESSIONAL ALARM control panels and all equipment. For a free catalog: voice or fax: 908-840-1390.

SEC **Sun Equipment Corporation**
P. O. Box 97903, Raleigh, NC 27624-7903
Test Equipment for Cost-Minded People

LODESTAR *Lodestar Electronics Corp.* Since 1979
One Year Warranty. 15 Day Money Back Guarantee. OEM welcome.
School purchase order accepted. Bids accepted.
SALES REP./DISTRIBUTORS/OEM WANTED.
1-800-870-1955 or (919)870-1955 Fax:(919)870-5720

DC POWER SUPPLY

PS-303 $159.00 0-30VDC, 0-3A; 0.02%+2mV line regulation; 0.02%+3mV load regulation; 1mVrms noise & ripple; Short circuit/overload protection; constant current/voltage (CC/CV).
PS-303D $314.95 dual, tracking
PS-305 $219.95, 0-30VDC, 0-5A.
PS-305D $399.95, dual, tracking.
8110 $289.95 0-60VDC, 0-3A.
8112 $399.95 0-60VDC, 0-5A.
8108(8109) $549.95($699.95) 0-60VDC, 0-3A(5A), dual, independent tracking. Low ripple.
8102(8103) $399.95($489.95) triple outputs, 0-30V/0-3A(5A) x 2, fixed 5VDC/3A, independent & tracking operation, constant voltage and current. Slave/Master, Serial/Parallel connection.
PS-1610S(8107) $289.00($399.95) 0-16VDC(0-30VDC), 0-10A.
PS-2243(2245) $139.00($159.00) 0-12/0-24VDC,3A(5A).
8200(8201) $179.95($239.95) 0-30VDC(digital meter), 0-3A(5A).
8210(8211) $199.95($259.95) two digital meters.
8202(8203) $499.95($549.95) digital display; triple outputs -- dual 0-30VDC/0-3A(5A) & a fixed 5VDC/3A; independent tracking operation; constant current and constant voltage (CC/CV).

AM/FM SWEEMAR SCOPE

SM-6225B/C $1999.95
Freq Range: (AM)490KHz; (FM) 10-11.4MHz; *Accuracy*: ± 0.1%
Marker: (AM)455KHz, ±5KHz, ±10KHz; (FM)10.7MHz, ±7.5KHz, ±150KHz.
STEREO SCOPE OS-7505B $369.00 trigger, 0-10MHz.
ALIGNMENT SCOPE OS-7001A $369.00 0-200KHz.

AM/FM STD SIGNAL GEN.

SG-4110A $1799.00
Freq: 100KHz-110MHz
Display: 6-digit LED
Accuracy: <±(5x10-E5 ±1 count)
Resolution: 100Hz (100-34.99MHz); 1KHz (35MHz-110MHz).
Output: -19dBu, -99dBu, 1dB steps. *Impedance*: 50Ω VSWR 1.2.

NTSC TV COLOR BAR PAT. GEN.

CPG-1366A $159.95, VHF NTSC;
Freq.: 45.75, 175.25, 187.25 MHz;
RF Output: 10mV.
Impedance: 75 Ohm;
Video Output: BNC, 1Vp-p.
CPG-1367A $159.95, VHF PAL.

SWR/RF/mW POWER METER

310 $89.95
Freq. Range: 1.8-150MHz.
RF Power: 0-4W/20W/200W
SWR Measure.:1.0 - ∞, 4W min.
Accuracy: 5%-10%; SO-239 plugs.
Insertion Loss: O.3dB.
Input/Output Imp.: 50Ω.
320 $89.95, 130-520MHz.
330 $119.95, 1.8-520MHz.
SWR-3P $26.95 1.7-150MHz; *RF Power*: 0.5-10W, 0.5W-100W.
SWR-2P $22.95, 1.7-30MHz; *RF Power*: 0.5-10W.

mW RF Power Meter 340 $219.00
1.8-500MHz; RF power: 20mW/200mW/2W; Imp.: 50Ω; Accuracy: ±10% full scale; N-type connector, SWR <1.15.

VHF/UHF ATTENUATORS

RT-8815 $199.00, VHF, 500MHz, 81dB, 50Ω, 0.5W.
RT-8815U $359.00, UHF, 950MHz, 81dB, 50Ω, 0.5W.
RT-8817 $199.00, VHF, 500MHz, 81dB, 75Ω, 0.5W.
RT-8817U $359.00, UHF, 950MHz, 81dB, 75Ω, 0.5W.
085E-2 $499.00, UHF, 950MHz, 61dB, 50Ω, 0.5W.
087E-2 $499.00, UHF, 950MHz, 61dB, 75Ω, 0.5W.

ON SALE - Power Supply

8102 ~~$399.95~~ $359.95 triple outputs, 0-30V/0-3A **x 2**, fixed 5VDC/3A, independent & tracking operation, constant voltage (CV) & constant current (CC), Slave/Master, Serial/Parallel connection.
PS-303D ~~$314.95~~ $282.95 dual outputs/tracking, CC&CV.
Limited quantity. Full one year warranty.

RF SIGNAL GENERATOR

SG-4160B $124.95
100KHz-150MHz up to 450MHz on 3rd harmonics; 6 ranges; AM modulation. *RF Output*: 100mVrms to 35 MHz. *Modulation*: Int. 1KHz AM, Ext. 50Hz-20KHz AM.
Audio Output: 1KHz, 1Vrms.
SG-4162AD $229.95, with Freq. Counter 1Hz-150MHz, 6 digits, for internal & external signals. Specification see SG-4160B.

AUDIO GENERATOR

AG-2601A $124.95
10Hz-1MHz, 5 ranges;
Output Level: sinewave 0-8Vrms, square 10Vp-p.
Output Impedance: 600 Ohm.
Distortion: <0.05% 500Hz-50KHz; <0.5% 50KHz-500KHz.
AG-2603AD $229.95, with Freq. Counter 1Hz-150MHz, 6 digits, for internal & external signals. Specification see AG-2601A above.

FUNCTION GENERATOR

FG-2100A $169.95
0.2Hz-2MHz in 7 ranges; Sine, Square, Triangle, Pulse & Ramp
Output: 5mVp-p-20Vp-p, 1% distortion.
VCF: 0-10V control freq. to 1000:1.
FG-2102AD $229.95 generates signals same as FG-2100; 4-digit counter display, TTL & CMOS outputs, 30ppm ±1 count accuracy
FG-2020B $159.00 0.5Hz-500KHz; Sine, Square, Triangle.
(FG)2103 $329.95, Digital sweep generator, 0.5Hz-5MHz in 7 ranges. *Operating Mode*: sweep, AM, gated burst, VCG.
Freq. Counter: Int. 0.5Hz-5MHz; Ext. 5HZ-10MHz.
FG-513 $719.95, Digital sweep generator; Sine, Square, Triangle, Pulse, Ramp, TTL & DC; 2Hz-13MHz in 7 ranges; ±(.01%+1dgt).
Freq. Counter & TCXO: 5Hz-100MHz, 6.5 digits. x1 & x20 attntn.

FM STEREO MODULATOR

AG-2011A $549.00
RF SECTION:
Carrier: 98MHz ±2MHz;
Output: 10mV, 1mV & 0.1mV
COMPOSITE SIGNALS:
Pilot: 19KHz ±2Hz, 0.8Vrms
INT. MODULATION: 400KHz, 1KHz ±1%, 1Vrms, distortion < .5%; *L-R Separation*: >50dB.
EXT. MODULATION: *Freq.*: 50Hz-15KHz
L-R Separation: >45dB 100Hz-3KHz; >35dB 50Hz-15KHz.

AC MILLIVOLT METER

MV-3100A $159.95 wide band 5Hz~1MHz; 3 scales, mV, dB &dBm; 300µV~100V in 12 ranges, 10µV resolution; -70~40dB in 12 ranges, 0dB=1Vrms,0dBm=0.755V); ±3% accuracy; Input impedance 10MΩ; Noise <2%. **MV-3201B $309.95** dual channels, simultaneous measurement.

OSCILLOSCOPES

OS-7305B $249.00 DC~7MHz; *Vertical*: 10mV/Div, Horizontal: 250mV/Div; 10Hz~100KHz in 4 ranges; 3" CRT; Internal and External Sync.; Input: 1MΩ/35pF.
OS-7010A ~~$369.0~~ $299.95 10MHz. 5" CRT, 10mV/cm~10V/cm, 1MΩ.
OS-622G $344.95 20MHz/dualtrace
OS-653 $699.95 50MHz, dual, delay sweep, ALT trigger, TV syn.
OS-6101$1499.95 100MHz, 4ch/8 trcs, delay swep,cursor readout

DIGITAL MULTIMETER

DMM-120 $24.95, 3½ digit, 600VDC/AC, 2ADC, 2MΩ, hFE/diode test.
DMM-123+Capacitance $44.95, 3½ digit, 600VDC/AC, 10ADC/AC, 2GΩ, 20µF, hFE/diode test, continuity beeper.
DMM-125 $54.95, Autorange/Bar Graph, 600VDC/AC, 2ADC/AC, 32MΩ, continuity beeper.
MIC-35 $59.95, Autorange, 3½ digit, LCD, 1000VDC/750VAC, 20MΩ, 20ADC/AC, diode/continuity check, data hold.
MIC-39 $149.95, Autorange/Bar Graph, True RMS, 3¾ digit, LCD, 40MΩ, 40µF, 1000VDC/750VAC, 20ADC/AC, 600KHz Freq. Counter, Data Hold, Drop-prove, Sleeping Mode, Memory, Read Functions.

GRID DIP METER

DM-4061 $89.95 1.5-250MHz, 6 bands; 6 plug-in coils, 2 transistor, and 1 diode.
Modulation: ≈ 2KHz Sinewave.
Crystal Oscillator: 1-15MHz.
Wave absorption meter. 9VDC battery.

AUTO DISTORTION METER

DM-3104A $799.95
MEASUREMENT:
Range: 0.01%-30%, 0.1/0.3/1/3/10/30% full scale.
Freq.: 400Hz±10%, 1000Hz±10%(HPF).
Input: 3mV-100V, ratio measuring 20dB.
Auto. Switching Ranges: Fundamental Freq. = (fo)±10%;
Fund. Rejection: >-80dB at (fo)±5%; >-70dB at (fo)±10%.
Harmonic Accuracy: ±0.5dB, 1.8(fo)-20KHz.
DM-3204 $1,599.00 dual channels.

FREQUENCY COUNTER

FC-5250C $119.95
Freq. Range: 10Hz-220MHz: (HF)10Hz-20MHz, (VHF)10MHz-200MHz
Gate Time: 0.1 & 1sec.
Max. Input: 10Vp-p.
Input Sensitivity: 35mV 10Hz-200MHz. *Display*: 7-digit LEDs.
Input Impedance: (HF) 1MΩ, (VHF) 50Ω.
FC-5260A ~~$146.00~~ $129.95 10Hz-600MHz. 7-digit LEDs.
FC-5270 $149.95 10Hz-1.2GHz. 8-digit LEDs.
FC-5600B ~~$321.00~~ $299.95 10Hz-600MHz. 10-digit LEDs.
(FC)5700 $329.95 10Hz – 1.3GHz. 10-digit LEDs.

SIGNAL TRACER/INJECTOR

SE-6100 $134.95
TRACER: Gain Max. 60dB
Attenuation: 0/20/40/60dB
Input Impedance: 100KΩ;
Output Imped.: 600Ω;
Speaker: 8 Ω.
INJECTOR: *Freq.*: 1KHz Squarewave; *Output Level*: Continuously variable 0 - 4.5Vp-p.

AUTO. CAPACITANCE METER

CM3300A $139.00 10 ranges, 99.9pF ~ 99.9mF, fully automatic.
Resolution: 0.1pF lowest, 0.1% full scale.
Accuracy: 0.5% of full scale±1 digit to 99.9µF, 1% of full scale±1 digit to 99.9µF.
Display: 3 digit LED.
Unit indicator: pF, nF, µF, mF. Overrange indicator.

WOW-FLUTTER METER

WF-3103A $699.95
Freq. Range: 3KHz±10% JIS/CCIR; 3.15KHz±10% DIN.
Range: 0.03/.1/.3/3% full scale.
Accuracy: ±5%.
WF-3105A $799.95, digital;
Function: LIN/WOW/Flutter/WTD.
Freq Counter: 10Hz-9.99MHz.
Indication: CCIR/DIN/JIS.

ELECTRONIC/PC TOOL KITS

9Z45 $29.99 U.S. Patented, 45-pcs. Contents: IC Inserter, IC Extractor with securers & Bows, 3-prong part Retriever, #0 Phillips Screwdriver, 1/8" Flat Screwdriver, Self-hold Tweezers, Metal Tweezers, Extra Parts Tube, Soldering Iron, Solder, Crimping Tool, Long-nose Plier, Cutting Plier, Zipper vinyl Case. Bits include: *Phillips*: #0, #1, #2, & #3; *Flat*: 1/8", 3/16", 1/4", 9/32"; PZ1, PZ2; T8, T9, T10, T15, T20, T25, T27, T30, T40, T45; *Hex*: 5/64", 3/32", 1/8", 5/32", 3/16"; *Sockets*: 3/16" (5mm), 7/32" (5.5mm), 1/4" (6mm), 9/32" (7mm), 5/16" (8mm).
8G23 $34.99 U.S. Patented, 23-pcs. Contents: IC Inserter, IC Tweezers, IC Extractor with securers & Bows, 3-prong part Retriever, 3/16" Nutdriver, 1/4" Nutdriver, 3/16" Slotted Screwdriver, 1/8" Slotted Screwdriver, #0 & #1 Phillips, Reversible T10/T15 Bits, Reversible #2 Phillips/¼" Slotted Bits, Tweezers, Long-nose Plier, Cutting Plier, 6" adj. Wrench, Soldering Iron, Solder, Crimping Tool, Zipper vinyl Case, Manual.

MICROPROCESSOR TRAINER

$699.00 learn 8088 hardware design and software programming.

PILGRIMS PROGRESS

FOOD for THOUGHT: MERCEDES or HYUNDAI?
We always strive to bring you the best products at the best price. Elsewhere you can find their "LIPSTICK" cam for $249! Our price is $129! That's $120 LESS! for the same camera. You can pay for their CEO's Mercedes or my Hyundai. Your money, Your choice.

CHECK THIS OUT! ULTRA MINI and WEATHERPROOF,

"LIPSTICK" camera sets new standards. Sleek black anodized, aluminum, housing is O-Ring sealed and RAINPROOF. Adjustable tilting mount included. Specs: 1/3" CCD, 380 Lines resolution, 0.3 Lux sensitivity, AGC, Auto Shutter. Operates on 9 to 16VDC @100mA, Std. model, 3.7mm, 78° FOV lens, Pinhole, 72° FOV. A real glass lens. NTSC video out. 1/2 once! SENSITIVE to IR. Ultra small Size only: 23mm diam. X 50mm long. PH is 35mm long. Both with 36" leads. Please note: Pinhole model is not waterproof.
GM-200K-STD,..$129 GM-200K-PH,....$129
power adapter $4.95

NEW MODEL MICRO CAMERA, w/audio

1/3" CCD, 410 Lines Res., 0.3 Lux sens., AGC, Auto Shutter. Power from 9 to 16VDC @100mA, 250k PIXELS, Std. model, 3.6mm, 92° FOV lens, Pinhole, 90° FOV. A real glass lens. Both focus from 10mm to infinity. Std. NTSC video out. 1/2 once! SENSITIVE to IR. Size Std: 1.25"sq. x 1"d. PH is 0.6"d, Both with 6" leads. **WARNING:** Don't confuse these models with LOW RESOLUTION, HIGH LUX C-MOS CAMERAS.
C-MOUNT model now available. Only 0.9" d
GM-1000A-STD,..$89 GM-1000ASTD/Audio,....$109
GM-1000A-PH,....$89 GM-1000A-PH/Audio......$109
GM-1000A-CM....$89 GM-1000A-CM/Audio....$109

C-Mount	**4mm, 80°......$32**	**Micro**	**2.5mm, 150°..........$22**
Lenses	**8mm, 40°.......$32**	**Lenses**	**4.3mm, 78° fast....$22**
f2.0	**12mm, 28°...$32**		**5mm, 70°PH..........$22**

OPTICAL ENCODER, 4000PPR quadrature/1000ppr direct.

SUMTAK Model LBL-004-1000. 5VDC @ 80mA operation. 6mm diam. ball bearing shaft construction. 38mm diameter overall and 32mm deep. 100kHz max. rate. A, B and Z outputs on color coded 6" leads. Removed from equipment, good condition. Always a sellout. Don't delay. **SPECIAL $29ea. or 2 for $50**

$4500 SURVEILLANCE SYSTEM NOW $599!!

- *MOTORIZED, 6X ZOOM LENS*
- *MOTORIZED, 360° CONTINUOUS PAN*
- *MOTORIZED, TILT up to 90°*
- *PHILIPS HIGH RES. 1/2" CCD CAMERA*
- *OPAQUE BLACK INNER DOME*
- *CLEAR ACRYLIC OUTER DOME*

Walk into any major dept. store and you will see these fully integrated systems in use. From the same mfg. who supplied the Atlanta Olympics! These late model, new in the box systems are virtually ready to use. All you add is power and toggle switches for remote control. Philips B&W CCD camera, 450 lines res., 0.5 Lux sensitivity! Their best grade CCD. All anodized aluminum construction. Camera plus Pan & Tilt are powered by external 24VAC. Zoom lens motors powered by external 6VDC. Integrated lens controller with camera power supply available. Size of dome: 14"diam. Includes mount for drop ceiling. 6X, f1.2, system. Ltd. Qty. **NOW...$599**
OPTIONAL LENS CONTROL w/CAMERA PWR...........$199

SCIENTIFIC, 1/2" COLOR CCD CAMERA

- *YC/SVHS output*
- *380K Pixels*
- *460 Lines*
- *1.5 Lux sensitivity*
- *Superior picture*

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

PALM SIZED CAR WASH? A very unusual gaget!

Intended as an internal cleaner for a large ink-jet printer. This unique assemble includes a precision, gear driven, 12VDC bellows type pump. Overall size: 5" x 3" x 3" Fluid is pumped to an atomizing spray nozzle. (removeable) Which resides next to a rotating nylon brush. A mini 12VDC solenoid valve is also mounted on the base. New units.

SPECIAL $12ea. or 3 for $29

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The WILD model M7 Microscope,

A truly magnificent instrument. Once you use a WILD all others pale! Magnification with 10X wide field eyepiece smoothly zooms from 6X to 31X. Working distance is 91mm. With included 0.5 objective the working distance is 156mm. Includes base shown, Panasonic WV-CD50 B&W mini CCD camera and Fiber optic ring light. Complete video microscopy system with one of the worlds finest microscopes. Like new condition. Other camera options available. **$2295.00**

C-MOUNT, CCD IMAGE INTENSIFIER, A MINI HAND HELD VIEWER ALSO.

Our EXCLUSIVE GM-15K, U.S. made 2nd GEN. I² system provides **up to 15,000X gain.** Add true night vision and super IR capability to any quality CCD camera. Installs between camera & your C-mount lens! Useful as a hand held viewer with our eyepiece & battery holder. Makes your intensifier twice as usefull. One of the smallest viewers available! Truly fits in the palm of your hand.

Size: 2"d x 3.4"L **GM-15K........$999**

NOW TWO C-MOUNT CAMERAS, The popular, super sensitive, GM410 or the general purpose GM412,

The GM-412 specs: B&W, size 1.5"sq. X 2.4"L, 250,000 Pixels, **380** Lines Resolution, Sensitivity **0.3** Lux, The GM410 specs: size only 1.5" SQ. x 1.6"L, >270,000 Pixels, **410** Lines Res., Sens. **0.05 LUX.,** Both cameras are 1/3" CCD with AGC & Electronic shutter. 12V @110mA power. NTSC out. IR SENSITIVE, GM 410 has RCA video connector, GM-412 has a BNC. Both use std. DC pwr. jack. Aluminum housings with dual threaded top and bottom mounting. True performance not hype! These cameras will outperform *ANY* camera in this magazine. Multi-lens options are available to exploit their superior performance.
GM412 less lens.....$139ea.
GM410 less lens.....$169ea.

Ultra fast	**16mm, f1.6, (15°)..$39ea.**	**Gen'l**	**4mm, 80°.....$32ea.**
for Low	**8mm, f1.3, (30°)....$49ea.**	**purpose**	**8mm, 40°.....$32ea.**
Light Use	**4mm, f1.4, (56°)....$49ea.**	**std. light**	**12mm, 28°.....$32ea.**

WORLDS SMALLEST, 100mW, VIDEO TRANSMITTER,

Incredibly only 0.95" x 0.79" x 0.45" in size. Transmits crystal controlled hi-res. images with 100mW output! The transmitter you've been waiting for. **Shown actual size.** Much smaller than the 9V battery which powers it. Draws only 35mA! Factory tuned ready to receive on cable channel 59. Will work with color or B&W cameras. UHF Bow tie antenna with balun, 3' F cable and adapter for TV Included. Perfect with our GM1000 camera shown above. Both will fit in a cigarette pack......with the battery!
TVX-100...$199. TVX-100 with GM-1000A-PH Camera...$288.

FEEL POWERFUL FAST !

SUPER BATTERY Number Two!
12V @ 12.5 AH SEALED LEAD ACID Each pack consists of six, 2 Volt cells. Excellent condition. Perfect for robotics and other high drain applications. Size: 6.25"L x 5.75"H x 4.25"D
$12ea., 4 for $39, 10 for $79

SUPER BATTERY Number THREE!
10V @ 2.5 AH SEALED LEAD ACID

Each pack consists of five, 2 Volt cells. Each cell the size of a std. 'D' battery. They are arrainged as 1X5 cells. Enclosed in an ABS outer shell. (removed for photo) Mint condition. Perfect for robotics and other high drain applications. Buy several, make custom packs of any rating. Size: 7.5"L x 2.8"H x 1.5"D
$5ea., 5 for $20, 30 for $99

ULTRA RESOLUTION & SENSITIVITY, B/W, 1/2" CCD

Type GM-600, 425K pixels, 600 Lines res. < 0.02LUX sensitivity. Access all operating parameters from outside the camera! Adjustable shutter speed, gain, auto/man. gain, ext. sync. and gamma. 12VDC powered. Dual mounts. Sony CCD! Perfect for use with the GM15K above.
GM600.......$399ea. GM600 with GM15K.......$1299

HITACHI HV-C10, 3-CCD COLOR CAMERA.

3 x 1/2" microlens CCD using an f1.4 prism, 681 x 582 pixels, 700 lines resolution. 510 lines via RGB outputs. 56dB signal to noise ratio, 15 lux minimum sensitivity. Electronic shutter to 1/2000 second. Full RS-232 remote control. Many auto functions. Bayonet lens mount. Digital Instruments microscope relay lens included. Composite and Y/C outputs. RGB with optional VA-C10 adapter included. Power unit and mating cable included.

REG. $6000 **SPECIAL $1895.00**

New, BRUSHLESS DC SERVOMOTOR with Hall Effect position sensors.

BEI Model DIH23-25-013Z. 2.25"diam. X 2.5" deep. with a 1/4" ball bearing shaft. A beautoiful precision motor. No specs. at press time. Don't delay.
SPECIAL $39ea. or 2 for $69

WEATHER RESISTANT Camera Enclosure

Solid, extruded aircraft aluminum. Glass window. Strain reliefs for cables. Size: 3.5"w x 3.7"h x14"L
Sale Price.................$49ea.
also available,
with 110VHEATER....$69ea.

NEW LASER DIODE MODULES, operate from 4.5 to 9VDC !

SPECIFICATIONS:
DC Power: 4.5 - 9V, @65mA
Power out: 4.5mw max.
Range: 400-800 Meters
Glass Collimator
Size: 0.41"diam.x0.7"L

Shown Actual Size

650nm 5X Brighter...$45
635nm 10X Brighter...$69
***635F adj. focus...$79**

The best value for commercial, Subminiature, laser modules. Glass collimating lens provides 1.5mRad performance. (divergence comparable to HeNe lasers.) Wide input, internal surface mount, 4.5 to 9VDC power supply. Machined brass for excellent thermal characteristics.

Exclusive "LAB STYLE" LASERS, 650nm and 635nm, Rugged, Dependable.

One year warranty. Adjustable X and Y beam position. Aircraft aluminum housing. Internal battery and on-off switch included. Makes a super pointer. .75d x 2.75"L **SALE..... 650nm $69, 635nm $99**

BURLE, Video Motion Sensor.

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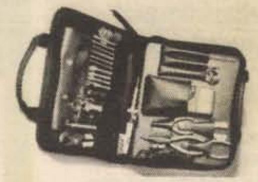

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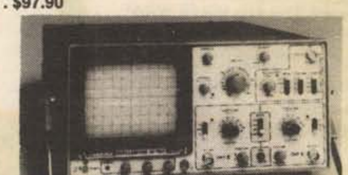

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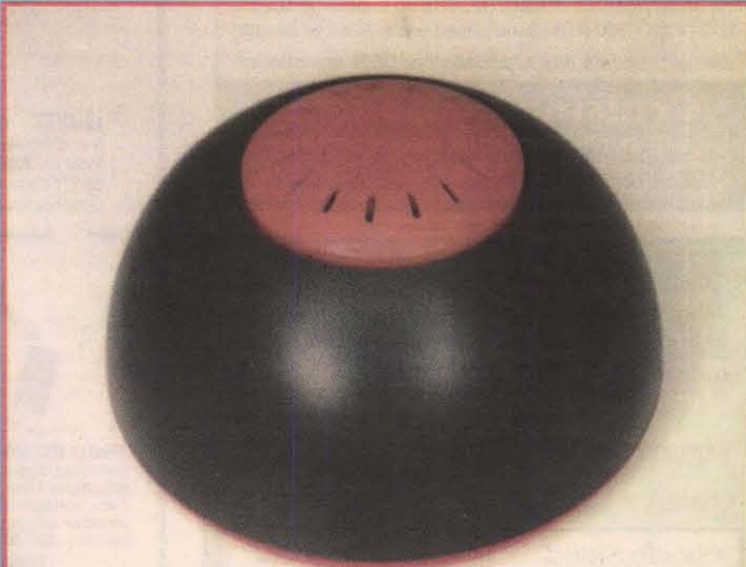
Enclosed in a black hemisphere housing with a red dome, you only need to press the top for instant voice reporting of the hour and minute, and whether it is AM or PM.

It can be set to announce hourly, or for any alarm time, with three different alarm sounds: beep, cuckoo, or rooster. A "snooze" function and volume adjustment are additional features.

Build the AK-210 Talking Alarm Clock

by Fred Blechman



The AK-210 is housed in a 4" diameter black hemisphere with a red dome on top. The dome is actually a switch. No other controls are visible.

This easy-to-build kit includes all the components — including many custom parts — to build a modern design talking alarm clock.

It should be made clear that this is not a design made from junk-box parts, or even parts you can buy independently. Many custom molded plastic and rubber parts, and stamped metal parts, are supplied. The printed circuit board, also supplied, has the "brain" — a custom integrated circuit — built right onto the board.

The benefit of building this project from the $14.95 Model AK-210 Talking Alarm Clock Kit (see Source) is the *Assembly and Instruction Manual* that not only guides you through a step-by-step assembly, but also is educational. You'll also have the pride of showing off a unique clock you have built.

If you build this kit, you'll want to read this review for some details not explained in the kit instructions. Also, I describe some slight difficulties I had in construction that may save you some time or effort.

Background

The dictionary defines time as a "measure of duration" and gives examples of seconds, minutes, hours, days, years, and ages. Since the dawn of the human race, people have used various standards to indicate the passage of time, and various devices to measure present time.

Using sundials, the position of the sun in the sky allowed civilizations to roughly estimate the time of day. The phases of the moon roughly established months. As mechanical clocks were developed to replace sundials, sand clocks, and water clocks, time discrimination became more precise, and various new standards were established.

For example, a portion of the year (Ephemeris Time), atomic resonance (Atomic Time), or rotation of the earth (Sidereal Time) are a few examples of today's attempts to establish standard time periods.

In 1956, the International Committee of Weights and Measures defined the basic unit of time as the "second" and made it equal to 1/31,556,925.9747 of the tropical year 1900. It was necessary to pick a specific year since each return of the sun to the vernal equinox decreases by about .0053 seconds.

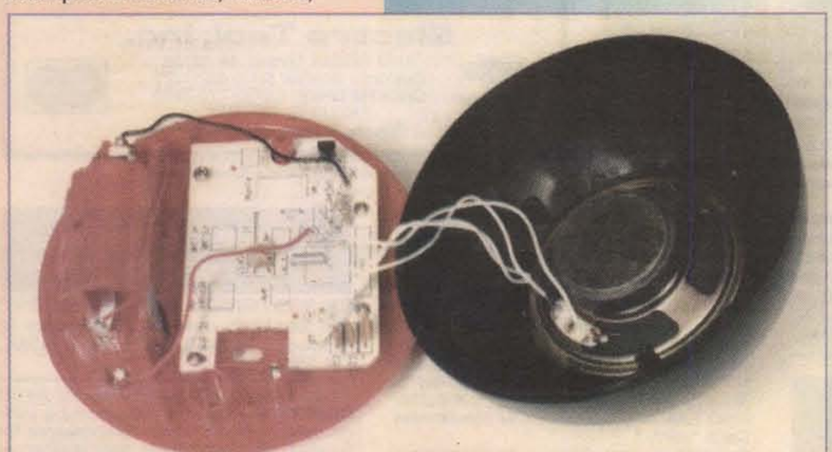
See the references at the end of this article, or check the Internet or your local library for more details.

Clocks

All instruments used to measure the passage of time must have a time reference built into them. Figure 1 shows the schematic diagram of the Model AK-210 Talking Clock, which uses a tiny vibrating crystal as its time standard. This is shown as Y1 in the schematic.

Crystals are used in electronic oscillator circuits to provide a stable frequency of oscillation. A crystal can be thought of as the electronic equivalent of a mechanical tuning fork.

When the tuning fork in Figure 2 is struck (excited), it will vibrate at only one frequency producing a clear, undistorted tone. When the crystal in the AK-210 clock circuit is excited (struck by an electronic



A printed circuit board mounts on the plastic base. The upper hemisphere contains the speaker and dome switch.

The LCD time display and all controls except the dome switch are underneath the clock.

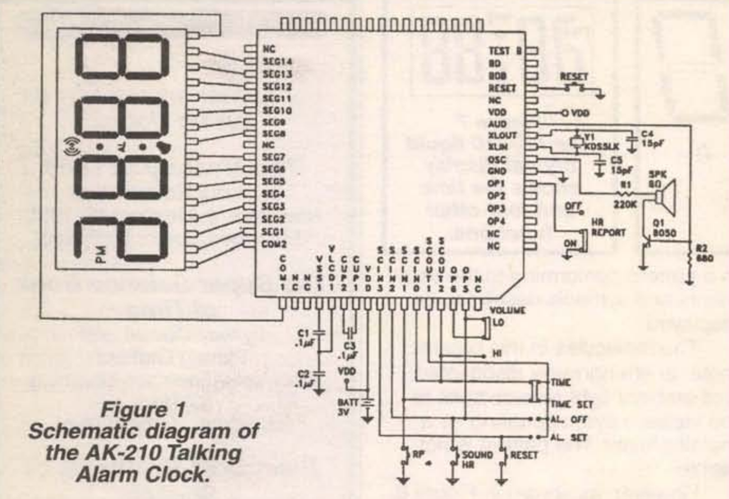


Figure 1
Schematic diagram of the AK-210 Talking Alarm Clock.

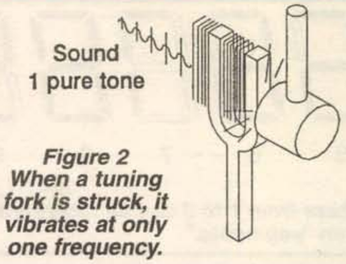


Figure 2
When a tuning fork is struck, it vibrates at only one frequency.

pulse), it will also vibrate at only one frequency, as illustrated in Figure 3.

The crystal supplied with the kit is designed to vibrate at a frequency of 32,768 Hz (Hz = Hertz = cycles per second). By continually dividing this frequency by 2, the frequency standard of 1.0000 Hz is obtained, as can be seen in Table 1.

Once the time standard of 1.000 seconds has been established, the custom integrated circuit attached to the AK-210 printed circuit board can calculate minutes, hours, and seconds. This information is then used to display digits or activate the appropriate speech.

This same built-on-board integrated circuit also checks to see if the time set in the alarm memory circuits has been reached. If the alarm time is the same as the time of day, the pre-selected alarm sound (beep, cuckoo, or rooster) will be activated. The alarm sound gets louder and repeats until it is deactivated.

Making the Clock Talk

There are numerous ways to record and reproduce speech. Records, tapes, CDs, video, and digital memory circuits are just a few well-known examples. The AK-210 uses words stored in digital memory to "speak" the time of day. Table 2 shows how many words are needed to verbally give the correct time.

The words in Table 2 are combined in certain ways to represent the correct time of day. For example, 11:14 in the morning would be "Eleven" "Four" "Teen" "_" "Oh" "Clock" "_" "A" "M."

Note there are two pauses that separate words to improve the speech quality.

In practice, these words are converted from a continuously changing voltage (analog) into a series of high (1) or low (0) voltage pulses (digital) by an analog-to-digital (A-to-D) converter. See Figure 4. When converting an analog signal to digital numbers, the constantly changing waveform is sampled, and each sample is converted electronically to a digital format — in this case, a four-bit (binary digit) "word."

When only four binary digits ("bits") are used, a decimal count of 0 to 15 is possible. Each bit has a "weight" based on the powers of 2, and only counts if it has a digital 1 value; 0 does not count.

The leftmost of the four bits (the most significant digit) is 2 to the third power, or decimal "8." Moving to the right, the second digit is 2 to the second power, or decimal "4." The next bit to the right is 2 to the first power, or decimal "2." The rightmost bit (the least significant digit) is 2 to the zero power, or decimal "1." If all binary bits are 1 (on), you would add 8+4+2+1, for a total of decimal 15.

Looking at Figure 4, you can see how the analog voltage sampled at nine different points each can be expressed as a four-bit digital word. For example, Sample #5 is 5 volts, which converts to digital 0101. Remembering that each digital 1 represents a power of 2, you evaluate from the left to the right and get (0+4+0+1=5).

The digital word samples are then stored in the integrated circuit and, when needed to operate the speaker, convert back to analog voltages electronically by a digital-to-analog (D-to-A) converter as shown in Figure 5.

If we say that a 1 means the voltage is present and a 0 means it is not, then 1001 would mean 8 volts is present, 4 volts is not, 2 volts is not, and 1 volt is present, yielding a total decimal value of 9.

After the digital numbers are converted to words, the words are amplified and sent to the speaker. The speaker reproduces the sounds that make the clock speak the time. As supplied, the AK-210 "speaks" only English. However, by special order (see Source), the integrated circuit used comes with words for any one of these foreign languages: Japanese, German, Spanish, Chinese, Italian, French, or Arabic.

The Visual Display

On the bottom of the AK-210 case is a small window where a four-digit time-of-day and some special symbols are shown using a liquid crystal display (LCD). Each number that appears in this window is made up of the appropriate combination of four vertical and three horizontal "segments," as shown in Figure 6.

For example, the num-

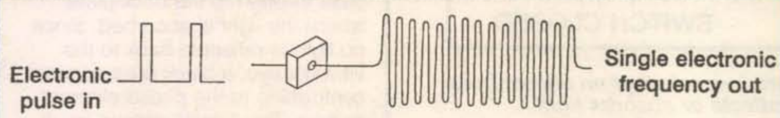
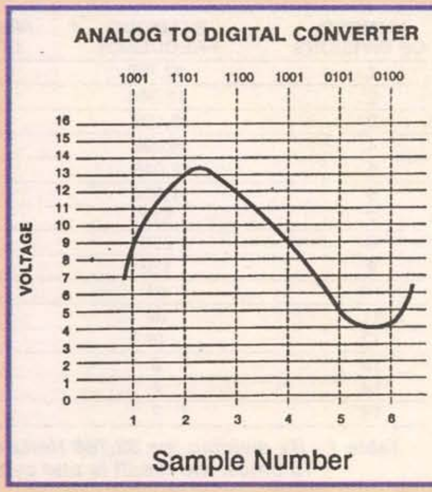
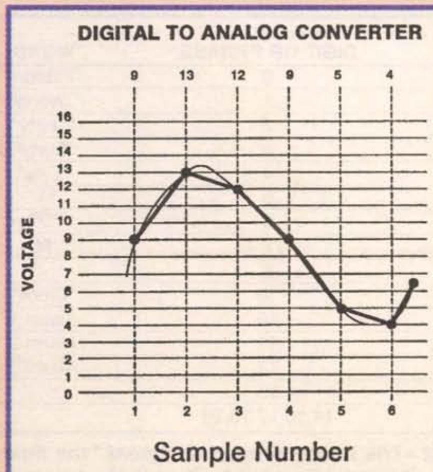


Figure 3 - When a crystal is excited, it vibrates at only one frequency.



Sample #	Voltage Analog	Voltage Digital
1	9	1001
2	13	1101
3	12	1100
4	9	1001
5	5	0101
6	4	0100

Figure 4 - Sampling an analog signal to convert to digital binary code.



DIGITAL	ANALOG
1001	= 1x8 + 0x4 + 0x2 + 1x1 = **9**
1101	= 1x8 + 1x4 + 0x2 + 1x1 = **13**
1100	= 1x8 + 1x4 + 0x2 + 0x1 = **12**
1001	= 1x8 + 0x4 + 0x2 + 1x1 = **9**
0101	= 0x8 + 1x4 + 0x2 + 1x1 = **5**
0100	= 0x8 + 1x4 + 0x2 + 0x1 = **4**

Figure 5 - Digital binary code converts back to digital sample values.

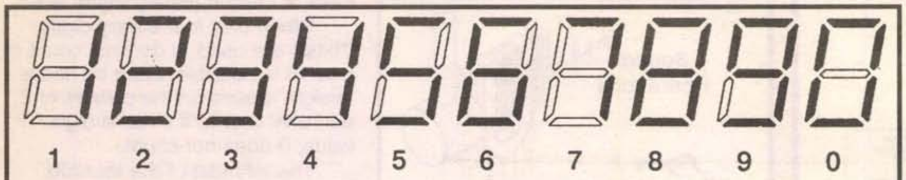


Figure 6 - All decimal numbers from 1 to 0 can be represented by seven "segments."

Figure 7 The AK-210 liquid crystal display shows the time and four other functions.

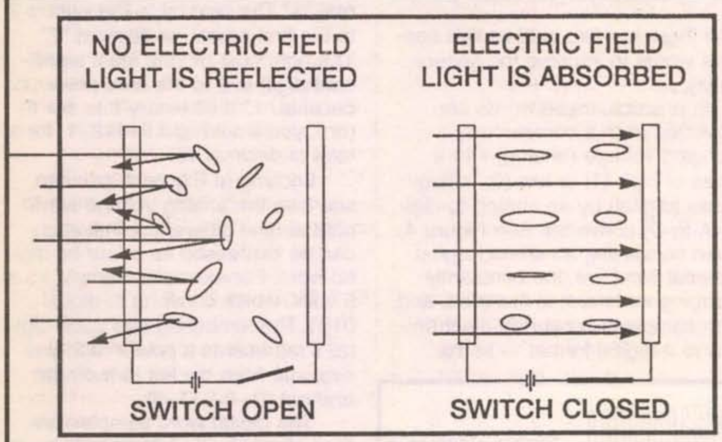


Figure 8 - An electric field determines whether an element of a liquid crystal display reflects or absorbs light.

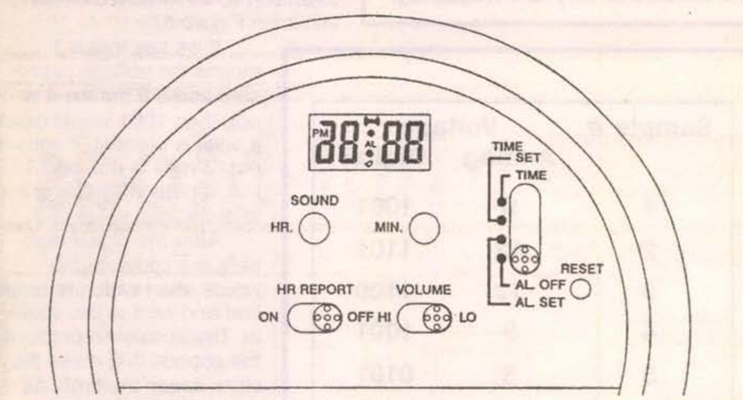


Figure 9 - The display and all the switches are on the bottom of the AK-210.

ber "8" uses all seven segments. The number "3" uses only the two right vertical segments and all the horizontal segments.

Figure 7 shows a close-up of the display with ALL segments and symbols "on." Note that the leftmost digit does not have (or need) the upper left vertical segment, since it never needs to show other than a "1" or a "2" (for military 24-hour time). The kit as supplied uses only 12-hour AM/PM time.

AM is not shown, but PM is. The symbol at the top center is to indicate the hourly announcement is active. The AL indicates the display is showing the alarm time. The little bell at the bottom center indicates the alarm is active.

Liquid Crystal Displays

The device used to create the black numbers and symbols on the bottom of the AK-210 is called a liquid crystal. An organic material is placed between two glass plates in a pattern conforming to the segments and symbols desired to be displayed.

The molecules in this organic material are normally disoriented, and ambient light reflects back to the viewer's eye, appearing as a metallic luster. The pattern is not visible.

However, as shown in Figure 8, when any of the pattern elements are exposed to an electric field (resulting from a voltage from the clock integrated circuit), the molecules of this element align themselves and allow ambient light to pass through to the back plate, where the light is absorbed. Since no light is reflected back to the viewer's eye, a black area appears conforming to the plated element pattern. This "black" area is much darker than the brighter metallic luster of the unaligned molecules in

For further information on talking clocks:

The Mystery of Time
by Harry Edward Neal
New York, J. Messner (C)1966
190 pages, Junior High level

The Super Science Book of Time
by Kay Davies and Wendy Oldfield
New York, Thomson Learning (C)1993
32 pages, Juvenile level

Electronic Synthesis of Speech
by Robert Linggard
New York, Cambridge University Press (C)1985
149 pages

Build-It Book of Digital Clocks
by Robert Haviland
TAB Books, Blue Ridge Summit, PA (C)1986
344 pages

NUMBER OF DIVISIONS	STARTING FREQUENCY	FREQUENCY DIVIDE BY	FINAL FREQUENCY
1	32,768	2	16,384
2	16,384	2	8,192
3	8,192	2	4,096
4	4,096	2	2,048
5	2,048	2	1,024
6	1,024	2	512
7	512	2	256
8	256	2	128
9	128	2	64
10	64	2	32
11	32	2	16
12	16	2	8
13	8	2	4
14	4	2	2
15	2	2	1

Table 1 - By dividing the 32,768 Hertz crystal frequency by 2, 15 times, the result is one cycle per second.

WORD	DIGIT OR PHRASE	WORD	DIGIT OR PHRASE
"Oh"	0	"Fifteen"	15
"One"	1	"Twenty"	20-29
"Two"	2	"Thirty"	30-39
"Three"	3	"Forty"	40-49
"Four"	4	"Fifty"	50-59
"Five"	5	"A"	A
"Six"	6	"P"	P
"Seven"	7	"M"	M
"Eight"	8	"_"	(Pause)
"Nine"	9	"Clock"	Clock
"Ten"	10	Alarm 1	(Sound of Rooster)
"Eleven"	11	Alarm 2	(Coo-Coo Clock Sound)
"Twelve"	12	Alarm 3	(Beeping Sound)
"Thirteen"	13		
"Teen"	14,16,17,18,19		

Table 2 - The words needed to "speak" the time are contained in the integrated circuit built onto the printed circuit board.

Source

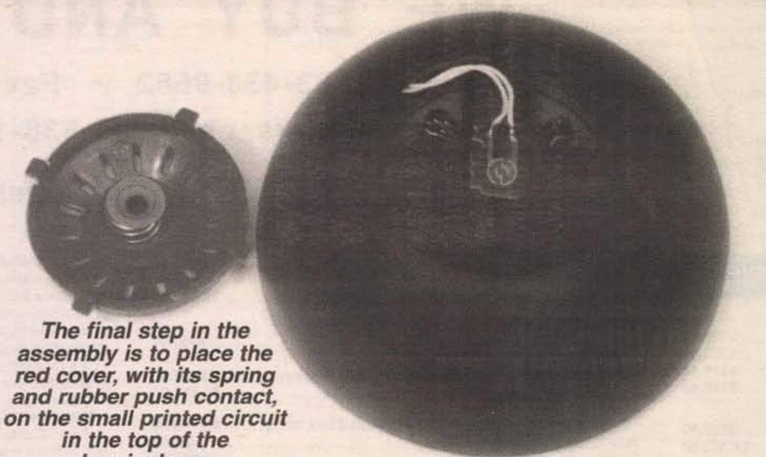
The Model AK-210 Talking Alarm Clock Kit is available only from C & S Sales, Inc., 150 W. Carpenter Ave., Wheeling, IL 60090. The kit price is $14.95. Add $5.00 North America shipping and handling. IL residents add 8.25% sales tax. North American orders: (800) 292-7711. For information or foreign orders call (847) 541-0710.

the unactivated area of the display.

Assembly

An excellent well-illustrated 16-page *Assembly and Instruction Manual* is included in the AK-210 kit. The kit includes wire and solder, as well as many special parts. The only things you'll need to supply (other than a soldering iron and pliers) are two "AA" 1.5-volt batteries. Each of the special molded or stamped parts is illustrated and identified in the manual, and each has its own part number if replacement is necessary.

Assembly is straighforward. The only parts soldered to the printed circuit board (which is nicely silk-screened to show all part locations) are two resistors, five capacitors, one transistor, the crystal, three jumpers, and six wires that go to the battery compartment, speaker, and dome switch. All the wires are precut to length and ends stripped, making it even easier. And there was more than enough solder supplied!



The final step in the assembly is to place the red cover, with its spring and rubber push contact, on the small printed circuit in the top of the hemisphere.

The only difficulty encountered in construction was with the metal parts. In order to be installed properly, two of the four battery contacts had to be bent about 135° instead of the 90° shown in the assembly illustrations. Also, the contact fingers on all three switches had to be bent upward to make better contact with the printed circuit board after assembly.

Testing

To assure proper operation before final assembly, the AK-210 is tested by installing two AA batteries in the battery compartment to see if the LCD segment and symbols all display. If not, you might have to adjust the physical alignment of the LCD and its flexible multi-contact strip, called a "zebra."

Figure 9 shows the switches and display on the bottom of the clock. With the LCD operating, you test out the various switch positions to see that you can set the present time and the alarm time. You also test the beep, cuckoo, and rooster alarm sounds, as well as the hourly announcement and volume settings. This is all adequately described in the manual.

Once testing is satisfactory, the dome switch (a small PCB contacted by pressing a rubber conductive cup) is installed, and the dome cover placed in position. Done!

Using

Simply tap the dome anytime and the clock will literally tell you the time. If the alarm is set, the sound you selected starts at alarm time and gets louder if you don't turn it off by moving a switch on the bottom. If you tap the dome switch instead, it acts as a "snooze alarm" and comes back on in 10 minutes.

If you set it for hourly announcements, it tells the time at the beginning of every hour. Setting the display for present time or alarm time involves setting a switch to the proper position and pressing an HOUR and MINUTE rubber button contact at the bottom of the clock to set the time. The RESET button sets it to 12:00 AM.

The Bottom Line

All controls (except the dome switch), and the display, are on the bottom of the AK-210 clock. All you see when the clock is on a table is a 4" diameter black hemisphere with a red top — very modern. You'll have a lot of people ask, "What's that?" Tell them to gently press the top red dome, and watch them jump when it "tells" them the time! **NV**

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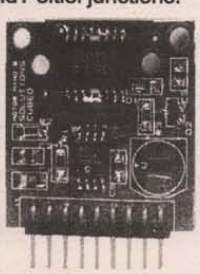
Miniature Engineering Modules

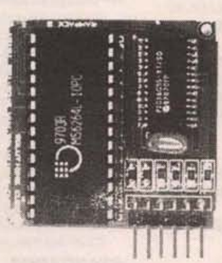
Serial Motor Controller. Control DC motors, fans, and Peltier junctions!



The Motor Mind B
only $29.95 qty. 1

1.2"x1.3" SIP module, up to 30V/2A DC motors, 254 speed steps, reverse, read tach(0-65,528Hz), auto-speed control, simple 1 or 2 pin serial communication.
(shown here without heat sink)

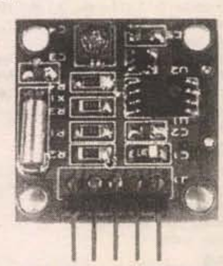
Serial RAM. Store all kinds of data with one i/o line!



The RAMPack B
only $29.95 qty. 1

1.6"x1.6" SIP module, 8K bytes of RAM, expandable to 32K, 1.2K-19.2K auto-baud detect, addressable Write, Byte Read, and Block Read commands, new buffer mode needs no addressing, 1, 2, or 4 pin serial communication.

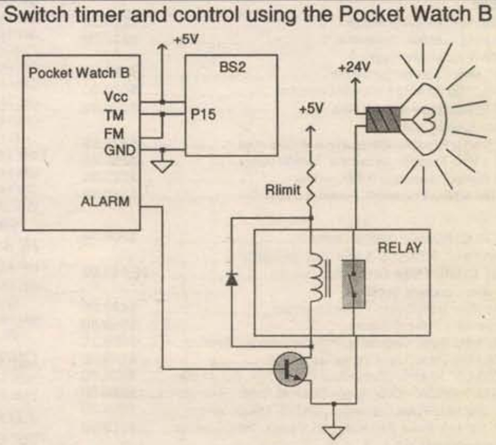
Serial Clock. Real time and your choice of 4 alarm types!



The Pocket Watch B
only $24.95 qty. 1

1"x1" SIP module, real time clock accurate to the second, year 2000 compatible, standard, single shot, short astable, and long astable alarm types, simple 1 or 2 pin serial communication.

Switch timer and control using the Pocket Watch B




```
'BS2 Code Snippet - This code will turn on the lamp for 15 minutes
'every 4 hours. The time is set to 6:30AM 11/20/97 before the
'alarm is set.

FM      CON   15
SEROUT FM,84,[$55,$00,$00,$1E,$06,$14,$0B,$61] 'Set time
SEROUT FM,84,[$55,$18,$03,$0E] 'Alarm on 15min. every 4hrs.
SEROUT FM,84,[$55,$14] 'Turn on alarm
END:
```

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Orders only **800-538-1493**

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OSCILLOSCOPES & ACCESSORIES

TO 100 MHz

- TEK 7A18 75 MHz Dual Trace Amplifier ... $100.00
- TEK 7A22 1 MHz High CMRR Differential Amplifier ... $300.00
- TEK 7B53A 100 MHz Dual Time Base ... $175.00
- TEK SC502 15 MHz Dual Trace Oscilloscope, TM500 series ... $375.00

ABOVE 100 MHz

- TEK 475A 250 MHz Dual Trace Oscilloscope ... $900.00
- TEK 7104 1 GHz Oscilloscope, with 7A29, 7A29-04, 7B10, 7B15 ... $4,500.00
- TEK 7844 400 MHz Dual Beam Oscilloscope frame ... $750.00
- TEK 7844 400 MHz Dual Beam Oscilloscope with 7A24,7A26,7B80,7B85 ... $1,250.00
- TEK 7854 400 MHz Waveform Processing Oscilloscope frame ... $1,250.00
- TEK 7904A 500 MHz System, with 7A24, 7A26, 7B92A ... $1,250.00
- TEK 7904A 500 MHz System, with 7A24, 7A26, 7B80, 7B85 ... $1,250.00
- TEK 7A13 105 MHz Differential Comparator ... $225.00
- TEK 7A19 600 MHz Single Trace Amplifier ... $150.00
- TEK 7A24 400 MHz Dual Trace Amplifier ... $300.00
- TEK 7A26 200 MHz Dual Trace Amplifier ... $175.00
- TEK 7B15 1 GHz Delaying Time Base ... $450.00
- TEK 7B80 400 MHz Delayed Time Base ... $175.00
- TEK 7B85 400 MHz Delta Delaying Time Base ... $175.00
- TEK 7B92A 500 MHz Dual Time Base ... $275.00

STORAGE

- TEK 7633 100 MHz Storage Oscilloscope frame ... $650.00
- TEK 7633 100 MHz Storage Oscilloscope with (2) 7A26, (1) 7B92A ... $1,000.00

PROBES

- HP 1122A Probe Power Supply ... $200.00
- TEK 1101 Accessory Power Supply, for FET probes ... $250.00
- TEK P6101A 34 MHz 1X Modular Probe, 2m length *NEW* ... $25.00
- TEK P6108A 100 MHz 10X Modular Probe, 2m length *NEW* ... $50.00
- TEK P6201 900 MHz 1X/10X/100X FET Probe ... $450.00
- TEK P6202A 500 MHz 10X FET Probe ... $300.00
- TEK P6701-opt.02 O/E Converter, 450-1050 nm/0-1 mW: DC-700 MHz, ST conn. ... $675.00

CALIBRATION

- TEK CG5001-opt.01/TM5006 Programmable Oscilloscope Calibrator, with power module ... $6,000.00
- TEK CG551AP/TM506A Oscilloscope Calibrator, with pulse head & power module ... $2,500.00

WAVEFORM GENERATORS

FUNCTION

- HP 3310A 5 MHz Function Generator ... $250.00
- HP 3310B 5 MHz Function Generator, monocycle & var.phase trigger ... $325.00
- HP 3312A 13 MHz Function Generator ... $750.00
- KROHN-HITE 2000 30 MHz Function Generator ... $600.00
- TEK DD501 Digital Delay & Burst Gen., for function & pulse gen's ... $275.00
- TEK FG501 1 MHz Function Generator, TM500 series ... $225.00
- TEK FG503 3 MHz Function Generator, TM500 series ... $250.00
- TEK RG501 Ramp Generator, TM500 series ... $225.00
- WAVETEK 186 5 MHz Phaselock Function Generator ... $350.00

PULSE

- BERKELEY NUCLEONICS 7085B Digital Delay Generator, 0-100 mS, 1 nS res.,5 Hz-5 MHz ... $900.00
- HP 214B-001 10 MHz Pulse Generator, 50 V/50 ohms, counted burst opt ... $2,000.00
- HP 8005B 20 MHz Dual Output Pulse Generator ... $450.00
- HP 8007B 100 MHz Pulse Generator ... $650.00
- HP 8012B 50 MHz Pulse Generator, variable transition time ... $600.00
- HP 8015A 50 MHz Dual Output Pulse Generator ... $700.00
- HP 8015A-002,007 50 MHz Dual Output Pulse Gen., burst option ... $800.00
- HP 8080A/91A/92A/93A 1 GHz Single Channel Pulse Generator ... $950.00
- TEK PG502 250 MHz Pulse Generator, Tr<1nS, TM500 series ... $600.00
- TEK PG505 100 kHz Pulse Generator, 80 V peak, TM500 series ... $275.00

PROGRAMMABLE

- HP 8165A-002,003 Prog. Signal Source, 1 mHz-50 MHz, log sweep, rear out ... $2,000.00
- TEK AWG5102 Arb.Waveform Gen.,20 MS/s, 12 bits,50ppm synthesis <1MHz ... $1,400.00
- TEK AWG5105-opt.02 Arbitrary Waveform Generator, dual channel option ... $1,900.00
- TEK FG5010 Programmable 20 MHz Function Generator, TM5000 series ... $1,200.00
- WAVETEK 288 20 MHz Synthesized Function Generator, GPIB ... $1,250.00

VOLTAGE & CURRENT

VOLTMETERS

- HP 3456A 6-1/2 Digit Voltmeter ... $850.00
- HP 3478A 5-1/2 digit Multimeter, HPIB ... $700.00
- KEITHLEY 181 6-1/2 digit Nanovoltmeter, 10 nV sensitivity, GPIB ... $1,200.00
- SOLARTRON 7081 8-1/2 digit Voltmeter ... $3,900.00

CALIBRATION

- FLUKE 343A DC Voltage Calibrator, 0-1100 V, 7 decades, 20 ppm acc. ... $950.00
- FLUKE 510A AC Reference Standard, 10 VRMS, 0-10 mA ... $450.00
- FLUKE 515A Portable Calibrator, DC/AC/Ohms, line & battery power ... $1,250.00
- FLUKE 5220A Transconductance Amplifier, DC-5 kHz, 0-20 A ... $3,750.00
- FLUKE 731B DC Reference Standard ... $400.00
- FLUKE 732A DC Voltage Standard ... $2,000.00
- FLUKE A40-series Current Shunts ... $200.00
- FLUKE A55-series AC Thermal Converters ... $300.00
- VALHALLA 2703 AC Volt.Std., 0-120V/10 Hz-100 kHz;120-1200V/10 Hz-1 kHz ... $2,250.00

VOLTAGE SOURCES

- HP 6115A Precision Dual Range Power Supply, 50V 0.8A / 100V 0.4A ... $875.00

CURRENT METERS & SOURCES

- HOLT HCS-1AF Primary Current Shunt Set, 0.02/0.2/0.5/2/5/20 Amp ... $750.00
- HP 4140B Picoammeter / DC Voltage Source ... $4,000.00
- HP 6177C DC Current Source, to 50V, 500mA ... $500.00
- HP 6181C DC Current Source, to 100 V, 250 mA ... $500.00
- HP 6186C DC Current Source, to 300V, 100mA ... $750.00
- KEITHLEY 225 Current Source, 0.1 uA-100 mA, 10-100 V compliance ... $500.00
- KEITHLEY 414A Picoammeter, 0.1 nA-10 mA ... $325.00
- KEITHLEY 486 Picoammeter ... $1,500.00
- KEITHLEY 642 Electrometer ... $2,900.00
- TEK CT-5 -opt.05 High Current Transformer for P6021/A6302, to 1000A ... $500.00
- VALHALLA 2301 Programmable Single Phase Power Analyzer ... $1,250.00

IMPEDANCE & COMPONENT TEST

L.C.R.

- BOONTON 62AD 1 MHz Inductance Meter, 2-2000 uH ... $550.00
- HP 4275A-001 5-1/2 digit LCR Meter, 10 kHz-10 MHz, 0-35 V int. bias ... $6,000.00

STANDARDS

- E.S.I. SR1010 Resistance Transfer Standards, 1 ohm-100 K/step ... $700.00
- E.S.I. SR1050-10M Resistance Transfer Standard, 10 Megohms/step ... $2,500.00
- E.S.I. SR1050-1M Resistance Transfer Standard, 1 Megohm/step ... $2,000.00
- GR 1403-SERIES Standard Air Capacitors, 0.1% accuracy ... $150.00
- GR 1406 Standard Air Capacitors, GR900 connector, 0.1% acc. ... $375.00
- GR 1412-BC Decade Capacitor, 50 pF - 1.11115 uF ... $350.00
- GR 1432-U 4-Decade Resistor, 0-111.10 ohms, 0.01 ohm resolution ... $125.00
- GR 1433-J 4-Decade Resistor, 0-1,110 ohms, 1 ohm resolution ... $350.00
- GR 1433-L 4-Decade Resistor, 0-11,110 ohms, 10 ohm resolution ... $350.00
- GR 1433-N 5-Decade Resistor, 0-11,111 ohms, 0.1 ohm resolution ... $400.00
- GR 1433-Q 4-Decade Resistor, 0-1,111,000 ohm, 100 ohm resolution ... $350.00
- GR 1433-U 4-Decade Resistor, 0-111.0 ohms, 0.01 ohm resolution ... $350.00
- GR 1433-X 6-Decade Resistor, to 111,111.0 ohms, 0.1 ohm res. ... $450.00
- GR 1434-G 7-Decade Resistor, 0-1,111,111.0 ohms, 0.1 ohm res. ... $300.00
- VALHALLA 2724A Programmable Resistance Standard, 0-11 Gigaohms, GPIB ... $1,675.00

HI & LO RESISTANCE

- HP 4328A Milliohmeter ... $1,300.00
- HP 4329A High Resistance Meter, 5E5-2E16 Ohms, 10-1000 V test ... $1,350.00
- VALHALLA 4150-ATC 4-1/2 digit Ohmmeter, 20 milliohms-2 kilohms, 4-wire ... $750.00

CURVE TRACERS

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

T.D.R.

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

POWER SUPPLIES

SINGLE OUTPUT

- HP 6012A Autoranging 0-60 V 0-50 A / 1000 Watt max. CV/CC Supply ... $1,250.00
- HP 6200B Dual Range Power Supply, 20 V 1.5 A / 40 V 0.75 A CV/CC ... $200.00
- HP 6201B 20 V at 1.5A CV/CC Power Supply ... $175.00
- HP 6206B Dual Range 0-60 V 0.5 A / 0-30 V 1 A CV/CL Supply ... $200.00
- HP 6207B 160 V at 200 mA CV/CC Power Supply ... $300.00
- HP 6260B-027 10V at 100A CV/CC Power Supply; 208 VAC line ... $675.00
- HP 6261B-027 20 V at 50 A CV/CC Power Supply; 208 VAC line ... $675.00
- HP 6263B 20 V at 10 A CV/CC Power Supply ... $400.00
- HP 6267B 40 V at 10 A CV/CC Power Supply ... $550.00
- HP 6281A 0-7.5 V 0-5 A CV/CC Power Supply ... $175.00
- HP 6290A 0-40 V 0-3 A CV/CC Power Supply ... $300.00
- HP 6299A 100 V at 750 mA CV/CC Power Supply ... $225.00
- HP 6384A 4.0-5.5 V at 8 A CV/CL Power Supply ... $175.00
- SORENSEN DCR 20-25B 20 V at 25 A CV/CC Power Supply ... $550.00
- SORENSON DCR 300-1.5B 300 V at 1.5 A CV/CC Power Supply ... $600.00
- SORENSON DCR 300-8A 300 V at 8 A CV/CC Power Supply, 208/230 VAC line ... $950.00
- SORENSON SRL 20-12 20 V at 12 A CV/CC Power Supply, low noise ... $500.00
- SORENSON SRL 60-8 60 V at 8 A CV/CC Power Supply, low noise ... $750.00
- TEK PS501-1 Power Supply, 0-20 V, 2 mV res., 400 mA, TM500 series ... $175.00

MULTIPLE OUTPUT

- HP 6228B Dual 50 V at 1 A CV/CC Power Supply ... $600.00
- HP 6236B Triple Output Power Supply, +/-20 V 0.5 A, +6 V 2.5 A ... $550.00
- HP 6237B Triple Output Power Supply, +/-20 V 0.5 A, +18 V 1 A ... $550.00
- HP 6253A Dual Output 20 V 3 A CV/CC Power Supply ... $550.00
- TEK PS5010 Programmable Triple Power Supply, TM5000 series ... $750.00
- TEK PS503A Dual Power Supply, TM500 series ... $200.00

MISCELLANEOUS

- ACME PS2L-500 Programmable Load, 0-75 V / 0-75 A / 500 Watts max. ... $400.00
- HP 59501B HPIB Isolated DAC/Power Supply Programmer ... $175.00
- TRANSISTOR DEVICES DAL-50-15-100 Programmable Load, 0-50 V, 0-15 A, 100 Watts max. ... $200.00

TIME & FREQUENCY

UNIVERSAL COUNTERS

- HP 5315A 100 MHz/100 nS Universal Counter ... $500.00
- HP 5315A-002,003 100 MHz/100 nS Univ. Counter, battery power, 1 GHz C-ch ... $750.00
- HP 5315B 100 MHz/ 100 nS Universal Counter ... $600.00
- HP 5316A 100 MHz/100 nS Universal Counter, HPIB ... $700.00
- HP 5316A-003,006 100 MHz/100 nS Counter, 1 GHz C-ch., offset/normalize ... $1,000.00
- HP 5316B 100 MHz/ 100 nS Universal Counter, HPIB ... $1,000.00
- HP 5334A 100 MHz Universal Counter, HPIB ... $875.00
- HP 5334B-010,060 100 MHz Universal Counter, HPIB, OCXO ... $1,000.00
- HP 5335A 200 MHz Universal / Statistical Counter ... $1,200.00
- RACAL 1996 200 MHz/1 nS Universal Counter, 1.3 GHz C-channel ... $1,000.00
- RACAL-DANA 1992-04 100 MHz/1 nS Univ. Counter, 1.3 GHz C-channel, OCXO ... $750.00
- TEK DC5004 Programmable 100 MHz/100nS Counter/Timer, TM5000 series ... $250.00
- TEK DC5009 Programmable 135 MHz Univ. Counter/Timer, TM5000 series ... $500.00

FREQUENCY COUNTERS

- EIP 575 18 GHz Source Locking Counter, GPIB ... $3,250.00
- EIP 578-opt.02,05 26.5 GHz Source Locking Counter; power meas., OCXO ... $5,000.00
- EIP 578-opt.06 26.5 GHz Source Locking Counter, millimeter wave ext. ... $8,000.00
- EIP 590-opt.92 WR19 Mixer Kit, 40-60 GHz, for EIP option 06 counters ... $875.00
- FLUKE 7220A 1.3 GHz Communications Counter ... $500.00
- HP 5340A-011 18 GHz Frequency Counter, HPIB ... $1,250.00
- HP 5342A 18 GHz Frequency Counter ... $2,400.00
- HP 5342A-001 18 GHz Frequency Counter, OCXO reference ... $2,500.00
- HP 5342A-003,011 18 GHz Freq.Counter, +22 dBm,-20 dBm dynamic range,HPIB ... $2,750.00
- HP 5342A-01,04,05,11 24 GHz Frequency Counter, OCXO, DAC, and HPIB ... $3,900.00
- HP 5343A-006 26.5 GHz Frequency Counter; limiter option ... $4,500.00
- HP 5345A/5355A/5356B 26.5 GHz CW/Pulse Frequency Counter ... $4,000.00

STANDARDS

- AUSTRON 1250A Crystal Frequency Standard, 0.1/ 1.0/ 5.0 MHz ... $600.00
- HP 105A Quartz Oscillator, 0.1/ 1.0/ 5.0 MHz ... $750.00
- HP 105B Quartz Oscillator, 0.1/ 1.0/ 5.0 MHz, battery power ... $1,500.00
- HP 5087A-opt.033 Distribution Amplifier; 12 outputs at 10 MHz ... $1,750.00

AUDIO & BASEBAND

SELECTIVE LEVEL METERS

- HP 3586C Selective Level Meter, 50 Hz-32.5 MHz, 50 & 75 ohms ... $1,500.00

DISTORTION ANALYZERS

- HP 339A Distortion Analyzer, built-in low distortion osc. ... $1,800.00
- HP 8903A-001 Audio Analyzer, 20 Hz-100 kHz; rear panel input ... $2,600.00
- HP 8903B-001,013,051 Audio Analyzer, 20 Hz-100 kHz; C-message, CCITT ... $4,250.00
- TEK DA4084 Programmable Distortion Analyzer ... $1,000.00

RMS VOLTMETERS

- FLUKE 8920A True RMS Voltmeter, 180 uV-700 V, 10 Hz-20 MHz ... $600.00
- FLUKE 8922A True RMS Voltmeter, 180 uV-700 V, 2 Hz-11 MHz ... $600.00

OSCILLATORS

- HP 204C Oscillator, 5 Hz-1.2 MHz, 5 VRMS ... $150.00

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HP 204D Oscillator, 5 Hz-1.2 MHz, ... $200.00
5 VRMS, 80 dB step attenuator
HP 209A Sine/Square Wave Generator, ... $225.00
4 Hz-2 MHz, 5 VRMS max.
HP 652A Test Oscillator, 10 Hz-10 MHz $250.00
TEK SG502 Sine/Square Osc., ... $200.00
5 Hz-500 kHz, 70 dB step atten.,TM500

MISCELLANEOUS

HP 4437A Step Attenuator, 0-119.9 dB, ... $175.00
DC-1 MHz, 600 ohms unbal.
HP 461A Amplifier, 20/40 dB, 1 kHz-150 MHz, 0.5 V/50 Ohms $125.00
KROHN-HITE 3103 High/Low Pass Filter, ... $500.00
10 Hz-3 MHz, 24 dB/octave
KROHN-HITE 3342R Dual HP/LP Filter, ... $1,100.00
0.001 Hz-99.9 kHz, 48 dB/octave
KROHN-HITE 3750 LP/HP/BP/BR Filter, ... $700.00
0.02 Hz-20 kHz, 6/12/18/24 dB/oct.
ROCKLAND 852 Dual Highpass/Lowpass Filter, 0.1 Hz-111 kHz $1,000.00
TEK AF501 Tunable Bandpass Filter / Amplifier, 3 Hz-35 kHz $300.00
TEK AM502 Differential Amplifier, 0.1 Hz-1 MHz, TM500 series $475.00

RF & MICROWAVE

SPECTRUM ANALYZERS

HP 11970A WR28 Harmonic Mixer, 26.5-40 GHz $1,100.00
HP 11970Q WR22 Harmonic Mixer, 33-50 GHz $1,400.00
HP 11971A WR28 Harmonic Mixer, 26.5-40.0 GHz, for 8569B $1,100.00
HP 11971K WR42 Harmonic Mixer, 18.0-26.5 GHz, for 8569B $1,100.00
HP 8406A Comb Generator, 1/10/100 MHz increments, to 5 GHz $450.00
HP 8444A-059 Tracking Generator, ... $1,250.00
0.5-1500 MHz, for 8554,8568,etc.
HP 8445B Preselector, 1.8-18.0 GHz, for HP 8555A $650.00
HP 8553B/8552B/8443/141 Spectrum Analyzer, ... $2,500.00
0.1-110 MHz, with tracking generator
HP 8565A-100 Spectrum Analyzer, ... $5,000.00
10 MHz-22 GHz, 100 Hz min.res.bw.
HP 8569B Spectrum Analyzer, ... $8,500.00
10 MHz-22 GHz, 100 Hz min.res.bw.
TEK 119-0098-00 WR42 Single Ended Mixer, ... $200.00
18.0-26.5 GHz, for Tek 491
TEK 119-0099-00 WR28 Single Ended Mixer, ... $200.00
26.5-40 GHz, for Tek 491
TEK TR503 Tracking Generator, 0.1-1800 MHz, for 492/4/5/6 .... $1,375.00
TEK WM782V WR15 Harmonic Mixer, 50-75 GHz $2,000.00

NETWORK ANALYZERS

HP 11664C Detector Adapter, for 8755/6/7 .... $200.00
HP 11666A Reflectometer Bridge, ... $1,100.00
0.04-18.0 GHz, for HP 8755/6/7
HP 8505A Network Analyzer, 0.5-1300 MHz $3,750.00
HP 8756A/(3)11664A-001 Scalar Network Analyzer, ... $3,750.00
w/(3) det., APC7, 0.01-18 GHz

SIGNAL GENERATORS

FLUKE 6060A/AN Synthesized Signal Gen., ... $2,000.00
10 kHz-520 MHz, 10 Hz res,GPIB
FLUKE 6062A Signal Generator, ... $5,500.00
0.1-2100 MHz, 10 Hz resolution
FLUKE 6070A Synthesized Signal Generator, ... $2,000.00
0.2-520 MHz, 1 Hz res.
GIGATRONICS 600/10-18 Synthesized Source, ... $2,600.00
10-18 GHz, 1 MHz res., GPIB
GIGATRONICS 605/10-18 Synthesized Source, ... $3,000.00
10-18 GHz, 1 kHz res., GPIB
GIGATRONICS 840-01 Freq. Doubler, ... $2,000.00
26.5-40 GHz (WR28) out, 13-20 GHz in
GIGATRONICS 875/50 Levelled Multiplier, ... $3,500.00
x4, 50.0-75.0 GHz output, -3 dBm
GIGATRONICS 875/86 Levelled Multiplier, ... $5,000.00
26.5-40.0 & 50.0-75.0 GHz outputs
GIGATRONICS 910/12-18,opt6,14,16 .... $3,500.00
Synthesized Source/Sweeper, 12-18 GHz, 1 Hz res., OCXO
HP 11720A Pulse Modulator, 2-18 GHz, 80 dB on/off ratio $750.00
HP 85100V Frequency Mult., ... $4,250.00
10-15 GHz in / 50-75 GHz out >0 dBm
HP 8640B-001,002,003 Signal Gen., ... $2,250.00
0.5-1024 MHz, AM, FM, var. audio osc.
HP 8654A Signal Generator, 10-520 MHz, ... $550.00
calibrated AM & uncal. FM
HP 8656A Signal Generator, 0.1-990 MHz, ... $2,900.00
100 Hz res, AM, FM, HPIB
HP 8660C/86602B-002 Synth. Sig. Gen., ... $3,250.00
1-2600 MHz, FM / Phase mod. w/86635A

SWEEP GENERATORS

HP 8600A Digital Marker, for HP 8601A $400.00
HP 8601A Generator/Sweeper, 0.1-110 MHz, +20 dBm levelled $400.00
HP 8620C Sweep Oscillator Frame $550.00
HP 8620C-011 Sweep Oscillator Frame, HPIB programmable $675.00
HP 86222A-002 RF Plug-in, 10-2400 MHz, ... $1,600.00
+13 dBm levelled, 70 dB atten.
HP 86230B RF Plug-in, 1.8-4.2 GHz, +10 dBm unlevelled $675.00
HP 86241A-001 RF Plug-in, 3.2-6.5 GHz, +8 dBm levelled $500.00
HP 86242D-004,008 RF Plug-In, 5.9-9.0 GHz, +10 dBm levelled $500.00
HP 86245A RF Plug-in, 5.9-12.4 GHz, +16 dBm levelled $1,100.00
HP 86250D RF Plug-in, 8.0-12.4 GHz, +10 dBm levelled $675.00
HP 86260A RF Plug-in, 12.0-18.0 GHz, +10 dBm unlevelled $800.00
HP 86260A-H04 RF Plug-in, 10.0-15.0 GHz, +10 dBm unlevelled $800.00
HP 86290A RF Plug-in, 2.0-18.0 GHz, +7 dBm levelled $1,750.00
HP 86290B RF Plug-in, 2.0-18.6 GHz, +10 dBm levelled $2,000.00

WAVETEK 962 Sweep Generator, ... $1,500.00
1.0-4.0 GHz, markers, +12 dBm unlvld.

POWER METERS

ANRITSU MP-81B/ML-83A Power Meter, ... $2,500.00
75-110 GHz (WR10), -20 to +20 dBm
ANRITSU MP-82B/ML-83A Power Meter, ... $3,250.00
90-140 GHz (WR8), -20 to +20 dBm
BOONTON 4200-01A,03/&-4A x2 Dual Channel $1,500.00
Microwattmeter, w/(2) 1 MHz-7 GHz sensors
BOONTON 42B/41-4B Analog Power Meter, ... $375.00
with 1 MHz-12 GHz sensor
BOONTON 42B/41-4E Analog Power Meter, ... $500.00
with 1 MHz-18 GHz sensor
GENERAL MICROWAVE 476/4240A Power $375.00
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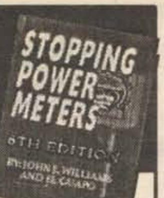

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The Bearcat 895XLT is superb for intercepting trunked communications transmissions (see BC235XLT description) with features like TurboScan™ to search VHF channels at 100 steps per second. This base and mobile scanner is also ideal for intelligence professionals because it has a Signal Strength Meter, RS232C Port to allow computer-control of your scanner via optional hardware and 30 trunking channel indicator annunciators to show you real-time trunking activity for an entire trunking system. Other features include ***Auto Store*** - Automatically stores all active frequencies within the specified bank(s). ***Auto Recording*** - This feature lets you record channel activity from the scanner onto a tape recorder. ***CTCSS Tone Board*** (Continuous Tone Control Squelch System) which allows the squelch to be broken during scanning only when a correct CTCSS tone is received. For maximum scanning enjoyment, order the following optional accessories: **PS001** Cigarette lighter power cord for temporary operation from your vehicle's cigarette lighter $14.95; **PS002** DC power cord - enables permanent operation from your vehicle's fuse box $14.95; **MB001** Mobile mounting bracket $14.95; **EX711** External speaker with mounting bracket & 10 feet of cable with plug attached $19.95. The BC895XLT comes with AC adapter, telescopic antenna, owner's manual and one year limited Uniden warranty. Save $80.00...order the package deal above.

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Software Wizardry

Understanding The Windows Registry

By Harry Helms

Windows NT introduced something called the registry. The registry was a central hierarchical database containing configuration data for the entire PC. This was in contrast to previous versions of Windows, where scattered .INI files contained configuration data. The registry was intended to be a "one-stop" location for configuration data and also to get around some of the limitations of .INI files (like being restricted to a maximum of 64K on some PCs).

Registry entries can include data, like text strings, not supported by .INI files. And by storing all configuration data in one place, the registry is easier to back up and restore than .INI files. Because of these advantages, the registry was incorporated into Windows95.

You've probably manipulated the registry several times without realizing it. Every time you install (or uninstall) software in Windows95, you're manipulating the registry. Have you changed the color of your Windows95 desktop or the display resolution? Even that alters the registry.

However, the registry doesn't entirely replace .INI files. (There's still a SYSTEM.INI file for compatibility with Windows 3.1, for example.) And the registry introduces some new problems of its own. For example, ActiveX controls used in Windows software are stored in the registry. A corrupted registry entry can bring an application (or even your PC) to a screeching halt. Installing new software often alters registry entries, so troubleshooting a software installation problem means you may have to look around in the registry. Getting to know the registry is the subject of this month's column.

The Registry Structure

In your Windows folders are a couple of huge files named SYSTEM.DAT and USER.DAT. The registry is just a way to organize and easily access the data in those two files.

SYSTEM.DAT contains settings that are specific to the PC hardware regardless of who is using it, while USER.DAT contains settings specific to a user regardless of the PC hardware. This distinction is because Windows NT and Windows95 were designed to be used in a networked environment. In a network, different users might use different PCs on a network, but might prefer to have the settings (like desktop color) available to them that they use on their "normal" PC. The registry's organization is designed to facilitate such "roving" users.

The registry uses the terms "keys" and "values" to refer to its entries. These are actually new names for concepts you're already familiar with. A key is actually a directory, and a value is just a file. The hierarchical relationships between keys and values is just like the one between directories and files.

Because of the potential for an inexperienced user to cause real problems to their PC, Microsoft went out of their way to make the registry hard to access. To view the registry, you need to go into the Windows folder and double-click the regedit.exe file. When you do, you see something similar to Figure 1. This is called the Registry Editor.

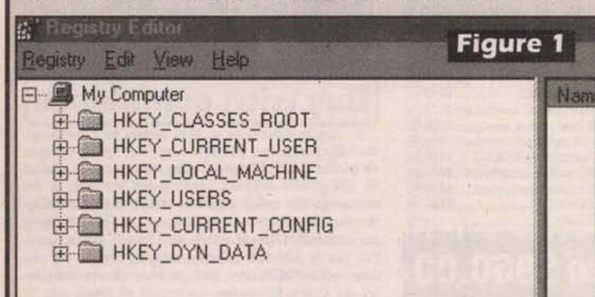

Figure 1

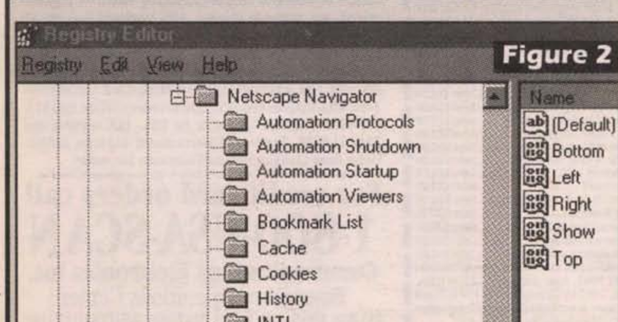

Figure 2

There are six top-level keys in the Windows95 registry. Here is what you'll find in each:

- HKEY_CLASSES_ROOT: This is similar to the REG.DAT file found in Windows 3.1 and contains data about object linking and embedding (OLE) servers and containers. This is also where data for "shortcuts" on the Windows95 desktop is found.
- HKEY_CURRENT_USER: If the PC is part of a network, this is where the settings and preferences for the user currently "logged on" at this PC are found.
- HKEY_LOCAL_MACHINE: This key stores configuration data for all of the hardware that was ever installed on the PC. For example, if you remove your old 28.8K modem and install a new 56K modem, this key will still store the configuration data for the 28.8 modem. In other words, if it was ever installed on your PC, you'll find the configuration data for it here!
- HKEY_USERS: If a PC is part of a network, this key stores settings and preferences for all users that have ever logged on to the network from the PC. When a user logs on to the network from the PC, his or her data is transferred from this key to HKEY_CURRENT_USER.
- HKEY_CURRENT_CONFIG: This key stores configuration data for the hardware currently installed on the PC. If you haven't changed any of the hardware on your PC, then this key and HKEY_LOCAL_MACHINE should be identical.
- HKEY_DYN_DATA: This key is created dynamically when the PC is in use and stores data about the performance of system hardware.

Each of these top-level keys contains sub-keys and values.

Viewing And Editing A Registry Entry

Figure 2 shows what you see when you view entries in the Registry Editor. At the left is a list of configuration keys for my copy of Netscape, and at the right are values for a particular key. In this case, the values are for the default location of the Netscape window when I launch that application.

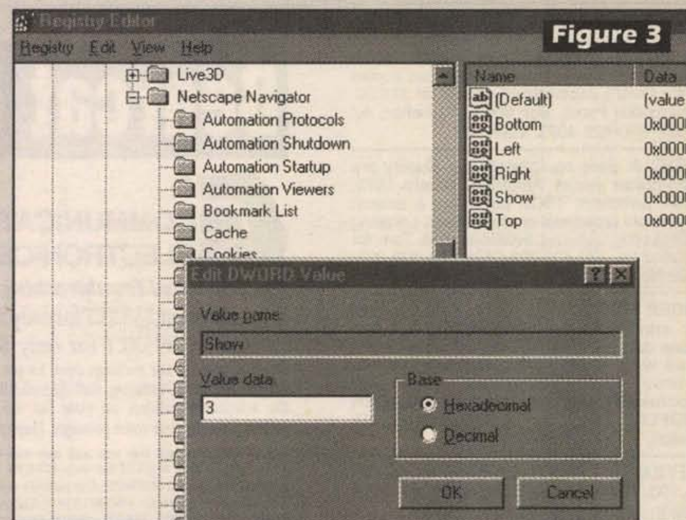

Figure 3

Each value in the registry has a name, which programs use when accessing it. In Figure 2, the names shown are bottom, left, right, show, and top. To the right of each name is the corresponding value associated with the name.

To edit a value, double-click on it in the right side of the Registry Editor. In this example, I clicked the Show value. Figure 3 shows what was displayed next.

You're probably wondering what the heck a "DWORD" value is. It is one of the three possible values a registry entry may have: binary, string, and DWORD. A binary value is just a string of bits, and a string value is a sequence of characters. A DWORD value is a binary value four bytes or less in size.

Notice in Figure 3 that the DWORD value can be expressed in either hex or decimal (hex is used by default in the Registry Editor). You can edit the value of "show" by entering the new value in the box provided in the "Edit DWORD Value" dialog box.

The Registry Editor can also be used to add new keys or values to the registry. To do so, right-click on the key that you want to add the new sub-key or value to. When you do, you will see something similar to Figure 4. Once the new sub-key or value is in place, it can be edited like any other registry value.

At this point, something needs to be very strongly emphasized: *As a general rule, you should not use the Registry Editor to change values.* Instead, change configuration data using the control panel, the set-up programs for an application, or other system tools other than the Registry Editor. The reason for this is because a mistake in changing a registry value can have catastrophic consequences, such as totally disabling an application, function, or even the entire PC. The real value of the Registry Editor lies in being able to quickly view configuration data and back it up, not in being able to change values.

But Why Are There Still .INI Files?

The registry doesn't completely replace .INI files. Each 16-bit Windows application running on your PC will have its own associated .INI files, and SYSTEM.INI and WIN.INI are still there because many 16-bit applications refer to those files when they load. Basically, the only way to get completely rid of .INI files is to get rid of all 16-bit code on your system!

At some point in the future, the registry is supposed to replace all .INI files in all versions of Windows (even Windows NT still has some .INI files for compatibility with 16-bit software). I have a feeling that .INI files are going to hang around a lot longer than Microsoft says or wants them to!

By the way, the Windows95 registry is not the same as the Windows NT registry. The big difference is that the Windows NT registry does not have a HKEY_DYN_DATA key since Windows NT does not yet support the "Plug and Play" configuration technology used by Windows95. Future versions of Windows NT will support Plug and Play, so the two registry versions should become identical.

When Disaster Strikes!

Since the registry stores all configuration data for a Windows PC, it is a major disaster if it is lost or corrupted in any way. The best way to handle such an event is to be ready for it.

The Add/Remove Programs icon in the Windows95 control panel lets you make an emergency start-up disk. You should always have a start-up disk handy, but unfortunately this disk will not have registry recovery data unless you manually add it. Thus, create a subdirectory on your start-up disk called "Registry Data" (or similar) and copy such files as SYSTEM.DAT, USER.DAT, WIN.INI, SYSTEM.INI, CONFIG.SYS, AUTOEXEC.BAT, and any device drivers into it.

Windows95 does provide a useful, but poorly documented, registry recovery aid. Each time Windows95 boots, it makes a new copy of the registry. The old versions on the hard drive are renamed SYSTEM.DA0 and USER.DA0. These files are stored as system files in the Windows directory.

Figure 5 shows the location of the SYSTEM.DA0 file on my PC. Note that it is located next to the SYSTEM.DAT file and both are the same size. This is because there was no change in the configuration data for my PC from the previous time I had booted it. The files should always be the same size (and otherwise identical) unless you do something like add a new driver or other software since the previous boot.

If your registry is damaged in some way, you can replace the corrupted or missing SYSTEM.DAT and USER.DAT files with the SYSTEM.DA0 and USER.DA0 files using the same copy procedures used to copy any files. If Windows95 itself won't load, you can use the MS-DOS "copy" command when you boot your PC from the start-up disk.

Despite its complexity and quirks, I think the registry is a real improvement over the scattered .INI files of earlier versions of Windows. Backing up and restoring two files named SYSTEM.DAT and USER.DAT is a lot easier than doing the same with dozens of files! **NV**

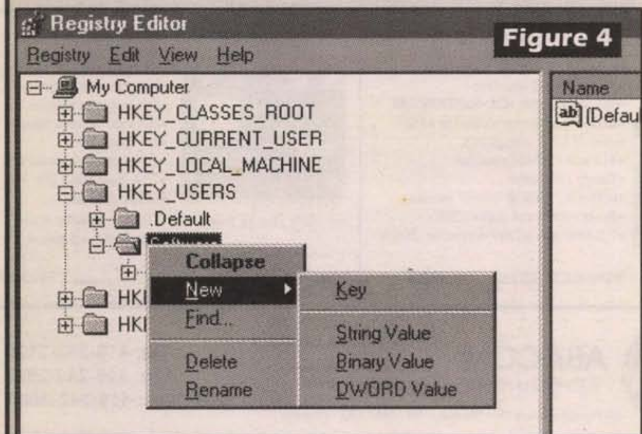

Figure 4

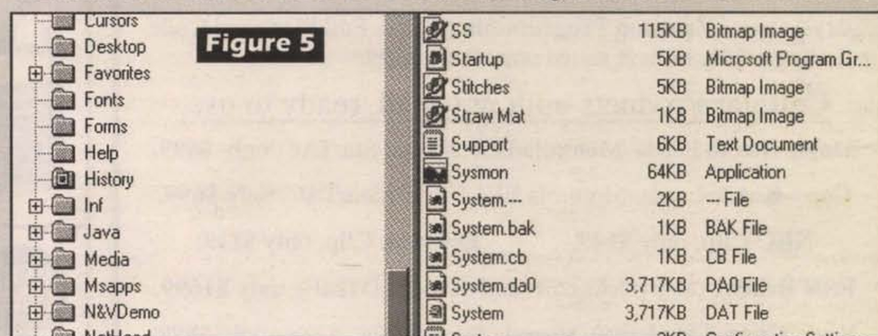

Figure 5

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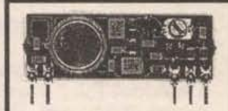

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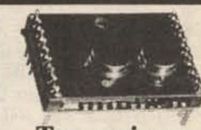

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BASIC CABLE converters. Sale & services. Tel. 405-631-1856, Fax 405-634-1526 Mon-Fri 8am to 5pm Central Time. We carry: Ragal model RR-92, RC-83 550MHz 99 ch.; Oak Micro 550MHz 99 ch.; Scientific Atlanta SA-8540 550MHz 99 ch. with vol., SA-8529 550MHz 99 ch.; Pioneer BC 4535 550MHz 86 ch.; Panasonic 175 550MHz 99 ch.; All equipment is unmodified. Dealers are welcome. Please call for latest price! or visit us at our Web onsite HTTP://WWW.VNTECHNOLOGY.COM. Send E-Mail to us at Danny@vntechnology.com

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THE GREATER L.A. /ORANGE COUNTY COMPUTER SHOW

EXHIBITORS FROM SOUTHERN CALIFORNIA WILL HAVE THE LOWEST PRICES ON COMPUTER HARDWARE AND SOFTWARE!

The November 15th show in Buena Park has been postponed.

NOVEMBER 16th at the SAN DIEGO CONVENTION CENTER	**Sunday** 111 West Harbor Drive in Downtown. Take I-5 South Exit Front Street Then turn left on Harbor Drive.
NOVEMBER 30th at the San Diego Scottish Rite Center	**Sunday** 1895 Camino Del Rio South, San Diego Take I-5 South to 8 east Exit Right on Mission Center Road. Then Left on Camino Del Rio South
DECEMBER 7th at the Sequoia Conference Center Fullerton	**Sunday** 1535 Deerpark Drive Take 57 Exit Right on Yorba Linda Right on Placentia, first right on Garnet Then Left on Deerpark Drive.

Admission Specials!!!
General: **$4.00** per person
GROUP SPECIAL: **$7.00** for 2 people
SENIORS & MILITARY: **$3.50** Per Person
Children under 16 free.
Admission good with Ad Only!

BEFORE PAYING HIGH RETAIL COME AND SEE THE LOWEST PRICES!!

FREE PARKING AT ALL EVENTS
EXCEPT THE SAN DIEGO CONVENTION CENTER.

SPECIAL: RECEIVE FREE ADMISSION TO THE DECEMBER 7TH SHOW WHEN ATTENDING ANY OF THE OTHER EVENTS!

FOR EXHIBIT RESERVATIONS AND CONVENTION INFORMATION
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10-5pm

WWW.SANDIEGOCOMPUTERSHOW.COM

Events CALENDAR

NOVEMBER 1997

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

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

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

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

NOVEMBER 1

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
CT - WATERFORD - ARC Auction. Senior Citizens Center, Waterford Municipal Complex. Bob KA1BB 860-739-8016
FL - SORRENTO - ARRL Hamfest. Chuck Crittenden KE4EXM, 352-669-2075
MI - LIVONIA - Super Computer Sale. Livonia Elks Lodge Hall. 31117 Plymouth Rd. 10am-3pm. Computers And You 313-283-1754
MI - SAULT ST. MARIE - Hamfest. Lyle Willett KI8CE 906-632-0168. E-Mail: lylewill@up.net
NH - SEABROOK - Computer Show. Greyhound Park. Northern Computer Shows 508-744-8440
OH - BROOKPARK - Hamfest. Dan Sarama KB8A 216-267-5083. E-Mail: kb8a@aol.com
OK - ENID - Hamfest. Garfield Co. Fairgrounds, Hoover Bldg. 8am-5pm. Tom Worth N5LWT, 405-233-8473
PA - YORK - Computer Show. York Fairgrounds, Old Main Bldg. 10am-3pm. Peter Trapp Shows. 603-272-5008. Web: www.petertrapp.com
RI - WEST WARWICK - Computer Show. West Warwick Civic Center. MarketPro 201-825-2229
SC - GREENVILLE - Computer Show. Palmetto Expo Center. 9:30am-4pm. MarketPro 201-825-2229
WI - MILWAUKEE - Hamfest. Burt Steingraeber N9VBI 414-328-0535. Web: http://execpc.com/~mrc/friendlyfest.htm

NOVEMBER 1-2

GA - LAWRENCEVILLE - ARRL Hamfest. Randy Bassett KR4NQ 770-410-3989
SC - GREENVILLE - Computer Show. Palmetto Expo Center. MarketPro 201-825-2229
TX - ODESSA - Hamfest. Ector Co. Coliseum, Exhibit Bldg. C, 42nd & Andrews Hwy. Sat: 8am-5pm, Sun: 9am-2pm. Robert Jordan N5RKN, 915-335-7980. E-Mail: n5rkn@apex2000.net Web: http://www.apex2000.net/personal/wd5cwj/main2.htm

NOVEMBER 2

CA - LIVERMORE - Swapmeet. Las Positas College. Noel Anklam 510-447-3857
CA - OXNARD - Computer Show. Community Center. 10am-5pm. MarketPro 415-456-6730
CA - STOCKTON - Computer Show. Civic Auditorium. 10am-5pm. MarketPro 415-456-6730
CT - WATERBURY - Computer Show. Waterbury Sheraton. MarketPro 201-825-2229
FL - PALM BEACH GARDENS - Computer Show & Sale. Palm Beach Gardens Marriott. 4000 RCA Blvd. Narisaam Computer Show 770-663-0983
MI - FLINT - Super Computer Sale. Holiday Inn, 5353 Gateway Centre. 10am-4pm. Computers And You 313-283-1754
NC - ASHEVILLE - Computer Show. Asheville Civic Center. 9:30am-4pm. MarketPro 201-825-2229
NY - FISHKILL - Hamfest. John Jay High School. Ken Akasofu KL7JCQ 914-485-9617. E-Mail: KL7JCQ@iname.com Web: http://www.mhv.net/~fritzing
NY - POUGHKEEPSIE - ARRL Hamfest. Ken Akasofu KL7JCQ 914-485-9617. E-Mail: KL7JCQ@iname.com
OH - CANTON - ARRL Auctionfest '97. Stark Co. Fairgrounds. Jack Cale N8FEB, 330-477-8261
PA - ALLENTOWN - Computer Show. Days Inn Conference Center. 10am-3pm. Peter Trapp Shows. 603-272-5008 Web: www.petertrapp.com
WI - KAUKAUNA - ARRL Hamfest. Chad Pennings N9PRC, 414-759-0799

NOVEMBER 7-8-9

IL - SPRINGFIELD - Super Computer Sale. State Fairgrounds. Blue Star Productions 612-788-1901
MI - MT. CLEMENS - Computer & Technology Show. Gibraltar Trade Center, 237 N. River Rd. 810-465-6440

NOVEMBER 8

AL - MONTGOMERY - ARRL State Convention, Hamfest & Computer Show. Garrett Coliseum, South AL State Fairgrounds. 8am-5pm. Phil 334-272-7980 after 5pm. E-Mail: prolan@juno.com
AZ - YUMA - Hamfest. Harvey Kutterhagen N7WAQ. E-Mail: n7waq@juno.com
CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves
CA - FRESNO - Computer Show. Fresno Fairgrounds. 10am-5pm. MarketPro 415-456-6730
CA - OAKLAND - Computer Show. Oakland Convention Center, Broadway @ 10th St. 1-800-243-7041 Web: http://www.robertaustin.com
FL - PORT ST. LUCIE - ARRL Hamfest. Frank Herring, Sr. N4FBX, 561-336-7169
IN - INDIANAPOLIS - AGI Computer Fair. Indianapolis Events Center. 3655 E. Raymond St. 10am-4pm. 317-299-8827
LA - WEST MONROE - Hamfest. West Monroe Convention Center, corner North 7th & Ridge Ave. 8am-3:30pm. 318-323-6621. E-Mail: tchc@iamerica.net
MI - TAYLOR - Super Computer Sale. Democratic Club Hall. 23400 Wick Rd. 10am-3pm. Computers And You 313-283-1754
NH - SALEM - Computer Show. Rockingham Park Race Track. Northern Computer Shows 508-744-8440. E-Mail: tchc@iamerica.net
NY - POUGHKEEPSIE - Computer Show. Mid-Hudson Civic Center. MarketPro 201-825-2229
SC - MYRTLE BEACH - Radio and Computer Show. Myrtle Beach High School, 38th Avenue North. 9am-5pm Robert Battle 803-236-2887 www.qsl.net/kf4hav/hamfest.htm www.qsl.net/kb8lxc/hamfest.htm

NOVEMBER 8-9

CA - SACRAMENTO - Computer Show. Cal Expo. 10am-5pm. MarketPro 415-456-6730
GA - KENNESAW - Computer Show. Outlet Mall, I-75 @ Exit 117. Georgia Mountain Productions 706-838-4827
MO - ST. CHARLES - Computer Show & Sale. St. Charles Exposition Hall, St. Charles Center, I-70 & 5th St. Sat: 10am-4pm, Sun: 11am-3pm. Computer Central Shows 888-296-6066. E-Mail: computershow.chicago@mcimail.com
NC - RALEIGH - Computer Show. Embassy Suites Hotel. MarketPro 201-825-2229
NY - SYRACUSE - Computer Show. NY State Fairgrounds, Int'l Bldg. Sat:10am-5pm Sun: 10am-3pm. Peter Trapp Shows. 603-272-5008 Web: www.petertrapp.com
TX - AUSTIN - Computer Blast '97. Palmer Auditorium. ComputerFest Productions 888-545-5432 www.computerblast.com

NOVEMBER 9

CA - SAN DIEGO - Computer Show. Scottish Rite Center. 10am-5pm. MarketPro 415-456-6730
IL - MACOMB - ARRL Hamfest. Kathy Page N9KP, 309-426-2723
IN - ANDERSON - AGI Computer Fair. Ramada Inn, 5901 Scatterfield Rd. 10am-3pm. 317-299-8827
KY - LOUISVILLE - Computer Fair South. Executive West Hotel. 9:30am-3pm. Sammy L. Hastings 812-333-9300
MA - SWANSEA - Computer Show. Venus DeMilo. Northern Computer Shows 508-744-8440
MI - GRAND RAPIDS - Super Computer Sale. Crowne Plaza. 5700 28th St., S.E. 10am-4pm Computers And You 313-283-1754
NY - WHITE PLAINS - Computer Show. Westchester Co. Ctr. MarketPro 201-825-2229

NOVEMBER 14

NJ - FAIR LAWN - Hamfest. Joe Sammartino N2QOJ 201-778-3211. E-Mail: jas130@juno.com

NOVEMBER 14-15-16

IA - DES MOINES - Super Computer Sale. State Fairgrounds. Blue Star Productions 612-788-1901

NOVEMBER 15

CA - BAKERSFIELD - Computer Show. Kern Co. Fairgrounds. 10am-5pm. MarketPro 415-456-6730
CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
FL - FT. LAUDERDALE - Computer Show & Sale. Holiday Inn West. 5100 N. St. Rd. 7. Narisaam Computer Show 770-663-0983
NY - BUFFALO - Computer Show. Hamburg Fairgrounds. MarketPro 201-825-2229
MA - PLYMOUTH - ARRL Hamfest. Jim Ford NM1F 508-747-2224
PA - HERSHEY - Hamfest. Hershey Armory. Harold Baer 717-566-8895

NOVEMBER 15-16

CA - VALLEJO - Computer Show. Solano Co. Fairgrounds. 10am-5pm. MarketPro 415-456-6730
FL - CORAL GABLES - Hamfest/Tailgate Swapfest. University of Miami, Coral Gables campus, Physics parking lot. 8am-Noon. Walt 305-895-0398
IN - FORT WAYNE - Hamfest & Computer Expo. Allen Co. War Memorial Coliseum and Exposition Center. Sat: 9am-4pm, Sun: 9am-3pm. Doug Jones 219-484-1314. E-Mail: djones2233@ol.com Web: http://www.pipeline.com/~dagagnon/
MI - DEARBORN - Super Computer Sale. Dearborn Civic Center, 15801 Michigan Ave. 10am-4pm. Computers And You 313-283-1754
NC - WINSTON-SALEM - Computer Show. Lawrence Joel Veterans Memorial. MarketPro 201-825-2229
OH - CLEVELAND - Computer Show. I-X Center. Sat: 10am-6pm, Sun: 10am-4pm. Peter Trapp Shows 603-272-5008. Web: www.peter trapp.com

NOVEMBER 16

CA - LANCASTER - Computer Show. Antelope Valley Frgnds. 10am-5pm. MarketPro 415-456-6730
CA - SAN DIEGO - Computer Show. San Diego Convention Center. 111 W. Harbor Dr. Paul Martinez 619-295-1221
FL - WEST PALM BEACH - Computer Show & Sale. Palm Beach Airport Hilton. 150 Australian Ave. Narisaam Computer Show 770-663-0983
IL - CHICAGO - Hamfest. George Sopocko WA9JEZ 773-545-3622
NC - BENSON - ARRL Hamfest. Paul Dunn KD4BJD, 919-894-3100
NH - LEBANON - Computer Show. Lebanon High School. Northern Computer Shows 508-744-8440
NJ - FAIRFIELD - Computer Show. Fairfield Radisson. MarketPro 201-825-2229
NY - HUNTINGTON - ARRL Hamfest. Joanne Coletti N2IME 516-399-1877
NY - ROCHESTER - Computer Show. The Dome Center. MarketPro 201-825-2229

NOVEMBER 19

FL - ST. PETERSBURG - ARRL Hamfest. Don Bice W4PCO, 813-347-2707

NOVEMBER 21-22

MS - OCEAN SPRINGS - Hamfest/Swapfest. Latimer Community Center. Fri: 4:30pm-9pm, Sat: 8am-3pm. Harry McLemore KD4AK, 601-872-0732

NOVEMBER 21-22-23

MI - TAYLOR - Computer & Technology Show. Gibraltar Trade Center, 15525 Racho Rd. 313-287-2000

NOVEMBER 22

CA - DALY CITY - Computer Show. Cow Palace, Gate #5, Geneva & Santos. Robert Austin Corp. 1-800-243-7041, Web: http://www.robertaustin.com
CA - SANTA ROSA - Computer Show. Sonoma Co. Fairgrounds. 10am-5pm. MarketPro 415-456-6730
MA - NEWTONVILLE - ARRL Hamfest. Eliot Mayer W1MJ 508-664-0773. E-Mail: w1mj@amsat.org Web: http://ourworld.compuserve.com/homepages/emayer/auction.htm
ME - AUGUSTA - Computer Show. Augusta Civic Center. Northern Computer Shows 508-744-8440
MI - FLINT - Super Computer Sale. IMA Arena, 3501 Lapeer Rd. 10am-3pm. Computers And You 313-283-1754
NY - BINGHAMTON - Computer Show. The Showplace. Binghamton Plaza. 10am-3pm. Peter Trapp Shows. 603-272-5008. Web: www.petertrapp.com
OH - GEORGETOWN - ARRL Hamfest. Harold Pryor, 513-378-2824
SC - CHARLESTON - Computer Show. King Street Palace. MarketPro 201-825-2229

NOVEMBER 22-23

FL - TAMPA - Radio & Computer Convention. State Fairgrounds, Expo Hall. Jean 813-525-5178. E-Mail: kd4phs@earthlink.new (Chris Schwab). Web: http://www.fgcarc.org
NY - LAKE GROVE - Computer Show. Sports Plus. MarketPro 201-825-2229

NOVEMBER 23

CA - SACRAMENTO - Computer Show. Scottish Rite Center. 10am-5pm. MarketPro 415-456-6730
CA - SAN DIEGO - Computer Show. Scottish Rite Center. 10am-5pm. MarketPro 415-456-6730
IL - WHEATON - Radio Fest Electronics Flea Market. DuPage Co. Fairgrounds. GMRS 815-756-3933
MI - MADISON HEIGHTS - Super Computer Sale. U.F. & C.W. Hall, 876 Horace Brown Dr. 10am-4pm. Computers And You 313-283-1754
NH - PORTSMOUTH - Computer Show. Yoken's Conference Center. Northern Computer Shows 508-744-8440
PA - ALLENTOWN - Computer Show. Days Inn Conference Center. 10am-3pm. Peter Trapp Shows. 603-272-5008 Web: www.petertrapp.com
SC - FLORENCE - Computer Show. Florence Civic Center. MarketPro 201-825-2229

NOVEMBER 28

NH - NASHUA - Computer Show. Sheraton Tara. Northern Computer Shows 508-744-8440
NJ - WESTFIELD - Computer Show. Westfield Armory. MarketPro 201-825-2229

NOVEMBER 28-29-30

FL - ST. PETERSBURG - Computer Blast '97. The Coliseum. ComputerFest Productions 813-319-8508 www.computerblast.com

NOVEMBER 29

CA - OAKLAND - Computer Show. Oakland Convention Center, Broadway @ 10th St. 1-800-243-7041 Web: http://www.robertaustin.com
IL - LITCHFIELD - Amateur TV Club Banquet. Ariston Restaurant. Scott Millick K9SM, 217-532-3837, E-Mail: smillick@cillnet.com
IN - EVANSVILLE - Hamfest. Vanderburgh County Fairgrounds. 8am-2pm. Neil WB9VPG, 812-479-5741
IN - COLUMBUS - AGI Computer Fair. Holiday Inn. 10am-3pm. 317-299-8827
MA - FALL RIVER - Computer Show. Whites of Westport. Northern Computer Shows 508-744-8440

NOVEMBER 29-30

CA - VALLEJO - Computer Show. Solano Co. Fairgrounds. 10am-5pm. MarketPro 415-456-6730
CA - VENTURA - Computer Show. Ventura Fairgrounds. 10am-5pm. MarketPro 415-456-6730
MI - FLINT - Computer Show. Holiday Inn, Gateway Centre, US 23 @ Hill Rd. Exit. Five Star Productions 810-890-0988
NJ - SECAUCUS - Computer Show. Meadowlands Expo Center. MarketPro 201-825-2229
PA - HARRISBURG - Computer Show. PA Farm Show Complex, East Bldg. Sat: 10am-4pm Sun: 10am-3pm. Peter Trapp Shows. 603-272-5008 Web: www.petertrapp.com

NOVEMBER 30

CA - SAN DIEGO - Computer Show. Scottish Rite Center. Paul Martinez 619-295-1221
CA - SANTA ANA - Swapmeet. ACP parking lot. Mary Russo 714-558-8813
IL - GLEN ELLYN - Computer Show & Sale. College of DuPage. Main Arena of Phys Ed Bldg. Corner of Park Blvd. & College Rd. 9:30am-3pm. Computer Central Shows 847-940-7547
IN - NOBLESVILLE - AGI Computer Fair. Hamilton Co. Fairgrounds, 2003 E. Pleasant. 10am-3pm.

Continued on page 82

CABLE TV *cont.*

CABLE FIELD pulls, unmodified. DP5, DPV5, DP7, DPV7, BB7, CFT, 8580, 8590, 8600, Pioneer 5535NP, Zenith ST-1600, Zenith DD-3, Tocom 5503 VIP, Panasonic 145. All equipment genuine unmodified. Catalog, credit cards, COD. 1-888-443-9185.

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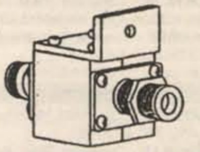

EXPLOSIVE CABLE TV GRAB! BRINKER ZAPPER/SNOOPER STOPPER combo module all in one! Buy wholesale factory-direct, no middleman. Let others get fined + zapped instead. Protect your cable box now! 100% COMPATIBLE. We supply over 80 advertisers weekly! Your order shipped fast, within hours! Why pay $39 when you can buy direct! LIFETIME GUARANTEE! We accept VISA/MC/AMEX/COD/MO/CHECKS. ONLY $10 (SPECIAL: 3/$20 plus FREE DESCRAMBLER PLANS!). SUPER ZAPPER MODULES ONLY $16! (3/$33)! NOTCH FILTERS (2-22, 95-99): BUILT $22, PLANS $5; CABLE TV CONVERTER BOX SOURCES (125+) $7, CATV LIGHTNING SUPPRESSOR $8. FREE SHIPPING, ALWAYS! Call us anytime 1-888-430-7576 ext. 3135. BRINKER ENGINEERING LABS. (RIP-OFF ALERT: Advertisers now selling empty cans as cable protection. BEWARE!)

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CABLE TV converters and accessories, best performance, best prices, introducing new Panasonic 5 with volume control. Dealers only. Call for lot prices. NTS 1-888-355-6687.

PANASONIC TZPC175 new 99 channel converters, with volume control. $85. Credit cards accepted. Call to order 303-428-4069 phone/fax.

CONVERTER BOX sales-unmodified SA Zenith, Jerrold. Repair, parts & accessories. Call 573-363-0402 8am-4pm CST or leave a message.

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NOTCH FILTERS 110, 108.5, 106.5, 97.5 75dB deep notch. $19.95 ea., 1-5 qty. $14.95 ea., 6-10 qty. $10.95 ea., 11-20 qty. $8.95 ea., 21 or more qty. Call 24 hr. order and information hot line 516-389-3536.

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So You Wanna Be In Pictures?

AT&T Model 2500 Video Phone Sub-Assembly

A real find! Each unit consists of a CCD color camera and backlit 3.5" LCD color display. Units are new and we have some documentation and pinout information which is included with your unit. Sold As-Is (non-returnable), this is a great item for anyone with a little knowledge and imagination. Approx 6.5" x 4.5" x 1.5". $100.00 ea.

BE A FLY ON THE WALL!!!

Well, actually, those little wings would look pretty stupid on you, but you can build a miniature "bug". Surface mount technology is the latest techno-buzz word, and a challenging new frontier for kit builders. The manufacturer understood that the first try might be a bit rough, so they included enough components to assemble two units. (so it is o.k. to lose or damage a SMT component!) With the entire FM broadcast band (from 88 - 108 MHz) for your receiver, and a transmit range of 300 feet, even James Bond would like this kit! This unit is powered by a 1.5 volt watch battery (included) and features an electret type high gain microphone for superior audio quality and extended pick up range - hear a whisper at 10 feet. A lot of fun in less than a square inch!!! Micro Size FM Wireless Transmitter Kit $19.95

LIGHTED HEADSET MAGNIFIER $27.50

A great new item, this is a hands-free way to see little tiny parts as you work on them without having to be a contortion artist with a soldering iron! The headband style magnifier features bright side lights (4 AAA batteries not included) so you can add a little light to the area without clutching a flashlight under your chin! The velcro adjustable headband fits comfortably around your head, and the "goggles" pull down over your eyes for easy visibility. The visor has a built-in 1.8X lens plus a flip-down magnifier lens and a pull-down loupe for extra magnification power up to 4.8 times!

VIRTUAL REALITY COLOR VIDEO HEADSET WITH AUDIO AND MOTION SENSOR

$65.00

Watch late night TV without disturbing anyone! This video viewing system can be connected to your vcr and you can watch (and hear) your program on the headset! Of course, it is not like the picture on that 12 foot big screen at the local sports pub, but you can watch in your jammies and see who the guests are on your favorite late night talk show!

Play your favorite video games arcade style!

Designed for use with many Super NES and Sega Genesis games, the headset has both audio and motion sensing capabilities. Generally speaking, this is ideal for racing, flight, and tank simulators with a first person or rear view perspective, and games with an eye level perspective. System features volume control, sensitivity control, brightness control, tint control, as well as a reset button and mode switches to select your application. Composite video headset system includes headset, tracking tube (for motion sensing), AC adapter, Super NES cable assembly and Sega Genesis cable assembly. A pinout is also included for TV/VCR viewing.

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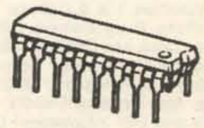

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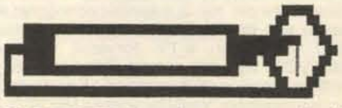

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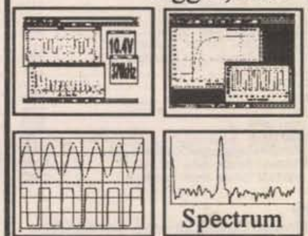

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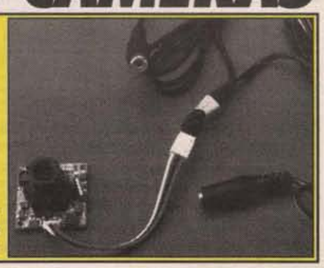

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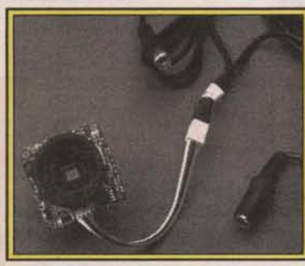

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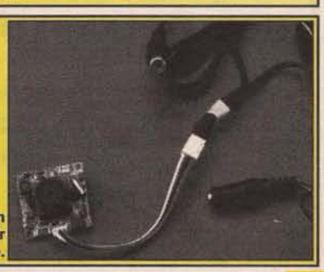

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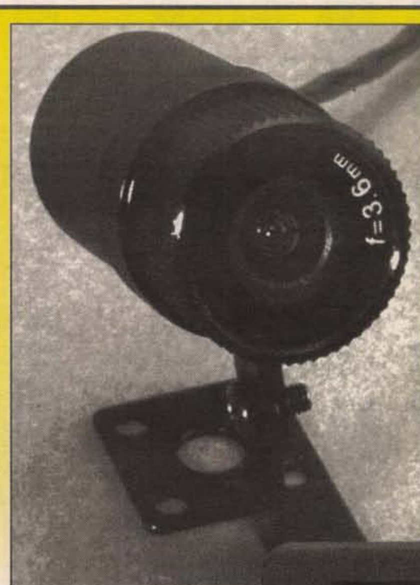

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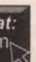

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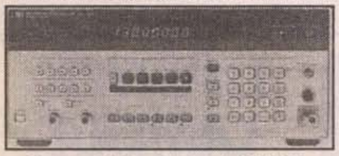

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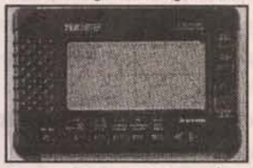

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http://www.dontronics.com is Don-Tronics Home Page. Hardware: Atmel and PIC microcontroller prototype and development boards, programmers, SimmStick™. **Software:** BASIC Stamp II Windows 95 Front End, AVRBasic for the AT90S1200, BascomLT for the AT89C2051, multi-media "Pac-man-like" tutorial for the PIC16F84, and lots more.

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USER'S GUIDE TO AUDIO POWER AMPLIFIER ICs

Part 4

by Ray Marston

Ray Marston looks at nine popular audio power amplifier ICs with maximum output power ratings in the range of 18W to 68W in this penultimate episode of this five-part series.

The first three episodes of this five-part series explained various audio power amplifier IC operating principles and presented a selection of practical application circuits based on popular audio power amplifier ICs with maximum output power ratings in the range of 325mW to 12W.

This month's episode continues the 'audio power amplifier' theme by looking at ICs with output power ratings ranging from about 18W to 68W.

Device number	Amplifier type	Maximum output power	Supply voltage range	Distortion, into 8R0	Z_{IN}	A_V	Bandwidth	Quiescent current
TDA2030	Mono	18W into 4R0	±6 to ±18V	0.1%, Vs = ±18V, Po = 4W	5M0	30dB	150kHz	40mA
TDA2005M	Dual	20W into 2R0	6 to 18V	0.25%, Vs = 14.4V, Po = 16W (2R0)	100k	50dB	40Hz - 20kHz	75mA
TDA2040	Mono	22W into 4R0	±3 to ±20V	0.08%, Vs = ±16V, Po = 10W into 4R0	5M0	30dB	100kHz	30mA
LM1875	Mono	25W into 4R0	20 to 60V	0.015%, Vs = 50V, Po = 20W	1M0	26dB	70kHz	70mA
TDA2050	Mono	32W into 4R0	9 to 50V	0.05%, Vs = ±19V, Po = 15W	500k	30dB	20Hz - 20kHz	55mA
TDA1514A	Mono	40W into 4R0	±7.5 to ±30V	0.003%, Vs = ±28V, Po = 32W	1M0	30dB	25kHz	60mA
LM3875	Mono	56W into 8R0	20 to 84V	0.06%, Vs = ±35V, Po = 40W	150k	30dB	80kHz	30mA
LM3876	Mono	56W into 8R0	24 to 84V	0.06%, Vs = ±35V, Po = 40W	150k	30dB	80kHz	30mA
LM3886	Mono	68W into 4R0	20 to 84V	0.03%, Vs = ±28V, Po = 60W (4R0)	150k	30dB	80kHz	50mA

Figure 1. Basic details of the nine ICs with output power ratings in the range of 18W to 68W.

HIGH-POWER (18W to 68W) ICs

Figure 1 gives basic details of the nine IC types that are dealt with in this episode. Note that all but one of these ICs are mono types, that a pair of these mono ICs are thus needed to make a stereo system, and that such an amplifier has a total output power equal to double the per-channel value.

The only 'dual' IC in the list is the TDA2005M, which actually houses a pair of independently accessible power amplifiers that, in most practical applications, are connected in the bridge configuration to provide 20W of drive into a 2R0 mono load in automobile applications. Throughout the remainder of this episode, the nine listed ICs are dealt with in the order in which they appear in Figure 1. Practical application circuits are given for each IC type but, in some cases, only very brief descriptions are given of individual IC circuit theory.

THE TDA2030

The TDA2030 is a very popular, high-quality audio amplifier IC that can be regarded as an uprated version of the TDA2006, and is housed in a similar five-pin TO220 package with built-in heat tab, as shown in Figure 2. The IC can operate with single-ended supplies of up to 36V, or with balanced split supplies of up to ±18V, and can deliver up to 18W into a 4R0 load. When used with a +28V single-ended supply, it gives a guaranteed output of 12W into 4R0, or 8W into 8R0. Typical THD is 0.05% at 1KHz at 7W output, rising to less than 0.1% at 8W.

The TDA2030 can be used in the same basic audio amplifier circuits as the TDA2006, but with suitable increases in the circuit supply voltages. Figure 3, for example, shows how to connect the TDA2030 as a 15W amplifier using a single-ended +30V supply and a 4R0 speaker load, and which gives a voltage gain of 30dB.

Alternatively, Figure 4 shows how to wire a pair of TDA2030 ICs as a split-supply bridge amplifier that can deliver 24W into a direct-coupled 4R0 speaker load while generating typical total harmonic distortion of less than 0.5%.

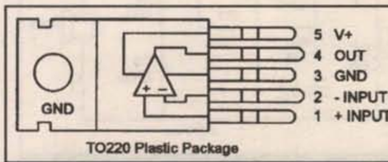

Figure 2. Outline and pin notations of the TDA2030 18W power amplifier.

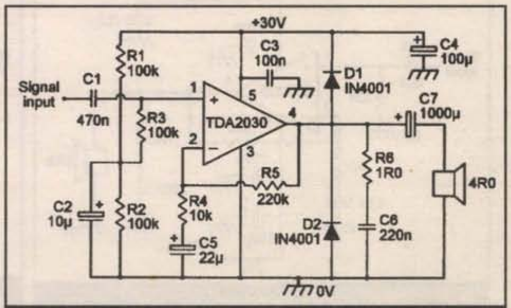

Figure 3. TDA2030 15W amplifier with a single-ended supply.

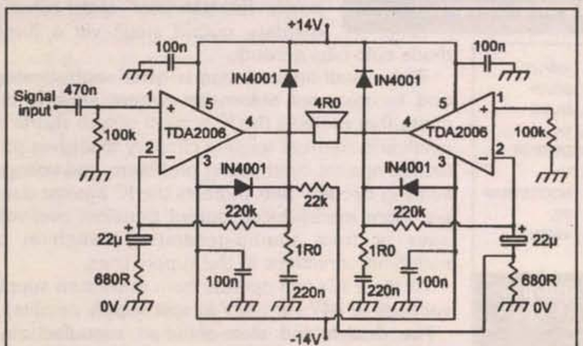

Figure 4. TDA2030 24W bridge amplifier with a split power supply.

THE TDA2005M

The TDA2005M is a 20W audio power booster IC specifically designed for use in automobiles, and is fully protected against output short circuits, etc. The IC actually houses a pair of independently accessible power amplifiers that can each pump about 4W into a 4R0 speaker load but, in most practical applications, are connected in the bridge configuration to provide 20W of drive into a 2R0 mono load when the IC is operated from the 14.4V (nominal) power supply of an automobile. The IC is housed in an 11-pin package, as shown in Figure 5. Figure 6 shows a practical applications circuit that can deliver 20W to a 2R0 speaker load; note that all capacitors must be rated at 25V minimum.

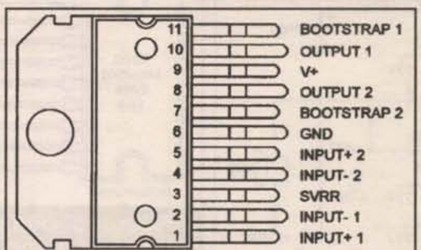

Figure 5. Outline and pin notations of the TDA2005M 20W bridge-connected amplifier IC.

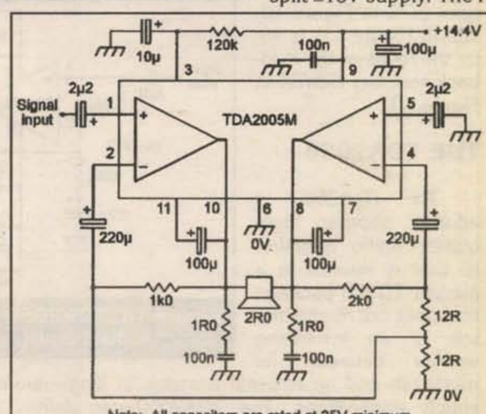

Figure 6. TDA2005M 20W power booster for use in automobiles.

THE TDA2040

The TDA2040 is a high-quality power amplifier IC intended for use in hi-fi applications, and is designed to operate from split power supplies. The device typically generates up to 22W of audio power (at 0.5% THD) in a 4R0 speaker when powered from a split ±16V supply. The IC is internally protected against temporary overloads or output short-circuits, and incorporates automatic thermal shutdown circuitry. The IC is housed in a five-pin package designed for vertical mounting on the PCB and has the outline and pin notations shown in Figure 7. Figure 8 shows the IC's basic application circuit as a 22W amplifier powered from split (dual) supplies. With the component values shown, the circuit gives a x32 voltage gain and has an input impedance of 22K.

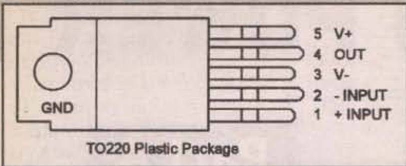

Figure 7. Outline and pin notations of the TDA2040 22W audio IC.

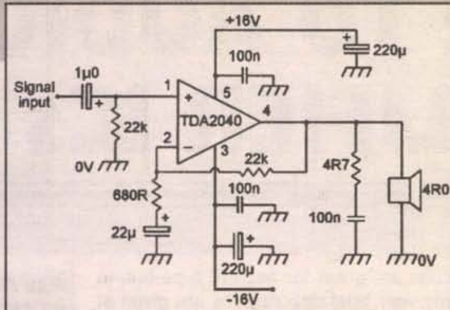

Figure 8. TDA2040 22W audio amplifier using split supplies.

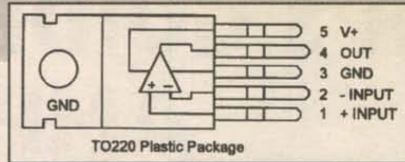

Figure 9. Outline and pin notations of the LM1875 25W amplifier.

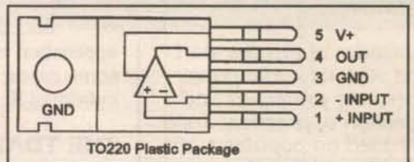

Figure 12. Outline and pin notations of the TDA2050 32W amplifier.

THE LM1875

The LM1875 is a very popular, very high-quality audio amplifier that can deliver a maximum of 25W into a 4R0 load; it will deliver 20W into a 4R0 load when using a 50V supply and generating a mere 0.015% of THD. The IC is housed in a five-pin TO220 package that does not require the use of an insulating washer between its metal tab and an external heatsink in single-ended supply applications. Note, however, that an insulating washer must be used if the device is powered from dual (split) supplies.

Figure 9 shows the outline and pin notations of the LM1875, which — like most modern audio high-power amplifier ICs — is very easy to use, but requires some care in the design of its PCB. Figures 10 and 11 show practical ways of using the IC in audio application circuits using single and dual power supplies, respectively. Note in both of these circuits that input capacitor C1 is a non-polarized electrolytic type, and that the closed loop voltage gain (x22 in Figure 10, x20 in Figure 11) is set by the ratios of the feedback resistors (R5/R4 in Figure 10).

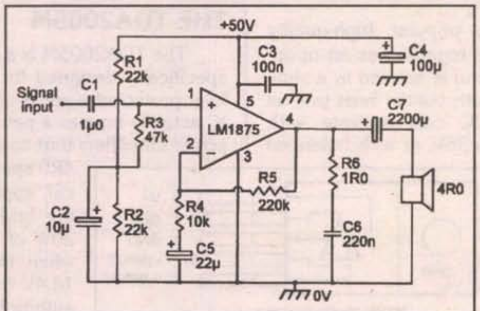

Figure 10. LM1875 20W amplifier using a single-ended power supply.

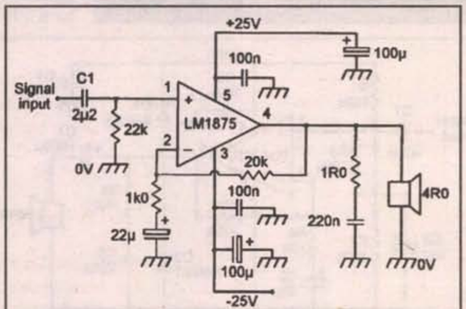

Figure 11. LM1875 20W amplifier using a dual (split) power supply.

THE TDA2050

The TDA2050 is another popular, high-quality audio amplifier IC that is housed in a five-pin TO220 package that does not require the use of an insulating washer between its metal tab and an external heatsink in single-ended supply applications. The TDA2050 can deliver a maximum of 32W into a 4R0 load or 25W into an 8R0 load when powered from a 45V (single ended) supply; when delivering 24W into a 4R0 load, it typically generates a modest 0.03% of THD.

Figure 12 shows the outline and pin notations of the TDA2050, and Figures 13 and 14 show practical audio amplifier application circuits that use single-ended or dual power supplies and can generate up to 32W in a 4R0 speaker load.

The circuits are very similar to those of the LM1875 (see Figures 10 and 11); note in both circuits that input capacitor C1 is a non-polarized electrolytic type, that the input impedance is set at about 47K by the input resistor (R3 in Figure 13), and that the closed loop voltage gain is set at x32 by the ratios of the feedback resistors (R5/R4 in Figure 13).

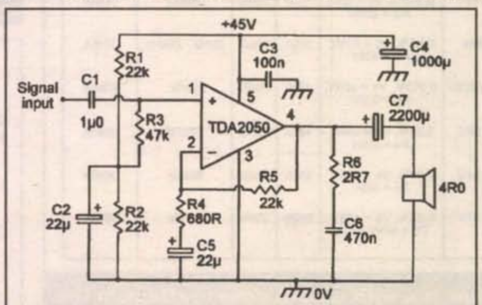

Figure 13. TDA2050 32W amplifier using a single-ended power supply.

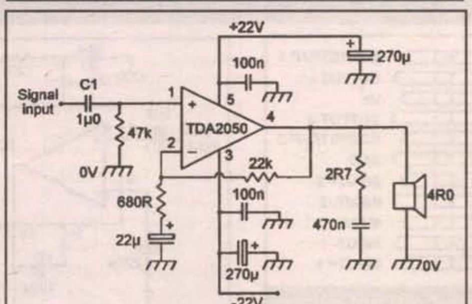

Figure 14. TDA2050 32W amplifier using a dual (split) power supply.

THE TDA1514A

The TDA1514A is a very high-quality, 'super-fi' audio amplifier IC that is designed for use with split power supplies and can deliver a maximum of 40W into a 4R0 load when using a ±21V supply or 40W into an 8R0 load when using a ±27.5V supply; it typically generates a mere 0.0032% of THD when delivering a 32W output. The IC is housed in a nine-pin flat package with an integral heatsink that is internally connected to the IC's negative supply pin (pin 4); the heatsink must be insulated from ground in all split-supply applications.

The IC is quite sophisticated, and incorporates output mute circuitry that eliminates speaker 'thumps' at power switch-on and switch-off, plus other circuitry that prevents damage from output short circuits or overloads, and from thermal run-away problems.

Figure 15 shows the outline and pin notations of the TDA1514A. Note that this is an underside view, seen from the metal mounting base side of the IC.

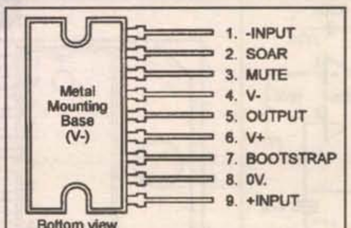

Figure 15. Outline and pin notations of the TDA1514A 40W amplifier.

Also note that the pin 2 'SOAR' title refers to the IC's *safe operating area region* thermal protection system.

Figure 16 shows a basic application circuit for the IC, as a super-fi audio amplifier that can generate up to 40W in a 4R0 speaker.

This same circuit can be used to generate 40W in an 8R0 load by simply using supply voltages of ±27.5V, or 25W in an 8R0 load by using a ±22V supply. Note in Figure 16 that the circuit's stability is enhanced with the aid of a 220p capacitor wired between input pin 1 and ground, that pin 7 is bootstrapped from the pin 5 output terminal, and that the IC's closed loop voltage gain is set at x32 by the 22K/680R feedback resistors.

In practical versions of this basic design, the circuit's high-frequency performance may be enhanced by shunting all signal-carrying electrolytics with 220n ceramic capacitors.

LM3875/76/86 BASICS

National Semiconductor produces a range of three super-fi audio amplifier ICs with maximum output power ratings that cover the range of 56W (into 8R0) to 68W (into 4R0).

The three ICs are the LM3875, the LM3876, and the LM3886, and they all use the same basic chip design.

This design consists of a high-impedance differential input stage that has its output direct-coupled to the input of a common-emitter output-driver that uses a constant-current generator as its high-impedance collector load.

This driver transistor drives a high-power five-transistor quasi-complementary output stage via a three-diode auto-bias network.

The overall basic design is quite sophisticated, and incorporates automatic current sensing circuitry that protects the IC against output shorts or overloads, thermal sensing circuitry that gives protection against overheating problems, and voltage-sensing circuitry that protects the IC against damage from load-induced output transient over-voltages or from thump-generating switch-on or switch-off conditions in the supply lines.

All three ICs can operate from maximum supply voltages of 84V (or ±42V in split supply circuits).

The design and state-of-the-art manufacturing techniques used in the construction of the basic

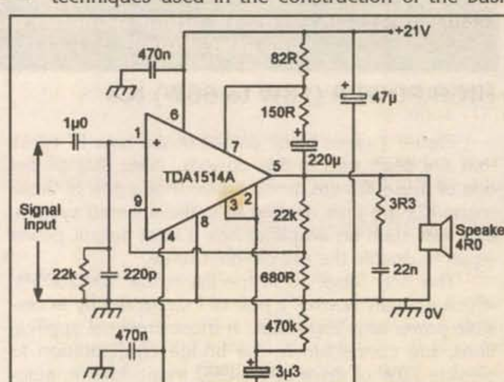

Figure 16. Basic application circuit for the TDA1514A, as a super-fi 40W audio amplifier.

Next month's concluding episode will describe practical IC-based audio power amplifier circuit design techniques.

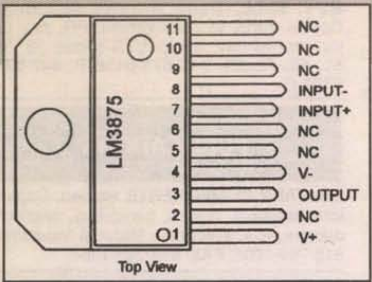

Figure 17. Outline and pin notations of the LM3875 56W amplifier.

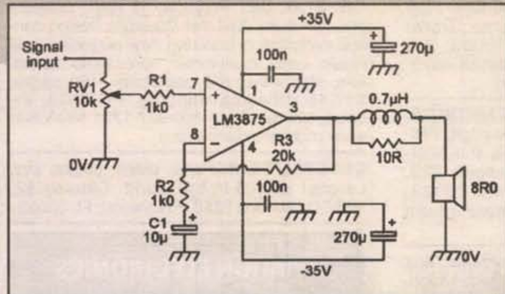

Figure 18. LM3875 56W amplifier using a dual (split) power supply.

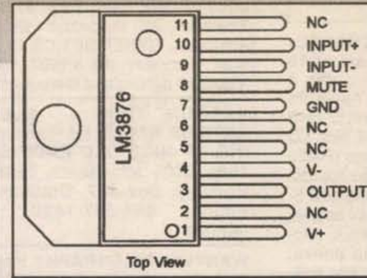

Figure 19. Outline and pin notations of the LM3876 56W amplifier with input muting facility.

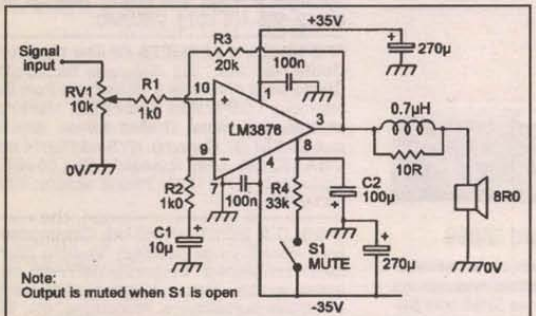

Figure 20. LM3876 56W dual-supply amplifier, with muting facility.

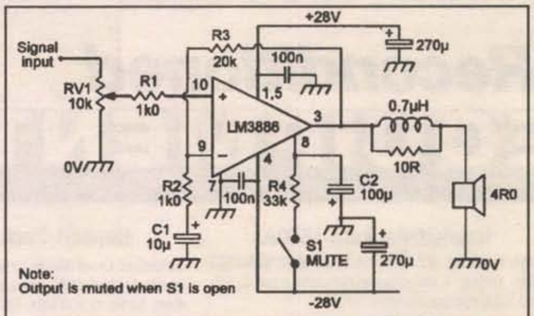

Figure 22. LM3876 68W (into 4R0) dual-supply amplifier, with muting facility.

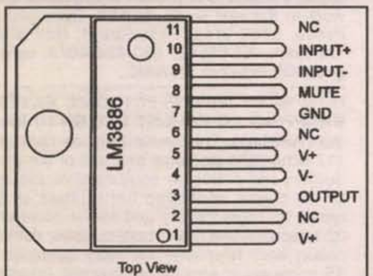

Figure 21. Outline and pin notations of the LM3886 68W amplifier with input muting facility.

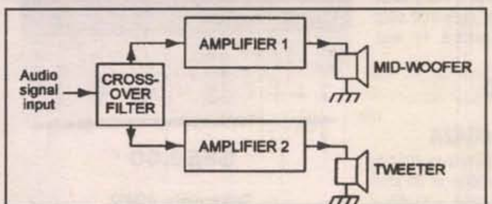

Figure 23. Diagram illustrating the basic principle of the so-called 'biamplification' technique.

semiconductor chips are such that all three ICs offer exceptionally good operating characteristics. They all have signal-to-noise ratios better than 95dB, have typical power supply rejection ratios of 120dB (enabling the ICs to use unregulated supplies), have typical open-loop gains of 120dB, and have typical gain-bandwidth product values of 8MHz. All three ICs use an 11-pin single-in-line TO-220 plastic package with an integral heat tab, but use their own unique sets of pin notations.

In the standard versions of these ICs (which carry a 'T' suffix at the end of their part number), the heat tab is internally connected to the IC's pin 4 supply-negative terminal, and the IC must thus be bolted to an external heatsink via an insulating washer in dual-supply applications.

Special versions of the ICs are available in packages with electrically isolated heat tabs that can be bolted directly to external heatsinks; these ICs carry a 'TF' suffix.

In all cases, pin 1 of the IC is indicated by a small round indent in the molded package. Brief descriptions, etc., of the three individual ICs are as follows.

THE LM3875

The LM3875 is the most basic of the three high-power super-fi amplifier ICs. Figure 17 shows the outline and pin notations of this particular device. Note that only five of the IC's 11 pins are internally connected, and the IC thus functions as a five-pin (V+, V-, Input-, Input+, and Output) device that can be regarded as a high-quality high-power op-amp.

Figure 18 shows a practical LM3875 application circuit as an amplifier that — when the IC is bolted to an adequate heatsink — can generate up to 56W of audio power into an 8R0 load when the IC is operated from a split ±35V supply.

In Figure 18, RV1 acts as a simple volume control, and R1 is an input protection resistor. Feedback components R3/R2 set the circuit's AC (signal) voltage gain at x20, and C1 ensures that the loop provides unity DC voltage gain.

The parallel-connected, heavy-duty 0.7µH inductor (which can be made from 20 turns of 18AWG enamelled wire close wound on an 8mm diameter former) and 10R resistor wired in series with the IC's output are used to prevent instability when the IC is feeding the speaker load via long (and significantly capacitive) connecting leads.

In practical versions of this circuit, the high-frequency stability can sometimes be enhanced by wiring a 220pF capacitor between the IC's inverting and non-inverting input pins.

THE LM3876

The LM3876 can be regarded as a simple variant of the LM3875, with a highly effective built-in input muting facility. Figure 19 shows the outline and pin notations of this particular device. Note that only seven of the IC's 11 pins are internally connected. The IC can be regarded as a special-purpose, high-quality, high-power op-amp.

Figure 20 shows the practical circuit of an LM3876 mutable amplifier that (when the IC is bolted to an adequate heatsink) can generate up to 56W of audio power into an 8R0 load when the IC is operated from a split ±35V supply.

The Figure 20 circuit is similar to that of Figure 18, with its signal gain set at x20 via feedback components R3/R2, etc., but uses different pin numbering and is provided with a switch-controlled (via S1) muting facility.

The mute circuit actually controls the supply current feed to the IC's internal input and driver stages. The IC's action is such that the input is fully muted (the IC gives zero audio output) if pin 8 (the MUTE terminal) is open, and only turns on (to give a normal audio output) if a current of 0.5mA or greater flows out of pin 8 towards the circuit's negative supply rail. Thus, in the diagram, the circuit is muted when S1 is open, but gives normal amplifier operation when S1 is closed.

In the mute switching network, R4 controls the muting current, and C2 adds a time constant that smooths out the mute-switching action.

THE LM3886

The LM3886 can be regarded as a slightly modified and uprated version of the LM3876, with the same built-in input muting facility. Figure 21 shows the outline and pin notations of this particular device. Note that eight of this IC's 11 pins are internally connected, with pins 1 and 5 both serving as V+ connecting points. Figure 22 shows a practical LM3886 application circuit as a mutable amplifier that — when the IC is bolted to an adequate heatsink — can generate up to 68W of audio power into a 4R0 load when the IC is operated from a split ±28V supply.

The Figure 22 circuit is very similar to that of Figure 18, with its signal gain set at x20 via feedback components R3/R2, etc., but uses slightly different pin numbering, plus different supply rail and speaker impedance values. If this circuit is used with an 8R0 speaker, it will generate output powers up to 38W when using ±28V supply rails, or up to 50W when using ±35V supply rails.

BIAMPLIFICATION

The weakest link in most audio power amplifier systems is the loudspeaker. It is almost impossible to design a self-contained loudspeaker that will — at a reasonable cost — linearly span the full audio frequency range.

In most modern hi-fi systems, this problem is overcome by feeding each channel's output to a speaker unit that contains a passive cross-over filter and two (or more) speakers.

One of the speakers (sometimes called a mid-woofer) is designed to efficiently span the low-to-middle frequency range (typically 40Hz to 10KHz), and the other (called a tweeter) to span the mid-to-high frequency range (typically 2KHz to 20KHz).

The cross-over filter feeds the power amplifier's bass signals to the mid-woofer, the treble signals to tweeter, and mid-band signals to both speakers, and is a vital part of this system. The above type of sound distribution system is reasonably efficient at input power levels up to about 25W, but beyond that level, its efficiency falls off significantly due to power losses in the passive filter system.

An increasingly popular solution to this particular problem is — in high-power audio systems — to use the so-called 'biamplification' technique illustrated in Figure 23. This system uses two power amplifiers, with one directly driving the mid-woofer speaker and the other directly driving the tweeter, but with the system's cross-over filter placed ahead of the two amplifiers, where it is used to split audio input signals into two paths. Usually, the filter's cross-over frequency is set somewhere between 500Hz and 1.6KHz.

A major feature of the biamplification system is that its available output power is approximately double that of a single amplifier. Thus, pairs of the various power amplifier IC circuits shown in this episode can — when they are used in the biamplification mode — be used to generate very high per-channel output powers (up to a maximum limit of 112W when used with 8R0 speakers). **NV**

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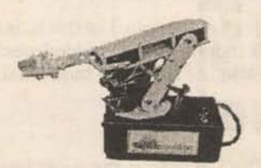

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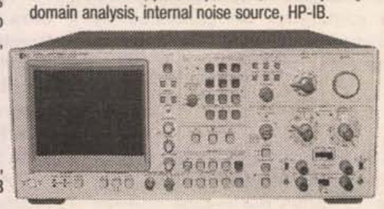

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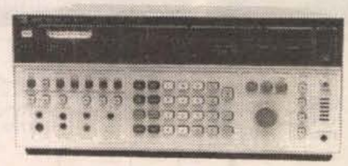

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Introduction

It did not take long before I got tired of looking up frequencies in my *Police Call* book and laboriously typing 200 of them into the tiny keypad on the front panel of my new Radio Shack PRO-2032 scanner.

I soon gave up the idea of taking the radio on business trips with me because that meant reprogramming the radio before and after each trip. Furthermore, once the radio was programmed, I would forget what I had put where.

I decided it was time to go where no unauthorized service person is supposed to go and peek under the cover of this baby to see how I could wiggle its channel banks from my PC. The result is this inexpensive computer interface that you can build for almost any modern scanner.

A service manual from Radio Shack revealed two feasible ways to control the radio. The channel set-up information in the PRO-2032 is written and read from a battery backed-up static RAM. I could have hijacked the address and data signals to this device and controlled the writing and reading of channel information from the PC.

I decided against this because it involved cutting several signal leads in the radio and switching between local and computer control of these signals. Furthermore, the resulting modification and software would have been useful only in this model scanner.

I chose instead to take a more brute force approach so that my computer control interface and software could be used in almost any scanner.

If you hand-wire yours like I did, the hardware cost will be about $15.00 for the parallel interface version. A serial port version is also described.

The PROgramit software is available from my web page as shareware. The Win3.1/Win95 SW is rather novel in that it provides a simple interface for you to "teach it" how your scanner is programmed and how you have wired the interface to your particular scanner.

Once that is accomplished, you can import frequency databases from popular sources, or create your own manually. You then populate a channel map database by dragging entries from the frequency database to the bank and channel in the channel map where you want that frequency programmed.

You can choose to download to individual channels, entire banks, or the entire scanner. When you are done, you can disconnect the interface and carry off your programmed scanner.

Theory of Operation

Like most modern scanners, the PRO-2032 keypad is actually a matrix of switches. The CPU sequentially enables one row of the matrix at a time, and reads back the columns to determine if a key in any row has been pressed (Figure 1). The interface described in this article makes use of a Harris CD74HCT22106 CMOS Matrix switch to parallel each switch in the hardwired keyboard in the scanner.

In the PRO-2032 and most other scanners, this can be accomplished easily and without cutting any traces in the scanner. The switch is programmed to "press" any key on command from your computer. Software on the computer can then perform any sequence of keystrokes to accomplish programming one or more frequencies, or setting the scan limits.

This article describes serial port and parallel port versions of the interface. The parallel port interface is a bit easier to build from scratch and is less expensive. I found it more desirable to add an inexpensive parallel port to my computer than to try to add a third serial port without causing interrupt conflicts.

The parallel version requires that a 25-pin connector be mounted in some fashion to your scanner. I did not have a problem cutting a rectangular hole in mine, but if you are not that daring, you should consider the serial interface version.

The software was designed to utilize a Standard Parallel Port (SPP). If your computer has its parallel port set for Enhanced Parallel Port (EPP), you may have to change it to SPP.

You can download and run the program diag.exe from the web page to determine if the SW works properly with your computer. The program toggles all of the I/O bits used by the interface at a slow rate so that you can monitor them with a voltmeter, logic probe, or oscilloscope. Further, the current SW for the parallel port version cannot be used on a Windows NT machine.

The serial port version makes use of an EDE300 preprogrammed PIC microcontroller from E-LABs to convert 9600 baud serial data from the PC to the parallel interface of the CMOS switch IC. Only two small mounting holes and a third hole for a round RCA jack need to be drilled in the scanner.

Construction

The complete schematic for the parallel interface version of the project is shown in Figure 2. The circuit can be built from thru-hole components on a 2-5/8" x 3" piece of perfboard (Figure 3). I chose to mount the DB-25 connector on the PC board and then cut a whole in the chassis through which the connector is mounted.

Be sure not to get any metal filings onto the scanner's circuitry if you go this route. You could also sneak a 25-conductor ribbon cable between the chassis and case to avoid cutting this hole. The board requires five-volt power which was easily obtained from the PRO-2032 power supply.

In some scanners, a small battery powers some of the five-volt power buses even when power is turned off. In that case, you will need to find a five-

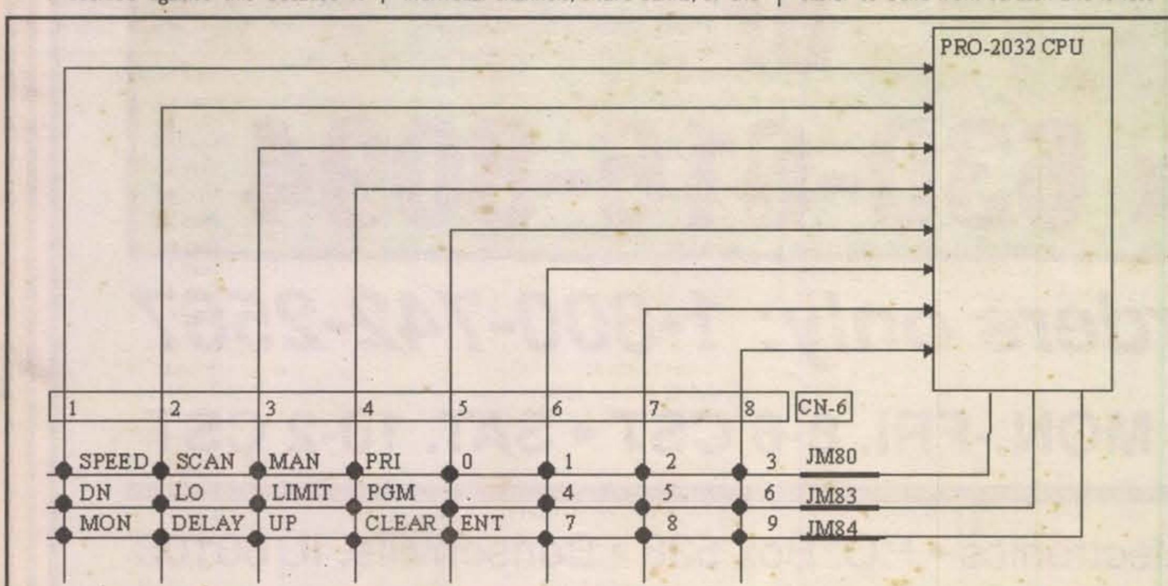

FIGURE 1 — The keypad in the PRO-2032 is scanned by the CPU in a four-row by eight-column matrix. CMOS switches in the PROgramit interface are connected across the intersection of each row and column (e.g., JM80 to CN-6 pin 8 in the PRO2032 for the "3" key).

volt bus that is switched off completely, or connect the optional on-board five-volt regulator to a switched source of 7.5-14 volts.

contact the center conductor to ground when inserting or removing the plug with power applied.

Installation

to identify the connections to the rows and columns of the keypad in your scanner from a schematic or by inspection of the scanner's PCB.

figuration from the menu bar. You will be presented with the screen shown in Figure 7.

Follow these simple steps:

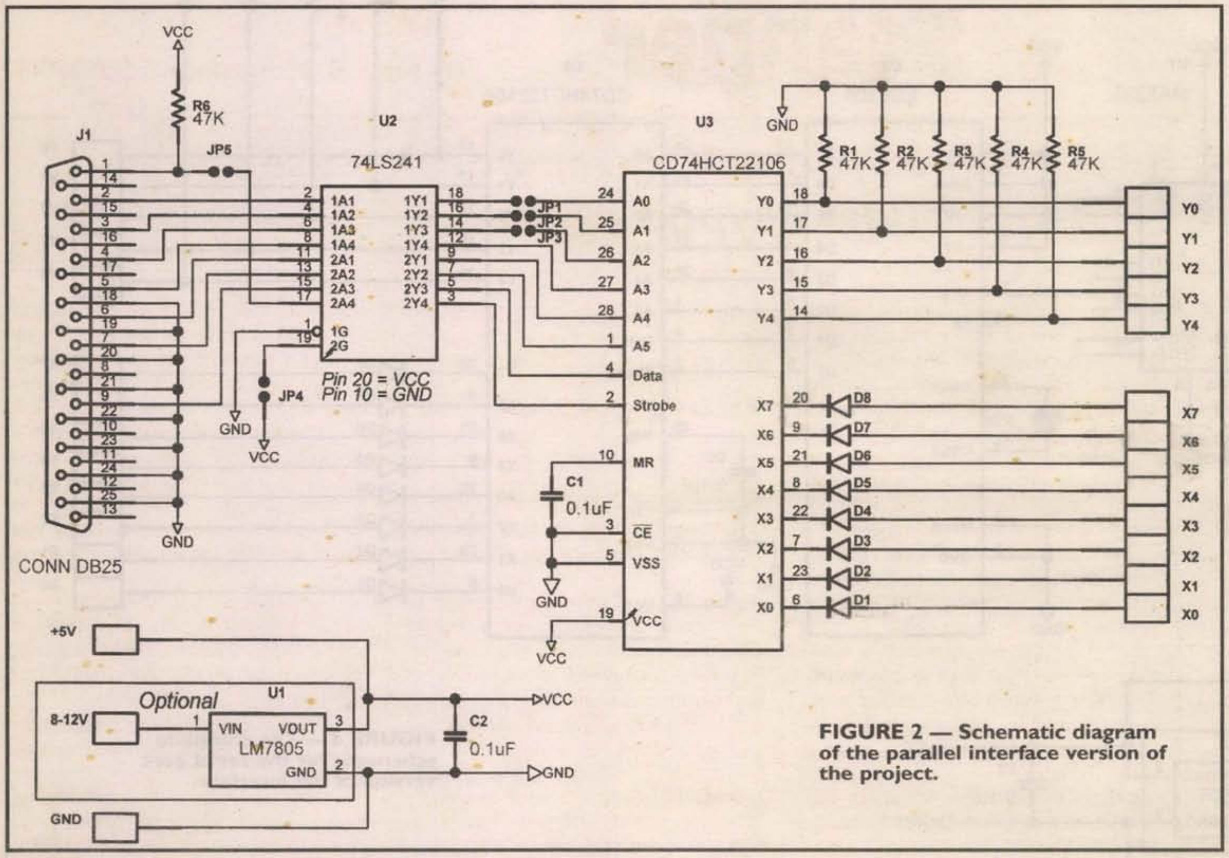

FIGURE 2 — Schematic diagram of the parallel interface version of the project.

1. The 54 text entry boxes represent switches in the CMOS switch. You need to tell the SW what key on the scanner you have connected that switch to in your implementation of the project. For example, I have connected the CMOS switch at X4,Y1 to the LIMIT switch in my scanner.
2. If your radio has a button that lets you program a priority channel, press the "Select Priority" button. Then choose the key from the matrix that represents your radio's "Priority" key.
3. If your radio has a button that lets you lockout a programmed channel, press the "Select Lockout" button. Then choose the key from the matrix that represents your radio's "Lockout" key.
4. If your radio has a button that lets you delay a programmed channel, press the "Select Delay" button. Then choose the key from the matrix that represents your radio's "Delay" key.
5. If your radio has a button that lets you select AM/FM/WFM reception modes, press the "AM/FM" button. Then choose the key from the matrix that represents your radio's "AM/FM/WFM" key.

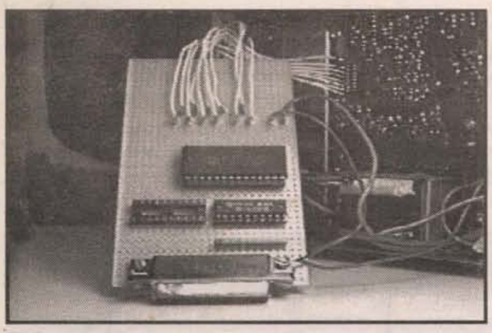

FIGURE 3 — The prototype was hard-wired using #30 gauge wire on a 2-5/8" x 3" piece of perfboard.

In the PRO-2032, eight wires connect X0-X7 from the switch to the pins of connector CN6 on the wiring side of the scanner's PCB (Figure 5). Three more wires from the CMOS switch (Y0-Y2) connect to jumpers (Y80, Y83, and Y84) behind the display on the component side of the circuit board (Figure 6).

Connections to other popular Radio Shack scanners are shown in the accompanying sidebar. These are even more straightforward than those for the PRO2032. I will post instructions for additional models on the PROgramit web page. If yours is not shown, it does not mean that your scanner is not supported. You will simply need

The complete schematic for the serial port version is shown in Figure 4. I recommend that you use a female RCA connector for the data connection to the PC since you will be less likely to

It is not critical which "X" lead from the interface goes to which column, or which Y lead goes to which row. The SW can be configured for the specific connections that you make.

Software Configuration

Select Settings/Hardware Con-

In radios that have this button, the mode is programmed to a default value based on the frequency that you are trying to program. The default values for various frequency ranges can be found in your owner's manual. You will have to teach the PROgramit SW what these default values are. When you press the Set AM/FM Mode Defaults button, you

Sources for the master database include:

1) The FCC web page at http://www.fcc.gov/wtb/databases.html

2) Contact Datafiles for information about Probe Software at datafiles@aol.com

3) Percon Corp.
4906 Maple Springs/Ellery Rd.
Bemus Point, NY 14712
716-386-6013 (24 hrs., 7 days a week)

4) Scanware Associates web page at and http://www.wvsc.wvnet.edu:80/~fcc/.

NAME	TYPE/SIZE
Frequency	Text 12
Callsign	Text 10
DBA_Name	Text 40
City	Text 20
County	Text 30
State	Text 24
Latitude	Text 6
Longitude	Text 7
Radio_Stat	Text 4
Class_Stat	Text 4
Priority (Default = False)	Boolean 1
Lockout (Default = False)	Boolean 1
Delay (Default = False)	Boolean 1
Mode (0 = NA, 1 = AM, 2 = NFM, 3 = WFM)	Byte 1
Channel (Not Used)	Integer 2
PLTone (Default = Blank)	Text 5
Spare1 (Default = Blank)	Text 12
Spare 2 (Default = Blank)	Text 12
Spare 3 (Default = False)	Boolean 1
Spare 4 (Default = False)	Boolean 1
Spare 5 (Default = 0)	Double 8
Spare 6 (Default =0)	Double 8
NumFreq (Frequency String Converted to Double)	Double 8

Table 1- Structure of Frequency Database Tables

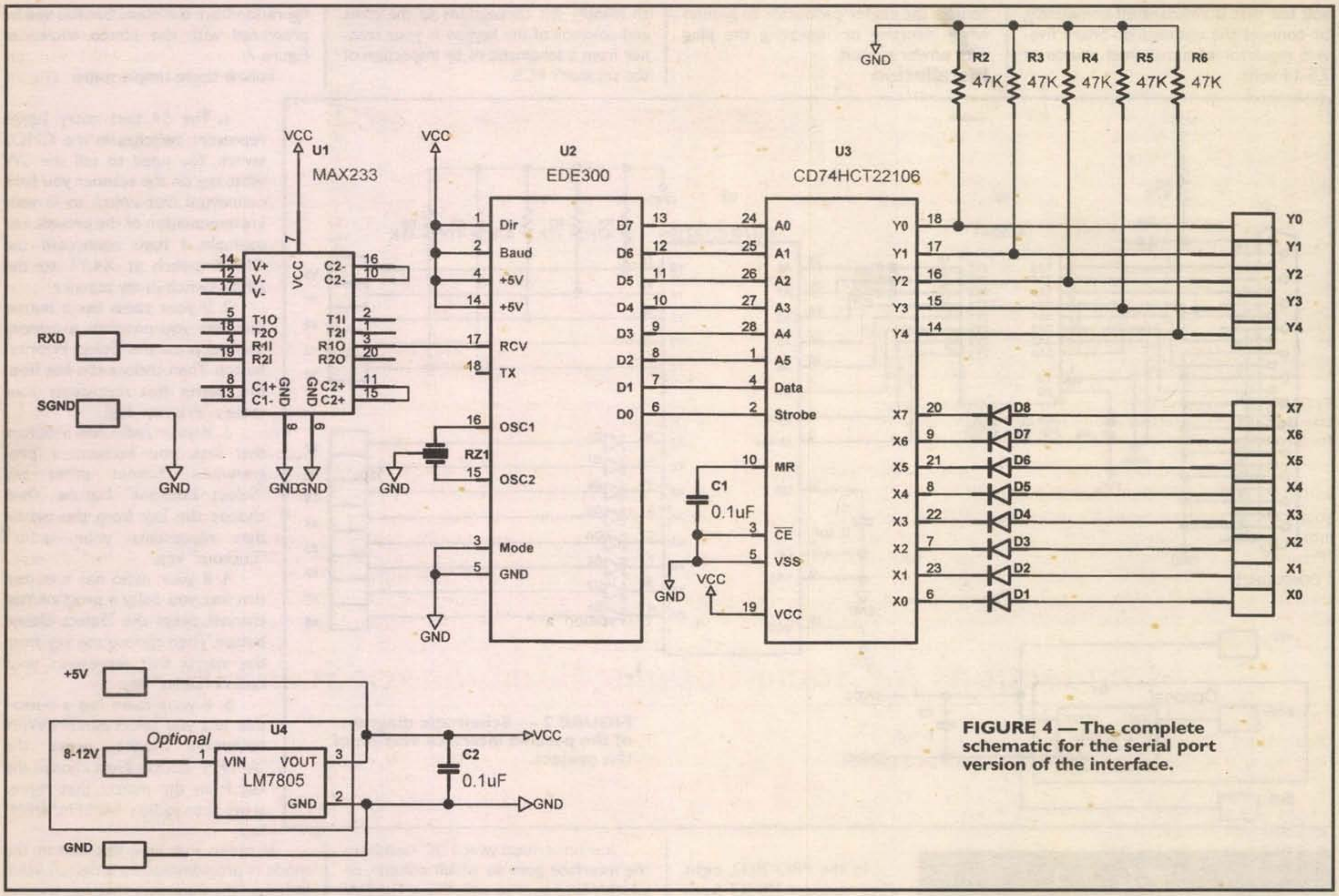

FIGURE 4 — The complete schematic for the serial port version of the interface.

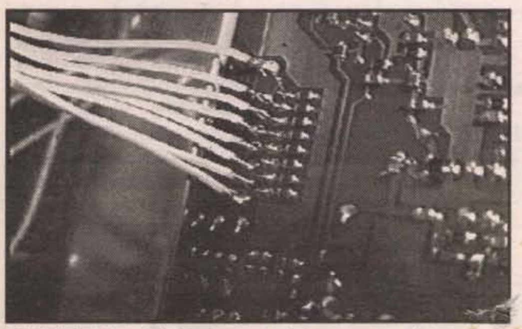

FIGURE 5 — Eight connections are made to CN-6 on the wiring side of the circuit board in the PRO2032.

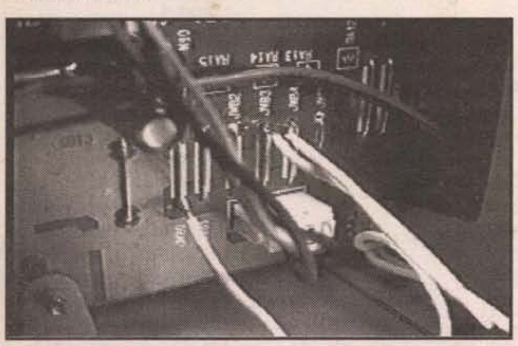

FIGURE 6 — Three connections are made to J80, J83, and J84 on the component side of the circuit board in the PRO2032.

will be presented with the dialog box shown in Figure 8

Enter the range limits and the corresponding AM/FM/WFM modes for your scanner and press done. The values are stored in a file called ModeDefs.cfg in the install directory. If your scanner does not have an AM/FM/WFM button, be sure to clear the AM/FM text box on the settings screen by clicking on an unlabeled X,Y text box.

1. Enter the total number of channels supported by your radio in the "Number of Channels" text box.

2. Enter the total number of banks supported by your radio in the "Number of Banks" text box.

3. Press the "Your Model" button and enter a character string to identify your model scanner. This will be used on the caption bars of some menus.

4. Press the "Port" button and select which port you have connected to the interface. Also set the Delay Factor to an integer number between 3000 and 20000. The delay factor determines how long the interface will "hold down" the buttons on your scanner. You should try to use the smallest number that works reliably with your computer and radio combination.

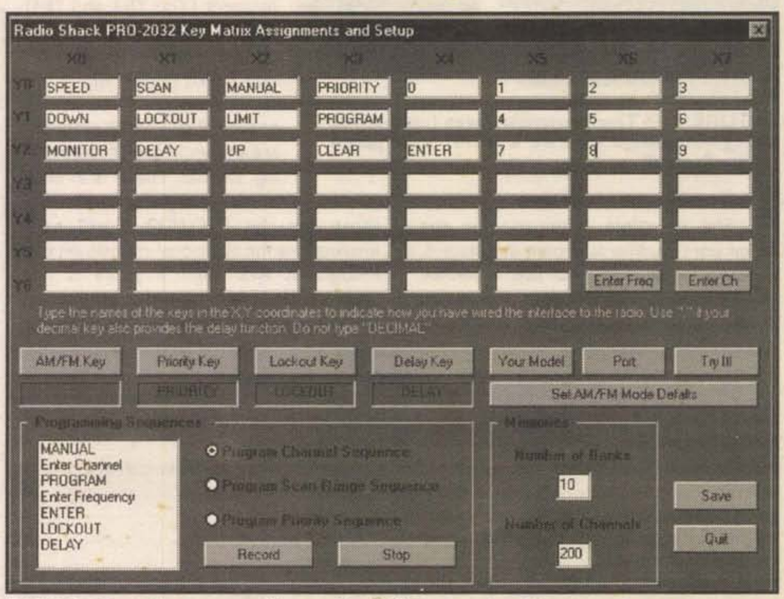

FIGURE 7 — You can configure the SW to work with almost any scanner using the configuration screen.

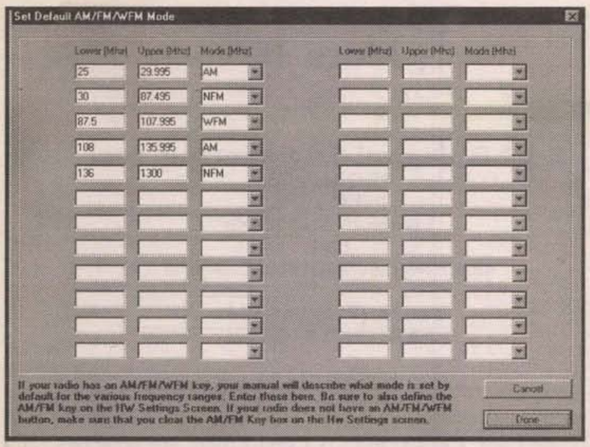

FIGURE 8 — You will need to tell the software what the default modulation mode is for a given range of frequencies in your scanner model.

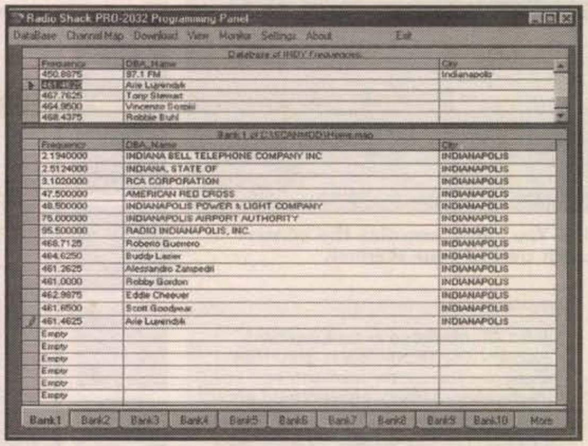

FIGURE 9 — The drag-and-drop interface makes changing your channel maps a breeze.

5. Next, the software needs to know the key sequences required by your radio to program a new frequency into a particular channel. Press the "Program Channel Sequence" option button and then "Record" to begin. For the PRO-2032 wired according to the schematic in this article, I press "Manual, The Enter Ch Button, Program, The Enter Freq Button, Enter, Lockout, Delay." Press Stop when complete.

6. To teach the software the key sequences required by your radio to program a new search range, press the "Program Scan Range Sequence" option button and then "Record" to begin. For the PRO-2032, I then enter "Program, Limit, The Enter Freq Button, Enter, Limit, The Enter Freq Button, Enter, ScanUp." Press Stop when complete.

7. To teach the software the key sequences required by your radio to program a new Priority Channel, press the "Program Priority Sequence" option button and then "Record" to begin. For the PRO-2032, I then enter "Program, The Enter Freq Button, Priority." Press Stop when complete.

8. Finally, fill in the number of banks and the total number of channels that your scanner provides. That's it! The software knows how to wiggle the buttons on your scanner and you are ready to run the Computer Control Software.

9. Press the "Save" button and then press "Try It." Now, when you select the boxes in the matrix, the radio should respond as if you were pressing the same keys on the radio's keypad. If the radio does not respond, and you have carefully checked your wiring and installation, you may need to increase the "Delay Factor" until the radio responds reliably.

10. Press "Stop" and then "Quit" and you are ready to try the software's simple drag-and-drop interface.

Using PROgramit

Figure 9 shows the program's main screen. Your frequency database is displayed in the upper table. The lower table displays one bank of frequencies at a time as they would be programmed into your radio along with the station's owner and city.

I refer to the upper grid as the "Frequency Database" and the lower grid as the Channel Map. You can open existing Frequency Databases and Channel Maps, or create new ones from the "Database" and "Channel Maps" pull-down menu items.

To program a frequency from the Frequency Database into the opened Channel Map, you simply drag it from one to the other. To get more information about a station in either grid, select the station and then right click anywhere in that grid.

When you right click on the Channel Map grid, you will also be able to clear a channel or set its "Priority, Lockout, and Delay" options if these are supported by your radio (Figure 10).

When you have all the channels programmed the way you want them, you can choose to download one channel at a time, one bank at a time, or all of the banks at once. You can save as many custom Channel Maps set-ups as you want, and recall them later to reprogram the scanner.

From the menu bar, you can also quickly program the scanner to monitor a range of frequencies that covers aircraft, weather, 2M, or 440 amateur radio.

Selecting the "Manual" menu option brings up a customizable control panel for your scanner from which you can manually operate the scanner (Figure 11).

Frequency Databases

With the advent of the CD-ROM and the Internet, it has become rather easy and inexpensive to find frequency databases to suit your needs. A few of these are listed in the sidebar. Unfortunately, each author has chosen to use a different database structure, so you often need special SW to access these.

PROgramit provides an Import feature to convert the most popular of these databases to the required format. Currently, the Probe, Percon, and Scanware formats can be converted. By the time you read this, other formats will be supported including delimited ASCII text which can be produced by most any database access program.

PROgramit uses Microsoft Access for the underlying database, but you don't need Access to use the SW. The current version of the program provides you with some very basic editing functions that allow you to create and edit a Frequency Database. Table 1 shows the database format.

That should be sufficient informa-

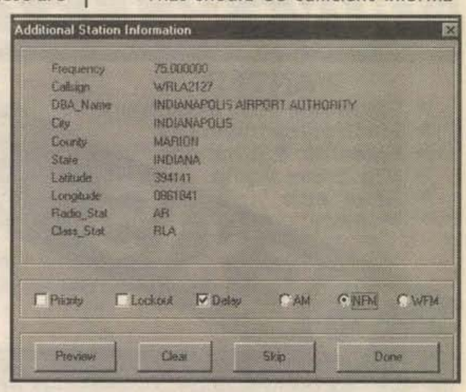

FIGURE 10 — Right click on either grid for additional station details.

Connections for Some Popular Radio Shack Scanners

Radio Shack PRO-2035 and PRO-2042

Connections are to the 15-pin board connector labeled CN503 (Keypad end is CN601)
Pin 15 is ground

Pin # on CN503	X0 to Pin 5	X1 to Pin 6	X2 to Pin 7	X3 to Pin 8	X4 to Pin 9	X5 to Pin 10	X6 to Pin 11	X7 to Pin 12
Y0 to Pin 1	MAN	AUTO	RECT	LIMIT	PRI	1	2	3
Y1 to Pin 2	SCAN	PGM	L/OUT	UP	MODE	4	5	6
Y2 to Pin 3	TUNE	WX	L/OUT/RVW	DWN	STEP	7	8	9
Y3 to Pin 4	SOUND SQ	ENT	DEL	MON	RESET	0	.	CLEAR

Radio Shack PRO-2004, 2005, 2006

The keypad connector is labeled CN601. This is a 13-pin connector between keypad and main PCB
Pin 13 is ground

Pin # on CN601	X0 to Pin 8	X1 to Pin 7	X2 to Pin 6	X3 to Pin 5	X4 to Pin 4	X5 to Pin 3	X6 to Pin 2	X7 to Pin 1
Y0 to Pin 9	X	MAN	PRI	LIMIT	X	1	2	3
Y1 to Pin 10	L/O RVW	SCAN	SPEED	UP	PRGM	4	5	6
Y2 to Pin 11	RST	DELAY	MODE	DWN	ENTER	7	8	9
Y3 to Pin 12	MON	L/O	STEP	DIRECT	CLEAR	0	.	X

Radio Shack PRO-2026

The 15-pin board connector is labeled J201
Pin 1 is ground

Pin # on CN601	X0 to Pin 8	X1 to Pin 7	X2 to Pin 6	X3 to Pin 5	X4 to Pin 4	X5 to Pin 3	X6 to Pin 2	
Y0 to Pin 12	POLICE	FIRE	AIR	1	2	3	ENTER	X
Y1 to Pin 11	WX	MARINE	DELAY	4	5	6	CLEAR	X
Y2 to Pin 10	SCAN	PROG	L/O	7	8	9	0	X
Y3 to Pin 9	MANUAL	MON	PRO	LIM	DOWN	UP	.	X

Radio Shack PRO-2032

The 8-pin board connector is labeled CN6.

Pin # on CN6 ----> Jumpers	X0 to Pin 1	X1 to Pin 2	X2 to Pin 3	X3 to Pin 4	X4 to Pin 5	X5 to Pin 6	X6 to Pin 7	X7 to Pin 8
Y0 to JM80	SPEED	SCAN	MAN	PRI	0	1	2	3
Y1 to JM84	DOWN	L/O	LIMIT	PGM	.	4	5	6
Y2 to JM83	MON	DELAY	UP	CLEAR	ENTER	7	8	9

tion for you to put this simple project together and get it running in your scanner. Once you do, you will probably never want to program it manually again.

This project would not have come together as it did without the help of a group of people on the programit@qth.net list server who helped debug the early hardware and software. Many thanks to each of you. Others can join the list by E-Mailing to majordomo@qth.net with the words subscribe programit in the body of the message.

For more information on the project, you can visit the PROgramit web page at http://www.geocities.com/SiliconValley/Way/1522 or contact me via E-Mail at jrmont@iquest.net **NV**

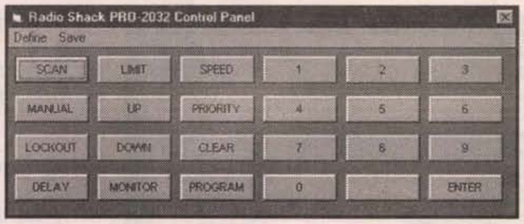

FIGURE 11 — You can customize the control panel to match that of your scanner.

John Montalbano is an Electrical Engineering Technologies graduate from the Rochester Institute of Technology (1981). He received his Master's Degree in Computer Science in 1986. He has worked as a circuit designer for AT&T in the areas of videoconferencing, medical imaging, 3D graphics, and interactive television. John welcomes E-Mail at jrmont@iquest.net

Parts List — Parallel Interface Version

Reference Designator	Description	Source
U1	74LS241	Digi-Key DM74LS241N-ND
U2	Harris CD74HCT22106	Digi-Key CD74HCT22106E-ND
U3 (Optional) *Used only when regulated 5V is not available in scanner.*	LM7805	Digi-Key NJM7805FA-ND
D1-D8	1N914 or 1N4148 Diodes	1N4148CT-ND
R6	4.7K ohm 1/8 watt	
R1-R5	47K ohm 1/8 watt	
C1,C2	0.1 uF Ceramic	Digi-Key 1203PHCT-NP
Female DB-25 right angle connector.		Digi-Key 325F-ND
Perfboard (Note 2)	approx. 2- 5/8" X 4.0"	Digi-Key V1119-ND

Parts List — Serial Interface Version

Reference Designator	Description	Source
U1	MAX233	MAX233CPP-ND
U2	E-Labs EDE300	See Note
U3	Harris CD74HCT22106	Digi-Key CD74HCT22106E-ND
U4 (Optional)	LM7805	Digi-Key NJM7805FA-ND
RZ1	Resonator	See Note
D1-D8	1N914 or 1N4148 Diodes	1N4148CT-ND
R2-R6	47K ohm 1/8 watt	
C1,C2	0.1 uF Ceramic	Digi-Key 1203PHCT-NP
2-pin serial connector of your choice. Suggest female RCA bulk-head mount.		Digi-Key 325F-ND
Perfboard (Note 2)	approx. 2-5/8" X 4.0"	Digi-Key V1119-ND

Note 1:

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PROgramit Software and updates are distributed as shareware at the PROgramit web page. The author requests a one time $12.00 registration fee be mailed to:

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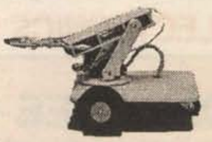

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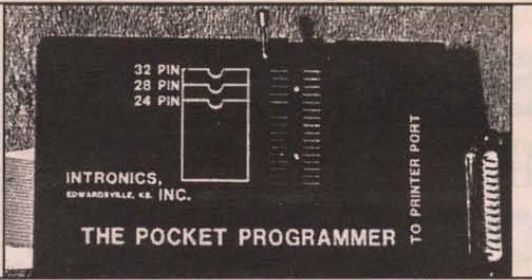

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Incoming Meteors Soon

by
Gordon West

In about 30 days from now, astronomers and radio enthusiasts are getting set for one of the biggest yearly light shows in the sky — the Geminids meteor shower.

The week-long aerial activities may begin on December 7th, illuminate the grand finale on December 14th, and still give you some visible "shooting stars" seen through December 17th.

This yearly meteor shower will delight skygazers late at night and into the pre-dawn hours with an expected 70 visual trails to be easily seen without the need of binoculars or a telescope. And while stargazers are outside looking up, ham radio operators and scanner radio enthusiasts will be listening to the airwaves and watching the television tube on an outside antenna for signals up to 1,000 miles distant. There will be excitement for all!

SHOOTING STARS

The earth regularly encounters incoming debris which instantly burn up into incandescents as the tiny particle as small as a grain of sand enters our dense atmosphere. The split-second streak of incandescents refers to the trail of light called a "meteor." The little speck of material is the actual meteoroid, and if it is large enough to withstand a trip through our atmosphere to actually make it down to earth, the recovered blueish-looking iron and silicon remnant is called a meteorite.

Random meteors occur every day, 24 hours a day, 365 days of the year. Random meteors are so predictably common that high-speed remote data stations rely on these meteors to reflect millisecond-long data messages between 30 MHz to 50 MHz over distances of 1,000 miles. But these kilowatt and megawatt stations are now going off the air in favor of polar-orbiting satellite relays.

Every year, our earth predictably passes through the debris of old comets, and this we call the annual meteor showers.

Name of Shower	Date of Peak	Average Hourly Rate
Quadrantids	Jan. 3	40
Lyrids	Apr. 21	10
Aquarids	May 6	12
Arietids	June 10	60
Taurids	July 2	30
Orionids	July 12	50
Aquarids	July 28	20
Persids	Aug. 14	50
Orionids	Oct. 22	30
Taurids	Nov. 5	15
Leonids	Nov. 16	12
Geminids	Dec. 14	70
Ursids	Dec. 22	12

The magazine *Sky & Telescope* will be your best source of information about what time of day the peak will occur, and in what general direction to aim your directional antennas. You can also look up meteor information at www.imo.net from the International Meteor Organization.

THE RADIO CONNECTION

While looking up at the night or early morning dark sky and seeing the trails from these incoming meteors (and quite possibly the incoming glow of satellite space junk, too), there is also major excitement out on the radio frequencies. Radio signals from 20 MHz to 250 MHz bounce off of the meteor trails and, for a few brief seconds, allow radio amateurs to conduct conversations over a 1,000 mile path on frequencies that might only support normal 10-mile contacts. And for television viewers with their TV hooked up to an outside antenna and tuned into an unused TV channel, all that white snow instantly transforms into a full-color picture that might last for as long as 30 seconds from the TV station over 800 miles away.

Same thing on the FM music band — where only 6 FM signals in your area may turn into a bedlam of incoming FM stereo stations that can be tuned in for up to a minute or two before the signals begin to fizzle away. The higher you go in frequency, the shorter the reflected signal duration.

VHF signals have just the right wavelength from 10 meters down to 1-1/4 meters long to easily reflect off of the meteor trail. As the meteoroid heats up to incandescence by friction of the earth's atmosphere, electrons and ions are scrambled and glow to incandescence, leaving a trail of ionization that might reach out to 20 miles in length, creating a pencil-like mirror that reflects and refracts back to earth normal line-of-sight VHF radio waves.

Sometimes the ionized trail may only last for a few seconds, giving ham radio CW operators a brief opportunity to quickly exchange each other's call sign at 30 wpm. Sometimes larger meteoroids grazing the earth's atmosphere create longer and more lasting meteor trails that may persist up to 30 seconds and allow remarkable television and FM music radio reception over 800-mile paths.

The meteor trail is best "worked" by radio enthusiasts when it is perpendicular to the path of the radio waves. Depending on what frequency you are tuned into may determine how long you are able to sustain communications or reception off of a single meteor trail.

As an example, a remarkable Geminids meteor shower about five years ago gave us a whopping meteor trail that allowed amateur operators to carry on communications with the other distant station almost 900 miles separated for a remarkable amount of time. The operators on the lower frequency had almost a full minute to exchange signal reports and niceties, while other operators only had a few seconds. In looking over the log books and listening to tapes, here is what I've found on that one single meteor contact:

222 MHz — a remarkable, successful two-second CW exchange
144.2 MHz — 22 seconds of "armchair" solid copy
50.2 MHz — 45 seconds of loud and clear communications
28.4 MHz — 1-1/2 minutes of solid communications
21.3 MHz — over three minutes of rough, but copy-able, two-way radio dialogue

THE PROCEDURE

If you plan just to watch the Geminids meteor shower, simply step outside on the nights of December 10th through the 14th, and look up to the dark sky and see where the meteor activity is. Within a minute or two, you'll get an idea of which direction they are coming from. This varies with the time of night or the just-before-dawn hours. Most reports indicate that 4:00 am to 5:00 am local time, here in the United States, will lead to some easily seen meteors.

If you plan to catch them on an entertainment radio or television, a directional antenna will help. Aim your TV or FM antenna in a direction of a major city about 700 miles away. Tune in between on-air stations, and be patient — out of nowhere a signal will come up and surprise you for several seconds.

If you're a scanner radio enthusiast, try tuning in 75 MHz. Every airport has a 75-MHz inner marker beacon that shoots a signal straight up. If you don't hear a thing on 75 MHz, just wait. All of a sudden, you may begin to hear a pulsed signal come out of nowhere, and this is probably a reflection from a Geminids meteor trail.

Amateur radio operators most reliably make contact off of meteor trails by setting up specific schedules with other stations many hundreds of miles away. The easternmost station transmits from 15 seconds to 30 seconds beaming west, and 45 seconds to 59 seconds aiming west. West Coast stations will beam east, and transmit their own call sign from 00 seconds to 15 seconds, and 30 seconds to 45 seconds. After several minutes, both stations will have received enough fractional information of the other station to confirm a meteor contact.

I like the excitement of unscheduled meteor contacts. The most popular band is six meters at 50.125 MHz, and on two meters at 144.200 MHz, both bands operating upper sideband. A no-code Technician has full privileges on both of these bands.

Working a random contact still adheres to the west calling east at 00 to 15 seconds, and 30 seconds to 45 seconds schedule. The east calls west at 15 seconds to 30 seconds, and 45 seconds to 59 seconds.

The trick is not to call for the entire 15-second period. The key is to be BRIEF AND CONCISE: "CQ meteors, this is WB6NOA in DM-13, break." I listen for a couple of seconds for a response, and then repeat this sequence again, squeezing three of them within my 15-second calling period.

I am giving my call sign, and I usually do it phonetically, along with my maidenhead grid square, the direction that I'm listening for, and the word "break" to indicate I am not doing the entire 15-second call, but rather briefly calling and briefly listening.

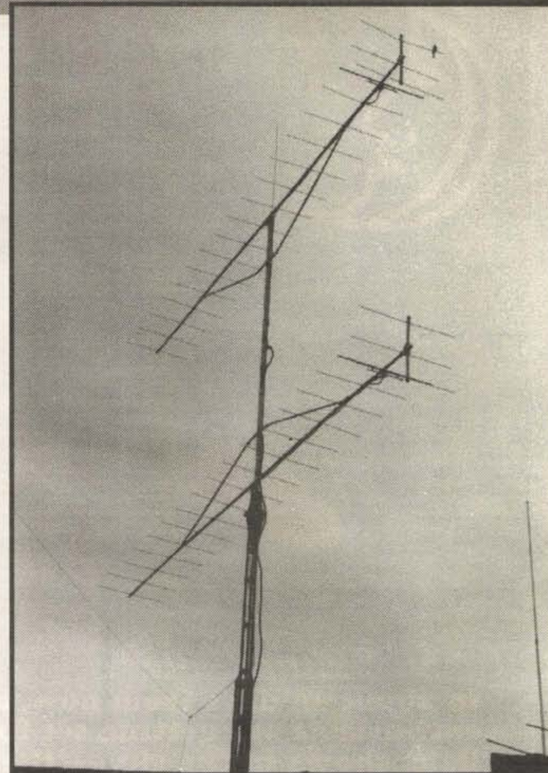
This short-shot approach works well. After about 10 tries, I usually get a fast response from another station, so I always keep my pencil ready. They indicate my signal is "S2," which is not signal strength, but rather they heard my complete exchange, and then they say the word "break" which means it's my turn to give them my response of their call sign, my call sign, my S2 of their signal, and they break for their final "roger." They give me a "roger," and I give them a "roger" plus 73, and that's that.

One fast meteor shower contact should be accomplished in less than 10 seconds. If you're taking more time than that, other hams will out-talk you and drive you off the frequency! The whole idea is to get in and get out, and let other amateur operators try to work that same station on the same "burn."

Sometimes the calling frequency gets so jammed with signals that no one can hear anything but QRM. Now it's a good idea to move 5 KHz higher or lower than the calling frequency. But don't move too far away because no one will be looking for you way up or way down the band. It's too bad that we can't spread out more during meteor scatter contacts, but the way that random contacts work is to make noise on the calling frequency.

I sometimes will kick on the amplifier, and give a 15-second transmission that I will be at a specific frequency for the next 10 minutes looking for contacts. Hopefully my signal will bounce off of a few incoming meteor trails that several stations will hear me saying I'm going to go off frequency to another specific spot on the radio dial, and they will follow me down there, and we can leisurely make a contact without jamming the calling frequency. This is good technique.

If you have not worked meteor showers before as a licensed ham, listen to the pros. You want to try to imitate their technique as best you can. During the peak of the meteor shower, most pros will develop big fangs and claws, and they'll strike out at anyone who isn't in tune with how to work meteors and to get on and off of the frequency in a hurry.


A stack of beams may be too much for meteor work, due to a very narrow beamwidth.

A small directional antenna is about all you need, with more than 25 watts of power preferred. Fifty to 100 watts is just fine; 1,500 watts is unnecessary unless you are blasting an announcement out that you are going to be listening up or down the band a few KHz for the next few minutes. That's the technique I use, and that's about the only time I turn on "big bertha."

SO GET SET FOR GEMINIDS

You have a month to prepare your station, and if all you want to do is to watch and listen, there's plenty of excitement without ever having to transmit over the airwaves. Every year, these different showers provide all sorts of surprises, plus some disappointments. But there are always a few good meteors out there, so see how you can next catch that falling star. **NV**

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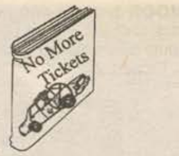

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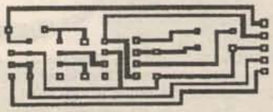

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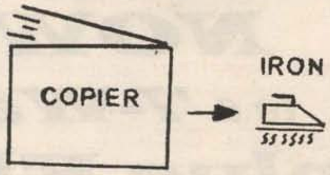

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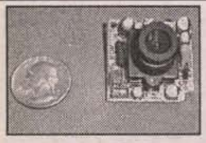

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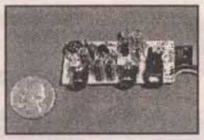

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WANTED: MANUAL copy for General Radio type 1360-A microwave oscillator. Ross Wollrab, 229 N. Oakcrest Ave., Decatur, IL 62522-1810. 217-428-7385.

MAINTENANCE/SERVICE manual for Joseph Kaye & Co., Inc. (now, Kaye Instruments) thermocouple reference system, model RJA1 Chr-AL) and power supply, model PS4. 906-227-1520 Voice, 906-227-1549 Fax.

WANTED: LATE MODEL TEST EQUIPMENT (Tektronix, HP, Fluke), and also, test equipment service manuals. Pepper Systems: 214-353-0257; 214-902-9511 FAX.

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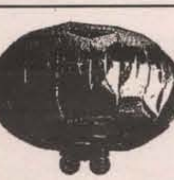

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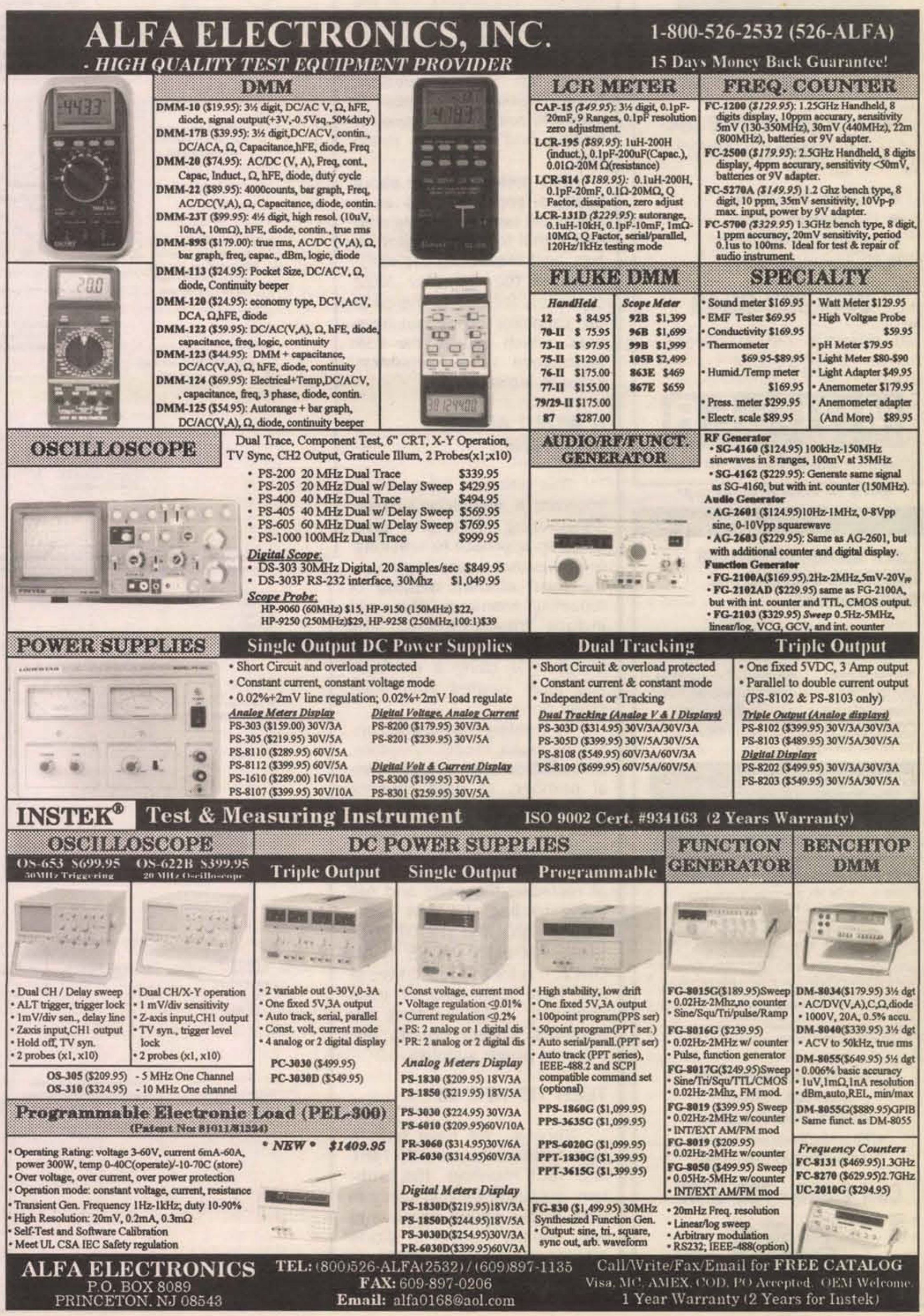

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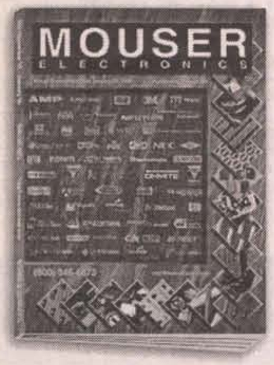

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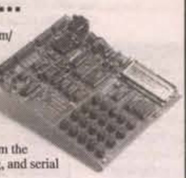

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junction(s), or short across one or more junction(s). More than 90% of the time, they will short. This makes it easy to find the bad transistor, often times in-circuit. But it is common to have to remove a transistor or diode from the circuit to get an accurate reading, due to other components such as resistors and transformers that make the component look shorted.

Some of the newer models of DVMs have capacitance checkers, but require that the capacitor be pulled from the circuit to get an accurate reading. Along those lines, a device called an ESR (Equivalent Series Resistance) meter is available and very effective for finding bad capacitors in-circuit.

ESR meters start at about $200.00 and are used as a power-off test by applying a 50 KHz signal to the capacitor in-test, and measuring the resistance of the capacitor. Most capacitors fail due to the oil in the capacitor drying out from heat, which causes the ESR (resistance to a frequency) value to increase.

A WORD ABOUT EFFICIENCY

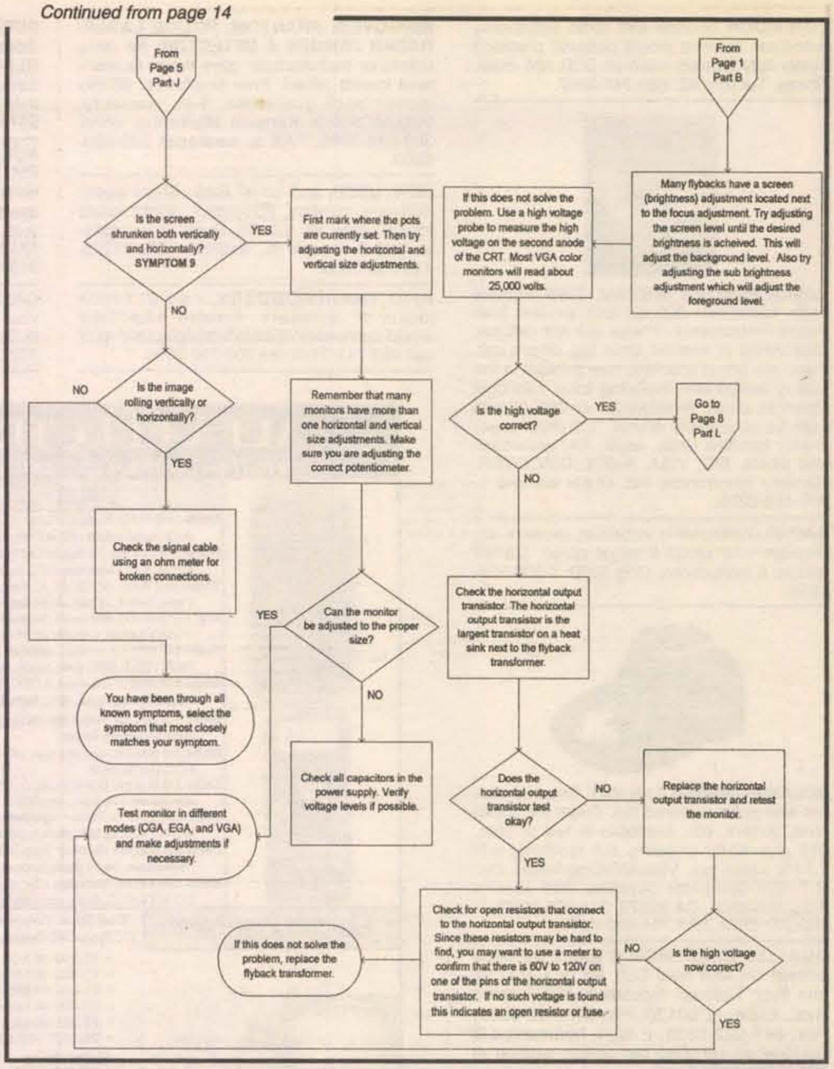
This article is intended to improve a technician's troubleshooting skills and give them an approach to repairing monitors that works. However, the most efficient method of repairing monitors does not include troubleshooting. The most efficient way to repair monitors is using a database you have created with each repair done.

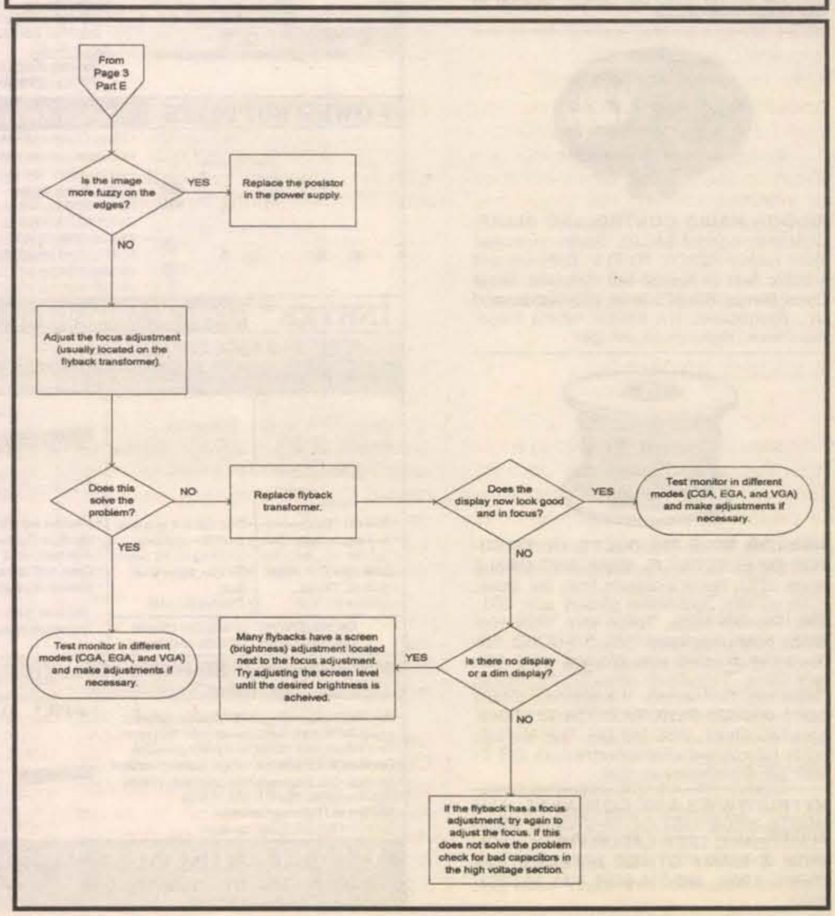
By creating a database containing make, model, symptom, and solution (and possibly serial number) of each monitor you repair, soon most of your fixes will not require any actual troubleshooting. So the only time involved in a repair is that of replacing the parts and not trying to find the bad parts. NEVER TROUBLESHOOT THE SAME PROBLEM MORE THAN ONCE. It is for this reason we at NAC have spent over 12 years compiling a list of fixes for monitors, system boards, drives, and power supplies.

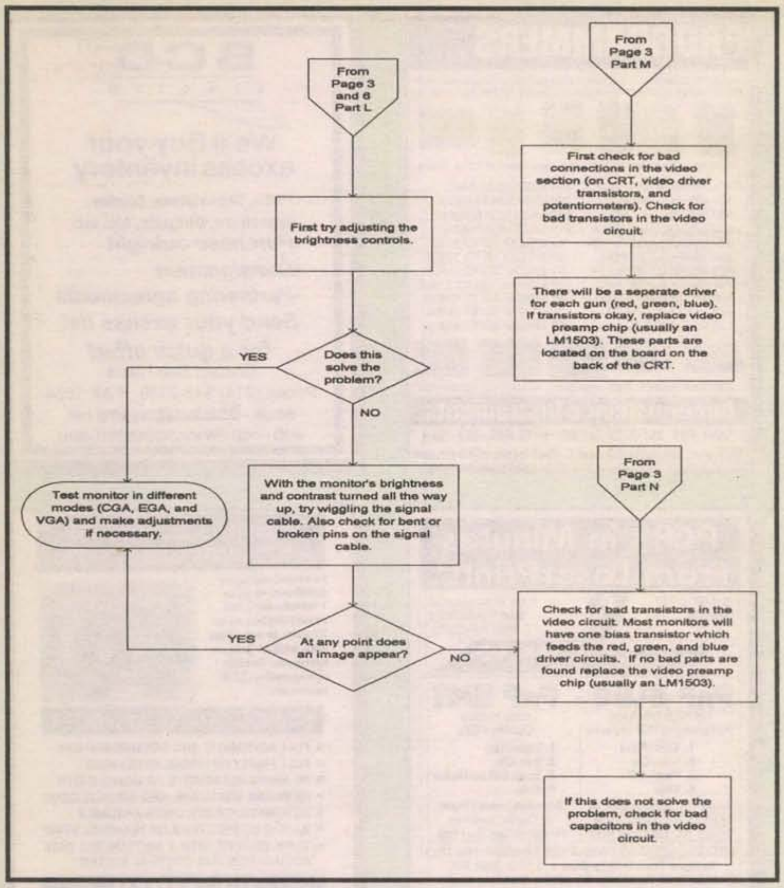
TECH TIP APC 95

Recently, we have seen a high failure rate on CTX 1461 and 1561 monitors. The problem is caused by bad connections in the power supply and will usually cause a diode ZD101 and transistor Q101 in the power supply to short and blow the fuse (about $7.00 in

Continued from page 14







parts). This problem can be prevented by resoldering the five connections on both sides of P104.

P104 is a connector that connects the switcher board to the main board. The switcher board must be removed from the circuit in order to get to the connections on the switcher board side of P104. After removing the old solder and resoldering these connections, the switcher board can be reinstalled.

If this is not done, chances are the monitor will fail when bumped or vibrated, causing the diode and transistor to fail. In about 10% of these failures, a resistor at R114 will open, causing about seven other components on the switcher board to fail.

A WORD ABOUT DAS

DAS stands for Digital Adjustment System. It refers to monitors that use software run on a PC (and usually some special hardware or cables) to make adjustments that used to be done with pots in the monitor. Both Goldstar (Packard Bell) and Viewsonic have recently started making monitors that use DAS. You may have seen Goldstar or Packard Bell monitors with bad digital control circuits. We have recently seen a large number of these monitors exhibiting problems with their control panels.

If you replace the chip that causes the problem, you will find it solves* your original problem, but now the monitor has a vertical roll. This is because the chip you just replaced contains the memory that stores these adjustments. The only way to fix this problem is using a special software and box that connects to the PC. We have not gotten far trying to get these products from the manufacturer, so we've started making our own and expect to be selling them soon.

TEST EQUIPMENT

The following is a list of highly effective, low-cost test equipment available for repairing monitors.

ESR METERS

A low-cost ESR meter is the best investment any technician can make for working on monitors. ESR stands for Equivalent Series Resistance, for those that have an electronics background. This is an equivalent measurement of a capacitor's reactance value (measured in ohms of resistance). Over 95% of the time, when an electrolytic capacitor fails, it drys out from heat in the circuit. This will usually not show up as a change in the capacitance value, but instead, when capacitors dry out, their internal resistance to a frequency increases making them more resistive and less capacitive.

Most ESR meters put out between 50 KHz and 100 KHz. Capacitors over 1 uF have an ESR value of under 10 ohms (at 50 KHz to 100 KHz generated by these testers). This makes the chance of a resistor in circuit affecting the readings unlikely. For this reason, ESR meters can be used to test capacitors in circuit with a high rate of accuracy.

Meters that measure the capacitance value are useless to the technician since the capacitor has to be removed from the circuit to get an accurate reading. If you have to remove a capacitor from the circuit for testing, you might as well replace it for the $.20 replacement cost and save the time spent testing the cap.

Creative Electronics - $199.00
810-435-8916

VI TESTER (OCTOPUS)

Another device that is helpful in troubleshooting monitors (and other analog circuits) is the VI tester. They are also called an Octopus, and are sold by Huntron as the Tracker 1,000, 2,000 and 5,000 models. The Huntron Trackers start at about $1,000.00 and go up to about $6,000.00. They are better than the simple VI testers with more ranges and more features, but they are expensive.

A simple VI tester with a built-in switcher (for doing a comparative test between a good and bad unit) can be built for under $70.00 and connected to any scope that supports XY settings. NAC sells a VI tester that connects to a scope and includes a built-in switcher for comparison testing for $145.00.

PATTERN GENERATORS

You have two options for pattern generating: **1.** Software-based products that run on a PC. **2.** Hardware-based products that are self-contained. The software option is cheaper, but not as efficient as a dedicated hardware device. However, the software option usually has more flexibility and more tests than a hardware-based device. You may want one of each (hardware and software).

Tech Assist (Software) - $295.00
800-274-3785
CMM (Hardware) - $295.00
800-466-4411

The longer I work in the repair industry, the more apparent it becomes that you do not have to spend a lot of money to work efficiently. In fact, as I have discovered new products over the years, it seems that the most useful tools are the least expensive. **NV**

Don Doerr, President of National Advancement Corporation, a Santa Ana, CA-based company that specializes in Advanced PC, Monitor, Macintosh, Printer, and Network maintenance training. NAC also makes test equipment and video tapes for the service industry. For information about NAC products and Services call (800)832-4787. Mr. Doerr is also Spokesperson for NAPCO, author of the book, "Servicing PC-based Equipment" (published by Prentice Hall), host of "The Computer Consultant" radio show, and works as a consultant for CBS, NBC, and Fox Television Networks.

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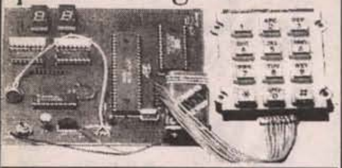

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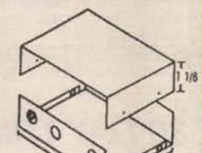

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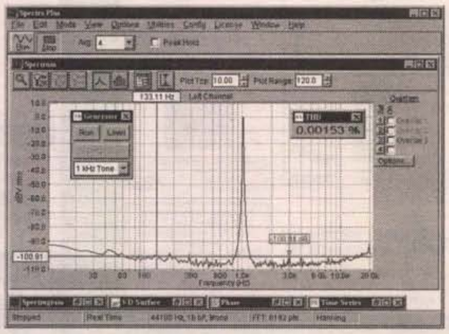

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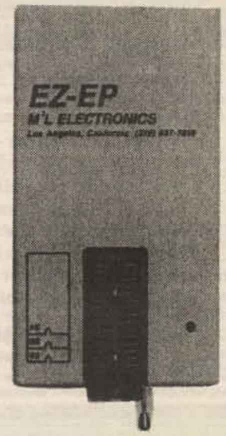

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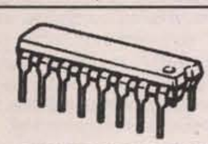

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Questions & Answers

TECH FORUM

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QUESTIONS

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11971 **Joe Riedi**
Renton, WA

I have a voice-changing device that outputs its audio to an external 8 ohm speaker. This system works like a small megaphone. I create a lot of voice mail greetings using this device, and it allows me to alter the voice characteristic, but it's cumbersome holding the mini speaker to the telephone handset with the other.

I want to feed the output of the LM386 audio chip, eliminating the speaker, into the handset mike through a phone jack.

The matching circuit for using handsets with the electret and carbon mikes is needed.

11972 **John Was**
Palm Springs, CA

I would like to construct a circuit that would allow me to vary the phase angle of a fixed 115 VAC 400 Hz power supply, where I can use any of the input phases as reference and I could shift the output 90, 180, 270 degrees lead or lag. I have used two variacs, but I find it costly and time-consuming every time that I have to set this circuit up.

11973 **Franklin A. Rivas**
Hollywood, FL

I'd like to monitor a room with a small child. I have a little black and white CCD video module that has video out via a coax cable and requires +12 volts DC. Is there any way to ride the +12 VDC on the video signal coax cable? This would save me the trouble of having to run two lines. Also, what kind of length can I expect to get? I need about 20'. Will I need some sort of amplifier or driver?

11974 **Bob**
via Internet

What components would be needed to develop an FM stereo receiver to pick-up FM signals on a cable or antenna TV system? Then, taking this FM signal and amplifying it to speakers or perhaps a stereo set thereby, giving me FM stereo for my non-stereo TV set. We have cable service with the converter set to channel 3 input to our TV set. If a schematic or commercially available kit can be ordered, I need addresses.

11975 **James Waite**
Eau Claire, WI

I am trying to build a wind generator to feed back into the power line to reduce my electricity costs here in Oregon. (The power company has to buy my power at the retail rate.) I need a schematic for a synchronous inverter to do this. I have been unable to find such a thing. Can anyone help?

11976 **David Bennett**
Astoria, OR

Can someone tell me how to test the safety interlock module used on lawnmowers? These modules are approximately 1" in diameter x 1" long with three leads. The ones for Briggs & Stratton are different from Tecumpseh/Kohler. What can be used to remove the sealer from these modules?

11977 **Bob Finley**
Henderson, KY

Can VCR video tapes be put on to a computer disk/CD? I have seen computer catalogs advertise computers with 2 MB video RAM. I've also seen computers displayed with video being ran on the monitor, and I've heard of the President's speech broadcasting over the Internet. Yet, I'm told a computer cannot hold video, only freeze frame pictures. Is this so and why?

11978 **Jim Cooper**
Haynesville, LA

I am interested in electrical discharge machining (EDM). I want to improve my amateur machining capabilities by constructing a small "shop made" EDM. I understand the basic theory of EDM. I am also comfortable with analog, digital, and motion control. I am looking for practical block and/or schematic diagrams and some hints on the implementation of the pulse control circuits and microprocessor interface. The power range need not be large.

11979 **David R. Howland**
Aptos, CA

ANSWERS

ANSWER TO #109718 - OCT. 1997

If you are using a Radio Shack computer from the same era (i.e., the Tandy 1000 or Color Computer series), then it should have a ready-to-use RCA line-out jack. It will work with any television with line-in RCA capability. If your television doesn't have line-in, then you can purchase an RF modulator (Radio Shack cat. #15-1273A) which will convert the signal to VHF channel 3 or 4. A VCR would also perform the same trick. (This is how I used my Tandy 1000 back in '89.) If your computer doesn't have an RCA jack, then you will have to purchase a more expensive converter.

Chuck Homic
Ballston Spa, NY
chuck@vvisions.com

ANSWER TO #10976 - OCT. 1997

It's true that an SCR can be used to switch DC loads, but only under certain conditions.

Recall that an SCR (Silicon Controlled Rectifier) functions as a diode, with one additional control electrode. Once switched into conduction, the SCR will continue to conduct until it is commutated or the holding current drops below a critical value determined by the particular device being used.

For AC circuits this is easily accomplished since the voltage reverses every half cycle, and since the SCR is a diode and doesn't conduct in the reverse direction, it turns off.

I'm not clear on how Melvin has connected his circuit or what he meant by his description of "using a capacitor to drop the voltage so the SCR could close," but using a capacitor and another SCR is one way to commutate the conducting SCR. Triggering the SCR into an on state is the easy part. Turning it off when a DC current is flowing is the harder part.

One way is to shunt current from the SCR that's carrying the main current so that the current will drop below holding value and the SCR will turn off. Using a capacitor (must be discharged to begin with) in series with an SCR in parallel with the main SCR is one way. When the second SCR fires, the capacitor will initially appear as a short, being charged through the second SCR. This will shunt current away from the first SCR, causing it to turn off. Once the capacitor on the second SCR is charged, the current through that SCR drops to zero and it turns off. The first SCR can then be turned on again as needed.

Note that the capacitor must be discharged before it can again be used to commutate the first SCR.

Use of a hexfet or other power device might be more practical since it sounds like the voltage and current Melvin is trying to switch are easily within reach of these devices. There are also GTO (gate turn off) devices that perform like SCRs, but with the added

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capability to be turned off on command.

Richard Nelson
Newport News, VA

ANSWER TO #10974 - OCT. 1997

The rotary tuners had a few I/O items: ANT, OUT, Power, Ground, and AGC.

The AGC voltage is related to signal strength. The sub-tuner may fix this voltage and make a SS meter impractical. Differentiating from power (a constant V) and the Automatic Gain Control Voltage (AGC) should not be difficult. If you find it add a DC meter at this test point.

On a solid-state tuner add digital band switching and tuning voltages to the above signals.

Ron Dozier
Wilmington, DE

ANSWER TO #109717 OCT. 1997

The easiest way to start (or stop) your VCR is with a simple two-wire connection. If you pop the front cover off of most VCRs, you will find that all of the control switches are nothing more than two contacts usually of the membrane type. Tracing the wires back to the board, you install two separate wires to the board and a normally open phono jack or any two-wire jack to these wires and attach it to the body of the VCR.

This allows you to connect the standard output from any motion detector's "N/O" switch contacts to this jack which, in turn, will start your VCR upon triggering. Having the phono jack allows quick disconnect for use of the VCR elsewhere.

Chris
Bieber, CA

ANSWER TO #10971 - OCT. 1997

I don't know what kind of computer you're using, but if it's a PC compatible, you're going to have some trouble. Because of the way the PCs are designed, you can't have multiple devices that use the same system resources.

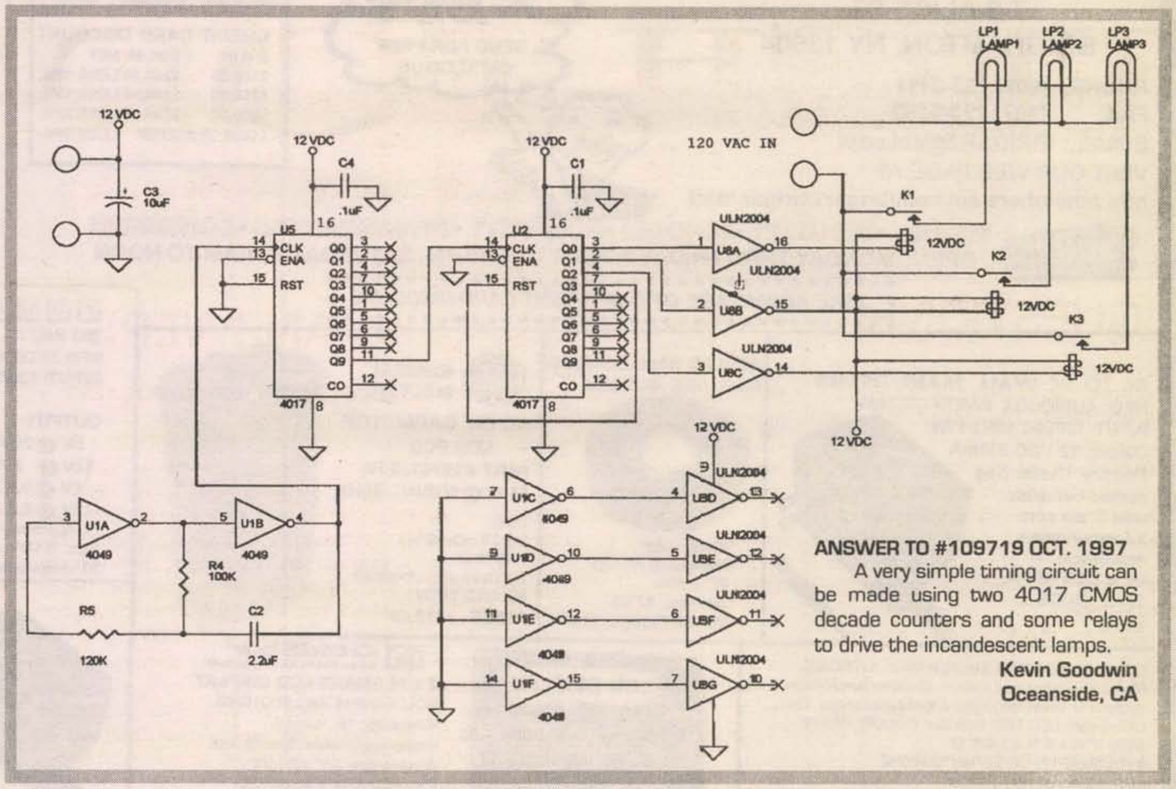
In the case of video adapters, you will have to worry about the system memory address that each card's VRAM will map to. For example, a CGA adapter uses 0B800h, VGA uses 0A000h and 0B800h, and monochrome uses 0B000h. As a result, you can use a monochrome monitor as a second monitor in a system that uses CGA or VGA. (Because the video addresses don't conflict.) Unfortunately, you need software that is specifically programmed to support dual monitors.

Many commercial debugging packages support dual monitors, so you can execute a program on your main video adapter, while viewing program data and source code on the second monitor. However, if you are writing your own software to use this setup, you can simply use address 0B000h for monochrome, and 0B800h or 0A000h for CGA or VGA, and the computer will write to the correct monitor. To support multiple mice, I believe you will again have to delve into custom code. While you can physically connect two mice (on COM1: and COM2:), there will be a driver problem. Mouse drivers are set up to control interrupt 033h, only expecting one mouse to be used, and therefore have no provision to choose which mouse is being accessed. Perhaps an inexpensive network would be a simpler solution? You could purchase a second computer (with only minimal RAM and HD so you can run a monitor, mouse, and keyboard).

Two ethernet cards, a null hub, and cables can be obtained for under $75.00.

I found this configuration to be much easier to construct, and far better in terms of software compatibility.

Chuck Homic
Ballston Spa, NY
chuck@vvisions.com



ANSWER TO #109719 OCT. 1997

A very simple timing circuit can be made using two 4017 CMOS decade counters and some relays to drive the incandescent lamps.

Kevin Goodwin
Oceanside, CA

ANSWER TO #10973 - OCT. 1997

Pinouts of the two seven-pin connectors on 1980's MOPAR auto radios are as follows.

GRAY connector (pin 7 is the one with the bump) is mostly for power:

Pin 1 - +13.8V to battery, hot all the

Continued on page 110

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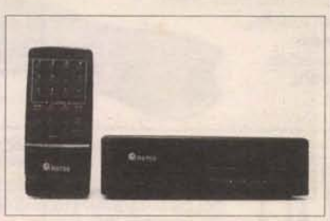

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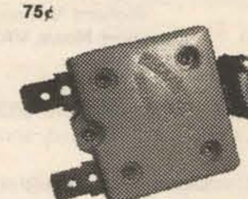

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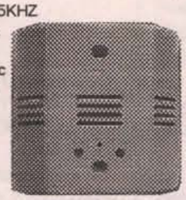

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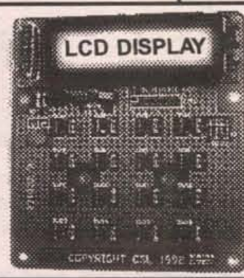

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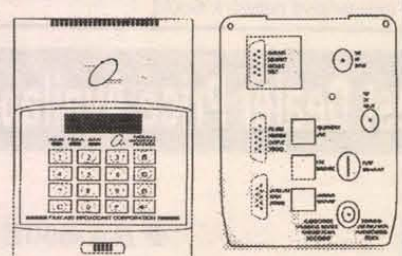

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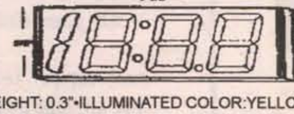

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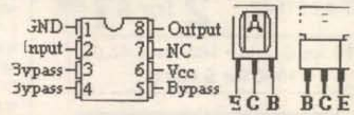

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DECEMBER 6

AL - DOTHAN - Hamfest. Tom Tucker KA4YES. Web: http://www.qsl.net/warc
AZ - MESA - ARRL Hamfest. Gary Roberts AB7MX, 602-827-2195
CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
IL - JACKSONVILLE - Hamfest. Jonathan Turner Jr. High School, 664 S. Lincoln Ave. 8am-2pm. Kaye Green KB9KHQ, 217-245-6778
LA - MINDEN - ARRL Hamfest. Lowell A. "Dusty" Collins KB5WFE, 318-371-0636
NC - GREENSBORO - Hamfest. Greensboro Coliseum Complex, 1921 W. Lee St. 910-851-1676
NH - SALEM - Computer Show. Rockingham Park Race Track. Northern Computer Shows 978-744-8440
NY - WHITE PLAINS - Computer Show. Westchester County Ctr. 9:30am-4pm. MarketPro 201-825-2229

DECEMBER 6-7

CA - SACRAMENTO - Computer Show. Cal Expo. 10am-5pm. MarketPro 415-456-6730
NC - CHARLOTTE - Computer Show. Charlotte Merchandise Mart. 9:30am-4pm. MarketPro 201-825-2229

DECEMBER 7

CA - FULLERTON - Computer Show. Sequoia Conference Center. 1535 Deerpark Ave. Paul Martinez 619-295-1221
CA - LIVERMORE - Swapmeet. Las Positas College. Noel Anklam 510-447-3857
CA - SAN DIEGO - Computer Show. Scottish Rite Center. 10am-5pm. MarketPro 415-456-6730
MA - TAUNTON - Computer Show. Holiday Inn. Northern Computer Shows. 978-744-8440
MI - HAZEL PARK - ARC Swap & Shop. Hazel Park High School, 23400 Hughes St. 8am-2pm. Tom Austin N8TMQ. 810-293-7398
NY - POUGHKEEPSIE - Computer Show. Mid-Hudson Civic Center. 9:30am-4pm. MarketPro 201-825-2229

DECEMBER 12-13-14

MI - TAYLOR - Computer & Technology Show. Gibraltar Trade Center, 15525 Racho Rd. 313-287-2000

DECEMBER 13

CA - DALY CITY - Computer Show. Cow Palace, Gate #5, Geneva & Santos. Robert Austin Corp. 1-800-243-7041, Web: http://www.robertaustin.com
CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves
CA - FRESNO - Computer Show. Fresno Fairgrounds. 10am-5pm. MarketPro 415-456-6730
FL - LAKE CITY - Hamfest & Computer Show. National Guard Armory. 8am-4pm. Colin Boutwell WA5RKR, 904-755-7969 1-800-752-7969. E-Mail: wa5rkr@isgroup.net
IN - INDIANAPOLIS - AGI Computer Fair. Indianapolis Events Center. 3655 E. Raymond St. 10am-4pm. 317-299-8827
MA - WEST SPRINGFIELD - Computer Show. Eastern States Exposition. MarketPro 201-825-2229
ME - PORTLAND - Computer Show. Portland Expo. Northern Computer Shows. 978-744-8440
SC - UNION - Hamfest. Roger Gregory KD4YFB. 864-427-1462

DECEMBER 14

CA - LANCASTER - Computer Show. Antelope Valley Frgnds. 10am-5pm. MarketPro 415-456-6730
CA - SAN DIEGO - Computer Show. Scottish Rite Ctr. Paul Martinez 619-295-1221 Fax 619-295-7726
CA - SANTA ROSA - Computer Show. Sonoma Co. Fairgrounds. 10am-5pm. MarketPro 415-456-6730
IN - KOKOMO - AGI Computer Fair. Ramada Inn, 1709 E. Lincoln. 10am-3pm. 317-299-8827
NH - DURHAM - Computer Show. Whitemore Arena UNH. Northern Computer Shows. 978-744-8440
NY - HEMPSTEAD - Computer Show. Best Western. 9:30am-4pm. MarketPro 201-825-2229

DECEMBER 20

CA - OAKLAND - Computer Show. Oakland Convention Center, Broadway @ 10th St. 1-800-243-7041 Web: http://www.robertaustin.com
CA - SACRAMENTO - Computer Show. Scottish Rite Center. 10am-5pm. MarketPro 415-456-6730
CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
NH - SEABROOK - Computer Show. Seabrook Greyhound Park. Northern Computer Shows. 978-744-8440
NY - BUFFALO - Computer Show. Hamburg Fairgrounds. 9:30am-4pm. MarketPro 201-825-2229

DECEMBER 20-21

CA - VENTURA - Computer Show. Ventura Fairgrounds. 10am-5pm. MarketPro 415-456-6730
GA - KENNESAW - Computer Show. Outlet Mall, I-75 @ Exit 117. Georgia Mountain Productions 706-838-4827
NY - STONY BROOK - Computer Show. SUNY Stony Brook. 9:30am-4pm. MarketPro 201-825-2229

DECEMBER 21

CA - RICHMOND - Computer Show. Memorial Auditorium. 10am-5pm. MarketPro 415-456-6730
CA - STOCKTON - Computer Show. Civic Auditorium. 10am-5pm. MarketPro 415-456-6730
MI - FLINT - Computer Show. Holiday Inn, Gateway Centre, US 23 @ Hill Rd. Exit. Five Star Productions 810-890-0988
NY - ROCHESTER - Computer Show. The Dome Center. 9:30am-4pm. MarketPro 201-825-2229

DECEMBER 26-27-28

MI - MT. CLEMENS - Computer & Technology Show. Gibraltar Trade Center, 237 N. River Rd. 810-465-6440

DECEMBER 26

MA - ROCKLAND - Computer Show. Sons of Italy Hall. Northern Computer Shows. 978-744-8440

DECEMBER 27

CA - BAKERSFIELD - Computer Show. Kern Co. Fairgrounds. 10am-5pm. MarketPro 415-456-6730
NH - MANCHESTER - Computer Show. Center of NH Expo. Northern Computer Shows. 978-744-8440
NC - FAYETTEVILLE - Computer Show. Cumberland County Civic Center. 9:30am-4pm. MarketPro 201-825-2229

DECEMBER 27-28

CA - SAN DIEGO - Computer Show. Scottish Rite Center. 10am-5pm. MarketPro 415-456-6730
CA - VALLEJO - Computer Show. Solano Co. Fairgrounds. 10am-5pm. MarketPro 415-456-6730
NJ - PARSIPPANY - Computer Show. Parsippany Hilton. 9:30am-4pm. MarketPro 201-825-2229

DECEMBER 28

NH - WORCESTER - Computer Show. Worcester's Centrum Centre. Northern Computer Shows. 978-744-8440
SC - FLORENCE - Computer Show. Florence Civic Center. 9:30am-4pm. MarketPro 201-825-2229

JANUARY 1998

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MN - ROCHESTER - Super Computer Sale. Mayo Civic Center. Blue Star Productions 612-788-1901. Web: http://www.supercomputersale.com

JANUARY 3-4

FL - FT. MYERS - ARRL Hamfest. Colleen Sammons KQ4TR. 941-936-1431

JANUARY 3

NH - NASHUA - Computer Show. Sheraton Tara Hotel. Northern Computer Shows. 978-744-8440

JANUARY 4

IN - SOUTH BEND - ARRL Hamfest. Bob Denniston KA9WNR. 219-291-0252
MA - HYANNIS - Computer Show. Tara Hyannis

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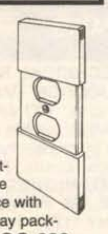

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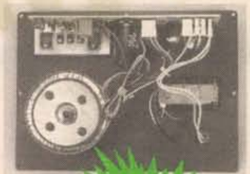

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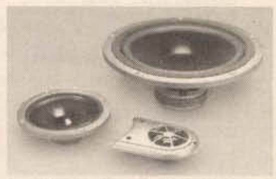

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Radio Direction Finding

Open Channel

by Joseph J. Carr
K4IPV

This month, we will take a look at some simple radio direction finding methods, including one that you can take along while backpacking (in case your GPS receiver fails!). But first, I want to "answer the mail" by answering a reader's question.

WWV Preamplifier

If you follow this column any length of time, you will find that I have a passion for what I call RadioScience Observing (a term I coined to cover radio astronomy, whistler hunting, propagation observations, and the like). One of the "tricks of the trade" is to make time and radio condition recordings by listening to WWV (Fort Collins, CO) or WWVH (Hawaii) and recording the audio on one channel of a stereo cassette recorder.

The audio recording becomes a record of the data at the same time as the event is being recorded on the other channel. Some shortwave receivers even come with tape recorder outputs, although most of the time you have to use the earphone output of the receiver to drive the cassette line input jack. Neat, huh? Not always. Unfortunately, many people use low-cost shortwave receivers that don't have a large amount of sensitivity. Some homebrew designs that are popular suffer this indignity.

The reader asked me how to boost performance of the WWV receiver in the field. My first thought was a "good antenna," but that was not a viable solution given that it would have to be erected in the field and then taken down when the data collection was completed. One good solution is to build an RF preselector and preamplifier circuit such as Figure 1.

This circuit uses a low-cost JFET transistor (the venerable MPF-102 or equivalent) as the amplifier.

The input transformer (T1) is wound on a T-50-2 (RED) toroidal core. The primary is wound with six turns of #28 enameled wire, while the secondary is wound with 18 turns.

The secondary is resonated by the combined capacitance of C1 (a trimmer), varactor D1, and the stray capacitances in the circuit. The varactor is a type NTE-618. The "NTE" series of semiconductors are intended for radio-TV/electronic service technicians, and are widely available both by mail order and in local parts distributors.

The NTE-618 is a varactor with a maximum capacitance near 400 pF. As a result, when the TUNING VOLTAGE is varied from 0 to +12 volts DC, the preamplifier will tune from a bit below 5 MHz to a bit more than 15 MHz. It will, therefore, cover the 5-MHz, 10-MHz, and 15-MHz WWV/WWVH signals. The ends of the tuning range are close to the desired minimum and maximum frequencies, so stray capacitances may prevent getting all three WWV/WWVH frequencies.

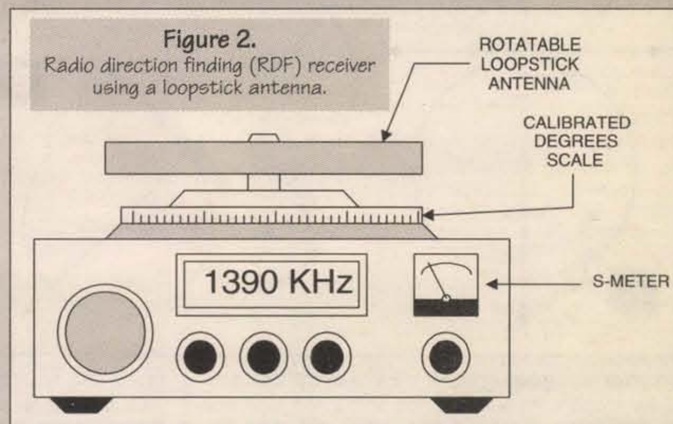

Figure 2.
Radio direction finding (RDF) receiver using a loopstick antenna.

In the prototype that I built in Joe's Basement Therapy Laboratory (where I go to let the wind outta my head), it worked from about 4.9 to 15.1 MHz.

The drain circuit of Q1 is coupled to the mixer stage to follow, or the receiver antenna input, by another transformer. You can either use one like T1, but reversed (the primary becomes the secondary), or use one of the Mini-Circuits Laboratories T-series transformers. The pinouts shown in Figure 1 reflect the T-612 transformer. You can get information about the RF transformers, plus anything else Mini-Circuits makes, by checking out their world wide web page (type "minicircuits" into your search engine).

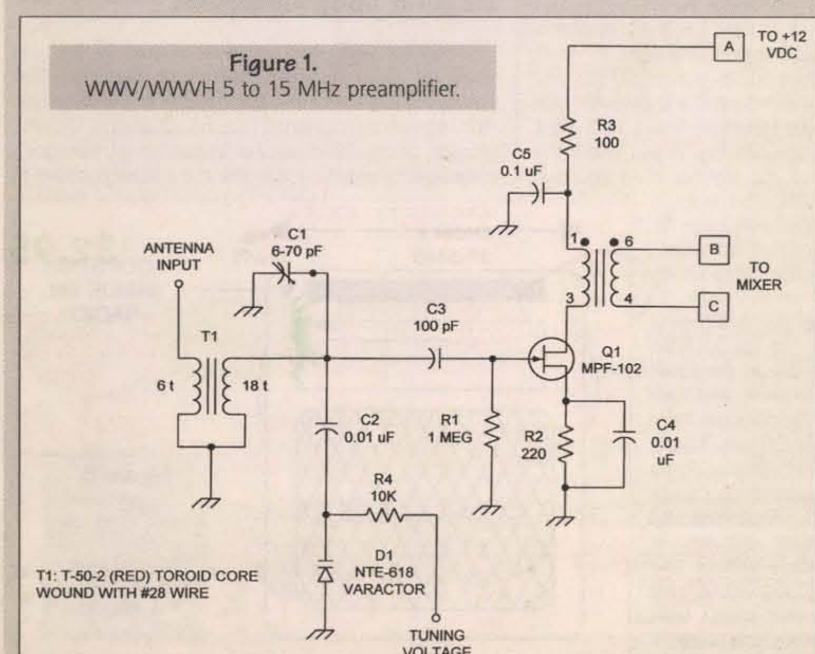

Figure 1.
WWV/WWVH 5 to 15 MHz preamplifier.

Radio Direction Finding

Radio direction finding is the art and practice of either locating your self or a radio station by using a directional antenna. When the FCC wants to locate an illegal station that is transmitting, they will use radio direction finders to triangulate the position. If they find the bearing from two stations they will locate the station at the intersection. However, there is a fair degree of ambiguity in the measurement. As a result, radio direction finders typically use three or more (hence "tri-angulate") sites. Each receiving site that can find the bearing to the station reduces the overall error.

At one time, aviators and seamen relied on radio direction finding. It is said that the Japanese air fleet that attacked Pearl Harbor, HI on December 7, 1941, homed in on a Honolulu AM radio station.

During the 1950s and early 1960s, AM radios came with two little "circled triangle" marks at the 640-KHz and 1040-KHz points on the dial. These were the "CONALRAD" frequencies that you could tune to in case of a nuclear attack (right before you kissed your butt goodbye, I suspect).

All other radio stations were off the air except the CONALRAD stations. The enemy was prevented from using these frequencies for RDF because the system used several stations that transmitted in a rapidly rotating pattern. No one station was on the air long enough to effect a "fix." The result was a wavering sound to the CONALRAD station (which we heard during tests) that would confuse any dirty, smelly bad guy who tried to DX his way into our cities with a load of nukes.

Radio direction finders based on the AM BCB looked a bit like Figure 2. A receiver with an S-meter (which measures signal strength) is equipped with a rotatable ferrite loopstick antenna to form the RDF unit. A degree scale around the perimeter of the antenna base could be oriented towards north so that the bearing could be read.

Loopstick antennas have a "figure-8" reception pattern (Figure 3A) with the maxima parallel to the loopstick rod and the minima off the ends of the rod. When the antenna is pointed at the signal, maximum reception strength is achieved. Unfortunately, the maxima are so broad that it is virtually impossible to find the true point on the compass dial where the signal peaks. The peak is too shallow for that purpose.

Fortunately, the minima are very sharp. You can get a good fix on the direction of the signal by pointing the minima toward the station. This point is found by rotating the antenna until the audio goes to zip or the S-meter dips to a minimum (Figure 3B).

The loopstick is a really neat way to do RDF ... except for one little problem: the darn thing is bidirectional. There are two minima because, after all, the pattern is a figure-8. You will get exactly the same

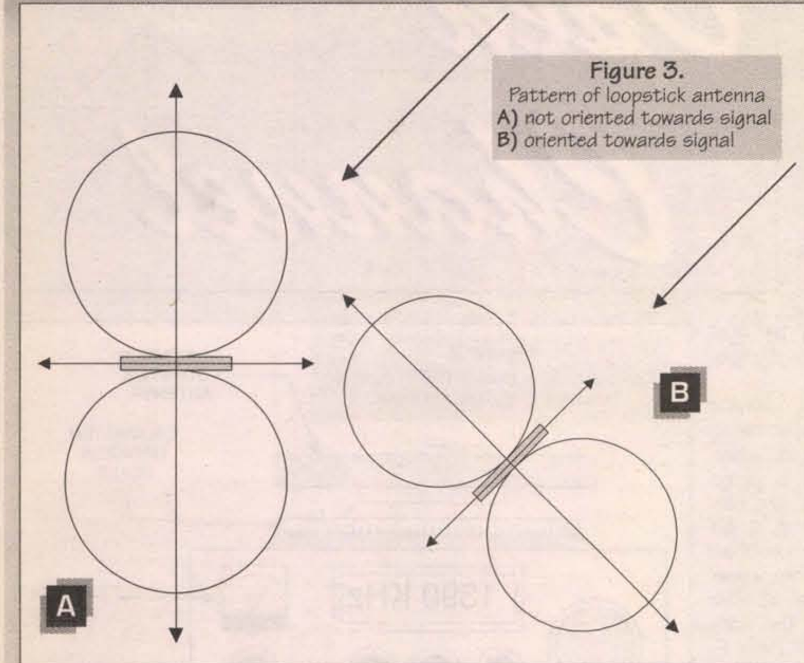

Figure 3.
Pattern of loopstick antenna
A) not oriented towards signal
B) oriented towards signal

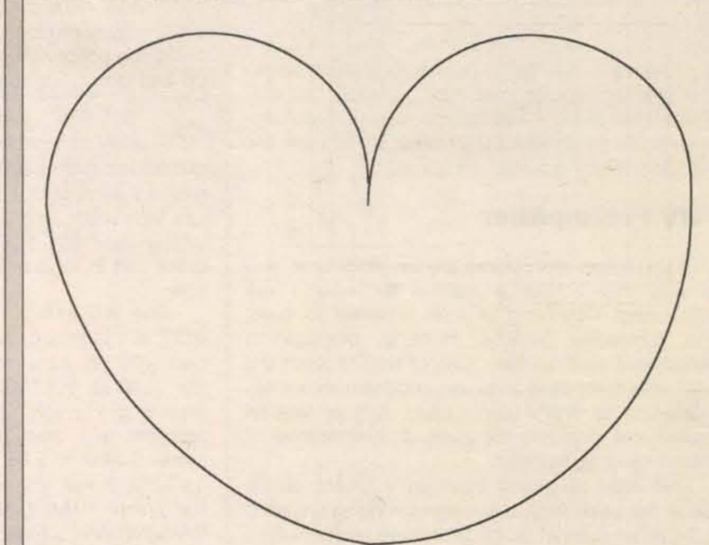

Figure 5.
Cardioid pattern of sense-plus-loopstick antennas.

response from placing either minima in the direction of the station. As a result, the unassisted loopstick can only show you a line along which the radio station is located, but can't tell you which direction it is. Sometimes this doesn't matter.

If you know the station is in a certain city, and that you are generally south of the city, and can distinguish the general direction from other clues, then the line of minimas of the loopstick will refine that information. A compass helps, of course.

Shortly, we will take a look at an impromptu radio direction finder using a portable radio.

The solution to the ambiguity problem is to add a sense antenna to the loopstick (Figure 4). The sense antenna is an omnidirectional vertical whip, and its signal is combined with that of the loopstick in an R-C phasing circuit. When the two patterns are combined, the resultant pattern will resemble Figure 5. This pattern is called a cardioid because of the "heart" shape it exhibits. This pattern has only one null, so it resolves the ambiguity of the loopstick used alone.

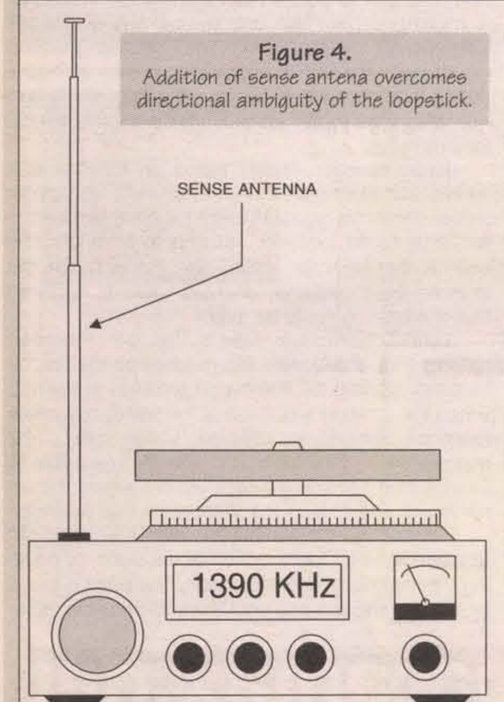

Figure 4.
Addition of sense antena overcomes directional ambiguity of the loopstick.

Field Improvisation

Let's suppose you are out in the woods trekking around the habitat of lions, tigers, and bears (plus a rattlesnake or two for good measure). Normally you find your way with a compass, a Geological Survey 7.5-minute topo map, and a Global Positioning System (GPS) receiver. Those little GPS marvels can give you real good latitude and longitude indication. But what happens if it breaks or a bear eats it? The answer to your direction finding problem might be the little portable AM BCB radio (Figure 6) that you brought along for company.

Open the back of the radio and find the loopstick antenna. You will need to know which axis it lays along. In the radio shown in Figure 6, the loopstick is along the top of the radio from left-to-right. In other radios, it is vertical from top-to-bottom. Once you know the direction, you can tune in a known AM station and orient the radio until you find a null. Your compass can give you the bearing. If you know the approximate location of the station, then you can reverse the compass direction from it and mark the line on the topo map. Of course, it's still a bidirectional indication, so all you know is the line along which you are lost.

But then you tune into a different station in a different city (or at least wide enough from the line to the other station to make a difference) and take another reading. Your approximate location is where the two lines cross. Take a third, fourth, and fifth reading and you will home in pretty tight. If you were smart enough to plan ahead, you will have selected candidate stations in advance and located their latitude and longitude. Alternatively, you would have bought the topo map that covers their location, as well as where you want to hike ... and from those maps you can find the latitudes and longitudes of the distant stations.

A fellow I met in a class told me of a situation that occurred when he was in Desert Storm. He was part of a communications battalion. They used GPS receivers to find their way. Unfortunately, the Army did not have enough of them for all hands, so many troops had their relatives send them receivers from home. I understand that a lot of Radio Shack, marine, outdoors, and aviation stores basically sold out of stock. That great high-pitched sucking sound was all of the nation's privately sold GPS receivers heading for Saudi Arabia. But Al's group didn't get enough for their troops. At a meeting of the officers and non-comms in a dusty tent, they lamented the lack of high-tech GPS gear. A grizzled old sergeant, who was probably left over from Verdun if not Gettysburg, offered a solution: "Let's do it like we used to ... teach 'em to read a damn map!"

Regular Loop Antennas

Regular wire loop antennas (Figure 7) are also used for radio direction finding. In fact, in some cases, the regular loop is preferred over the loopstick. The regular loop antenna may be square (as shown), circular, or any other regular "n-gon" (e.g., hexagon), although for practical reasons, the square is easier to

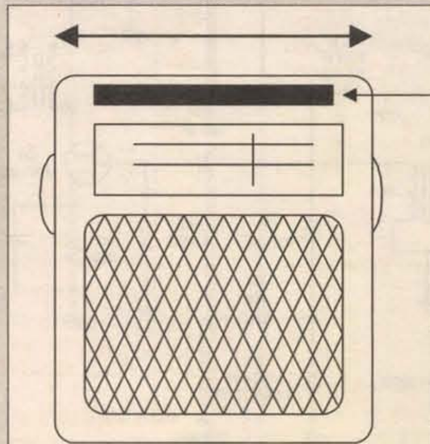

Figure 6.
AM portable radio. Dark bar represents position and direction of internal loopstick.

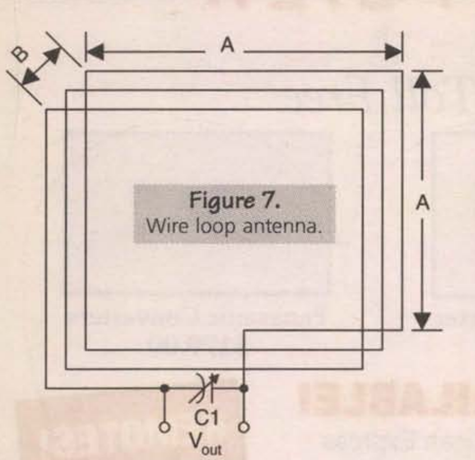

Figure 7. Wire loop antenna.

build. The loop has pretty decent inductance even with only a few turns. One loop I built was 24 inches square ("A" in Figure 7) and had, if I recall correctly, about 10 turns of wire spaced over a one-inch width ("B" in Figure 7). It resonated to the AM BCB with a standard 365-pF "broadcast" variable capacitor. I don't want to go too much into loop antennas here, but if you want more information then see my book *Joe Carr's Receiving Antenna Handbook* (see how shamelessly I plug my stuff??!!).

When you use a regular loop antenna be aware that the antenna has a figure-8 pattern like the loopstick, but it is oriented 90-degrees out of phase with the loopstick antenna. In the regular loop, minima (nulls) are perpendicular to the plane of the loop, while the maxima are off the sides. In Figure 7 the minima are in and out of the page, while the maxima are left and right (or top and bottom).

Fox Hunting

An activity popular with ham radio operators in the 1960s was Fox Hunting. A fiendishly clever ham would go hide with a mobile or portable transmitter (usually on either 10-meters or 75-meters). The "hunters" would then RDF his brief transmissions and try to locate the transmitter. If you could locate the antenna then you located the station (according to the most common set of rules). Sometimes the "hunt" got a little wild as guys raced each other (a no-no) in the final stretch.

One friend of mine had an interesting experience. He drove a 1949 Plymouth that was painted a hideous dark green with fire engine red hub caps. It looked just plain awful (especially since the paint looked like it was put on with a whisk broom!). He used a Gonset converter linked to the AM BCB receiver installed in the car. The antenna was a wire loop on the end of a broom handle, similar to Figure 8. The antenna was mounted about where you would expect the left-side rear view mirror to be located. He could reach his hand out the window and rotate the antenna while listening for the minima on the receiver. Worked rather well and he won some Fox Hunts.

The Fox Hunts in his area were usually held on Saturday or Sunday morning and, after it was all over, the whole crew would go to a restaurant for brunch or beer or something. One morning, however, my buddy with the hideous green car was racing down a residential area to be the first to the transmitter. Others were in the area, and the end game was in motion. Unfortunately, a little old lady called the police complaining about a "... nut racing up and down the street in a strange car waving a cross out the window." Breakfast had to wait that morning, I bet.

Some of those Fox Hunting guys were clever. I recall one incident where the guy brought along a wide-range antenna tuner, set up a 3875-KHz transmitter in the bushes alongside a railroad track, and then loaded up the rails as the antenna. It worked, but the signal was ambiguous. It seemed that darn rail radiated for a good long distance. In that case, the "fox" won and the hunt was called after time-out.

Another fellow took a similar tuner and loaded up the chain link fence around a factory site. That fence was several hundred yards on a side, and had a really strange radiation pattern. He was found, but not without a heckuva lot of difficulty.

Shortwave and AM BCB "Skip" RDF

Radio direction finding is most accurate over relatively short distances. If you can use the ground wave, then all the better (which is what you use during daylight hours for nearly all AM BCB stations). Skip rolls in on the AM BCB after local sundown, so you can hear all manner of stations all up and down the dial. You can RDF distant stations. Some rather interesting sites have turned up when SWL DXers RDFed some of the infamous "numbers stations." Those stations transmit either CW or voice numbers groups, and are believed to be sending messages to spies around the world. RDFing by DXers has located some of these transmitters at, well, "interesting" sites.

Unfortunately, there are some problems with skip RDFing. When we look at propagation drawings of skip in textbooks, we usually see a one-plane view. The curvature of the earth shows, as does the transmitter and receiver site. A "pencil beam" radio signal travels at some angle up the ionosphere, where it is "reflected" (actually, it's a refraction phenomenon, but looks like reflection to an observer on the surface) back to earth. We can tell from the drawing that the angle of incidence equals the angle of reflection, just like they told us in high school science classes. Oops! The real world is not so neat and crisp, however.

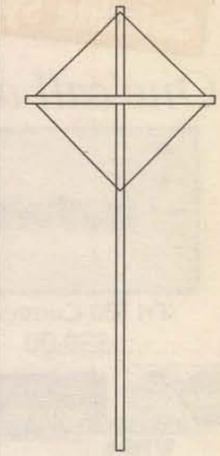

Figure 8. "... waving a cross out the window" antenna.

In the real world, the wave might encounter a different ionization density along its path of travel and therefore be deflected from its original path. It might return to earth at a location offset from the direction it appears. If we look at the true bearing from the receiver site to the transmitter site, and then note the azimuthal angle of arrival of the signal, we note that something is amiss.

Actual reflection also causes some problems, especially when RDFing a station in the high end of the HF band or the VHF/UHF bands. Radio waves will reflect from geological features such as mountains, as well as man-made structures (e.g., buildings). If the reflection is strong enough it might appear to be the real signal, and cause a severe error in RDFing. Be wary of RDF results when the "skip is in."

Conclusion

There is a lot more to radio direction finding. In the future, we will look at a few other methods that are more sophisticated than the crude methods shown in this article. Stay tuned ... if you can find me! **NV**

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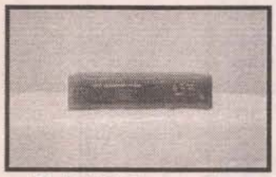
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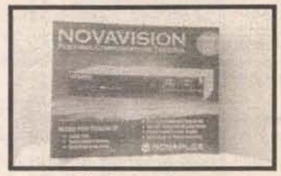

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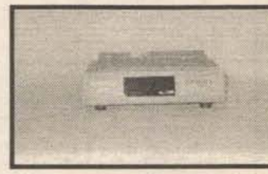
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Events CALENDAR

Continued from page 82

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JANUARY 9-10-11

WI - LA CROSSE - Super Computer Sale. La Crosse Civic Center. Blue Star Productions 612-788-1901. Web: http://www.supercomputersale.com

JANUARY 10

CO - LOVELAND - ARC Superfest. Larimer County Fairgrounds. 700 Railroad Ave. 9am-3pm. 970-352-5304

JANUARY 11

WI - WAUKESHA - ARRL Hamfest. Phil Gural W9NAW, 414-425-3649

JANUARY 16-17-18

MN - SHAKOPEE - Super Computer Sale. Canterbury Park. 1100 Canterbury Rd. Blue Star Productions 612-788-1901. Web: http://www.supercomputersale.com

JANUARY 17

LA - HAMMOND - Hamfest. Southeastern Louisiana Jack Stang N5XVJ. 504-542-7605.

MO - ST. JOSEPH - Hamfest. Ramada Inn. 9am-4pm. Jean Pearson KC0GB, PO Box 8547, St. Joseph, MO 64508

JANUARY 18

FL - ST. PETERSBURG - Hamfest. Jean Endicott KC4KZU. 813-525-5178

NY - YONKERS - Flea Market. Lincoln High School. Kneeland Ave. 9am-3pm. Otto Supliski WB2SLQ, 914-969-1053

VA - RICHMOND - ARRL Hamfest. Craig Spain KE4CIT, 804-526-9838. E-Mail: frostfest@rats.net Web: http://www.frostfest.rats.net

JANUARY 23-24-25

KS - WICHITA - Super Computer Sale. Century 2 Conv. Ctr. 225 W. Douglas. Blue Star Productions 612-788-1901. Web: http://www.supercomputersale.com

JANUARY 24

MO - ST. CHARLES - Hamfest. James E. Welby WB0ZJW. 6059 Sutherland, St. Louis, MO 63109-2247

JANUARY 25

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

MD - ODENTON - ARRL Hamfest. Odenton Vol. Fire Dept. Hall, 1425 Annapolis Rd. Bill Ziegler KA6TYY. 410-987-2384. E-Mail: ka6tyy@juno.com

OH - DOVER - ARRL Hamfest. OH Nat'l Guard Armory, 2800 No. Wooster Ave. 8am-1pm. Howard Blind KD8KF. 330-364-5258

TN - GALLATIN - Hamfest & Computer Show. Gallatin Civic Center. 8am-2pm. TN Valley Amateur Radio Network. Bill Ferrell N4SSB, 615-451-5992

JANUARY 30-31-FEBRUARY 1

WI - MADISON - Super Computer Sale. Dane Co. Expo Center. 1881 Expo Hall E., Blue Star Productions. 612-788-1901. Web: http://www.supercomputersale.com

JANUARY 31

AL - GREENVILLE - Hamfest. Bob W4MPQ. E-Mail: w4mpg@alaweb.com

JANUARY 31-FEBRUARY 1

MO - ST. CHARLES - Computer Show & Sale. St. Charles Exposition Hall, St. Charles Center, I-70 & 5th St. Sat: 10am-4pm, Sun: 11am-3pm. Computer Central Shows 888-296-6066. E-Mail: computershow.chicago@mcimail.com

FEBRUARY 1998

FEBRUARY 6-7-8

IL - PEORIA - Super Computer Sale. Peoria Civic Center. 201 S.W. Jefferson St. Blue Star Productions 612-788-1901. Web: http://www.supercomputersale.com

FEBRUARY 7

SC - NORTH CHARLESTON - APRL Hamfest. Jenny Myers WA4NGV, 803-747-2324

FEBRUARY 7-8

FL - MIAMI - Hamboree. Dade Co. Fair & Expo Center, SW 112th Ave. & Coral Way. Evelyn 305-642-4139. E-Mail: edg@elink.net Web: http://hamboree.org

FEBRUARY 13-14-15

IN - INDIANAPOLIS - IN Convention RCA Dome. 100 S. Capital. Blue Star Productions 612-788-1901. Web: http://www.supercomputersale.com

FEBRUARY 13-14

FL - ORLANDO - Northern Florida Section Convention. John P. Lenkerd W4DNU. 407-645-2026

FEBRUARY 14

MN - BLAINE - ARRL Hamfest. Susan Baker N0JND, 612-537-1722

FEBRUARY 20-21-22

KS - KANSAS CITY - Super Computer Sale. Overland Park Trade Ctr. 6800 W. 115th St. Blue Star Productions. 612-788-1901. Web: http://www.supercomputersale.com

FEBRUARY 21

NC - ELKIN - ARRL Hamfest. Jimmy Holbrook KB4GKI, 910-957-3820. E-Mail: jholbro363@aol.com

FEBRUARY 21-22

OH - CINCINNATI - Great Lakes Div. Convention. Bill Tittle KA8LAY. 513-661-1805

FEBRUARY 22

OH - CUYAHOGA FALLS - ARRL Hamfest. Dan Adkinson KC8CFJ. 330-923-9045

PA - PITTSBURGH - Hamfest. Steve Lane N3RNY, 412-341-1043. E-Mail: slane@sgi.net

FEBRUARY 27-28-29

CO - DENVER - Super Computer Sale. National Western Complex. 4655 Humboldt St. Blue Star Productions 612-788-1901. Web: http://www.supercomputersale.com

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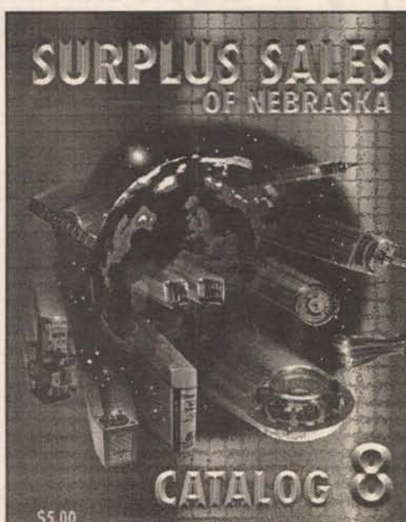

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MARCH 8

IN - INDIANAPOLIS - Hamfest. Brian Elliott N9JPX, 317-342-7236. E-Mail: belliott@surf-ici.com

NY - LINDENHURST - ARRL Hamfest. Walter Wenzel KA2RGI, 516-457-0218. E-Mail: Tom Carrubba: ka2d@li.net Web: http://www.li.net/~tomcar/hamfest.htm

WI - WAUKESHA - Hamfest. Mary J. Adams KB9IFF. 414-358-1003. E-Mail: mjadams@execpc.com

MARCH 13-14-15

NE - OMAHA - Super Computer Sale. Omaha Civic Auditorium. 1804 Capital Ave. Blue Star Productions 612-788-1901. Web: http://www.supercomputersale.com

MARCH 14

FL - SEBRING - ARRL Hamfest. Dennis Koranda KF4JTM. 941-382-9560. E-Mail: kf40strato.net

MARCH 15

OH - MAUMEE - ARRL Hamfest. Brenda Krukowski KB8IUP. 419-866-5928

MARCH 20-21-22

WI - WEST ALLIS - Super Computer Sale. WI State Fairgrounds. 8100 W. Greenfield Ave. Blue Star Productions 612-788-1901. Web: http://www.supercomputersale.com

MARCH 22

NC - KINSTON - ARRL Hamfest. Doug Burt W4OFO. 919-524-5724

MARCH 28

KY - ELIZABETHTOWN - ARRL Hamfest. Harold Bennett AF4AC. 502-351-9599. E-Mail: hbennett@bbtel.com

OR - EUGENE - ARRL Hamfest. John Brambora KB7SXS. 541-747-2898

MARCH 28-29

MD - TIMONIUM - Maryland State Convention. William Dobson N3WD. 410-HAM-FEST. E-Mail: gbhc@concentric.net Web: http://www.concentric.net/~gbhc

MARCH 29

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

APRIL 1998

APRIL 4

NC - MORGANTON - Hamfest. Thomas Taylor KC4QPR. 704-433-6205. E-Mail: kc4qpr@vistatech.net

PA - FREDERICKSBURG - ARRL Hamfest. Paul Felty WB3HEC. 717-566-2606

WA - VANCOUVER - ARRL Hamfest. Luther Brisky KC7KVL. 360-896-8909

APRIL 5

IA - DELOIT - Hamfest. John Amdor KD6MXL. 712-748-8162. E-Mail: johnmxl@netins.net Web: http://www.netins.net/showcase/johnmxl/deloit98.html

NC - RALEIGH - North Carolina State Convention. Wilbur Goss WD4RDT. 919-266-9335

WI - MADISON - ARRL Hamfest. Jeremy Charles N9VHT. 608-245-8890

APRIL 10-11

MS - TUPELO - ARRL Hamfest. Jack Ellis KI5QV. 601-842-7255

APRIL 18

MO - JOPLIN - ARRL Hamfest. Andy Gabbert KA0TUD. 417-673-8371. E-Mail: agabbertka0tud@hotmail.com

APRIL 19

MA - CAMBRIDGE - Hamfest. Steve Finberg W1GSL. Nick Altenbernd KA1MQX. 617-253-3776

APRIL 24-25

AR - LITTLE ROCK - Hamfest. Jim Blackmon KB5IFV. 501-246-6736. E-Mail: 1rhamfest@usa.net Web: http://www.aristotle.net/~n5xay/lrh98.html

APRIL 25

IA - DES MOINES - ARRL Hamfest. Ron Hobbs N0XWI. 515-255-4020

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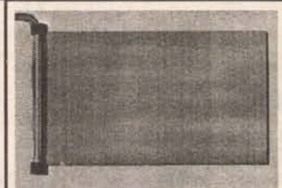

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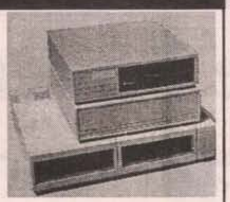

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Don Lancaster's

RESOURCE BIN

number seventy

Exploring PostScript PIC Flutterwumpers

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PostScript PIC Flutterwumpers

For quite a long time now, I've been really enthused by *Adobe's* PostScript computer language. I'll routinely use PostScript well beyond its printing and graphics capabilities. What I find really exciting is that with some brand new happenings, PostScript can now expand into *robotics.*

Specifically by getting low-end PIC microprocessors to speak PostScript!

PostScript and PICs working with each other might be a killer combo for ultra low-cost robotic apps. Especially with such things as re-using existing artwork, interfacing popular design programs, selecting fancy fonts, doing microsizing, tool path corrections, or exotic coordinate transformations.

And most of it is simple stuff that you can easily explore all by yourself. Opening up some mind-blowing new opportunities for you.

Others have been quietly extending and greatly improving on PostScript all along. PostScript now has total web friendliness, transparent video titling apps, document scan conversion, catalog indexing, interactive forms, internal font provisions, drivers that print anywhere, disability aides, and great heaping bunches more.

But the real biggie is that PostScript itself has recently gotten ridiculously easier to use and lots more fun for you to play with.

Getting Started with PostScript as Language

The easiest way to start exploring PostScript is by using a *host-based interpreter.* This is simply a program you run on your PC. You send the interpreter PostScript language code, and the interpreter carries out those commands for you.

NEXT MONTH:
Don takes another look into secrets of web-based research.

Usually with nothing but a simple drag-and-drop. There are normally three possible results from your PostScript code:

(A) You could generate a file that can be used to print or image or webify or CD-ROMify a graphic picture. Such pictures are fully device-independent, superbly high quality, and an industry-standard mix of actual images, text, line art, and fancy fonts.

(B) You can generate a simple log file that quickly gives you important answers directly on your screen.

(C) You can write an output data file to disk. Such an output file can have virtually *any* format you want it to. In most *any* language!

These output files can then be used for anything from taking over control of a computer to running a hot tub.

PostScript can similarly get taught to read and act upon just about any input file format you care to. Details are found in SIXCLICK.HTML.

There are two very popular host-based PostScript interpreters. The first and older is that freebie *GhostScript* shareware from *Aladdin Systems.* The second is the *Acrobat Distiller* that is part of the commercial *Adobe Acrobat* package. By using a student discount, Distiller is available for under $55.00.

Get Version 3.01 or higher.

Do not let the name mislead you. Acrobat Distiller is really a full-blown PostScript language interpreter that is easily and quickly applied for totally general-purpose computing.

When combined with a companion *Acrobat Exchange* viewer, you'll get everything important that genuine Display PostScript offers. Especially the ability to have source code and fast updating graphic results side-by-side on your screen at once.

Distiller also acts as "somewhat" of a compiler. In that it automatically reduces PostScript code into the bare minimum "just the facts ma'am" and fast running compressed .PDF format. For instance, an input PostScript proc may include very elaborate fill justify calculations or math-intensive plots. The output PDF format simply shows where to mark the pages or what final numeric data values to output.

Which PostScript interpreter is for you? My own preference is to always use the Acrobat Distiller. Distiller is faster, way easier to run, much better supported, is fully up-to-date, has only official bugs, and gives you more attractive final results. On the other hand, GhostScript is free and gives you better error reporting.

Two Examples

Let's look at two examples to get you started off using PostScript as a programming language. Assume you want to find the sine of 60 degrees. Punch this code into your favorite editor or word processor ...

```
%!
% find sine of 60 degrees
60 sin ==
```

... and then save it as either a .PS file or as an ordinary .TXT text file. Drag and drop this file into Distiller or GhostScript, and an output value of 0.866025 should promptly appear in the log window on screen.

We can see several things here. A PostScript file consists of an ordinary text file containing more or less plain English words and numbers. Other more compact file formats are also available for

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advanced users.

At a minimum, your file *must* start off with a "%!". To be formally legal, special *document structuring convention* comments are also strongly suggested for use in fancier projects.

Any line which starts with a "%" is treated as a comment. Thus, only the third line of your program actually does anything useful. This line places a numeric value of 60 onto an internal *stack*. A *sin* command then obeys the rule "take the value in degrees on the top of the stack, find its trigonometric sine, and replace the top stack value with this calculated result.

That odd "==" is shorthand for "intelligently print the top stack value to your log file."

Should the PostScript program also produce some graphic or printable output, you simply click on Exchange to view it on the screen. Your round trip edit-interpret-view time is typically well under 10 seconds and can be done in as little as six mouse clicks.

In PostScript, we have a powerful and quite modern general-purpose language that is *interpretive* (you tell it what to do ahead of time); is *stack-oriented* (everything goes on or off one or more stacks); *Polish structured* (you give it some values first, followed by your needed instructions that act on those values); is quite *object-oriented* (individual procs can be manipulated with uniformly predictable results); *threaded* (any command can call any other); *weakly typed* (most any data structure can get converted to any other); *re-entrant* (commands can call themselves); *dictionary intelligent* (the grouped key-value pairs play a big role); *re-definable* (you can add new commands or procs and change any existing ones); and *device-independent* (the same code runs on any host and controls any PostScript device of any quality level).

Let's look at a second and fancier app. Finding out who accesses your website when is a big deal these days. There's lots of fancy programs (such as *WebTrends*) which can give you all sorts of exotic plots and graphs. But only with horrendous use of memory and disk space.

PostScript can easily read and then interpret web log files. A no-cost 5K PostScript file can trivially extract log file data that the big programs may miss. Such as analyzing the loyalty of repeat visitors. Or maybe tracking the popularity of a brand new file as it moves up through the ranks.

The site analysis code is a tad too long to show you here. But you can grab examples of these programs as WEBSITAN1.PS or WEBLOGU2.PS off my www.tinaja.com/psutils.html — There's extensive documentation inside either file. All you have to do is rename your target and destination files for your own use.

There are dozens more PostScript as language examples where these two came from. Recapping, PostScript is now really fast, fun, and easy to use. You first create a text file, then drag and drop it into Distiller, and then you optionally view it with Exchange reading any file format, or creating any new file format, or generating graphics.

Robotic Flutterwumpers

What does all this have to do with robots? Let's backtrack a tad. I like to call a *flutterwumper* anything robotic that moves and either chomps or spits.

Printed circuit drills, sign routers, engravers, silkscreen cutters, *Santa Claus* set-ups, or animation stands are typical examples.

The basics of flutterwumpers are shown in FLUTWUMP.PDF.

Let's say you decide to build a custom 2-1/2 D flutterwumper. One that has independent X and Y motions in small steps, but only allows a gross "tool up" or "tool down" in your Z direction. Let us further assume that fonts play an important role and that you want to access large libraries of existing symbol icons or whatever, as well as use standard CAD, *Mathlab, or Illustrator* design software.

A PIC or two is the obvious choice to handle all your low-level custom flutterwumper controllers. But how on earth can you get it to do the fancy stuff while still remaining both low in cost and elegantly simple?

Your secret lies in the interactions between ...

Flutfiles and PICs

For some strange reason, I seem to be having some difficulties burning a full PostScript version 2019 interpreter into the 12C508 baby PIC. Mostly, if I did so, it just wouldn't be very fair to Motorola or Intel.

Let's instead *partition* the problem. Let host PostScript software do the sort of things it is really good at. Let a small and low-cost PIC do all your flutterwumper stepper controlling. And let's dream up some way that PostScript can talk to PICs and that PICs can talk back to PostScript.

We have two obvious choices here that certainly should work. *Hewlett Packard* has long had its HPGL plotter language. And there's the *Gerber File Format* used on fancier photoplotters. Either of these will work just fine. But they might end up gross overkill for a low-cost flutterwumper. And either will tie up a substantial part of your PIC's resources.

Instead, let's get elegantly simple. Let's create a new ultra simple meta language. One that's PIC optimized on one end and PostScript optimized on the other.

I'll call this one a *flutfile*.

We will limit our new language to ordinary printing ASCII characters and carriage returns in a plain old textfile. We will use the rule of *one character per action.* Now, this might seem slow and cumbersome, but you usually have more than enough time available on any mechanical motion flutterwumper. And the economics are stunning.

On a 2-1/2 D flutterwumper, there will only be eight possible horizontal actions. You can go one step positive or negative in directions of X, Y, or both at the same time.

So, let the ASCII numeral 0 be east; 1 be northeast; 2 be north. And so on around to a 7 at southeast. To round out your commands, add a U for up, a D for down, and an H for home. And maybe a few initializing, debug, and repeat commands.

All your PIC has to do is receive a dozen or so serial ASCII characters and then act upon them. For instance, command "0" causes one full step in the positive X direction. Command "1" moves both the X and Y steppers one full step. For max smoothness, your individual partial steps between X and Y can get *interleaved*. Command "2" moves Y only, and so on.

Now all that PostScript has to do is accept programming commands and generate a meta file which is a lot easier than it sounds. I've got lots of ready-to-run code for you.

Let me briefly outline the PS to flutfile process: The Distiller normally reduces all wanted motions to *moveto* positioning, *lineto* straight line paths, *curveto* curved path generation, and *closepath* operators. We then eliminate any curveto's with use of PostScript's *flattenpath* command.

Since any command in PostScript can be re-defined at any time for any reason, your remaining stock *moveto* and *lineto* commands are intercepted and *replaced* with your custom code. Among other tasks, this custom code does vector-to-step conversion at the exact resolution needed by your PIC and saves it in a flutfile format.

Detailed flutfile conversion tutorial examples appear in POSTFLUT.PDF FLUTOOLS.PS, FLUTDEMO.PDF, and VECTSTEP.PDF on my website.

Included are specific programming details on how you handle boxes, circles, and fancy font characters. You can use these as preliminary test files for your own PIC design.

How it Works

Here's a summary of how to bring PostScript to any PIC robotic: Install Acrobat Distiller and Exchange 3.01 or better on your host PC. Find suitable project material from CAD programs that provide a PostScript output, from *Illustrator*, or by fun writing your own raw PostScript like I always do.

Use Distiller and a custom software module to convert your pattern files into flutfiles, the simple step-by-step commands that a low-end PIC can understand and easily deal with. Such magic tricks as tool path adjusting or fancy coordinate transforms could also be included in this step.

Save your flutfile as an ordinary textfile. Gather up this flutfile with a comm program or whatever and send it to your PIC. Obviously, the flutfiles can be saved for reuse, broken up into module libraries, get web distributed, or combined into projects.

Suitable handshaking takes care of machine busy times. This two-step process thus brings PostScript to your PICs simply, cheaply, and elegantly.

For More Help

That Adobe "red" book *(PostScript Reference Manual)* and their Adobe "blue" book *(the PostScript Tutorial & Cookbook)* are your standard starting points to learn and love PostScript. These could get combined with my *PostScript Beginner Stuff* coursework or the *Whole Works* package that lets you get into PostScript all at once and really big-time. Refer to my nearby *Synergetics* ad for details.

Lots more info on exactly how to bring PostScript to PICs appears in the previously noted files on my website. For bunches more background, also check the *PostScript, Acrobat, PIC,* and *Flutterwumper* library shelves found at www.tinaja.com — More on the PICs themselves from manufacturer *Microchip Technology*, from *Parallax*, and from *Scott Edwards Electronics*.

Some 600+ annotated hot links to useful PIC sites appear at www.tinaja.com/pic500.html and also in www.tinaja.com/picwb01.html — More on those briefly mentioned PostScript transparent video apps by way of www.videonics.com — and, of course, lots more on PostScript and Acrobat at their www.adobe.com

More technical help, *InfoPacks*, full consulting, custom programming, or development is available by E-Mailing me through don@tinaja.com

This Month's Contest

For our contest this month, just tell me what you would do with your PostScript speaking PIC. Especially one of the new minidip baby PICs.

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

Send all your *written* entries to me here at *Synergetics*, rather than to *Nuts & Volts* editorial. **NV**

*Microcomputer pioneer and guru Don Lancaster is the author of 33 books and countless tech articles. Don maintains his no-charge US tech helpline found at **(520) 428-4073**, besides offering all of his own books, reprints, and consulting services. Don also offers a free catalog full of his unique products and resource secrets. The best calling times are 8-5 on weekdays, Mountain Standard Time.*

*Don is in the process of setting up his Guru's Lair at **http://www.tinaja.com***

*Full reprints and preprints of all Don's columns and ongoing tech support appear here. You can reach Don at Synergetics, Box 809, Thatcher, AZ 85552. Or send any messages to his US Internet address of **don@tinaja.com***

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Continued from page 5

Dear Nuts & Volts:

I found the article "Juju! Disk Fiksing!" Sept. '97 somewhat elementry. I'm very experienced in having floppy disk problems. It's more than just cleaning the disk to get it to work, you need to move the bad sectors.

This is my big secret on how to retrieve data from a corrupt disk:

The first thing I do when a disk is not reading is run Norton Disk doctor (Win 95), or fsck (Linux), or some program similiar to this (not clean the disk).

When you diagnose the floppy disk with Norton, it will check each sector of the disk until it gets to a bad sector. NDD (Norton Disk doctor) will usually attempt to move the data on this bad sector to a clean sector.

The disk will work if you have space for the bad sector. But what if you don't have room on the disk to move the bad sector because you made a ZIP or ARJ disk set? You can't delete the file on the disk because there is only one file.

Run NDD, and take note when NDD says where the bad sectors are in the disk.

You need to find a program that will split a file into two and run this program on the ZIP or ARJ file in the disk. I usually use gnu split from Linux, but recompiled it for DOS.

Try to split the file with all the bad sectors on one file. Now copy the file from the disk that supposedley does not have the bad sectors to your hard drive. Now delete the file that you just copied from the disk and run NDD. You will now have free space to move those bad sectors. Once the second part of the file is readable, you can copy it to your hard drive and re-combine it with the other half of the file. Now copy the file to a brand new disk. The new disk is just like your old disk except that it's not corrupt.

AGENT

Dear Nuts & Volts:

The Sept. '97 issue was great. I really liked the articles about how to fix floppies that went bad, data encryption, Windows 95 advanced techniques, how to use Stamp applications written for the common man, and the Resource Bin. The rest was pretty good too. You're the best!

William Keene
Rawlins, WY

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ELECTRONICS Q & A

With TJ Byers

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

What's Up:

Where to buy servos and solar panels. More on taking your modem on the road; includes a phone line tester circuit. A discussion of monster cables for audiophiles, and digging for earth worms without a shovel. How to build a 9-pin to 15-pin monitor adapter, and how to plug 30-pin SIMMs into a 72-pin slot, plus more talk about free telephone power.

Seeking Servos

Q. I saw your Simple Servo Controller in the Aug. '97 issue, and would like to experiment with these fascinating devices. However, I'm unable to find where to buy servo motors, not even in any of the electronic parts magazines. So where do you find them?

Robert J. Covert
Crescent City, CA

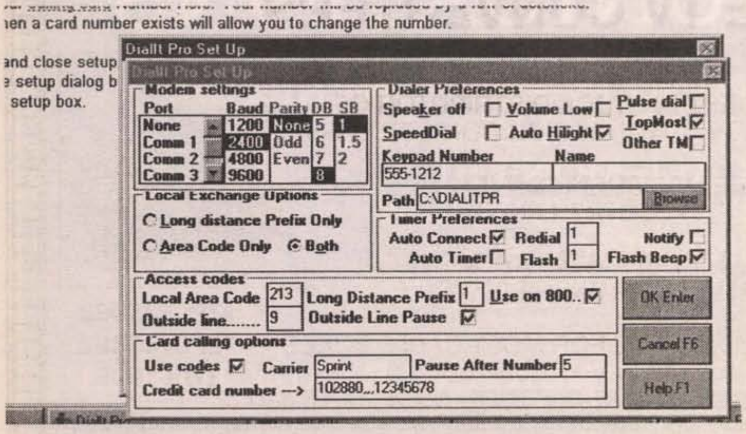
A. You can buy them at just about any hobby shop that deals in radio-controlled (RC) model planes, boats, or cars. The prices range from $10.00 to $65.00, depending on the size and torque. You can buy them via mail order, too. Tower Hobbies (217-398-3636; http36;http://www.tower lobbies.com/index.html) stocks a large selection of servo motors at the best prices in town. Servos are also used extensively in robotics to move limbs and steer the monsters. One of our advertisers, Lynxmotion (309-382-1816; http://www.lynxmotion.com), sells the popular Hitec HS-300 for just $15.00 each, or $80.00 for a six pack. Have fun!

Road Warrior Needs Dial Tone

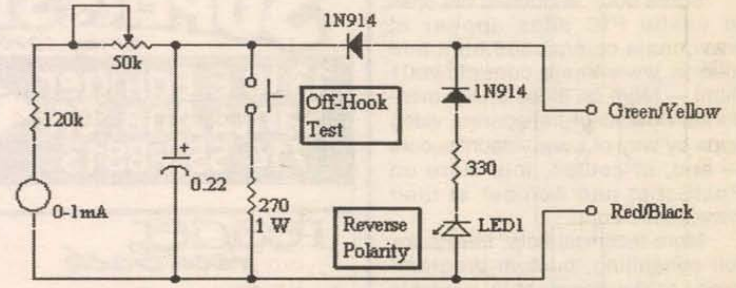
Q. Your explanation in the May '97 issue on dialing from a motel was well done, but I have two additional questions on the subject. First, how can I use my long distance calling card, which requires responding to prompts at specific times. Second, I've seen devices which are supposed to protect against modem damage if the modem is connected to the wrong kind of phone system. How do the devices work, are they needed, and how can I identify which phone systems might cause damage? Can I construct such a device?

Mike Roe
via Internet

A. That's five questions, Mike, but who's counting? In response to your first question, about your long-distance calling card, I'd use a software dialer that supports calling cards, like Dial-It Pro. You can find this program on our Web site (http://www.nutsvolts.com) under the title DIAL.ZIP.



This shareware program lets you dial the phone from virtually any Windows application. In your case, what you want to do is enter a string of numbers and pauses in an order that will access your service's dial tone. (Pauses are created by inserting commas between digits; each comma represents a two-second delay.) Once you hear the dial tone, simply run your communications software as usual (have it ready first, or you'll lose the dial tone) and let it do its thing with the modem. To run Dial-It, you need to have a file called VBRUN300.DLL (included in DIAL.ZIP) present in the C:\WINDOWS directory. In response to your next series of questions, phone line testers abound in retail outlets like Radio Shack and larger hardware stores. Unfortunately, most are simple LED devices that test only for correct polarity. Here's a circuit that actually lets you see what the voltages on the phone line look like before you plug in your modem.



Basically, this is an analog voltmeter that monitors both the line and ringer voltages. It identifies the line polarity, too, via the steering diodes. When the polarity is reversed, the LED lights and the meter registers nothing. When connected to a line of the correct polarity, the meter should read 48 to 52 volts. Pressing the Off-Hook Test button should drop the line voltage to 10 volts. If not, don't plug in your modem. When the phone rings, the diodes rectify the AC voltage, which should read between 40 and 90 volts, and the LED flashes. The circuit is built around a 0-1 mA analog meter, such as the Radio Shack 270-1754. In fact, this meter is the perfect choice because the scale reads from 0 to 15, which can be calibrated to represent 0 to 150 volts by adjusting the 50K pot, and the price is right. There are several ways to calibrate the meter. The best way is to measure the voltage of a good phone line with a DMM and adjust the meter to read the same value.

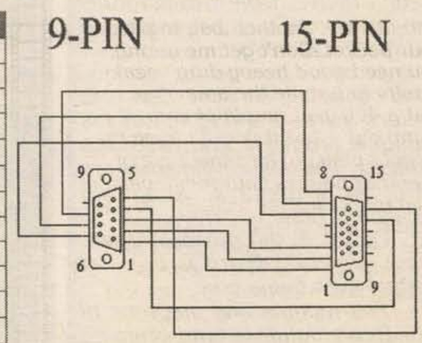
9-Pin To 15-Pin SVGA Adapter

Q. I have an AST Vision 4i monitor that has no video cable. It's SVGA, but the port on the back is 9 pin, not the standard 15 pins. I could make a cable if I knew the pinouts but I have no documentation. Can you help?

John Covington
via Internet

A. I've answered this question so many times that it's starting to become a staple. So I'm gonna post the schematic on our Web site under the name SVGA9PIN.BMP. This file is in BMP format that you can view with Windows Paint. Meanwhile, here's what you're looking for.

15-Pin	9-Pin	Description
1	1	Red gun
2	2	Green gun
3	3	Blue gun
4	--	Monitor ID bit 2
5	--	no connection
6	6	GND (red return)
7	7	GND (green return)
8	8	GND (blue return)
9	--	no connection
10	--	GND
11	--	Monitor ID bit 0
12	--	Monitor ID bit 1
13	4	Horizontal sync
14	5	Vertical sync
15	--	no connection



Oh yeah, don't forget to flip the monitor's MODE switch from TTL to ana-

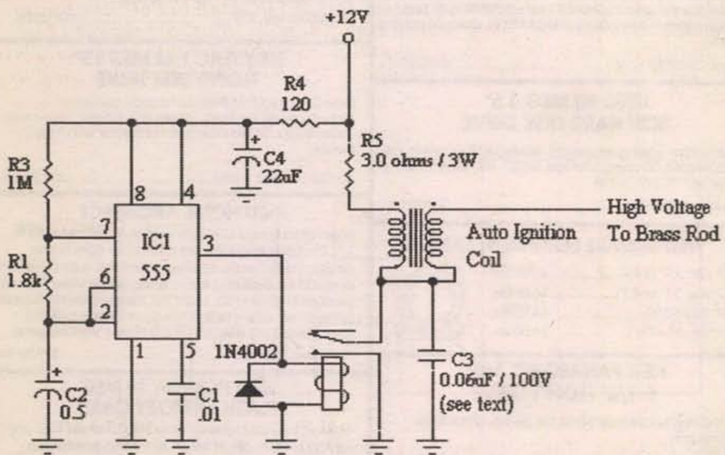
log when using it with an SVGA card.

Worm Chaser

Q. My question is about the "Battery-Powered Fence Charger" in the Aug. '97 issue. I may be dumb, but I can't locate capacitor C1 in the drawing. Anyway, I built the device and it doesn't work. Is it because C1 is missing? I would like to use the zapper to collect fishing worms by chasing the critters out of the ground with a high-voltage jolt. Would one brass rod in the ground work or do I need two of them?

Terry Crowe
Woodruff, SC

A. *Well, you're not dumb or blind. C1, the 0.01 uF capacitor coming off pin 5, isn't labeled, but the circuit will work without it. The text reference to C1 is actually talking about C2 (0.5 uF). My guess is that Q1 has died. Since you're going to be drawing a lot of current from this coil to chase worms, I'd replace Q1 with a relay, as shown below.*



If it still doesn't work, I suspect that C3 isn't matched to the coil or it's defective. In answer to your second question, yes you have to have two rods in the ground. Although I've never tried this, I hear it works quite well – but only if the soil is moist, and not too wet. It doesn't work in dry earth, so you'll have to experiment with moisture and the rod spacing. I hope you catch a big one!

Monster Cables

Q. Every part of my stereo has been upgraded – except the speaker wires. They're still the thin plastic wires that came with the original system. I'm ready to take the final plunge, but I'm confused about this last upgrade. Can you explain the difference between monster cables and Litz wire, and which I should choose?

Sam Goldmann
Sylmar, CA

A. *Some purist will tell you that the speaker cable can make or break a stereo system. That's rubbish. It's just another way to pick your pocket. Don't get me wrong, you need good heavy-duty speaker wire to handle the amperage that a 400-watt amplifier can pump out – but it doesn't have to be gold plated! The same type of wire that powers your microwave oven works just as well. But to answer your question, the difference between monster cables and Litz wire is the way the wire is constructed. Contrary to common belief, electricity doesn't flow through a conductor. Instead it flows on the surface of the wire. The amount of current penetration depends on the frequency. At 60 Hz, 90% of the current flows through 10% of the outside layer of a solid wire. The core of the wire sees virtually no current. This is why stranded wire is preferred to solid – greater surface area! Litz wire differs from regular stranded wire in that each strand is insulated to maximize the surface area. When to use Litz and when not to depends on the frequency. The skin effect (electrons flowing on the surface of the conductor) doesn't really make a difference until the frequency exceeds 1 MHz. As the frequency goes higher, the more the skin effect, which is why microwave conductors are hollow lengths of tubing called waveguides. Starting to get the message? (This is a very superficial discussion – only skin deep. For more details you need to understand wave theory, but I'll save that for another column.) So, if you're wiring a subwoofer, forget Litz and the gold plate. What you need is heavy-duty stranded wire, like lamp cord. Okay, audiophiles, I'm ready for your flack. My only qualification is that you have to prove I'm wrong with real numbers, not your subjective "Golden Ears."*

(Continued on page 109)

Reader's Tip: Hard Disk Recovery Routine

In the Sept. '97 issue, you responded to a reader with a hard disk that had frozen out FDISK. The cause of the problem is that FDISK cannot recognize the format of the disk, and therefore can't operate on the Master Partition Table. You suggested using a Seagate utility that does a medium-level format. I've written a simple Debug routine (just five instructions) to solve the same symptom that your readers might find useful. This routine wipes out Sector 1 (writes all zeros), Cylinder 0, Head 0, which makes the drive look like an unformatted drive to FDISK. To run this routine, boot the system from a floppy that contains DEBUG, FDISK, and FORMAT. At the DOS prompt, type "debug" and enter the following sequence (enter the capitols only, not the lower-case comments). Press the Enter key at the end of each line.

```
A              ;debug assemble command
MOV AX,0301    ;write one sector (512 bytes)
MOV BX,0020    ;data address ds:0020 (all zeros)
MOV CX,0001    ;set cyl 0 and sect 1
MOV DX,0080    ;head 0 and physical drive 0 (0081 sets drive 1)
INT 13         ;execute interrupt 13
[enter]        ;assemble and return to debug prompt
G=100 10E      ;go do it
```

WARNING: *This program will wipe out ALL data on the hard drive* – data will now be forever lost and totally unrecoverable. It doesn't ask if you really want to do it – it just happens. So be absolutely sure this is what you want before you press that final Enter. I've recovered drives from used and surplus machines using this routine, even though I was told the drives couldn't be formatted. I hope this trick helps someone else, too.

Don Pomeroy
via Internet

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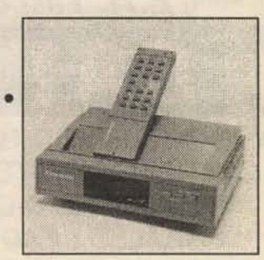
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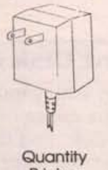

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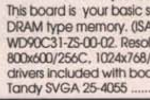

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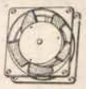

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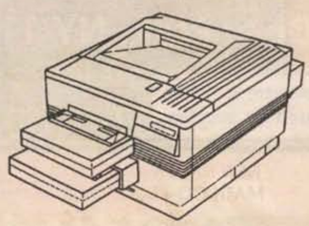

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EX JUMBO HOPPER

Chenesko Products, Inc. announces the addition to their product line of a new EX Jumbo Hopper, which fits all standard HP OEM EX toner cartridges increasing capacity up to 600 grams of toner.

The new EX Jumbo Hopper is designed to fit and expand the toner capacity of the three standard HP EX toner cartridges — Models C-3973A; 92298A; and the new 92298X. The resulting Jumbo EX Cartridge will fit into both the HP LaserJet 4 & 5 series of printers.

For more information, contact:

CHENESKO PRODUCTS, INC.
2221 FIFTH AVE., STE. 4
DEPARTMENT NV
RONKONKOMA, NY 11779
516-467-3205 1-800-221-3516

R11 TEST RECEIVER

Optoelectronics, Inc. announces the new R11 nearfield FM test receiver. The R11 sweeps from 30MHz-2GHz in less than one second locking onto the strongest signal in the nearfield, up to 600 feet away with a 5-watt UHF transmitter. Once the R11 locks onto a signal, the FM audio is demodulated through its built-in speaker allowing the user to monitor that transmission.

The R11 incorporates 10 LEDs on the front panel as a way of indicating the general frequency range of the captured signal. Each LED has a specific numerical value with each representing a particular frequency. Another new feature to the R11 is its ability to lock out up to 1,000 unwanted frequencies like, FM stations, TV stations, paging towers, etc. Using a specific power-up sequence, an approximate number of lockouts in memory will be indicated by the illumination of one of the LEDs with numerical values. The R11 also incorporates a hold feature so that a frequency can be monitored until the sweep function is enabled.

Another unique feature of the R11 is its ability to interface with the Optoelectronics Scout Frequency Recorder for Reaction Tuning. Both the R11 and Scout have CI-5 interface jacks which allow a 2.5 mm mono cable to connect the two so the Scout may Reaction Tune the R11 to the frequency it captures. All versions of the Scout can Reaction Tune the R11. In addition to Reaction Tuning, the Scout may also Memory Tune the R11 by recalling any one of its possible 400 frequencies in memory.

The retail price of the R11 test receiver is $399.00.

At the time of this release the R11 Test Receiver had not been approved for sale by the FCC.

For more information, contact:

OPTOELECTRONICS, INC.
5821 N.E. 14TH AVE., DEPT. NV
FT. LAUDERDALE, FL 33334
954-771-2050 FAX: 954-771-2052
1-800-327-5912
E-MAIL:
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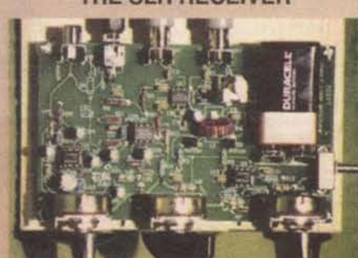
THE SLR RECEIVER



Jade products, Inc. announces its first receiver kit, The SLR Receiver. Designed by N1BYT, this Shielded Loop Receiver is a revolutionary approach to small receiver design.

The receiver is small; all of the circuitry is contained on a single 3" x 5" PC board. The accompanying indoor antenna stands about one-foot tall.

The kit comes in two flavors. The SLR-40 can be configured for either the 30M or 40M bands. The SLR-80 is for the 80M band. The kit comes complete and the detailed manual simplifies assembly. All you need is a nine-volt battery and headphones, or a small speaker. The receiver can be mounted in an enclosure or on a small piece of wood. It does not have to be shielded.

The receiver tunes the entire 30M band, about 250 KHz of the 40M band and about 140 KHz of the 80M band. It can detect a 0.1 µV signal. Current drain is less than 10 mA with moderate headphone volume, using a nine-volt battery.

To order the kit from Jade Products, Inc. please specify which model, SLR-40 or SLR-80. The kit cost $95.00 plus $6.50 S & H.

For more information, contact:

JADE PRODUCTS, INC.
P.O. BOX 368, DEPT. NV
EAST HAMPSTEAD, NH 03826
1-800-JADEPRO
FAX: 603-329-4499
E-MAIL: jadepro@jadeprod.com
WEB: http://www.jadeprod.com/

TECHTOYZ MICRO COUNTER

Optoelectronics, Inc. announces the second product to be released under the new Techtoyz name, the Micro Counter.

The Micro Counter is housed in a pager-style case making portable operation easy and convenient. Just clip the counter on your belt or put in in your pants pocket or jacket pocket.

With a frequency range of 10 MHz to 1.2 GHz, the Micro Counter can lock onto a 5 watt UHF radio from as far away as 125 feet using the optional TMC100 rubber duck antenna. With an initial accuracy of 1 ppm and a sensitivity level of <5 mV, the Micro Counter is ideal for testing radios in the shop or in the field. In addition, there are three selectable gate times for increased resolution of the frequencies captured.

The Micro Counter has four modes of operation: normal, filter, recall, and our patented digital auto capture. Once a frequency has been captured, it will be logged into one of three memories for later recall.

The new Techtoyz Micro Counter retails for $99.00. The optional TMC100 antenna retails for $9.00.

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PC HF FACSIMILE 8.0 FOR WINDOWS

SSC announces the release of PC HF Facsimile 8.0 for Windows. PC HF Facsimile 8.0 allows users of Windows PCs to receive wefax charts, weather satellite photographs, radio teletype, NAVTEX, FEC, SITOR, ASCII, and Morse code digital news, and weather broadcasts.

By connecting the package's demodulator between the computer's serial port and a single side band shortwave communications receiver, digital radio transmissions can be received, displayed, printed, or recorded on disk.

SSCs new Windows FSK demodulator allows the program to operate in the background while the operator is performing other tasks under Windows.

The package is ideal for

mariners, aviators, agriculture, and weather enthusiasts.

The package includes image and text decoding software, a miniature demodulator, tutorial audio cassette, comprehensive manual, world wide frequency list, and broadcast schedules. System requirements are: Window 3.1x, Windows 95, or Windows NT, 8 MB RAM memory (4 MB under Windows 3.1x), 6 MB hard disk space.

Suggested retail price is $179.95.

For more information, contact:

SSC
615 S. EL CAMINO REAL
DEPARTMENT NV
SAN CLEMENTE, CA 92672
714-498-5784

IC-T7AHP TRANSCEIVER

Available immediately, ICOM's IC-T7AHP dual-band (two meter/440 MHz) handheld transceiver now comes standard with a BP-173 battery pack enabling it to have four watts of output power. Coupled with its other features, the IC-T7AHP offers hams a "high powered" compact handheld with VHF and UHF capability.

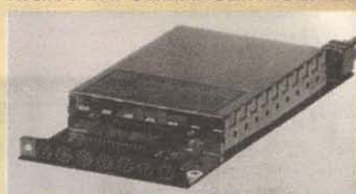
With a height of about four inches, the palm size IC-T7AHP is designed for both convenience and easy operation. The keypad is well spaced and comes with a "thumb touch" lock-switch and "single push action" feature selection (no function key). Changing bands may be achieved by simply depressing the band key to toggle between two meters and 440MHz.

Storing up to 70 channels in any combination of VHF or UHF frequencies, this handheld has nine DTMF (dual-tone multifrequency) memories for auto dialing. The IC-T7AHP also provides 50 separate encode and decode frequencies, as well as a tone scan function for easy subaudible tone selection.

For more information, contact:

ICOM AMERICA, INC.
2380 116TH AVE., N.E. DEPT. NV
BELLEVUE, WA 98004
425-454-8155 FAX: 425-454-1509
http://www.icomamerica.com

HIGH-PERFORMANCE RECEIVER



Neulink introduces the DCL-VHF-RX high-performance, synthesized, digital receivers operating in the 153 MHz to 173 MHz and 450-470 MHz bands, respectively.

They are currently being used in the National Emergency Alert Systems and Law Enforcements applications.

The receivers support digital data, and have excellent audio output that outperforms many high-end commercial radios.

The band spread is 10 MHz in the 153/174 MHz, and the receivers can be tuned to any frequency in the selected band.

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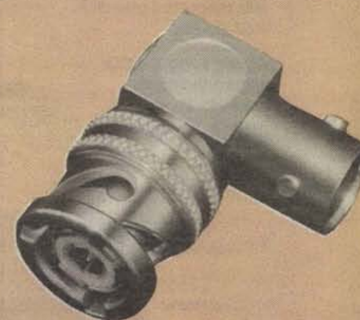

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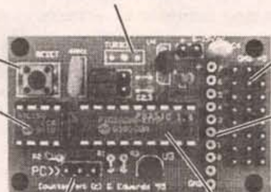

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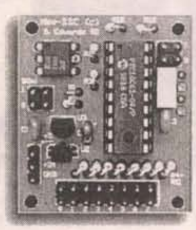

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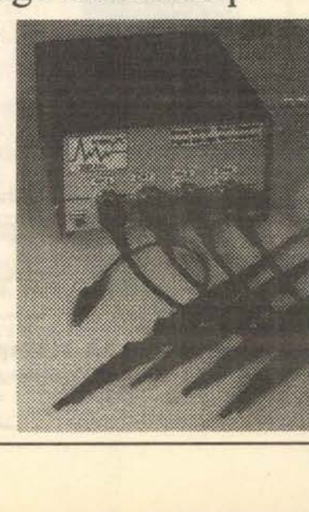

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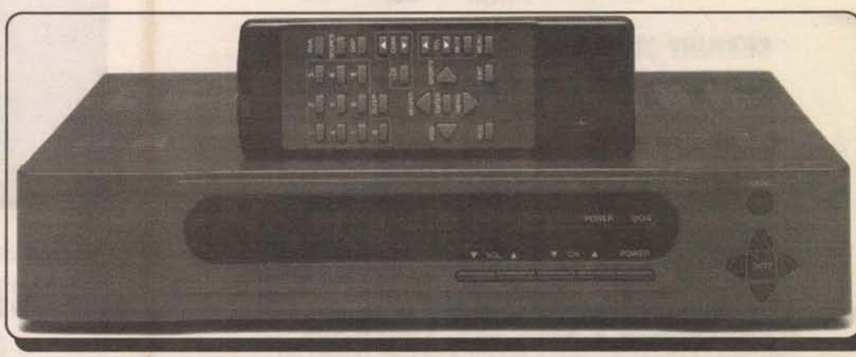

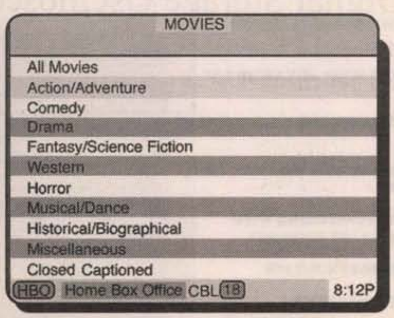

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AMATEUR ROBOTICS

by Karl Lunt

Fire in the Home!

The 1998 Trinity College Fire-Fighting Home Robot Contest takes place April 18 and 19, on the Trinity College campus in Hartford, CT. The contest's home page at www.trincoll.edu/~robot claims "this is the largest, public, true Robotics competition held in the US that is open to entrants of any age, ability, or experience from anywhere in the world." Be that as it may, the contest offers a serious robotics challenge, so I figured I'd give it a shot.

Briefly stated, your robot must move through a mock floor-plan of a house, locate a fire (actually, a lit candle), and extinguish the flame. Bonuses and penalties are applied, as necessary, to arrive at an operating score for each of three runs. The lowest operating score on the two best runs serves as the robot's overall score, and the lowest overall score wins the contest.

Note, however, that it is not enough just to put the robot on the floor and hope for the best. Your robot must find the candle and put out the flame in at least two runs just to qualify for a prize; any run in which your robot fails to put out the flame isn't counted for scoring.

The contest rules include several penalties that will further separate the very best machines from the rest of the herd. Touching a wall, with either the robot body or a feeler, gets your machine an immediate five-point penalty for each occurrence. Run a feeler along the wall ... that'll cost your machine one point per inch traveled, plus the contact penalty. And touching the candle means a fast 50 extra points slapped on your robot's time score.

As for positive reinforcement, the contest format rewards those robot designers who put in the extra effort. If your robot starts its run based on a sound signal supplied by the referee, it gets 5% off of its time score. Putting out the flame, then returning to the starting point nets a 10% reduction. If your robot does its thing with furniture (actually, yellow steel cylinders) in each room, it nets a 30% bonus. And any robot that puts out the candle on all three runs gets an additional 10% off of its best score.

This is not an exhaustive list of the penalties and bonuses; get a copy of the rules or check the web site for the official information. But these details show the care the organizers have put into designing the event. The format gives you a wide range of options in your strategy. For example, you might emphasize speed and the ability to return to the starting point, hoping to make a fast enough run to out-class another builder whose robot runs more slowly, but in "furniture-mode."

One interesting aspect of this event concerns the floor plan. It is known, within limits, well before the event starts. In fact, I've included a copy of the approximate floor plan for you to review. Note, however, that this is only an approximation. The actual contest floor plan may vary by as much as one inch in any dimension from those shown.

The designers have made a few aspects of the contest robot-friendly. The walls are all painted flat latex white, the floor is flat black, and the starting point is a 12" white circle painted on the floor. Even the candle is easier to find than it might be; the designers have mounted it on a 3" by 3" yellow wooden base. Other navigational aids, such as 1" wide white lines to mark the doorways, will make your job as robot designer somewhat easier, but only somewhat. This is still a challenging contest.

Jake Mendelssohn has been involved with this contest for years, and serves as a contact point. You can order a copy of the updated rules to the 1998 event by sending a $3.00 check or money order, payable to Trinity College, to Jake at the address listed elsewhere in this article. For $25.00, you can order a 57-minute VHS video tape of highlights from the 1997 event.

The fire-fighting contest runs in two divisions. The Junior section is limited to those in high school, while the Senior section covers everyone else. Talk about a perfect contest for that Science Fair project! What's more, first place in each division garners a cool $1,000.00 cash first prize, with additional awards for other top finishers. Again, check the official rules and web site for details.

Okay, so this is a way cool robot event. But I'm stuck in the rain and drizzle of the Puget Sound, so why am I pumped about a contest being run clear across the country? Because the Seattle Robotics Society is hosting the Northwest Regional for the Fire-Fighting Home Robot Contest, on March 21, 1998.

Last year's event in Hartford drew over 80 robots, and the running time became so long that it basically filled an entire weekend. To try and contain the chaos, Trinity College decided to hold several regional events, with winners moving on to the finals in Hartford, and the SRS is happy to be involved. Current plans call for first prize in both divisions to include some subsidy from Trinity College on air-fare to Hartford, so the winners can participate in April. Those of you who live elsewhere in the robotic hinterlands should check the contest's web page for details on the other regional events.

Several SRS members have already swung into action, committing to build the necessary frames and venues needed to host the event, and to build robots that can compete. You can find out more information on the SRS' involvement by hitting our web page at: www.seattlerobotics.org — Also watch this column for more details as they become available.

Getting started

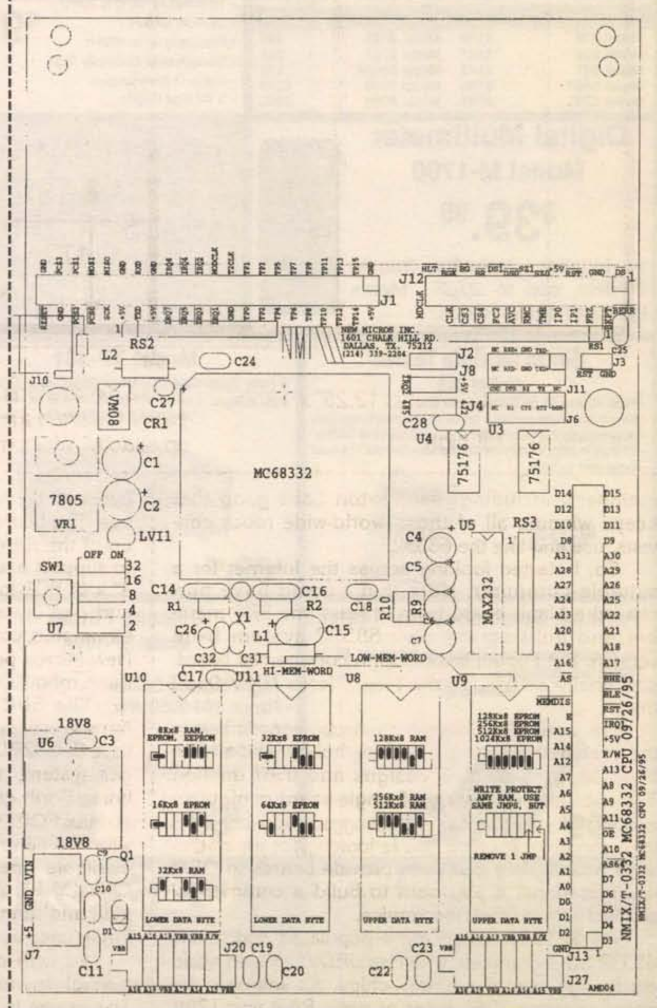
I began my first-order solution to the robot design by stretching out on the couch with a beer nearby. After much mulling, I decided to begin with a round base and a direct-drive stepper motor drive system. The contest rules limit the robot to a 12" cube and the running time shouldn't be too great, so I should be able to keep the weight low enough so the steppers will work. I'm expecting the stepper motors to help with another problem — that of navigation.

The robot's computer will already have a workable map of the house, but knowing how to get from point A to point B means you have to move reliably. One method of moving precisely involves encoders attached to wheel shafts or to a rolling floor contact. Another technique uses very precise motion increments, such as those supplied by steppers.

Another advantage with going the stepper route concerns borrowing technology. I can draw on Bill Bailey's stepper driver electronics and the wealth of experience other club members have gathered over the years, to make my task easier. Add a gel-cell battery of the proper size and weight, a little bit of wiring, and the easy part should be done.

Now for the hard part. This robot will need much more than a BOT-Board for brains. At first, I considered a 68hc12 computer, since I really like the newest microcontroller family from Motorola. Even though I eventually chose another chip, I suggest you check the Motorola web site for details on these new devices. Fast, small, low-power, and source-code compatible with the 68hc11, they provide plenty of oomph for your robot designs.

But I decided instead to go with a 68332 MCU. I've used this 68000-like device in the past, but never in a robot design. The 32-bit architecture, powerful addressing modes, and lots of on-board I/O and timer subsystems make it an ideal choice for upper-level robot designs. Plus, several SRS



Trinity College Fire Fighting Home Robot Contest
1998 Arena Floor Plan
Contest Rules, Attachment A

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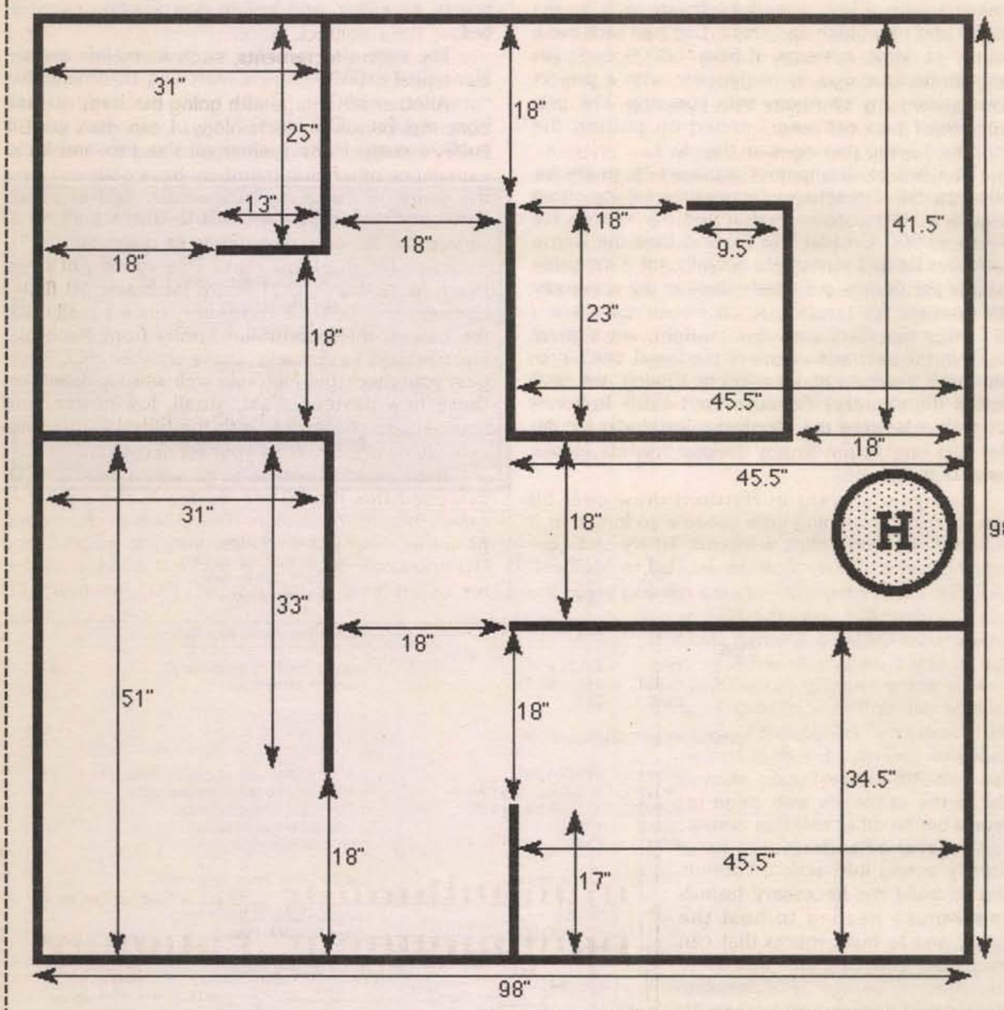

Maximum size of Robot is 12.25" x 12.25"

All walls are 13" high

These dimensions are approximations and are NOT 100% accurate and that's why the numbers don't add up exactly. Welcome to the real world!

members, including the Newton Labs gang that keeps winning all of those world-wide robot contests, use and like the 68332.

So, I started looking across the Internet for a suitable computer. Note that I could have purchased a blank board from at least one SRS member and built up my own 68332 system from scratch. But I opted instead for a commercial board, and finally settled on the New Micros NMIX-0332 unit.

I've used New Micros' products many times in the past, both for my job and my hobby, and always been happy with their designs and their quality. They sell a large variety of single-board computers and peripheral boards, and I suggest you consider their products anytime you're looking for an off-the-shelf board. They can even provide boards in OEM configurations, if you want to build a commercial product around their electronics.

My $239.00 netted me a populated and tested 68332 SBC, complete with four JEDEC 32-pin sockets for my mix of memory chips. As shipped, the board contains 256K bytes of static RAM and 128K bytes of EPROM, both arranged on a 16-bit data bus. The board contains provisions for battery backup of the RAM, and you can restrap the electronics to support a wide variety of different chip sizes. The 4" x 6" PCB includes a useful-sized prototyping area and pad layouts for I/O signals. It also sports an expansion connector that mates with any of the New Micros peripheral boards, should I need to add more robot horsepower quickly.

The SBC arrived with two strong pieces of firmware already installed. The pair of EPROMs contain CPU32BUG, Motorola's 32-bit monitor/debugger system, and Max-FORTH, New Micros' workhorse Forth compiler. I've used the eight-bit version of Max-FORTH on several projects before, mostly with the 68hc11 SBCs, so I like having that option available when it comes time to write code. And CPU32BUG provides some real power for debugging and running any assembly language programs I may need to try out.

As with other New Micros' products, I went through my usual likes and dislikes with this board. The design is clean and well-done, and the board is well-made and has lots of features on it that I like. But the documentation is very haphazard, and could serve as a barrier to those not well versed in details of microcontroller design.

For example, the docs include two pages of schematics, both D-size and reduced to single 8-1/2" by 11" sheets, then photocopied, so you can imagine how difficult they are to read. The page labeled "Memory Map" contains a single paragraph of vaguely relevant information, but no memory map. There is no well-designed manual that takes you step-by-step through the board and its capabilities, just 31 pages of printed material on assorted topics. I also got a floppy disk containing additional software, such as a public-domain assembler and a public-domain C compiler, and text files related to Max-FORTH and the NMIX-0332.

To their credit, New Micros does include a spiral-bound manual on CPU32BUG and a copy of the MC68332 *User's Manual* — both vital tools — but they are actually printed and distributed by Motorola. The bottom line: I love New Micros' hardware and firmware, but if this is your first microcontroller, you might have more success going with another vendor.

The software

Next up, I needed some form of compiler and assembler for developing my robot code. I briefly considered modifying SBasic so it could support the 68332, but discarded the idea for this project. That doesn't mean I've given up on the notion entirely; you may yet see a 68000 SBasic. But it won't likely be done for the Fire-Fighting contest.

No, this kind of project needs a higher-horsepower solution than SBasic. Assembly language for the whole project is right out; I'm not that big of a masochist. But elements of the project will require some low-level work, so an assembler is necessary. This still leaves me with a decision on the high-level tool.

After much thought, I ended up opting for C. I actually prefer doing robotics in Forth, but face it, C is more widely known, and explaining C functions to someone without a lot of programming experience is going to be easier than explaining those same functions written in Forth. (Been there, done that.)

So having chosen a language, I now needed to find the toolset. My requirements list for this assembler/compiler package was short but firm. One, it had to be free. Not cheap, free. I figure several of you will try to duplicate or improve on my efforts as these columns go by, and I'm not going to start off with a $2,000.00 compiler suite and expect you to follow suit. What's more, I'm just as cheap as the next cash-strapped hobbyist.

Second, I wanted an assembler/compiler system that was well-regarded by other users, sported a good set of features, and didn't take a Master's in CS to use or maintain. Note that wanting a commercial-grade package doesn't necessarily conflict with item one above; it just means I have to look a little harder and be a little more discriminating.

Finally, the compiler had to generate good, compact code. I realize that after working on a 2K platform for several projects, 128K of code space seems like oceans of room. But bloated code builds up fast (can you say "Windows?") and, at this point, I can't see the end of the project, so I'll error on the side of caution.

With this list in mind, I headed for my favorite freeware shopping mall, the Internet. After a few hours with AltaVista, I uncovered some candidates. The Free Software Foundation maintains a suite of tools based around the Gnu C compiler. Doing a web-search for gcc turned up a raft of various Gnu spinoffs. Many of these sites contain the full source code and build files for making gcc compilers for nearly any chip, including the 68000.

As an aside, you can even find a gcc for the 68hc11, should you want to try this compiler on the eight-bitter. Oli Kraus' web site at www.e-technik.uni-erlangen.de/~kraus/olihc11.html contains a full 68hc11 implementation of the gcc cross-compiler.

Those hardcore software hackers out there should note, however, that this is an executable only, no source. Also note that despite repeated efforts, I was unable to get a working set of va_arg macros running, so I could not create functions with variable-length argument lists, such as printf(). But I really like this compiler, even with these problems, and you may yet see a 68hc11 or 68hc12 design based on this tool.

But the Gnu tools really require more software expertise to use and maintain than I was willing to accept for my project and my readers, so I continued looking. Another possibility lies in the public-domain C compiler provided by Motorola and shipped on the New Micros floppy disk. The disk contains the executable for both the C compiler and the matching assembler. It also contains what looks like the full source code for the C compiler, though I haven't tried rebuilding the compiler yet.

But the .doc file on the compiler indicated a few problems that left it short of my requirements list. Again, however, those software hackers out there could have a lot of fun with this compiler. Wally Brandt, the original developer of this compiler, did a terrific service to the 68000 community when he released his work, and I'd like to see others carry onward from there. Given the long expected life of the 68000 family and the ever-growing number of hobbyists on the prowl for cheap tools, an upgrade to this compiler would find a lot of grateful users. Think about it.

Meanwhile, back at the ranch, I was running out of options. I had found two good compilers that were more of a software project than I was willing to tackle just to get a robo-tool running, and I still needed a compiler and assembler. Then, in a fairly typical Zen thunderbolt, the answer called me up one morning at work.

Louis Meadows is a sales rep for a company called Software Development Systems, which makes a suite of very powerful software tools for the 68000 and other high-end chips. Lou had sent me a couple of demo systems of SDS' 68000 compiler tools some time ago, in conjunction with a project investigation my company was pursuing. The project didn't pan out and I ended up putting the unopened demo packages on the shelf.

So I had to disappoint Lou when he made his follow-up call. But we spent some time talking about related matters, and I mentioned my search for cheap 68000 C tools. He replied that the demo packages he had sent might actually solve my problem, as the demos are widely used in the university environment for teaching C on microcontrollers. I had originally dismissed this outright, since most such demo packages are crippled and can't produce very much code. Lou said he thought the limit on the demo compiler was about 100K bytes of code. He answered my shocked question by saying that you can't really do any serious projects in less than 100K of code.

As soon as we hung up, I ripped open one of the demo packages and installed it. The more I read and tested, the more convinced I became that this was the end of my software search. The seven-floppy package contains SDS' C/C++ Starter Kit for the 68K, version 7.03, which runs under Windows 3.1, Win95, and WinNT. The main product is the SingleStep 68000 debugger and simulator, a powerful Windows-based program for testing your final object files. SingleStep is crammed with powerful features such as source-level debugging and breakpoints, an editor, and built-in downloading capabilities.

The suite also includes a command-line assembler called as68000 and a matching command-line compiler, cc68000. These tools are easy to use from regular DOS batch files, or you can grab a public-domain Make system off the web and build

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```
;
; Typical 68332 startup file, based on original provided by
; Software Development Systems in their SDS Startup Kit.
;
;
; Use the Motorola equate file to declare the 68332 I/O registers.
;
#include equ332.asm
;
; Declare some important externals and publics.
;
        XDEF    START,__brkp,__brksz,__exit
        XREF    STKTOP,DATA,_main
;
; I removed the C++ initializers. See the original start.s file
; for their declaration.
;
;
;
; Define variables to track memory allocations for mbrk().
;
        SECTION ram
__brkp
        DS.L    1               ; point to available memory
__brksz
        DS.L    1               ; number of available bytes
;
;
; The reset vector will point to this code (START).
; By the time we get here, A7 will have been initialized.
;
        SECTION code
        .STK    "none"          ; terminate call chain for -OG
START
        MOVE.L  #STKTOP,A7      ; set the stack pointer
        MOVE.L  #0,A6           ; terminate call chain for -Og
;
; Perform low-level configuration of system hardware. Configuration
; relies on the table at label config below.
;
        move.w  #$2700,SR       ; setup the status register
        move.l  #config,a0      ; point to start of config tbl
tbl1:
        move.w  (a0)+,d0        ; get size word
        move.l  (a0)+,a1        ; get destination addr
        move.l  (a0)+,d1        ; get data to move
        cmp.w   #0,d0           ; write a byte?
        bne     tbl2            ; branch if not
        move.b  d1,(a1)         ; write byte to addr
        bra     tbl1            ; do next
tbl2:
        cmp.w   #1,d0           ; write a word?
        bne     tbl3            ; branch if not
        move.w  d1,(a1)         ; write word to addr
        bra     tbl1            ; do next
tbl3:
        cmp.w   #2,d0           ; write a long?
        bne     tblx            ; if not, all done
        move.l  d1,(a1)         ; write long to addr
        bra     tbl1            ; do next
tblx:
;
; Zero out uninitialized RAM.
;
        MOVE.L  #`BASE(ram),A1  ; A1 = base of region ram
        MOVE.L  #`SIZE(ram),D0  ; D0 = size of region ram
        LSR.L   #2,D0           ; compute size in longs
        BRA     ZDBF            ; enter a fast loop
ZLP:
        CLR.L   (A1)+           ; clear four bytes at a time
ZDBF:
        DBF     D0,ZLP          ; up to 256K in inner loop
        SUB.L   #$10000,D0      ; rest in outer loop
        BHS     ZLP
;
; Initialize other RAM from ROM.
;
        MOVE.L  #DATA,A0        ; A0 = ROM base of region data
        MOVE.L  #`BASE(data),A1 ; A1 = RAM base of region data
        MOVE.L  #`SIZE(data),D0 ; D0 = size of region data
        LSR.L   #2,D0           ; compute size in longs
        BRA     IDBF            ; enter a fast loop
ILP:
        MOVE.L  (A0)+,(A1)+     ; move four bytes at a time
IDBF:
        DBF     D0,ILP          ; up to 256K in inner loop
        SUB.L   #$10000,D0      ; rest in outer loop
        BHS     ILP
;
; Initialize memory allocator.
;
;       MOVE.L  #`BASE(malloc),D0       ; address of malloc region
;       MOVE.L  #`SIZE(malloc),D1       ; size of malloc region
; .IF "ptrd"?"2"
;       SWAP    D0              ; handle 2-byte C "pointers"
; .ENDIF
; .IF "long"?"2"
;       SWAP    D1              ; handle 2-byte C "longs"
; .ENDIF
;       MOVE.L  D0,__brkp       ; vars referenced by mbrk()
;       MOVE.L  D1,__brksz
;
; Invoke main() with no arguments.
;
        JSR     _main           ; "int" return value in D0
;
; Control reaches this point if control leaves main().
;
__exit
DONE
        BRA     DONE            ; loop if main ever returns
;
;
; If your program needs standard character I/O routines, this makes
; a good place to stash them. The following routines assume that
; CPU32 is available, and rely on the monitor's TRAP mechanism.
;
;
; outch   output char in D0 to active port
;
        XDEF    _outch
        .FDEF   _outch,4
_outch
        move.b  d0,-(a7)        ; save char on stack
        trap    #15             ; use CPU32
        dc.w    $0020           ; output a char
```

up make files for automatically compiling and assembling your projects. The assembler supports macros and relocation, and the package includes a linker (but no librarian) for creating a large project out of several smaller library files. In short, this demo kit is a godsend for the hobbyist or student on a budget.

One feature of this kit that I really like is the ability to generate absolute listings from the relocatable output files. If you've used any of the older relocating compiler suites, you know how irritating it can be to try and use a monitor to debug your code. All of the listings contain labels addressed at 0, since the linker will fix them up later, so you never know where a label or variable lies in memory. The SDS kit, however, includes a program called abs, which merges the linker information with the relocatable listings, giving you printouts with real addresses for all those variables. Mighty handy, and way cool for a free compiler.

There are a few restrictions on this system worth noting. As I said, the linker does not include a librarian, so you cannot alter the two main library modules supplied with the package, nor can you create your own object library modules. Also, each invocation of the linker supports a maximum of three different object files plus the library files, so you end up having to create large source files to stay within the three-file limit. Finally, the compiler and assembler apparently are restricted to using available memory for holding their working tables, which puts an effective, but unknown limit on the size of files you can assemble or compile. Still, if Lou's approximation is on-target, I'll write a lot of robot code before I hit that wall.

The bottom line: Run, don't walk, to your web browser, telephone, or fax, and order a copy of the SDS Starter Kit for the 68000. Check their web site at www.sdsi.com for full details. I have the floppy disk package, but Lou mentioned a CD-ROM version as well. If the CD-ROM version includes the user manuals, it is a must-have. Contact info is:

Software Development Systems, Inc.
815 Commerce Drive, Ste. 250
Oak Brook, IL 60521
Voice: 708-368-0400
Fax: 708-990-4641

Making it work

Now comes the tricky bit. I have this first-class compiler and a first-class microcontroller; I just have to make the compiler create code that the board can run right out of reset. Those of you who have created Windows programs using tools such as Visual Basic have been able to skip over this next problem, as you have an operating system shielding you from the low-level tasks. But there are no such shields in place in robotics, and your software design has to cover everything that happens from the very first CPU clock cycle.

The reset start-up task requires that you, as the system engineer, know all you can about the microcontroller your code will run on and the runtime module your compiler will graft onto your object file. The 68332 MCU contains a variety of extra I/O subsystems, each more complex than its 68hc11 counterpart, if there is such. Still, the general startup flow can be (grossly) simplified to the following steps.

First, initialize such system-wide elements as the MCU clock frequency and the CPU's stack pointer. Next, set up the MCU's chip-select lines so the external memory is remapped from its reset state to its final working configuration. Finally, begin executing the top-level program by jumping to the address of the function main().

The key element behind this start-up task is an assembler source file called start.s. The SDS demo kit includes a good start.s file to show you the basics, but I modified it extensively during my experimentation. I've included a copy of my current version of start.s, so you can see what is involved in setting up the 68332 after reset. Note that this is a preliminary version and will change rapidly and often as my development continues. For now, however, this file will give you a good start. Keep an eye

As always, you can reach me at:
Karl Lunt
116 173rd St. S.W., Bothell, WA 98012
E-Mail: karllunt@seanet.com
Web: http://www.seanet.com/~karllunt

```
        rts                             ; and leave

;
; inch  get char from active port, return in D0
;
        XDEF    _inch
_inch
        subq.l  #2,a7                   ; make room on stack
        trap    #15                     ; use CPU32
        dc.w    $0000                   ; input a char
        move.b  (a7)+,d0                ; put char in D0
        rts                             ; and leave

;
; Define the system configuration table.
;
; The following table works for the New Micros 68332 board. Change
; this table as needed for your hardware.
;
; Each entry in the configuration table specifies the
; size of a value to write to memory, the address affected, and
; the data to write to it. The config implementation is based
; on the TINIT routine used by New Micros in their MAXForth/332
; firmware. I liked their idea so much I had to use it in my
; system.
;
; Each entry in the table consists of a word and two longs, in the
; following order:
;
;       dc.w    0, 1, or 2              ; 0=byte, 1=word, 2=long
;       dc.l    addr                    ; address to change
;       dc.l    data                    ; value to write to addr
;
; For example, to write the word $0038 to address SCCR0 (sets
; baud rate to 9600 baud), you would use the following table entry:
;
;       dc.w    1                       ; SCCR0 (word)
;       dc.l    SCCR0                   ; set baud rate
;       dc.l    $0038                   ; to 9600
;
; Mark the end of the table with a size field other than 0, 1, or 2.
;
; Note that the configuration values are written to the hardware
; registers in the order of appearance.
;
config:
;       dc.w 1                          ; 16.667MHz
;       dc.l SYNCR
;       dc.l $7F00
;       dc.w 0                          ; BME, NO WATCHDOG TIMER
;       dc.l SYPCR
;       dc.l 4
;       dc.w 1                          ; 1st rom, 128K at 0000
;       dc.l CSBARBT
;       dc.l $0004
;       dc.w 1                          ;
;       dc.l CSORBT
;       dc.l $7B70
;       dc.w 1                          ; 2nd rom, 16K at 4000
;       dc.l CSBAR0
;       dc.l $0042
;       dc.w 1                          ; ram is mapped via cs1
;       dc.l CSBAR1
;       dc.l $0007
;       dc.w 1                          ; and cs2 - 1024K each
;       dc.l CSBAR2
;       dc.l $0107
;       dc.w 1                          ; io space, 128K at f00000
;       dc.l CSBAR3
;       dc.l $F004
;       dc.w 1                          ; wait states for CS
;       dc.l CSOR0
;       dc.l $7B70
;       dc.w 1                          ;
;       dc.l CSOR1
;       dc.l $7B70
;       dc.w 1                          ;
;       dc.l CSOR2
;       dc.l $7B70
;       dc.w 1                          ;
;       dc.l CSOR3
;       dc.l $7B70
;       dc.w 1                          ; sci=9600 baud
;       dc.l SCCR0
;       dc.l $0038
;       dc.w 1                          ; enable rcv and xmt
;       dc.l SCCR1
;       dc.l $000C
;       dc.w 1                          ; setup internal ram
;       dc.l TRAMBAR
;       dc.l $FFE8
        dc.w    $ffff                   ; marks end of table
;
; Declare the reset vector, stored in supervisor space at address 0.
; Address 0 holds the 32-bit address to write to A7, the stack pointer.
; Address 4 holds the 32-bit address to write to PC.
;
        SECTION reset
        DC.L    STKTOP                  ; initial stack pointer
        DC.L    START                   ; initial execution address
;
;       OTHER EXCEPTION VECTORS: to supervisor data space at address 8,
;       or 8 bytes beyond where the vector base register will point.
;       This table is commented out because no actual interrupt rou-
;       tines are provided.
;**********************************************************************
;       SECTION vects
;       DC.L    BUSERROR,ADRERROR                       ; 0x08
;       DC.L    ILLEGAL,ZERODIV,CHK,TRAPV               ; 0x10
;       DC.L    PRIVILEGE,TRACE,EMULA,EMULF             ; 0x20
;       DC.L    RESVD,PROTO,FORMAT,UNINIT               ; 0x30
;       DCB.L   8,RESVD                                 ; 0x40
;       DC.L    SPURIOUS,AUTO1,AUTO2,AUTO3              ; 0x60
;       DC.L    AUTO4,AUTO5,AUTO6,AUTO7                 ; 0x70
;       DC.L    TRAP0,TRAP1,TRAP2,TRAP3                 ; 0x80
;       DC.L    TRAP4,TRAP5,TRAP6,TRAP7                 ; 0x90
;       DC.L    TRAP8,TRAP9,TRAPA,TRAPB                 ; 0xa0
;       DC.L    TRAPC,TRAPD,TRAPE,TRAPF                 ; 0xb0
;       DC.L    FUNORD,FNEXACT,FZERODIV,FUNFLOW         ; 0xc0
;       DC.L    FOPND,FOVFLOW,FSNAN,RESVD               ; 0xd0
;       DCB.L   8,RESVD                                 ; 0xe0
;       DCB.L   192,USER                                ; 0x100
```

on my web site for ongoing updates to this and other 68332-related files.

Immediately after reset, the 68332 fetches the 32-bit value at address $0 and uses it as the stack pointer (register A7). It also fetches the 32-bit value at address $4 and uses it as the program counter (PC). The CPU sets up its internal registers and flags, then passes control to the program at the address currently in PC. Given the start.s file below, that starting point is the label START. Browse through the file, checking both the code at START and the code in the vector table, so you understand how this reset mechanism works.

Notice that the source at START follows an assembler SECTION directive that references an area called code. This SECTION directive tells the linker that subsequent object code should be placed in an area of memory named code. Later, when you run the linker to build the final executable, your linker commands must assign an address to this code section. The linker, in turn, will pull together all the various code sections, regardless of what object file they appear in, and stack them up at the designated code address. The linker will perform this same task for all the other SECTION directives it encounters. As it does so, the linker will automatically adjust the addresses of any referenced variables and labels, so the final executable file contains the correct addresses for the memory areas you have defined.

This operation is known as relocation, and lets you write a program without knowing exactly where in memory it will ultimately execute, with one small caveat. The SDS compiler will always generate code that can be successfully relinked, since that is how it was designed. The assembler, however, relies on you to make sure your code is relocatable. The linker will trip up if you try to make it relocate something that isn't relocatable, but the back-and-forth edit, assemble, and link operations can get to be a drag. For this reason, it's usually handy to write in C rather than assembler.

At START, the code sets up some internal registers, then begins a large loop that sets up the hardware registers. The 68332 has about a billion I/O registers, some of which are vital to your program and many of which are irrelevant. But the vital ones must be set up before your program will run successfully, and which ones you need to alter will vary depending on your design. So the register set-up loop uses a table that you can customize quickly without getting bogged down in a bunch of nasty looping code and special conditions. Simply check the code further down in the file, at label config. This is a typical configuration table and should provide all the details you need for building your own table.

Next, the program prepares two areas of memory reserved by the C compiler. One area, in the section named RAM, contains all uninitialized C variables. By convention, these variables must all contain 0 following reset, and the short loop around label ZLP makes sure this task gets done. Immediately after this loop lies a second loop with a similar function. The code around the label ILP takes care of those variables that must be filled with preassigned values following reset. Notice how the code copies values from the section named DATA, which lies in ROM, to the section named data, which lies in RAM. Again, the command options you specify to the linker assigns these addresses so the linker gets everything sorted out properly.

Finally, everything is set up and the CPU is ready to run your top-level program. It does this by executing a JSR instruction to the address _main, which is where the compiler puts the start of your main() function. Now your top-level code takes over, causing your robot to roll forward, find the candle, and claim first prize. By convention, control should never leave the main() function in an embedded control program such as this. If it should, however, the tight loop at label _exit will snag the CPU, preventing it from running away and executing trash.

Every C program you write must include the object file created by assembling the file start.s or something similar. Therefore, your work with the SDS compiler package is immediately limited to just two other files, as the third and final file you get will be start.o, the object file for start.s. Note that I have included a pair of character I/O routines in my start.s. These provide the low-level code for exchanging characters via the 68332's SCI. In this version of start.s, I've used a TRAP instruction that invokes the CPU32BUG's character I/O subfunctions. In later versions of start.s — which will run when the CPU32BUG monitor has been removed — I will include code that performs these I/O operations directly.

That's a wrap

This completes the first phase of my robot design. I realize there isn't much in the way of hardware or electronics here, but I foresee software as the biggest hurdle, and I want to get a quick start on it. I will keep you informed in upcoming articles as to my progress on this project. Bear in mind that this design is evolving as I write these articles, so elements of the design will change from month to month. Given the time lag between my writing and your reading, I will always be about six weeks ahead of what you see here. And you won't even see the final project before the contest runs. But it should prove interesting, and I hope you'll stay tuned. **NV**

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Seeking A Solar Panel

Q. I've enjoyed your writings over the years, but alas, I missed all but the last installment of the Nuts & Volts Solar Workshop, and was sorry to see that it's now gone. However, I need help on photovoltaics. A few years ago, I bought a 15-18V (800 mA) panel and used it in a project. Now I find myself in need of another panel, but can't remember the name (or location) of the company. I know it's not much to go on, but I'd sure appreciate it if you suggest a few companies to me. This time my needs are for about 10-13 volts, to be regulated down to 6.5 volts at 500 mA.

Jeff Kerner
via Internet

A. *Sure, here's a short list of companies that I trust. For a more comprehensive list, download the SOLAR.TXT file from our Web site. By the way (BTW), the N&V Solar Workshop isn't dead. It'll resurface from time to time as the need arises.*

Alternative Energy Engineering
800-777-6609
http://www.asis.com/aee/index.htm

Jade Mountain, Inc.
800-442-1972
http://www.indra.com/jade-mtn/pv.html

Sierra Solar Systems
800-517-6527
E-Mail: solarjon@oro.net

Solar Electric Inc.
800-842-5678
http://www.solarelectricinc.com

30-Pin To 72-Pin SIMMs Converter

Q. I have a dozen or so 30-pin SIMMs that I want to use in my PC, which has four 72-pin SIMMs slots. I was thinking of making a circuit board that would accept all these SIMMs that I'd plug into a single 72-pin slot, but I don't know the pinouts or the schematic. I'm good with electronics, so I know I can do this.

Shirley Brown
via Internet

A. *I suggest buying a SIMMs 30-pin-to-72-pin converter card instead of trying to make your own adapter. That's because of the speed at which these devices operate. Unless you're extremely careful with wire length and termination, you'll get ringing and noise that'll cause your PC to crash. You can buy these converters from Jameco (800-831-4242; http://www.jameco.com) for under $30.00.*

DOS Hidden Files

Q. In your response to "COMMAND.COM, Where Are You?" you advised to simply recopy COMMAND.COM to the C:\ root directory. As I remember it, there are two hidden files, too, that have to be located at the very beginning of any bootable disk. Simply copying them to the disk won't necessarily put them where they belong because that space could be occupied by another file. Am I wrong, or has DOS evolved to the point where it's smart enough to make space for these files?

Jerry P. Franklin
via Internet

A. *No, you're absolutely right. The two hidden files, MSDOS.SYS and IO.SYS, have to be located at the very beginning of a bootable disk. And no, DOS isn't smart enough to make room on the platter for these two critical files if the area is occupied by another file. They have to be put there using the Format command, which wipes the disk clean of all data. If you want to upgrade the DOS on an already formatted, bootable disk, though, you can use the SYS command. This command replaces the older hidden files with the new version and copies the new COMMAND.COM in the root directory.*

Open, Sez Me

Q. I want to make a garage door opener for the garage in our building. The building charges $30.00 a month for the remote, and if I knew the right frequency I could build my own. However, I don't have a frequency counter. Do you know what the frequencies are?

Alexander Belenky
via Internet

A. *Unfortunately, just knowing the right frequency isn't enough. You need the digital code, too — the code that tells the door that it's you and not a stray radio signal that's trying to open it, and that I surely can't provide.*

MAILBAG

Mr. Byers:

While I agree with most of what you said regarding phone line characteristics, I would most emphatically discourage anyone from trying to use the phone line for anything but what it was intended. Uses such as described by Mr. Rothfus are some of the reasons the phone companies fought for years against foreign attachments on the line, and why for years, type-accepted couplers had to be used to interface "foreign" devices to the phone system — to protect the network from damage. I would like to stress the fact that when the "trip current" point is exceeded, indicating an off-hook condition, which is caused by some reason other than making a phone call, the central office equipment senses this, and eventually you will incur the wrath of the phone company. You can get into trouble messing with the phone system.

Bob Roehrig K9EUI
via Internet

Response:

I agree wholeheartedly! Real damage can be done if you don't know what you're doing. Moreover, there are legal repercussions for the misuse of a public utility. If you notice the intro to my answer, I recommended a small solar panel instead. On the other hand, many commercial products tap into the the phone company's power, which can lead one to believe there's a free lunch out there. So if a person insists on tapping into this free-

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PB33 6v @ 1200 mAh
PB34 9.6v @ 600 mAh
YAESU FT-11/51R
FNB-31 4.8v @ 600 mAh
FNB-33(S) 4.8v @ 1500 mAh
FNB-35SS 7.2v @ 1500 mAh
FNB-38 9.6v @ 600 mAh
ICOM-W21AT/2GX
BP-157 7.2v @ 900 mAh
BP-157(S) 7.2v @1500 mAh
BP-132 12v @ 850 mAh
available with and without microphone
MOTOROLA
GP-300 7.5v @ 1200 mAh

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Write in 192 on Reader Service Card.

power, too, it's better to have a full knowledge of what they're working with than no knowledge at all. That's why I opted to go with the bridge rectifier buffered with a voltage regulator. It provides the best isolation, and is standard fare on most commercial phone-powered equipment.

TJ Byers
Q & A Editor

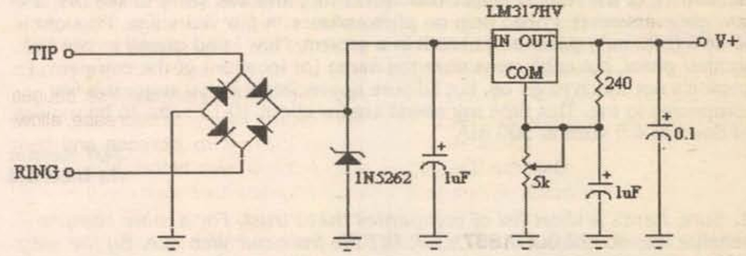
Mr. Byers:

In your Sept. '97 issue, page 72 (Electronics Q & A), you show a circuit using a 78Lxx regulator to derive low voltage from a phone line. The 78Lxx series has a maximum input voltage rating of 35 volts. With the tip-to-ring voltage at times exceeding 50 volts, the regulator will blow. I suggest using an LM317HV from National Semiconductor instead, which has a maximum input voltage rating of 60 volts.

Lada Leitner
via Internet

Response:

Actually, I tested this circuit using an LM78L12 with a 20 mA load, and had no problems. It's because the 1 uF capacitor has to charge first, which gives the regulator time to turn on and load the phone line before it exceeds the maximum input voltage. But your point is well taken. Under no-load conditions, the regulator is at risk, in which case, the more-expensive LM317HV should be used. Here's how it's connected.



An item I forgot in the original circuit was a ringer snubber that would prevent the ring voltage (which can exceed 100 volts) from destroying the IC. I've added it to this design, and suggest that readers who want to use the 78xxx series do the same (use a 1N5289, though).

TJ Byers
Q & A Editor

TECH FORUM

Continued from page 79

time. This takes care of the clock and memory settings. Pin 2 - +13.8V from ignition switch. Shuts off when ignition off, main power to radio. Pin 3 - Power to front panel lamps from dimmer switch on dash. Dims lamps with dimmer control. Pin 4 - Power from side marker lamps. Dims fluorescent display during park. Pin 5 - Right channel front and rear speaker common (same as black connector, pin 1). Pin 6 - Left channel front and rear speaker common (same as black connector, pin 2). Pin 7 - Audio muting (used as test point).

BLACK connector (pin 1 is the one with the bump) is mostly for speaker outputs:

Pin 1 - Right channel front and rear speaker common. Pin 2 - Left channel front and rear speaker common. Pin 3 - Right front speaker hot. Pin 4 - Left front speaker hot. Pin 5 - Right rear speaker hot. Pin 6 - Left rear speaker hot. Pin 7 - Switched +13.8V operates power antenna when radio turned on.

NOTE: There are no grounds on either connector. Ground has to be applied to the chassis. Ground could come through the antenna coax shield, however, it is not wise to depend on this. If you do repair work on these radios, be aware we have available a "house number" to "real world" number cross list for the ICs used in these, as well as other brand auto radios. This can save a lot of money, as the mark-up on "house" number chips can be huge!

Bomarc Services
Casper, WY

ANSWER TO #10977 OCT. 1997

The answer to your question is yes. The problem is, what do you know about precision optics and high-speed timing? If you are comfortable with beam splitters and high-speed counters then what you want should be no problem. If you have these skills then I would first suggest that you purchase one of the many surplus range finders that are becoming available through many surplus dealers and repair it, and/or modify it for finer detail.

Doing it this way saves you the time and effort of shopping for what would otherwise be a "very expensive shopping spree" and it allows you to learn the ways of the past, mistakes included.

If you intend to start from scratch, then you do have a up-hill task in front of you in which you will need to learn and familiarize yourself with many factors including precision optical alignment and phase alignment.

There are several ways to achieve "phase or coherent" timing. (Count) and again, what you know is everything. Accuracy can be down to less than what you described, if the math is correct.

The precision of these numbers today can be realized with the readily available GHz counters, consequently your project is possible, but you will need to know quite a bit about optics and electronics if you are to succeed.

Chris
Bieber, CA

ANSWER TO #109716 OCT. 1997

I'll discuss two main methods. The first involves some kind of sensor, i.e., a PIR or microwave motion detector, pressure switch, or glass-break detector, that is connected to either a contact closure relay or some other "bridge" which interprets an alarm condition and activates the appropriate device (VCR/Alarm).

The second, is a true "video" motion detector per se. Older video motion detection consisted of an actual light sensing device mounted on the receiving monitor from the camera in question. It was placed in the area of the monitor that consisted with the critical area that the camera was "seeing." Like a door, for example. When someone passed through that area, the light value of the screen would change, thus would the light sensor and trip the alarm.

This method has evolved quite a bit, and sensors are no longer needed physically on the monitor, as the actual video signal is scanned. Several areas and cameras can be monitored at once.

Ryan Gamache
wild-hair@juno.com

ANSWER TO #10975 - OCT. 1997

Programming a screen saver in MS-DOS is a daunting task for a beginner (or an expert, for that matter ...). Assuming you want to be able to detect inactivity over a period of time, this will take a great deal of knowledge concerning interrupts, service routines, and such. A relatively simple screen blanking program could be written in assembly language that monitors interrupt 08h (for keyboard activity) and interrupt 09h (so it can activate after a period of time). Then, upon triggering, it can turn off the video refresh until another key is pressed. If you want to draw your own graphics (as most screen savers do) then you will have to save the video state, then restore it before returning control to the program.

If you want to simply make a program that can be activated on the com-

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mand line, then it is very easy. You can use any programming language that has a PC version. (For the beginner, I would recommend Quick BASIC.) Since you already have knowledge of BASIC, the on-line help should have all the information you need to get up to speed.

Chuck Homic
Ballston Spa, NY
chuck@vvisions.com

ANSWER TO #10972 OCT. 1997

You are the victim of what is called "thermal runaway" in solid-state electronics. What you first need to know is that LEDs are light-emitting-diodes, not incandescent lamps!

LEDs don't have filaments, just junctions as in any other type of diode. The rating of 100 mA is the absolute maximum current useable before damage occurs. The 1.2-volt rating is the typical forward voltage drop across the junction, held at 25°C, with 100 mA flowing through it.

The forward current is an exponential function of the forward bias voltage. If the voltage increases by about 0.1 volts, the current increases by one decade! Thus, it is much safer to use a bias current to illuminate the LEDs. Also complicating matters. As the junction temperature increases, the forward voltage decreases.

If you apply 12 volts directly to a series string of 10 LEDs, the current will start out at somewhere near 100 mA, which is enough current to self-heat the diode junctions. This causes the forward voltage to decrease, allowing the current to increase and heat the junctions even hotter, allowing the voltage to decrease even more. Sooner or later, one or more of the devices fail, with the remainder damaged!

Try this instead: power a series string of five LEDs in series with a 68 ohm, 1W resistor, using a 12-volt supply. This will limit the current to about 90 mA, a somewhat safe region for the LEDs. A much safer current would be about 50 mA, which you could obtain using a 120 ohm, 1/2W resistor instead of the 68-ohm unit.

You can parallel as many of these strings as you require on the same 12-volt supply. Simply add up the currents for each string to figure the total required from your supply. If you require further information on the subject of LEDs, please refer to my article. "Semiconductor Diode Guidebook" in the June '97 issue of *Popular Electronics Magazine.*

Skip Campisi
Bound Brook, NJ

ANSWER TO #109721 OCT. 1997

Since the author did not list the unique boot-up sequence of numbers that appears on the bottom of the screen from his BIOS ID, it is very difficult to answer his question. I have, however, found the SIS 471 chipset he mentioned.

The Award BIOS ID appears at the bottom of the screen after power on, during memory count up. The PAUSE key should work at that point, allowing you to write down the BIOS number, the BIOS date, and the version. Then compare those numbers with the list below, the manufacturer of the motherboard can be located. Further information can be found at the website listed below and at http://www.motherboards.org/

The AWARD BIOS number page can be located at the following website http://ping4.ping.be/bios/numbers.shtml and the following information was located there for the SIS 471 and 486-based motherboards.

SIS 471 B/E Chipset (486 based M/B) and SIS 85C471B/E/G Chipset (486 based M/B)
2C4I8C30: Chaintech 486SLB / Chipset: SIS-85C471
2C4I8F21-00: Genoa (model:???) or firenze 486 VL. VII (or Freetech?)
2C4I8F30-00: ??? (Full Yes?)
2C4I8G01-00: Gigabyte GA-486VS
2C4I8G30: OPTI 895 GREEN PC VL/ISA-PB486P3
2C4I8S21: Soyo 25M/N/P
2C403U0Z-00: Uniboard KS-TG919 Ver.3.1 (Chipset SIS-471B/D-B 01/17/96???)
2C4I9000-00: ???
2C4I9521-00: ??? 03/08/95-SIS-85C471B/E/G
2C4I9523: ??? 09/26/94-SIS-85C471B/E/G
2C4I9A12: Abit (model: ???)
2C4I9AD0:???
2C4I9C21: Chicony CH-471B
2C4I9C21-08: Chicony C471
2C4I9C31-00: Chaintech (model: ???)
2C4I9E30-00: EFA 4DMS-HL3G
2C4I9F20-01: Freetech (model: ???) or Genoa 486VLGX4
2C4I9F21-00: Freetech (model: ???)
2C4I9F30-00: Full Yes (model: ???)
2C4I9G01: Gigabyte GA-486VF (Rev. 8B)
2C4I9G30: Gemlight GMB-486SG
2C4I9M92-00: MLE (model: ???)
2C4I9M93: MLE (model: ???)
2C4I9R01: M-Technology (Mtech) R407
2C4I9P82-00: Azza (model: ???)
2C4I9S21-00: Soyo (model: ???) (E2.1 08/01/94)
2C4I9S22: Soyo (model: ???)
02/08/94 SIS-85C471-I486SV2G-80: ???
10/11/94-SIS-85C471-I486-SV2G00: (Chipset: SIS 85C471), Model: VL/I-486SVG0X4 Manuf: ???

Arthur Hazboun

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You may fax in ad copy or changes before the closing date (5:00pm on the 10th) at 909-371-3052 using MasterCard or Visa. Include credit card expiration date, the name that appears on the card, a daytime phone number, and your *Nuts & Volts* account number. Ads without credit card information will not be listed as received until payment is received in full. **WE DO NOT CALL OR FAX BACK VERIFICATION OR QUOTES OF FAXED-IN ADS.** For verification of faxed-in ads, please call 909-371-8497.

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60. Computer Software
70. Computer Equipment Wanted
80. Test Equipment
85. Security
90. Satellite Equipment
95. Military Surplus Electronics
100. Audio/Video/Lasers
110. Cable TV
115. Telephone/Fax
120. Components
125. Microcontrollers
130. Antique Electronics
135. Aviation Electronics
140. Publications
145. Robotics
150. Plans/Kits/Schematics
155. Manuals/Schematics Wanted
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ADVERTISER'S INDEX

ADVERTISERS INDEX

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Don't let the price fool you. This meter is a digital multimeter designed for engineers and hobbyists. Equipped with 5 functions and 19 ranges. Each test position is quickly and easily selected with a simple turn of the FUNCTION/RANGE selector rotary switch.

Rubber Boot Included

Our Best Offer Ever on a High Quality Full Sized DMM

$19.00 any qty

General

Display: 3-1/2 Digit LCD, 21mm Figure Height with Automatic Polarity
Overrange Indication: 3 Least Significant Digits Blank
Temperature for Guaranteed Accuracy: 23°C±5°C RH<75%
Temperature Ranges:
Operating: 0°C to 40°C (32°F to 104°F)
Storage: -10°C to 50°C (14°F to 122°F)
Power: 9V Alkaline or Carbon-Zinc Battery(NEDA1604)
Low Battery Indication: BAT on Left of LCD Display
*Dimensions:*188mm long x 87mm wide x 33mm thick
Net Weight: 400g

DC Voltage (DCV)

Range:	Resolution:	Accuracy:
200mV	100µV	
2000mV	1mV	±(1%rdg+2dgts)
20V	10mV	
200V	100mV	
1000V	1V	

Maximum Allowable Input: 1000V DC or Peak AC.

DC Current (DCA)

Range:	Resolution:	Accuracy:
200µA	100nA	
2000µA	1µA	±(1.2%rdg+2dgts)
20mA	10µA	
200mA	100µA	
10A	10mA	±(1.2%rdg+2dgts)

Overload Protection: mA Input. 2A/250V fuse.

AC Voltage (ACV)

Range:	Resolution:	Accuracy:
200V	100mV	±(1.2%rdg+10dgts)
750V	1V	

Resistance (Ω)

Range:	Resolution:	Accuracy:
200Ω	100mΩ	
2000Ω	1Ω	
20KΩ	10Ω	±(1.2%rdg+2dgts)
200KΩ	100Ω	
2000KΩ	1KΩ	
20MΩ	10KΩ	±(2%rdg+10dgts)

Maximum Open Circuit Voltage: 2.8V

Diode Test
Measures forward voltage drop of a semiconductor junction in mV test current of 1.5mA Max.

ohFE Test
Measures transistor hFE.

Frequency Range: 45Hz-450Hz
Maximum Allowable Input: 750V rms
Response: Average Responding. Calibrated in rms of a Sine Wave.

CAT NO	DESCRIPTION	PRICE
9300G	Rugged High Quality DMM with Rubber Boot	$19.00

Switchable Scope Probe Sets

(Selectable X1/Ref/X10)

These high quality scope probe sets are for oscilloscopes up to 60MHz (model HP 9060) or 150MHz (model HP9150). Both sets include a handy storage pouch and include an IC test-hook adapter for the probe. The BNC connector rotates to avoid cable tangle or kink. Cable length is 1.4 meters.

CAT NO	DESCRIPTION	PRICE EACH 1	10	100
HP-9060	Scope Probe Set DC~60MHz	$16.49	$14.49	$11.58
HP-9150	Scope Probe Set DC~150MHz	24.95	21.95	18.62

CCD Camera - IR Responsive

As Low As $85!!

This black and white monochrome CCD Camera is totally contained on a PCB (70mm x 46mm). The lens is the tallest component on the board (27mm high from the back of the PCB) and it works with light as low as 0.1 lux. It is IR Responsive for use in total darkness. It comes with six IR LED's on board. It connects to any standard monitor, AUX or video input on a VCR or through a video modulator to a TV. Works with a REGULATED 12V power supply (11V-13V). Hooks up by connecting three wires: red to 12V, black to ground (power & video) and brown to video signal output.

Power Supply Regulating Kit for CA-H34 This simple kit is designed to fit onto the back of the CA-H34 CCD camera. It resolves the problem of hooking up the camera to an UNREGULATED supply (which damages the camera) by providing safe regulated power from any 12V-14V DC supply. It also provides regulated 12V DC from a 12V AC source.

CAT NO	DESCRIPTION	PRICE EACH 1	5
CA-H34A	PCB Mounted IRCCD Camera	$99.00	$85.00
A34	Power Supply Regulating Kit	$6.95	----

PM-128: 3-1/2D LCD Digital Panel Meter; PM-129: 3-1/2D LED Digital Panel Meter

Features

- 200mV Full Scale Input Sensitivity
- PM-128 - Single 9VDC Operation
- PM-129 - Single 9VDC Operation
- Decimal Point Selectable
- PM-128 - 13mm Figure Height
- Automatic Polarity Indication
- Guaranteed Zero Reading for 0 Volt Input
- High Input Impedance (>100Mohm)

Specifications - PM-128/PM-129

Maximum Input : 199.9mV DC
Maximum Display : 1999 counts (3-1/2 Digits) w/Automatic Polarity Indication
Indication Method : PM-128 - LCD Display; PM-129 - LED Display
Measuring Method : Dual-Slope Integration A/D Converter System *(cont.)*

(cont.)
Overrange Indication : "1" Shown in the Display
Reading Rate Time : 2-3 Readings per sec.
Input Impedance : >100 Mohm
Accuracy : +-0.5% (23+-5°C, <80% RH)
Power Dissipation : PM-128 - 1mA DC; PM-129 - 60mA DC
Decimal Point : Selectable w/Wire Jumper
Supply Voltage : PM-128 - 9V DC; PM-129 - 9V DC
Size : 67mm x 44mm

Applications Include:

- Voltmeter
- Thermometer
- pH Meter
- dB Meter
- Watt Meter
- Current Meter
- Capacitance Meter
- LUX Meter
- LCR Meter
- Other Industrial & Domestic Uses

Positive Photo Resist Pre-Sensitized Printed Circuit Boards

These pre-sensitized printed circuit boards are ideal for small production runs. They provide high resolution and excellent line width control. High sensitive positive resist coated on 1oz. copper foil allows you to go direct from your computer plot or art work layout. No need to reverse art.

Single-Sided, 1oz. Copper Foil on Paper Phenolic Substrate

CAT NO	DESCRIPTION	PRICE EACH 1	10	50
PP101	100mm x 150mm/3.91" x 5.91"	$2.55	$1.90	$1.70
PP114	114mm x 165mm/4.6" x 6.6"	2.98	2.45	1.98
PP152	150mm x 250mm/5.91" x 9.84"	5.40	3.98	3.60
PP153	150mm x 300mm/5.91" x 11.81"	6.15	4.48	4.10
PP1212	305mm x 305mm/12" x 12"	12.78	10.65	8.52

Single-Sided, 1oz. Copper Foil on Fiberglass Substrate

CAT NO	DESCRIPTION	PRICE EACH 1	10	50
GS101	100mm x 150mm/3.91" x 5.91"	$ 3.90	$2.98	$2.60
GS114	114mm x 165mm/4.6" x 6.6"	4.80	3.49	3.20
GS152	150mm x 250mm/5.91" x 9.84"	8.69	5.98	5.78
GS153	150mm x 300mm/5.91" x 11.81"	10.20	7.20	6.80
GS1212	305mm x 305mm/12" x 12"	18.88	15.73	12.59

Double-Sided, 1oz. Copper Foil on Fiberglass Substrate

CAT NO	DESCRIPTION	PRICE EACH 1	10	50
GD101	100mm x 150mm/3.91" x 5.91"	$ 5.07	$3.68	$3.38
GD114	114mm x 165mm/4.6" x 6.6"	5.95	4.29	3.99
GD152	150mm x 250mm/5.91" x 9.84"	10.47	7.39	6.98
GD153	150mm x 300mm/5.91" x 11.81"	11.95	8.69	8.30
GD1212	305mm x 305mm/12" x 12"	22.09	18.35	14.68

Developer

This product is used as the developer on our positive photo-resist printed circuit boards. Includes instructions. 50 gram package, mixes with water, makes 1 quart.

CAT NO	DESCRIPTION	PRICE EACH 1	10	25
POSDEV	Positive Developer	$ .95	$ .80	$ .50

Etching Tank

This handy etching system will handle PC boards up to 8" x 9", two at a time. Ideal for etching your PCB's! System includes an air pump for etchant agitation, a thermostatically controlled heater for keeping etchant at optimum temperature and a tank that holds 1.35 gallons of etchant. A tight fitting lid is also supplied to prevent evaporation when system is not being used. Typical etching time is reduced to 4 minutes on 1oz. copper board!

CAT NO	DESCRIPTION	PRICE
12-700	Etch Tank System	$37.95

REDUCES ETCHING TIME!

Etching Chemicals/Ferric Chloride

A dry concentrate that mixes with water to make 1 pint of etchant, enough to etch 400 sq. inches of 1oz board.

CAT NO	DESCRIPTION	PRICE EACH 1	5
ER-3	Makes 1 pint	$3.50	$2.75

Digital Panel Meters (LCD & LED)

3-1/2 Digit LCD 3-1/2 Digit LED 4-1/2 Digit LCD

PM-328: 4-1/2D LCD Digital Panel Meter

Don't let the prices fool you. These digital panel meters are not surplus, so even if you design them into an ongoing manufactured product, you can be assured of continued availability. These high quality digital panel meters are decimal point selectable with guaranteed zero reading at zero volts input.

Specifications - PM-328

Maximum Input : 199.99mV DC
Maximum Display : 19999 counts (4-1/2 Digits) w/Automatic Polarity Indication
Indication Method : LCD Display
Overrange Indication : "1" Shown in the Display
Input Impedance : >100 Mohm
Accuracy : +-0.05% (23+-5°C, <80% RH)
Power Dissipation : 1mA DC
Decimal Point : Selectable w/Wire Jumper
Supply Voltage : 9V DC
Size : 67mm x 44mm

Features:

- 200.00mV Full Scale Input Sensitivity
- Single 9V DC Operation
- Decimal Point Selectable
- 11mm LCD Figure Height
- Automatic Polarity Indication
- Low Battery Detection and Indication
- High Input Impedance (>100 Mohm)

CAT NO	DESCRIPTION	PRICE EACH 1	10	25	100	250
PM-128	3-1/2 Digit LCD Panel Meter	$ 9.90	$ 7.09	$ 6.40	$ 5.86	$ 5.25
PM-129	3-1/2 Digit LED Panel Meter	11.49	9.54	8.67	7.95	6.95
PM-328	4-1/2 Digit LCD Panel Meter	19.88	16.40	14.90	13.66	11.93

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Patent No. 5,471,408

FEATURES

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BASIC Stamp® computers

Tiny computers run PBASIC programs

BASIC Stamps answer the request for small, low-cost, easily programmable computers. BASIC Stamps are programmed in Parallax BASIC (PBASIC), a simple language with powerful I/O instructions. BASIC Stamps have their own PBASIC interpreter, non-volatile EEPROM, and 5-volt regulator. Because of their reliability and ease of programming, BASIC Stamps are the microcontroller of choice for hobby projects and industrial control.

Mechanical insect controlled by BASIC Stamp
Parallax's United Kingdom distributor Milford Instruments (www.milinst.demon.co.uk) uses the BASIC Stamp I to control servos, LEDs and antennae switches in their BASIC Stamp Bug kit. The BASIC Stamp Bug was a popular guest in our booth at the June COMDEX show in Atlanta, Georgia, and now finds its way into our regular product line. Call for pricing and availability of this little beast.

Plastic extrusion machine industrial application
Fisher Automation of Whitestone, New York uses BASIC Stamps in their plastic extrusion machines to sense the appropriate time to start a cut cycle and sequence several pneumatic valves. Fisher Automation reports that "the BASIC Stamp has proven extremely reliable in our applications, running 24 hours per day, seven days a week, and performing up to 70 cuts per minute."

BASIC Stamp® modules

BS1-IC Module **$34**
8 I/O lines
80 PBASIC instructions max.
2000 instructions/sec.
2400 baud serial I/O
14-pin SIP module

Familiar PBASIC language with I/O instructions including BUTTON, HIGH, INPUT, LOW, OUTPUT, POT, PULSIN, PULSOUT, DEBUG, PWM, REVERSE, SERIN, SEROUT, SOUND, and TOGGLE.

BS2-IC Module **$49**
16 I/O lines
500 PBASIC instructions max.
4000 instructions/sec.
50k baud serial I/O
24-pin DIP module

Similar language as BS1-IC, plus DTMFPUT, FREQOUT, SHIFTIN and SHIFTOUT, XOUT (X-10 powerline control), etc. I/O functions common to both modules have a higher resolution on the BS2-IC, due to its faster clock speed. Larger EEPROM, high speed, and diversity of instructions make the BS2-IC our most popular product.

BASIC Stamp® Starter Kits

BASIC Stamp I Starter Kit (part #27205) $99
BASIC Stamp II Starter Kit (part #27203) $149

BASIC Stamp Starter Kits include the BS1-IC or BS2-IC modules shown above, carrier board with prototype area and 9-volt battery clip, manual, application notes, and software. Free technical support is also included.

BASIC Stamp II Starter Kit shown with BS2-IC module on carrier board

Serial LCD Displays

2-line x 16 character LCD display (part #27910)	**$54**
4-line x 20 character (part #27919)	**$109**

Serial LCD modules from Scott Edwards Electronics take one BASIC Stamp I/O line and ground, and are controlled with simple SEROUT instructions.

BASIC Stamp AppKits

MAX7219 8-digit LED display driver (part #27914)	**$26**
LTC1298 12-bit A/D convertor (part #27916)	**$26**
DS1620 digital thermometer / thermostat (part #27917)	**$26**
CM8880 DTMF Transceiver (part #27915)	**$26**
Xicor X25640 8k serial EEPROM (part #27918)	**$26**

AppKits include all the materials you need to learn about interfacing electronic parts to the BASIC Stamp. Each AppKit contains a sample device and supporting components, easy to read documentation, and source code.

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