

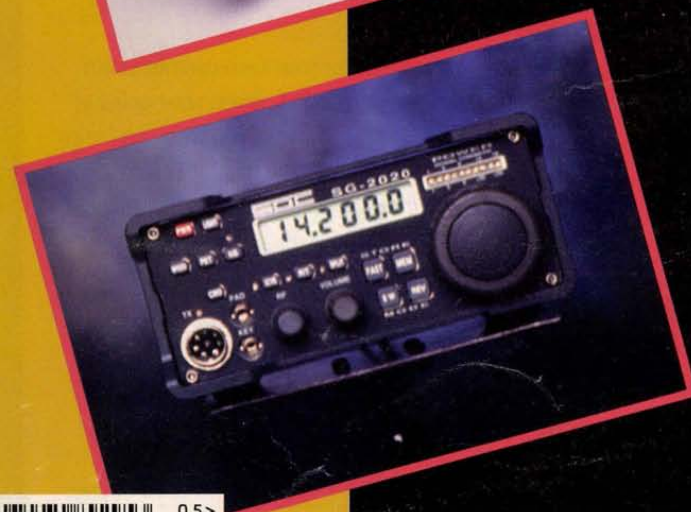
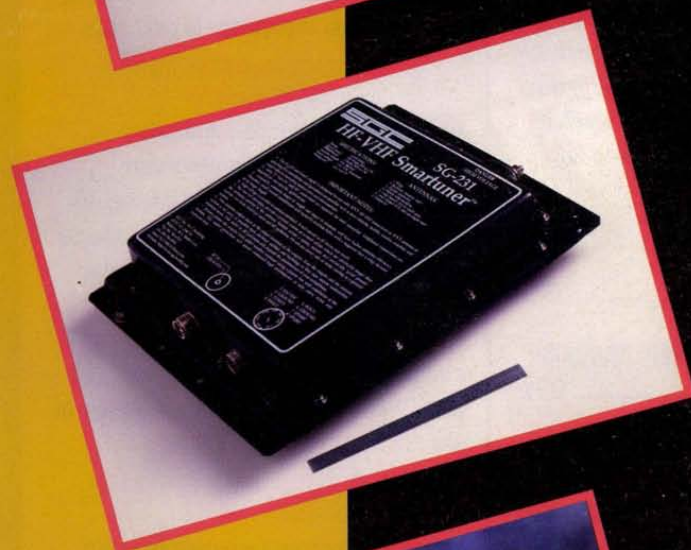
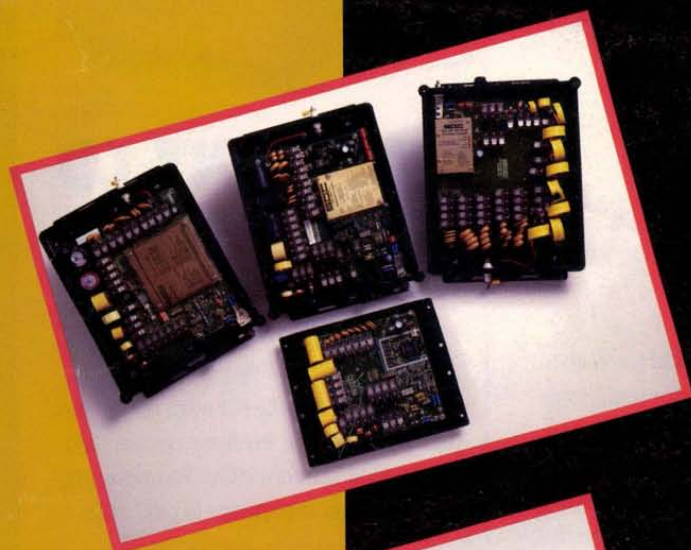
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May 1998 Vol. 19 No. 5



**HIGH-
FREQUENCY
2-50 MHz
AUTOMATIC
ANTENNA
COUPLERS**

From SGC

**PINT-SIZED
SSB OFFERS
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- For those who purchased (or missed out) on our offering of the Kalidor palmtop computers, please inquire at our Santa Clara store. Although the original new computers we had sold out very quickly, we have come up with a limited supply of refurbished units, as well as some accessories, like the parallel-port keyboards (above) and RAM modules.

Sound Card Specials!

- Diamond Multimedia Wavetable Sound Card**
- Multi-interface for CD-ROM (Sony, Mitsumi, Pana., IDE)
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- New OEM pack, instruction sheet, 90-day HSC warranty

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- MediaVision Premium 3D Sound Card**
- 16-bit audio, 44.1KHz digitized stereo sound
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- Internal SCSI-2 CD-ROM port, microphone jack (mike not included), line-in & speaker jacks, joystick port
- Includes driver disks, instruction sheet
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- Bargain on used, knee high 19" rack cabinets!
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- Made by AMCO Engineering
- Units are used, but in good shape
- Best if you pick up (cannot go UPS)
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HSC# 17069

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Absolute Last of the Red Hot Reno!

- Now at clearance price -- Media Vision **Reno**:
- Consists of new external Reno CD-ROM drive, docking bay with SCSI2 port, AC Adapter, cable kit, travel pouch, headphones
- Late Model version Uses AC adaptor (included) or AA alkaline batteries (not included)
- Double-speed 180ms drive is lightning fast!
- Drive detaches from docking bay, use with headphones as a portable personal audio CD player
- Great for Mac or IBM (adaptor bracket included)
- SCSI Controller & software required for IBM use
- Brand new, 90-day warranty

Now -
\$59.00

Available Separately:
A. Macintosh Powerbook SCSI Adapter (HDI-30 to 25-pin D connector) HSC#15704 \$12.50 if purchased alone, or with purchase of Reno Kit, \$5.00

PCMCIA Device Corner

We present here a collection of PCMCIA items that we have accumulated (note - limited quantities!):

Trimble Mobile GPS Gold Card

- Turn your notebook into a GPS locator!
- Receiver is PCMCIA Type I card
- Includes roof or panel-mount antenna with 15' cable
- Trimble Mobile GPS software & instructions included
- Software gives coordinates, not maps
- New, OEM pack, 90-day warranty

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85MB PCMCIA Hard Disk Drive

- Integral Peripherals Model 1882PA 85 MB drive
- Add Plug and Play storage to your notebook any time!
- New, OEM package (no box), 90-day warranty

\$69.00

170MB PCMCIA Hard Disk Drive

- Integral Peripherals Model 8170E "Viper 170E" drive
- Add even more storage to your notebook any time!
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Flash RAM Mass Storage Modules

- These are not technically PCMCIA devices, but they are small modules that will enhance your notebook computer!
- SunDisk Solid-state Mass Storage modules behave like a hard disk with no moving parts...nothing to wear out!
- Non-mechanical storage means high speed, ruggedness!
- IDE-interface (2mm 44-pin-style), instruction sheet
- New pulls from custom systems -- DOS formatted

10.4MB Flashdrive

\$65.00

20.9MB Flashdrive

\$95.00

41.9MB Flashdrive

\$175.00

X-Windows Terminal!

- Tiny Axil/Hyundai X/11C smart terminal has big features!
- Connect to Ethernet (Coax or AUI), SLIP, or both!
- Built-in 10Base2 transceiver, 10Base5 AUI interface
- Uses a variety of protocols, TCP/IP, SLIP, TELNET, RARP, BOOTP, XDMCP, or PPP
- Comprehensive self-test and help menus for setup
- Requires 63.75KHz Horizontal, 67.9KHz Vertical (workstation-type) monitor, resolution is 1152 x 900
- RAM can be upgraded to 16MB (4MB SIMM included)
- New in box, includes 101-key keyboard, mouse, manual
- Measures 11.5" x 11" x 2", keyboard is 18" x 7"



HSC#17213

\$149.95

Infrared Connections!

- IBM "Options" series ISA-Bus and PCMCIA card adaptors will add industry standard infrared communications capability to your desktop PC (with ISA slots) or notebook computer! (Win95 instructions available on our website)
- Allows wireless connection to compatible notebooks, workstations, printers, and other peripherals supporting the Infrared Data Association (IrDA) standard.
- Also will emulate a COM port for cable-less hook-ups
- Communicates up to 115Kbps, or up to 1.152Mbps with the included TransIt Software.
- Operates over distances up to 3 meters (10 ft.)
- Includes Card, transceiver module, driver disk & book
- Both styles new in box, 90-day warranty



HSC#16483 PCMCIA Version

\$19.95

HSC#16813 ISA-Bus Version

\$19.95

Or a package deal...get both for

\$29.95

PC Videotape Editor!

- Use your computer to edit your home videos!
- Delete footage, rearrange up to 99 scenes automatically!
- No expensive computer cards to install!
- Requires 386 or higher computer, Sony-type Control-L (LANC) source camcorder and a recording VCR with infra-red remote control with TV or video monitor.
- Unit consists of a cable to control the playback of your camcorder, and an infra-red transmitter to control VCR
- Plugs into parallel port of your computer -- no disassembly of your computer required!
- Includes software (Win3.1 compatible) cables and manual
- New in box - 90 day warranty
- Requires 9V battery, not included

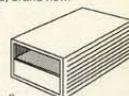


HSC#17154

\$29.95

SCSI Drive Case Deal!

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



HSC# 17130 5.25" SCSI Drive Case

\$39.95

Full CD-ROM / Sound Card Kit

- Diamond Multimedia 12X CD-ROM kit -- Full Bundle!
- 12X Mitsumi Internal IDE CD-ROM drive
- 32-voice Wave Table sound card, 3D Audio
- Installation video, manuals, driver software included
- Includes Myst, CorelDraw 4.0, several CD Games
- New in colorful retail box, 90-day warranty

HSC#17198

\$99.00

Briefcase of Goodies!



- These handsome hardshell cases were used to carry a laptop-computer estimating system (laptop not included)
- They accept a Compaq LTE laptop, and provide a SCSI port to connect a CD-ROM drive with battery back-up!
- Large Nicad pack has 10 D-size Sanyo Cadnira cells.
- Built-in charger and battery monitoring circuitry
- Tiny piggy-back PC board is a SCSI interface
- Case measures 18" x 14" x 7", with several compartments
- SCSI II to CEN50 SCSI cable, many great parts inside!
- Hurry, these won't last long, especially the 50-footers!
- Buy either the whole assembly, or just the component parts you are interested in! Used, 30 day warranty

HSC#17180 Complete Laptop Case \$49.95

HSC#17182 Empty Hardshell Case \$29.95

HSC#17181 Nicad Pack, 12.5VDC, 5AH \$17.50

HSC#17179 SCSI II Cable, 1 ft. long \$12.50

Media Vision PCMCIA Sound!

- Great for Portables, Laptops with PCMCIA Slot
- External pod has joystick port, mic. input, line in & line out jacks, volume control.
- Installation software, instructions included
- Windows 3.x, Windows 95 compatible
- New in OEM packaging (no box), 90-day HSC warranty
- We had these before at \$39.95 and they went fast!

HSC#17036

\$29.95

Rugged Mike & Speaker!

- Extra-heavy duty hand-held microphone & enclosed speaker for extreme environmental use
- Made by GE for Ericsson EDACS "Orion" mobile radios
- Easily modifiable for your own use (ham, CB, etc.)
- Brand new in box, with custom Ericsson power cable



HSC#17172

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Extra-long Cord Outlets!

- Don't daisy-chain those outlet strips to get power where you need it! (The fire department doesn't approve!)
- Multi-outlet SG/Wabur outlet strips have extra-long cords
- UL Approved, metal housings, 15 Amp circuit breaker
- Brand new, two lengths to choose from!
- Hurry, these won't last long, especially the 50-footers!

HSC#17172 4-Outlet strip w/ 15' cord \$9.95

HSC#94148 3-Outlet strip w/ 50' cord \$17.50

Backup Tape Drive Deal!

- Conner Peripherals CTM 420R-F 400MB tape drive
- Unit fits in 5.25" drive bay
- Uses commonly available DC2120XL tapes
- Connects to standard floppy interface
- Works directly with Windows 95 Backup utility
- Includes new Sony QW5122F QIC tape (\$4.95 value!)
- New, OEM package, 90-day warranty

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2-50 MHz
AUTOMATIC
ANTENNA
COUPLERS**

From SGC



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SSB OFFERS
GREAT
PERFORMANCE**

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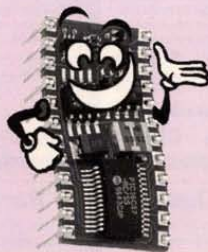
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Nuts & Volts Magazine encourages article submissions and queries. Send a SASE for a copy of our writer's guidelines. All submissions should be on 5-1/4 or 3-1/2 inch diskettes and include hard copy as well. If return of materials is requested, include a SASE with your submission. Deadlines should be discussed in advance with the editor, but generally all material should be submitted two weeks prior to the 1st of the month for the next month's issue.

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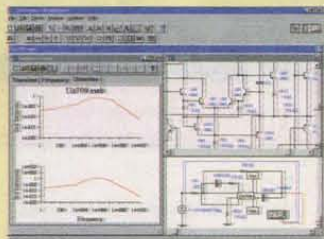
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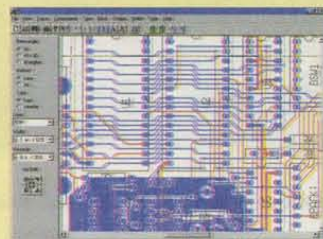
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PINT-SIZED SSB OFFERS GREAT PERFORMANCE

by Gordon West

The name "SGC" is well-known and respected in marine communications, amateur radio MARS installations, and military COMMS. SGC equipment is built in the USA at their large corporate office settled among the tall trees in Bellevue, WA.

SGC is also known for automatic antenna couplers. These couplers require absolutely no data line connection to a transceiver, and they tune up any kind of long wire or vertical radiator from 10 feet to 300 feet, from 1.8 MHz through 54 MHz.

And if it's POWER that you may want, SGC also produces a solid-state, 500-watt, 1.8 MHz-30 MHz linear amplifier, along with a 500-watt automatic antenna tuner that can take the half a kilowatt.

SG-2020

SGC has just introduced a new high-frequency SSB transceiver, Model SG-2020. This pint-sized performer weighs only 4-1/2 pounds minus the snap-on, 12-volt power pack, and covers from 1.8 MHz to 30 MHz CW, lower sideband, and upper sideband frequencies. The ham band version transmits on all amateur radio high-frequency bands, and an export ver-

sion transmits continuously from 1.8 MHz to 30 MHz.

The SG-2020 gets its model number name by 20 pre-memorized memo channels, and 20 watts minimum peak output power. The ham version we tested was factory pre-memorized on each one of the ham bands including the WARC bands plus reception of WWV at 10 MHz and 15 MHz. The time signals allow hams, mariners, or shortwave listeners to tune into the WWV ionospheric propagation report at 18 minutes past the hour, plus GPS and ocean weather updates, plus every-second time ticks. Also, the inclusion of WWV in the memory may allow mariners to accurately set the tuning dial within 1 Hz for the reception of weather facsimile signals.

The 20 watts listed for power output is a conservative rating. On our test bench, we could actually whistle it up to 40 watts of peak envelope power output on the ham bands. Power output slightly fell off on the 10-meter band, but was still well above the 20-watt minimum.

But don't sneeze at 20-40 watts of power output when thinking that this radio might not perform as well as one of those super-small ham rigs. Most of the new ham rigs have the ALC (automatic limiting control) set so tight that normal speech is around the 30-



The LCD display was easy to see in the bright daylight.



Passband tuning of the IF reads out on the front panel.



The SSB radio works all the way down to 10 volts without any problems.

reader FeedBack

Dear Nuts & Volts:

On page 88 of the Jan. '98 issue, Mr. Carr discusses the gain of the preamplifier. He gives the formula: Gain = $(R2/R1)+1$. This is not correct.

If we assume that the intrinsic gain of the opamp is very large, then the voltage at the input to the opamp will be near zero. However, the currents into/out of a given node must add up to zero, thus, $E_{out}/R2 = E_{in}/R1$, and hence, Gain = $R2/R1$.

G. Zomber
Venice, CA

Dear Nuts & Volts:

Your advice on "Refilling

Toner Cartridges," pg. 105, Mar. '98 issue, is not very good.

1. It is hardly worth the effort to do just one. The inexperienced person is more likely to ruin the cartridge through inept handling and render it useless even for an established recycler.

2. The toners are not all the same. A copier cartridge may look like a laser printer cartridge, but they are totally different. A copier uses visible light. A laser printer uses infrared. They are not interchangeable. Though they may appear identical, except for a subtle keyway, the OPC imaging cylinders are formulated for the respective light source. The toner is also specifi-

cally formulated.

3. Merely refilling with toner is insufficient as other critical parts need to be replaced: seals, wiper blade, OPC, etc. An experienced recharger does all this and makes the cartridge as good as new.

4. Trade in your used, unaltered cartridge at your local recharger and get one as-good-as-new at much less than store prices.

Dan
Sacramento, CA

Dear Nuts & Volts:

I am writing in regard to TJ Byers' answer to Will Byers about sources of dual pots in the Mar. '98 issue.

The only dual pot listed in All Electronics catalog #697 is a 5K linear taper. Another good source of surplus pots is Electronics Goldmine 1-800-445-0697 (see their ad on pg. 7 of the same issue of *Nuts & Volts*). All Electronics and Electronic Goldmine are surplus suppliers, and may, or may not, have a

required value.

Another *Nuts & Volts* advertiser, Mouser Electronics 1-800-992-9943 (see ad on pg. 16 of the Mar. '98 issue), stocks new, non-surplus, dual pots. Xicon 24 mm linear taper dual pots are stocked in nine resistance values, including 10K and 50K, at less than \$2.50 each. Piher dual linear taper pots, 10K and 100K, are less than \$3.00 each.

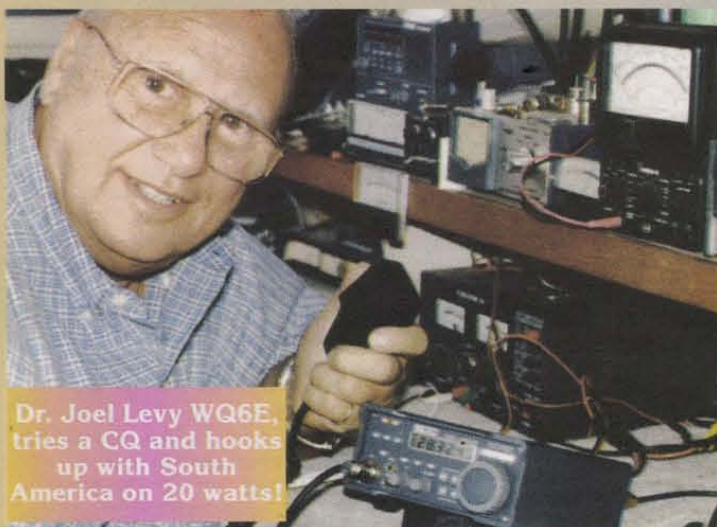
Unfortunately, audio taper dual pots, which Mr. Byers prefers, are harder to find. The only one I am aware of is a 100K unit from Radio Shack (stock number 271-1732, \$1.99 in their 1998 catalog).

Bill Stiles
Hillsboro, MO

Dear Nuts & Volts:

In the April '98 issue, page 107, the figure at the bottom (answer to Question #2984 by Robert V. Miller), I believe diode D2 needs to be flipped so the anode is on top and the cathode on the bottom. Or else it looks

Continued on page 11



Dr. Joel Levy WQ6E, tries a CQ and hooks up with South America on 20 watts!

40 watt level. Sure, you can whistle an ICOM, Alinco, and Kenwood up to 100 watts, but as they come from the factory, typical power output loads around 30 to 50 watts with normal speech.

The SGC-2020 SSB HF transceiver is ideal for field day operation. Output power is adjustable from just a few milliwatts up to 20 watts and more peak envelope power. At 20 watts, current consumption is only four amps, and down at 1 to 5 watts QRP operation, current consumption is just over one amp. This means you could power this unit quite nicely off of a small gel battery and a solar panel during field day operation. The LCD display is perfectly readable in the bright sunlight, and is back-lit for nighttime operation, too. You can even turn off the back light to conserve power requirements.

If you're into CW, the SG-2020

contains a fully adjustable lambic keyer, menu-adjusted from 5 wpm to 60 wpm. A 3.5 mm stereo jack is provided for the keyer paddle. The tip connects to the dot paddle, and the sleeve connects to the dash paddle. There is also a 3.5 mm phone jack for a straight key. The key sees +5 volts at a few mils. We found that the 2020 is set up for full break-in operation, and transmits when the key is closed. A side tone of 650 Hz is also activated.

We liked the idea that the twin-key jacks were on the front of the radio, rather than inconveniently placed on the back.

The 2020 runs on DC, operational from 10 volts DC to 15 volts DC. There was very good synthesizer regulation and, as long as the voltage would not fall below 11 volts, or exceed 15 volts, we could not tell any drift of incoming CW signals.

HF TO GO

The World's Smallest Full-Featured HF-SSB Radio

Write in 219 on Reader Service Card.



The SG-2020 is the perfect choice for base, backpacks or business trips. • Weighing in at just 4.5 pounds, the SG-2020 features fully adjustable output power from 0 to 20 watts PEP. • Low current requirements in receive mode allow practical battery pack operation. • A bullet-proof front end provides third order intercept at better than +18dB, virtually eliminating adjacent channel interference. • Designed with the portable user in mind, it comes complete with built-in, fully adjustable mode 'B' lambic keyer, VOGAD baseband speech processing and RF clipping. • All this plus legendary SGC quality and reliability at an incredibly low price.

SG-2020

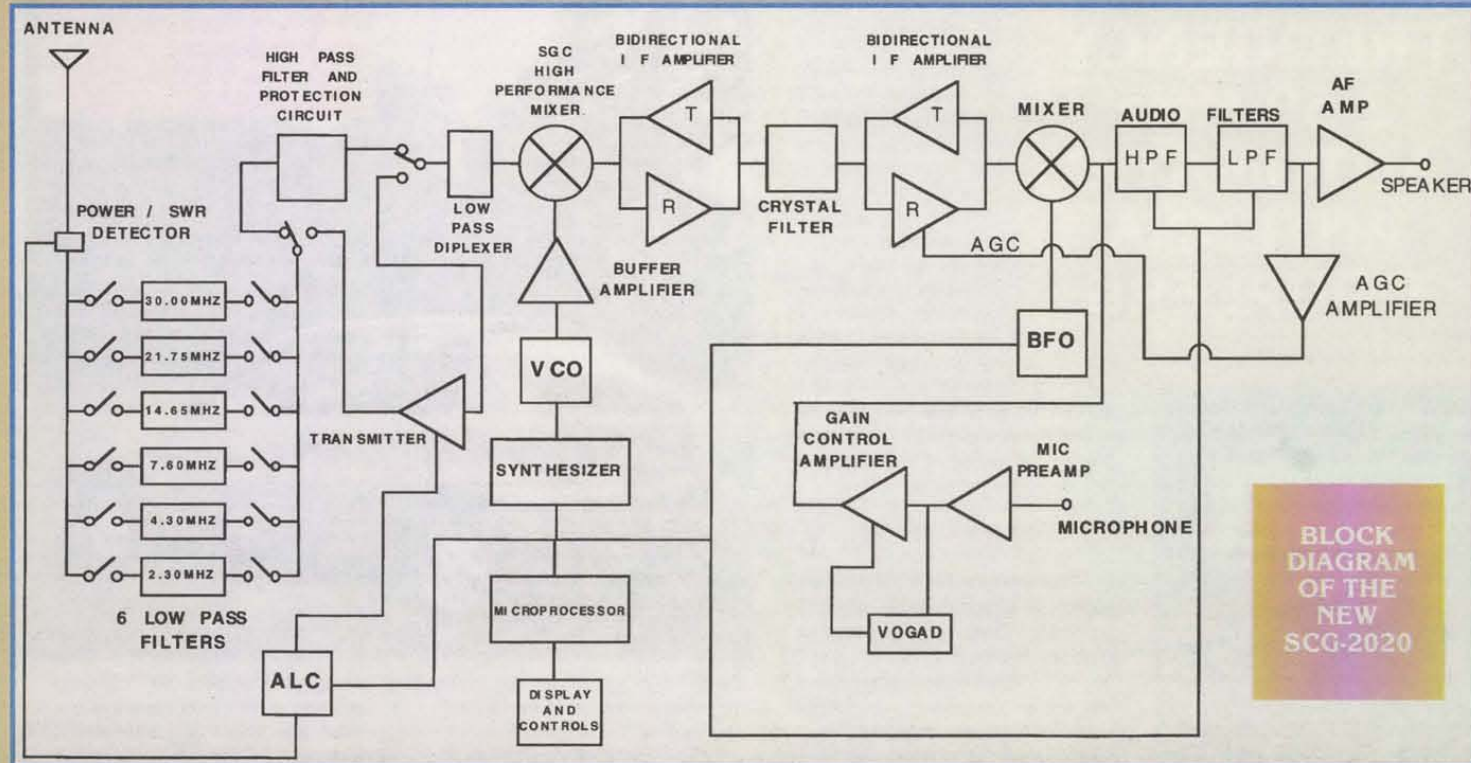
For complete details on the SG-2020, see your SGC dealer, or check out our website.

SGC

1-800-259-7331
www.sgcworld.com



P.O. Box 3526 Bellevue, WA 98009 USA
Phone: (425) 746-6310 Fax: (425) 746-6384 Email: sgc@sgcworld.com



**BLOCK
DIAGRAM
OF THE
NEW
SGC-2020**

Two unique features of the receiver are the capabilities of shifting the pass band, as well as adjusting the band width. Pass-band tuning will shift the IF from -1000 Hz to +300 Hz in 100-Hz steps. This allows you to favor one side of a signal or the other to escape adjacent frequency interference. You can also crank down the band width in all modes from a pre-set of 2.7 KHz all the way down to 100 Hz in 100-Hz steps. If you do a lot of CW work, you'll preset the band width around 500 Hz as we did.

There is an RF gain control, and we normally left this full on. The receiver was plenty sensitive, but we didn't notice the customary amount of background noise on the higher bands usually associated with a built-in pre-amplifier. But nonetheless, sensitivity was good. There is also a button for noise blanker, but our prototype test radio may not have had the noise blanker module included. Pushing the button made absolutely no difference on any kind of pulse-type noise.

The 2020 also gives you full capabilities to operate split. This might allow you to listen on one frequency for rare DX just below the USA band limits, and transmit

back to that station on USA bands. There is also a REV button that lets you momentarily listen for a clear spot to return the call to them within your USA band limits.

Tuning steps off the big knob are about 5 KHz per revolution in 10-Hz steps. You can go to fast tuning by pressing the fast button while tuning the main knob, and now you are at 120 KHz per revolution. And to change bands quickly, press and hold MEM and turn the big knob, and it will cycle through the pre-memorized ham bands plus WWV.

I bet this radio becomes a popular one with mariners who may operate out-of-country. The export version of this radio tunes continuously on BOTH transmit and receive from 1.8 MHz to 30 MHz. And, with the split capabilities, it could allow you to work the high seas Coast Guard and the high seas marine operator quite nicely. It would work just fine for ship-to-ship use on marine bands, and the fast switching time between transmit and receive could allow it to work with some of the high-frequency E-Mail providers. But there are no auxiliary jacks on the back, so you'll need to tie in your modem via the front microphone jack. Yes, there

is a provision for an external speaker out the rear — but aside for the SO-239 antenna connector, and the 13.6-volt DC plug that always seem to fall out, that's it for the back.

A very bright light-emitting diode S-meter also doubles as a power output meter. You can also judge by power output on what your SWR is doing, too. If you transmit full power into a mismatched load, you'll notice that after your second syllable, power will automatically adjust back to only one or two light-emitting diodes. As soon as you hook up the proper antenna for the right band you are on, at 20 watts the power output LEDs go all the way to the right.

There are also several sub-menu functions. One we liked — fast incremental value tuning. While pressing CMD and FAST simultaneously, we would turn the main tuning knob to adjust the incremental tuning value by .1, .5, 1, or 10 KHz. We could then store this value into memory by pressing MEM. But if you remove power, or if the power plug should drop out, this setting goes away along with pass-band tuning. Like all good HF radios, the SG-2020 has all sorts of memory scan options,

including adjustable dwell time, pause, audio blanking, frequency step, and the like. You can either scan by pre-memorized channels, or simply look up the band electronically via the scan control.

Probably the best part of this equipment is the capabilities to snap on the accessory 12-volt power pack. This could allow you to stick this radio in a back-pack, and go QRP mountain-topping. You might want to drag along a flexible solar panel to keep things all charged up. A simple little dipole, and you're on the air.

I also see this rig popular among mariners who may use this rig out-of-country on marine bands, and in country on ham bands. It's about \$200.00 less than the Kenwood TS-50 ham set.

Looks like SGC has another industrial-strength, high-frequency transceiver to add to a complete line-up of ham and marine HF high-power sets. With the strap-on battery kit, this is indeed a unique transceiver for portable field day operation. **NV**

For more information, contact SGC, Bellevue, WA; 425-746-6310, or E-Mail SGC at SGCworld.com. Street price \$699.00.

HIGH-FREQUENCY 2-50 MHz AUTOMATIC ANTENNA COUPLERS

by
Gordon West

In the last couple of months, we have described high-frequency antennas for mobile and mobile-marine applications, using half-wavelength resonant configurations. This could be the simple halfwave dipole, cut for a specific frequency, or a one-quarter wavelength whip mounted over metal that makes up the necessary counterpoise.

In the past couple of issues, we looked at the effects of small mobile whips and saw how easily they mount on a vehicle for good omnidirectional coverage. We also saw that the shorter the whip, the lower the radiation resistance, the less signal you get out onto the airwaves. We also looked at the importance of a good ground plane and a good surface ground to enhance the performance of the whip on high-frequency bands.

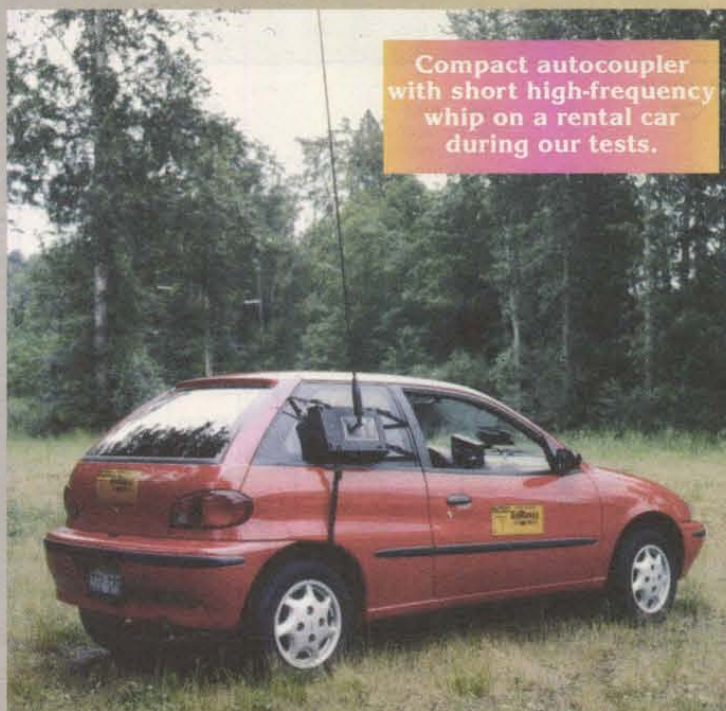
ONE WIRE/ALL BANDS

This month, we'll explore a single tall whip that can be externally resonated to work on any and all frequencies from 1.8 MHz up to 52 MHz. No screwdriver motor needed. We will also explore base station use of a long-wire antenna that may be externally resonated so it looks

like a perfect load to your all-band, high-frequency transceiver between 1.8 MHz to 52 MHz.

You are probably thinking ANTENNA TUNER. You might be right. But, you might be wrong because the term "antenna automatic tuner" may not necessarily

built into the modern high-frequency amateur transceiver should really be called an automatic antenna TRIMMER. These devices are found in your larger amateur radio high-frequency transceiver that may be advertised with a "built-in automatic antenna tuner." Gosh, wouldn't this



Compact autocooupler with short high-frequency whip on a rental car during our tests.

be the right gizmo for the particular job that it may need to do. Let's explore further.

The automatic antenna tuner

work great on that big long wire, strung out from your backyard palm tree over to the barn roof, 200 feet away? Or maybe mount that

new high-frequency transceiver in your vehicle and push the automatic tuner button to resonate that big stainless steel whip coming off the back bumper that has been hanging around since your early years on CB.

Won't work. Here's why. BUILT-IN ham radio high-frequency automatic tuners are designed specifically to "touch up" 50-ohm resonant antennas that may need to be operated slightly off of their resonant center frequency. *slightly.*

The built-in automatic antenna tuner into ham high-frequency transceivers can generally handle an SWR of 3:1 or less. The built-in automatic tuner works nicely if you have set your 75-meter resonant whip to 3950 KHz, but you need to check into Bob's CAT net at 3868 KHz. Although your mobile whip or home station dipole may not be exactly set for this portion of the band, the built-in ATU (automatic tuner unit) will click or grind away and find the resonant point to unleash full power output.

You see, unless you bring a perfectly resonant load to your antenna port, your transceiver will usually cut back on power output. At 2:1, power output is reduced to about 70 watts on most HF sets. At 3:1, your power output drops below 40 watts on most sets. Kick in the ATU, and it fools the transmitter into thinking it's going into a perfect load, and power now is back at 100 watts plus. Most of the power makes it to your slightly off-resonant antenna, and a little bit of power is soaked up by the feedline because your SWR is still 3:1 from the output of the antenna SO-239 on the back of the rig.

Now let's try transmitting into that eight-foot stainless steel CB whip up on the 10-meter band. No problem here — that 11-meter whip is just a little off-resonance on 10 meters, and the built-in ATU should bring the SWR down to a flat 1:1.1. But now let's try it down on 20 meters. The SWR will probably be whacko, but you bought this new high-frequency transceiver specifically for its automatic antenna tuner built-in capabilities, so let's give it a try.

After about 20 seconds of clicking and grinding, your radio tuner kicks out. It's doing exactly what it was supposed to do — tune everything below 3:1 and reject anything above 3:1 SWR. You go up to 15 meters, and then down to 40 meters, and the same thing happens — your built-in ATU grinds and clicks away, only to reject that CB whip.

Occasionally, the ATU may see the coax run as somewhat resonant, and clicks in. Wowzers, your CB whip is getting automatically tuned by your built-in automatic antenna tuner unit. Nope! While the tuner is unleashing your

HF transceiver's 100 watts output, that output is running into the cable with a dribble getting up into the whip, and most of it is coming back, and things are beginning to heat up. After a few minutes, you notice that no one is coming back to your CQs, your coax is getting warm, the ATU within your transceiver is getting red hot, and something may be wrong.

Built-in automatic antenna tuners are meant for 50-ohm resonant antennas that will be operated slightly out of resonance. While occasionally they may tune up on an SWR sky high, what they are actually tuning is the coax feedline, and you won't get much signal out on the airwaves.

MANUAL TUNERS

Manual tuners do a nice job of taking almost any kind of antenna system and coming up with the right amount of inductance and capacitance to resonate whatever you have onto a 50-ohm match for your transceiver. In our classes, I regularly manually tune up garbage cans, bicycles, shopping carts, patio furniture, and anything else that has metal in it to act as the radiator, against one heck of a good copper foil ground coming off the back of the antenna tuner to a massive metal ground to act as the counterpoise. The manual tuner may take several minutes of adjustment to figure out where the exact "sweet spot" is.

If you've never adjusted a manual tuner, I can tell you there is an art in how it's done. First, peak all the controls for noise, then go to transmit, and then wiggle the outside capacitors for a dip in SWR. On 10 meters, 15 meters, and 20 meters, you will have little inductance off of the click-click-click rotary knob, and capacitance about mid-scale on both outside knobs.

On 40 meters, 75 meters, and 160 meters, you will have plenty of inductance dialed in, and capacitance will need to be adjusted just as precisely as you would open up the combination of a safe. And the more metal you have out there acting as the radiator, the more signals you are going to pull in with the manual tuner.

AUTOMATIC ANTENNA COUPLERS

The automatic antenna coupler is mounted far away from the transceiver to keep the RF cable stone cold to hot SWR currents. All of the tuning to a 50-ohm match is accomplished out at the distant automatic antenna tuner installation, and that long length of coax running into your ham shack or marine SSB installation is "cold." Everything goes up in the inside, and the outside shield

is keeping everything in.

Also important is the RF safety fact that you're not having radio frequency energy jumping off of "hot" coax right into your face. Anytime you tune an antenna system down at the rig, the coax is part of the radiating antenna, and this puts unwanted power right back in the shack. With the remote-mounted automatic antenna coupler, your shack and the entire feedline run stay RF cold.

The remote-mounted automatic antenna coupler should go up in the attic of a home or townhouse. In an apartment, it needs to go up on the roof, because this is where the actual antenna radiation begins. Get it away from everyone!

In a vehicle, the automatic antenna coupler needs to go as far away from the radio system as possible, and far away from anyone sitting or standing in or around the vehicle. In a motorhome, put it way up at the roof line. In a conventional vehicle, place it back in the trunk or side-mounted on the exterior of the vehicle.

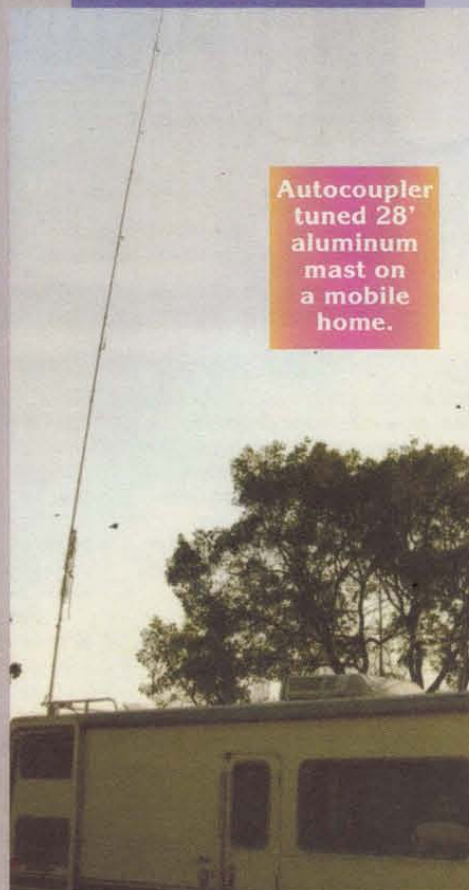
On a boat, mount it way up on the flying bridge, or way back aft in a locker for a sailboat installation. In an airplane, place it way back in the tail. In a field day installation, the tuner needs to go up at the antenna feedpoint as far away from the operator and equipment as possible.

The automatic antenna coupler is an accessory external "box" that sells for approximately \$500.00:

- ICOM AH2/AT-130, works with ICOM radios only
- Alinco EDX-2, works with Alinco radios only
- Kenwood AT-50, works with Kenwood radios only
- Yaesu FC-800, works with Yaesu radios only
- SGC-230, 231 & 235, work with all and any HF ham, air, marine, and military radio systems. SGC-303 whip recommended for ham vehicle installations.



SGC Model 303 whip on the stern of a sailboat.



Autocoupler tuned 28' aluminum mast on a mobile home.

The SGC automatic antenna coupler does not require a data line exchange with the host HF radio. All it needs is 12 volts, and any kind of RF from 10 watts and up from any kind of HF transceiver will cause it to tune up. With the other manufacturers' automatic antenna couplers, they need a

radio "handshake" in order to start tuning, stop tuning, and in some cases, band select.

And you can't mix specific-brand tuners, like trying to take an ICOM tuner and run it on a Kenwood set. Or take a Kenwood radio, and run it from an Alinco tuner. Won't work.

But the SGC will work on any radio, so it's a favorite of mine. There is also the SEA fully automatic marine HF tuner, but this equipment is only available from authorized marine electronic dealers, so we'll stick with SGC as the tuner of choice when it may run on several different pieces of equipment.

All automatic tuners feature a built-in microprocessor that analyzes the antenna load, the ground, the frequency, and the best selection of pi output or inverted-L. All tuners *must* have a

MM5480 decoder/driver. During operation, data is transferred into the CPU under program control from the array of sensor/comparators. The program monitors the status of the input sensors and, starting from a preset condition base line, manipulates the RF coils and capacitors through a control algorithm which results in a correctly-tuned condition. When the tuning algorithm is complete, the computer creates a table in non-volatile memory which correlates the status of the various network relays with the applied RF frequency.

This is memorized in EPROM IC8 and is the basis of the SGC learning feature.

This memory feature is important because going to a frequency you have operated on before down on 75 meters or 160 meters allows for the unit to recognize this same

put. Modern ham sets all throttle back if the SWR is above normal.

The SGC-230 also has the capabilities of turning on a light-emitting diode indicating correct tune. This same tuner can also take a tune-lock control assembly which commands the tuner to stay put, even though you have driven up beside a big 18-wheeler and your mobile antenna is temporarily seeing a different loading characteristic because of all the metal around it.

The SGC-230 tunes as high as 30 MHz. The SGC-231 goes as high as 52 MHz, and the SGC-235 gives you increased power output capabilities. If you plan to operate six meters, get the 231. If all you plan to operate is worldwide HF up to no higher than 29.7 MHz, get the SGC-230. If you're going to be running 500 watts, better think about the SGC-235.

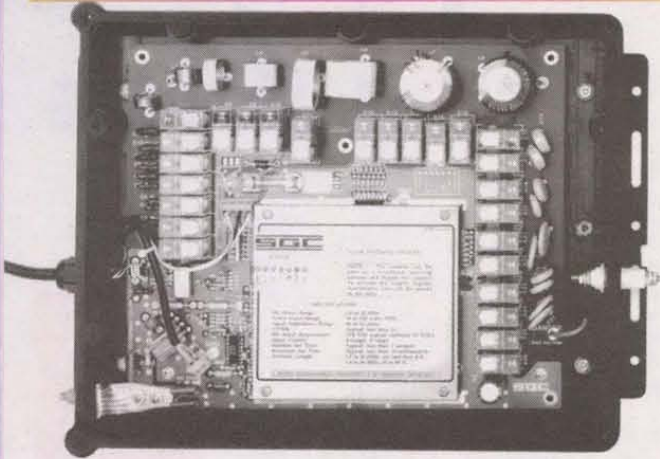
Putting out a good signal

you're going. Now you may be approaching one-quarter natural wavelength, and the tuner really does its job well.

I have found that 40 feet or more of any kind of radiating material will give you a terrific incoming and outgoing signal, just as long as you have your automatic tuner well grounded. Remote-mounted automatic antenna tuners really want to see a lot of wire on them, so I would suggest you only consider them in this long-wire configuration, rather than expecting them to perform miracles on a short CB-type whip.

In fact, during recent tests, we compared automatic antenna couplers with all sorts of eight-foot loaded mobile whip antennas, and we found that we could actually achieve a stronger transmit and receive signal strength by going to a resonant equal-length mobile whip antenna for the band we were

The automatic antenna coupler draws about one amp of current during tune-up.



ground system equal to the quarter wavelength frequency of operation as a minimum. Generally, the greater the ground, the higher the radiation resistance, and the more current that is developed on the antenna radiator.

All automatic antenna tuners from each of these manufacturers contain reed relays. No way around it. When you're switching RF currents from a 100-watt (or higher) transceiver, PIN diodes cannot handle the task at these power and dollar levels. But not to worry — the relays have been no problem, even in wet marine installations.

The job of the relays is to select the correct amount of inductors and capacitors to achieve resonance on a specific frequency with a specific length hunk of random wire and the associated ground system.

On the SGC Model 230 antenna coupler, the microprocessor is designed around the CMOS MC146805E2 CPU which features a versatile instruction set and on-chip timer and RAM. The relays are controlled through IC9, an

spot for an almost instant click-in of the multiple relays. This memorized relay latching should take about 20 milliseconds. If you're going to a new spot on the radio dial, it may take the automatic coupler one or two seconds to come up with the right amounts of inductance and capacitance for an optimum match.

With the SGC automatic antenna coupler, you need to present some RF at the frequency you plan to operate on for the tuner to recognize where you are on the radio dial. I first tune my radio for a clear frequency, double-check that I'm authorized to transmit on that frequency, quickly give my calls letters, and then say the word, "FFFFOOOOUUUUURRRR."

As I hold the word, "Four," out for a second or two, I watch the RF output indicator on whatever radio I am using; and when the RF output goes to 100 watts, I know my SWR is close to 1:1. I can verify a low SWR by going to the SWR mode on my transceiver or, if my transceiver doesn't show SWR, simply looking at power out-

depends on what you are tuning up. Generally, anything shorter than a natural quarter wavelength of wire will put you in the minus category when compared to a full-length dipole or full-length one-quarter wavelength whip off of a good counterpoise. The whole idea is to approach zero loss when compared to a dipole, and this means having plenty of wire hung on the end of your automatic antenna coupler.

For mobile operation, SGC recommends their Model 303 helical-loaded black fiberglass whip. It's several hundred dollars expensive, but it will give you an increase of performance than what might be achieved with a similar length stainless steel CB whip. You can hear the difference, but it's not going to blow your socks off switching from a stainless steel whip to the SGC-303 couple hundred dollars whip.

But the big performance increase occurs when you add some wire to that whatever length mobile whip, and throw 20 or 30 feet of wire over a nearby palm tree when you finally get to where



Automatic antenna coupler mounted on a rental car during field tests.

operating on. No automatic antenna coupler required!

But, of course, when you're going down the road and switching from 40 meters to 10 meters to 20 meters to 160 meters to 17 meters, the automatic antenna coupler and its specialized helical-loaded whip offers the ultimate in advantage with an ever-so-slight decrease in performance versus a whip for each band.

To date, no one has figured out how to get a big powerful signal on high frequency from a scaled-down antenna. So, if you have room for a big long wire up in the clear, and you plan to operate on many different frequencies, DO consider the remote-mounted, fully automatic antenna coupler for some terrific results and capabilities of operating anywhere on high frequency, including six meters, just by saying the magic word "FFFFOOOOUUUUURRRR" into the microphone from any rig.

Ask for the SGC free automatic antenna tuner fact book by calling 1-800-259-7331. **NV**

reader FeedBack

Continued from page 6

almost like a short circuit during one-half of the cycle when AC is applied.

**David Mehrl
Lubbock, TX**

Dear Nuts & Volts:

Regarding Karl Lunt's "Amateur Robotics" column on hacking the Nintendo Game Boy, for those interested in playing with video games, we have available schematics on every video game system (with a very few exceptions) to come out since day one, some 25 years ago. We often get these to reverse engineer one-two years before they are even released in this country.

**Bomarc Services
P.O. Box 1113
Casper, WY 82602**

Dear Nuts & Volts:

In the Jan. '98 issue Q & A, a reader inquired about strain gauges. Although I don't know too much about the reader's application, I believe I can offer some additional help. A wonderful source for strain gauge information is Omega Engineering (1-800-622-2378). Ask for their Volume #28 handbook/catalog — **IN THE MOST PROFESSIONAL MANNER POSSIBLE**. While Omega products can be a bit on the expensive side, Omega's support and information makes it a value for that one-of-a-kind project. In other words, get the catalog and bone up on strain-gauge basics before plunking down your hard cash.

**John P. Rivera
Bronx, NY**

Response:

The new volume is #29, and, yes, you have to sound very professional when requesting it because it's a collection of seven hardbound books that cost Omega a lot to publish. Moreover, they take up a lot of shelf space, so be careful of what you wish for, you may just get it. Fortunately, you can find the same information on their Web site (<http://www.omega.com>) — including free software demos! Omega sells a wide selection of sensor devices ranging from temperature to pressure to environmental. Check it out.

**TJ Byers
Q & A Editor**

Dear Nuts & Volts:

Regarding Mr. Chun's Doorbell Light project — although many LEDs are rated at 5V Vr (reverse voltage), they will operate at far above those ratings with no problems.

An HP rectangular green

LED will take 12 VDC (100% duty cycle) reverse voltage at infinite current (across a car battery) forever, and shows only two microamps of leakage, indicating that it is not reverse conducting even at 250 times the rated reverse voltage rating.

Modern LEDs are very robust in construction and conservatively rated.

Thank you for publishing articles that are practical — all too often we are caught up in the technical and theoretical aspects of an idea and never get around to implementing them.

Mr Chun's articles have been very entertaining and informative. Keep up the great work.

Sandy Thorpe

Response:

I'm glad to see there is so much interest in the doorbell project.

I "stress test" all of the projects I write about. As of 4/9/98, my doorbell light has been running for over 5,000 hours without any sign of trouble.

A diode in series with an alternating current is a single-wave rectifier and only rectifies in the positive half cycle, hence the assumption of a 50% duty cycle. Because it only conducts when the voltage reaches at least the forward conduction of about two volts, the power dissipation in the device will be less than 50% of the fullwave power source.

Although it is true that

EPROM+ A DEVICE PROGRAMMER FOR BENCH AND FIELD

A professional system for service and development

IMPROVED!
New features plus
more devices

FIRST GENERATION EPROMS (24 PIN) 2708, TMS2716*, 1702*
SECOND GENERATION EPROMS (24,28,32 PIN) 2516,32,64,68764/66
2716,32,64,128,256,512,513,011,010,101,1001,020,2001,040,4001,080,8001
(40,42 PIN*) 27C210,1024,220,2048,240,4002,4096,27C400,800, 27C160 (16MEG)
EEPROMS/NVRAMS (16-32 PIN) X2210/12,2804,16,17,64,65,256,512,010,ER5901,12XXX
FLASH EPROMS (28,32 PIN) [28F] [29C] [29EE] [29F] 256,257,512,001BX,010,101,020,040
SERIAL EPROMS (8 PIN INCLUDES C.S.L.C.E) [2401] 02,04,08,16,21,32,44,64,65,256 [25010]020,040,080,160,320,640,128
[59C11]13,22 [8572]82,92 [9306]13,14,46,56,66,86 [95010] 020,040,080 [35C102]104,108 [14 PIN] ER1400, MS8657
BIPOLAR PROMS (16 THROUGH 24 PIN) 82SXXX AND 74SXXX FAMILIES **FPGA CONFIGURATORS** [17C65] 128,256
PIC MICROs [12CXXX] [16C54] 55,56,57,58,55X [16C61] 62,63,64,65,62X [16C71] 73,74,71X [16C84] [16F8X] [14000]
MICROCONTROLLERS (8 BIT) [8741] 42,48,49 [8751] C51,5X,C55X [87C75X] [89C51] 52,55 [89C1051] 2051
MOTOROLA MICROS [68705P3] U3,R3 [68HC705C8] C9,J2,P9 [68HC711E9] D3
* REQUIRES SNAPS IN ADAPTER (DIAGRAMS INCLUDED OR PURCHASE ASSEMBLED AND TESTED)
□ READ, PROGRAM, COPY, COMPARE, DISK FILE LOAD & SAVE (PLUS MORE)
□ FULL SCREEN BUFFER EDITOR WITH 25 COMMANDS PLUS BYTE & WORD MODES
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most LEDs have a Vr (reverse voltage rating) of about five volts, and running it at 7 VAC RMS exceeds this, the LED will not be destroyed by it. It will only conduct in this reverse direction for a part of the negative cycle.

This reverse conduction is not linear; it has a very sharp knee somewhere between 100% and higher of the reverse voltage rating for the device.

In the worst case, the device will conduct equally in the reverse direction, doubling the power draw. In the Q & A (page 28 April '98) calculation, this would yield a total power draw of .168 watts, or about a 30% overload on a 1/8-watt resistor. If

for some reason the experimenter were to get ahold of a bad LED, it would burn out immediately on power up. One that runs at all will probably run nearly forever.

If the reader would like to have total assurance of forever operation, they can always wire two LEDs in series which will guarantee that they will not exceed the Vr for any individual device.

Small rectangular green LEDs available from parts distributors in this publication will fit just fine.

Glad to see people are looking at the projects. But one will never know for sure until they pick up a soldering iron and give it a try!

Kenton Chun

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

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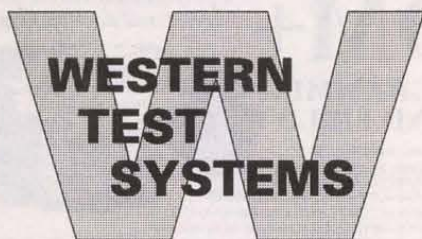
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TEK 7B53A 100 MHz Dual Time Base	\$175.00
TEK SC502 15 MHz Dual Trace Oscilloscope, TM500 series	\$375.00

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STORAGE

TEK 7633 100 MHz Storage Oscilloscope frame	\$600.00
TEK 7633 100 MHz Storage Oscilloscope with (2) 7A26, (1) 7B92A	\$900.00

PROBES

HP 1122A Probe Power Supply	\$200.00
TEK 1101 Accessory Power Supply, for FET probes	\$250.00
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 067-0587-01 Signal Standardizer	\$300.00
Calibration Fixture, 7000 series	
TEK CG5001-opt.01/TM5006 Programmable Oscilloscope Calibrator, with power module	\$6,000.00
TEK SG503 Level Generator, 250 kHz-250 MHz, TM500 series	\$600.00

WAVEFORM GENERATORS

FUNCTION

HP 3310A 5 MHz Function Generator	\$250.00
HP 3310B 5 MHz Function Generator, monocyte & var-phase trigger	\$325.00
HP 3312A 13 MHz Function Generator	\$750.00
TEK D9501 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

PULSE

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HP 214B-001 10 MHz Pulse Generator, 50 V/50 ohms, counted burst opt	\$1,750.00
HP 8005B 20 MHz Dual Output Pulse Generator	\$400.00
HP 8007B 100 MHz Pulse Generator	\$650.00
HP 8012B 50 MHz Pulse Generator, variable transition time	\$600.00
HP 8080A/81A/83A/84A 300 MHz Word Generator	\$800.00
HP 8080A/81A/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 3325A 21 MHz Synthesized Function Generator, HP1B	\$1,650.00
HP 8161A-020 100 MHz Programmable Pulse Generator, dual channel opt.	\$3,500.00
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, 500mV synthesis <1MHz	\$1,400.00
TEK AWG5105-opt.02 Arbitrary Waveform Generator, dual channel option	\$1,900.00
WAVEYEK 288 20 MHz Synthesized Function Generator, GPIB	\$1,000.00

VOLTAGE & CURRENT

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HP 3468A 5-1/2 digit Multimeter	\$300.00
HP 3478A 5-1/2 digit Multimeter, HP1B	\$700.00
KEITHLEY 181 6-1/2 digit Nanovoltmeter, 10 nV sensitivity, GPIB	\$1,000.00
SOLARTRON 7081 8-1/2 digit Voltmeter	\$3,900.00
TEK DM501A 4-1/2 digit Multimeter, TM500 series plug-in	\$225.00

CALIBRATION

FLUKE 5100B-03.05 Calibrator, wideband AC & GPIB options	\$4,500.00
FLUKE 510A AC Reference Standard, 10 VRMS, 0-10 mA	\$450.00

FLUKE 515A Portable Calibrator, DC/AC/Ohms, line & battery power	\$1,000.00
FLUKE 5220A Transconductance Amplifier, DC-5 kHz, 0-20 A	\$3,000.00
FLUKE 720A 7-decade Kelvin-Varley Voltage Divider	\$1,250.00
FLUKE 731B DC Reference Standard	\$400.00
FLUKE 732A DC Voltage Standard	\$2,000.00
FLUKE A55-series AC Thermal Converters	\$300.00
HOLT 11 AC Thermal Converter	\$3,000.00
Set, 0.5-1200 V, 20 Hz-30 MHz	
VALHALLA 2703 AC Volt Std., 0-120V/10 Hz-100 kHz; 120-1200V/10 Hz-1 kHz	\$2,250.00

VOLTAGE SOURCES

HP 6114A Precision Dual Range Power Supply, 25V 2A / 40V 1A	\$850.00
HP 6115A Precision Dual Range Power Supply, 50V 0.8A / 100V 0.4A	\$850.00
KEITHLEY 230 Programmable DC Voltage Source	\$1,250.00

CURRENT METERS & SOURCES

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 227 Current Source, 1 uA-1 A, 0-50 V compliance	\$800.00
KEITHLEY 228 Programmable Voltage/Current Source	\$2,500.00
KEITHLEY 251 Picoampere Source	\$375.00
KEITHLEY 614 Electrometer	\$800.00
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VALHALLA 2575A AC/DC Wideband Current Shunt, 20 mA-100 A, DC-10 kHz	\$950.00

IMPEDANCE & COMPONENT TEST

L.C.R.

BOONTON 62AD 1 MHz Inductance Meter, 2-2000 uH	\$550.00
BOONTON 72B 1 MHz Capacitance Meter	\$600.00
ESI 2160 LCR Bridge, 20 Hz-150 kHz, GPIB	\$2,000.00
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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
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E.S.I. SR1-set Set of eight Standards, 1 Ohm - 10 Megohms	\$900.00
GR 1404-A 1000 pF Reference Standard Capacitor	\$700.00
GR 1406 Standard Air Capacitors, GPR90 connector, 0.1% acc.	\$375.00
GR 1409-F + L + T + Y Standard Capacitor Set, 0.001, 0.01, 0.1, and 1.0 uF	\$600.00
GR 1412-8C Decade Capacitor, 50 pF - 1.11115 uF	\$350.00
GR 1432-U 4-Decade Resistor, 0-111.1 Ohms, 0.01 Ohm resolution	\$125.00
GR 1433-J 4-Decade Resistor, 0-1,110 Ohms, 1 Ohm resolution	\$350.00
GR 1433-N 5-Decade Resistor, 0-1,111 Ohms, 0.1 Ohm resolution	\$400.00
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 1482-series Standard Inductors	\$275.00
VALHALLA 2724A Programmable Resistance Standard, 0-11 Gigaohms, GPIB	\$1,675.00

HI & LO RESISTANCE

GR 1666 DC Resistance Bridge, 1 Microhm - 100 Kiloohms	\$600.00
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HP 4329A High Resistance Meter	\$1,200.00

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
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POWER SUPPLIES

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HP 6261B-027 0-20 V 0-50 A CV/CC Power Supply, 208 VAC line	\$675.00
HP 6263B 0-20 V 0-10 A CV/CC Power Supply	\$400.00
HP 6266B 0-40 V 0-5 A CV/CC Power Supply	\$400.00
HP 6267B 0-40 V 0-10 A CV/CC Power Supply	\$550.00
HP 6269B-028 0-40 V 0-50 A CV/CC Power Supply, 230 VAC line	\$950.00
HP 6281A 0-7.5 V 0-5 A CV/CC Power Supply	\$175.00
HP 6284A 0-20 V 0-3 A CV/CC Power Supply	\$225.00
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KEPCO ATE 36-8M 0-36 V 0-8 A CV/CC Power Supply	\$375.00
SORENSEN DCR 20-25B 0-20 V 0-25 A CV/CC Power Supply	\$550.00
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SORENSEN DCR 600-0.75B 0-600 V 0-750 mA CV/CC Power Supply	\$600.00
SORENSEN SRL 20-12 0-20 V 0-12 A CV/CC Power Supply	\$400.00
SORENSEN SRL 60-8 0-60 V 0-8 A CV/CC Power Supply	\$650.00
TEK P5501-1 Power Supply, 0-20 V, 2 mV res., 400 mA, TM500 series	\$175.00

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HP 6227B Dual 0-25 V 0-2 A CV/CC Power Supply	\$600.00
HP 6228B Dual 0-50 V 0-1 A CV/CC Power Supply	\$600.00
HP 6237B Triple Output Supply, +/- 0-20 V 0.5 A, 0-18 V 1 A	\$550.00
HP 6253A Dual Output 0-20 V 0-3 A CV/CC Power Supply	\$550.00
TEK P55010 Programmable Triple Power Supply, TM5000 series	\$750.00
TEK P5503A 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 89501B HP1B 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
TRANSISTOR DEVICES DVLP-50-300-3000 Programmable Load, 0-60 V / 0-360 A / 3000 Watts max.	\$1,200.00

TIME & FREQUENCY

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HP 5315A 100 MHz/100 ns Universal Counter	\$450.00
HP 5315A-002.003 100 MHz/100 ns Univ. Counter, battery power, 1 GHz C-ch	\$650.00
HP 5315B 100 MHz/100 ns Universal Counter	\$500.00
HP 5316A 100 MHz/100 ns Universal Counter, HP1B	\$600.00
HP 5316B 100 MHz/100 ns Universal Counter, HP1B	\$1,000.00
HP 5334A 100 MHz Universal Counter, HP1B	\$850.00
HP 5334A-010.030.050 100 MHz Univ. Counter; OCXO, DVM, 1.3 GHz C-ch., rear in	\$1,000.00
HP 5334B-010.000 100 MHz Universal Counter, HP1B, OCXO	\$1,000.00
HP 5335A 200 MHz Universal / Statistical Counter	\$1,200.00
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
TEK DC5010 350 MHz / 3.125 ns Universal Counter, TM5000 series	\$1,200.00
TEK DC503A 125 MHz/100 ns Universal Counter, TM500 series	\$275.00

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
HP 5340A 18 GHz Frequency Counter	\$1,200.00
HP 5342A 18 GHz Frequency Counter	\$2,400.00
HP 5342A-001 18 GHz Frequency Counter, OCXO reference	\$2,500.00
HP 5342A-003 18 GHz Freq Counter, +22 dBm, -20 dBm dynamic range	\$2,400.00
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STANDARDS

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

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SPECTRUM ANALYSIS

HP 3586C Selective Level Meter, 50 Hz-32.5 MHz, 50 & 75 ohms	\$1,500.00
TEK 7L513/F17603 Spectrum Analyzer, 20 Hz-5 MHz, 10 Hz min. res., w/frame	\$1,500.00

DISTORTION ANALYZERS

HP 333A Distortion Analyzer, 10 Hz-600 kHz	\$450.00
HP 339A Distortion Analyzer, built-in low distortion osc.	\$1,500.00



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	\$3,750.00
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
HP 204D Oscillator, 5 Hz-1.2 MHz, 5 VRMS, 80 dB step attenuator	\$200.00
HP 209A Sine/Square Wave Generator, 4 Hz-2 MHz, 5 VRMS max.	\$225.00
TEK SG502 Sine/Square Osc., 5 Hz-500 kHz, 70 dB step atten., TM500	\$200.00

MISCELLANEOUS

HP 3575A-001 Phase-Gain Meter, 1 Hz-13 MHz, dual display option	\$850.00
HP 4437A Step Attenuator, 0-119.9 dB, DC-1 MHz, 600 ohms unbal.	\$175.00
HP 461A Amplifier, 20/40 dB, 1 kHz-150 MHz, 0.5 V/50 Ohms	\$125.00
KROHN-HITE 3103 High/Low Pass Filter, 10 Hz-3 MHz, 24 dB/octave	\$500.00
KROHN-HITE 3342R Dual HP/LP Filter, 0.001 Hz-99.9 kHz, 48 dB/octave	\$1,100.00
KROHN-HITE 3750 LP/HP/BP/BR Filter, 0.02 Hz-20 kHz, 6/12/18/24 dB/oct.	\$700.00
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 11517A/18A/19A/20A Mixer Set, 12.4-40.0 GHz, for HP 8555A/8569A	\$600.00
HP 11970A WR28 Harmonic Mixer, 26.5-40 GHz	\$1,100.00
HP 11970Q WR28 Harmonic Mixer, 33-50 GHz	\$1,400.00
HP 8444A-059 Tracking Generator, 0.5-1500 MHz, for 8554A, 8568, etc.	\$1,250.00
HP 8445B Preselector, 1.8-18.0 GHz, for HP 8555A	\$650.00
HP 8555A-100 Spectrum Analyzer, 10 MHz-22 GHz, 100 Hz min. res.	\$4,500.00
HP 8566B Spectrum An., 100 Hz-22 GHz, HP calibration certificate	\$37,500.00
HP 8569B Spectrum Analyzer, 10 MHz-22 GHz, 100 Hz min. res. bw.	\$8,500.00
TEK 119-0098-00 WR42 Single Ended Mixer, 18.0-26.5 GHz, for Tek 491	\$200.00
TEK 119-0099-00 WR28 Single Ended Mixer, 26.5-40 GHz, for Tek 491	\$200.00
TEK 492-1, 2, 3 Spectrum Analyzer, 50 kHz-21 GHz, 100 Hz min. res.	\$6,500.00
TEK TR503 Tracking Generator, 0.1-1800 MHz, for 492/4/5/6	\$1,375.00
TEK WM490A WR28 Harmonic Mixer, 26.5-40 GHz	\$850.00
TEK WM490K WR42 Harmonic Mixer, 18.0-26.5 GHz	\$850.00
TEK WM490U WR19 Harmonic Mixer, 40-60 GHz	\$850.00
TEK WM782V WR15 Harmonic Mixer, 50-75 GHz	\$2,000.00

NETWORK ANALYZERS

HP 11665B Modulator, 0.15-18.0 GHz, N(mf)	\$325.00
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SIGNAL GENERATORS

FLUKE 6060A Synthesized Signal Gen., 0.1-1050 MHz, 10 Hz res., GPIB	\$2,750.00
FLUKE 6060A/AN Synthesized Signal Gen., 10 kHz-520 MHz, 10 Hz res., GPIB	\$2,000.00
FLUKE 6062A Signal Generator, 0.1-2100 MHz, 10 Hz resolution	\$5,500.00
FLUKE 6070A Synthesized Signal Generator, 0.2-520 MHz, 1 Hz res.	\$2,000.00
GIGATRONICS 60510-18 Synthesized Source, 10-18 GHz, 1 kHz res., GPIB	\$3,000.00
GIGATRONICS 6052-8 Synthesized Signal Gen., 2-8 GHz, 1 kHz res., GPIB	\$3,000.00
GIGATRONICS 840-01 Freq. Doubler, 26.5-40 GHz (WR28) out, 13-20 GHz in	\$2,000.00
GIGATRONICS 875/50 Levelled Multiplier, x4, 50.0-75.0 GHz output, -3 dBm	\$3,500.00
GIGATRONICS 875/86 Levelled Multiplier, 26.5-40.0 & 50.0-75.0 GHz outputs	\$5,000.00
GIGATRONICS 910/12-18, opt6, 14, 16 Synthesized Source/Sweeper, 12-18 GHz, 1 Hz res., COXO	\$3,500.00
HP 11720A Pulse Modulator, 2-18 GHz, 80 dB on/off ratio	\$750.00
HP 85100V Frequency Mult., 10-15 GHz in / 50-75 GHz out >0 dBm	\$4,250.00
HP 8640B-001, 002 Signal Gen., 0.5-1024 MHz, AM, FM, var. audio osc.	\$2,200.00
HP 8654A Signal Generator, 10-520 MHz, calibrated AM & uncal. FM	\$550.00
HP 8660C/8660B-02 Synth. Sig. Gen., 1-1300 MHz, FM / Phase mod. w/86635A	\$3,250.00
HP 8660C/86603A/86633B Synthesizer, 1-2600 MHz, AM, FM	\$3,750.00

SWEEP GENERATORS

HP 8350B/83592C-004 Sweep Oscillator, 10 MHz-20 GHz, +10 dBm levelled	\$18,500.00
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, HP1B programmable	\$675.00
HP 86222A RF Plug-in, 10-2400 MHz, +13 dBm levelled	\$1,250.00
HP 86222B-002 RF Plug-in, 10-2400 MHz, +13 dBm levelled, 70 dB atten.	\$1,750.00
HP 86230B RF Plug-in, 1.8-4.2 GHz, +10 dBm unlevelled	\$675.00
HP 86235A-001, 002 RF Plug-in, 1.7-4.3 GHz, +14 dBm levelled, 70 dB atten.	\$1,000.00
HP 86240C RF Plug-in, 3.6-8.6 GHz, +16 dBm levelled	\$1,000.00

HP 86241A-001 RF Plug-in, 3.2-6.5 GHz, +8 dBm levelled	\$500.00
HP 86242D-004, 008 RF Plug-in, 5.9-9.0 GHz, +10 dBm levelled	\$500.00
HP 86245A RF Plug-in, 5.9-12.4 GHz, +16 dBm levelled	\$1,100.00
HP 86250D 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, 1.0-4.0 GHz, markers, +12 dBm unlvld.	\$1,500.00
WILTRON 6617A-40 Sweep Generator, 10 MHz-8 GHz, +16 dBm levelled	\$3,000.00

POWER METERS

ANRITSU MP-81B/ML-83A Power Meter, 7 5-110 GHz (WR10), -20 to +20 dBm	\$2,500.00
BOONTON 4200-01A, 03/8-4A x2 Dual Channel Microwattmeter, w/(2) 1 MHz-7 GHz sensors	\$1,500.00
BOONTON 42B/41-4B Analog Power Meter, with 1 MHz-12 GHz sensor	\$375.00
BOONTON 42B/41-4E Analog Power Meter, with 1 MHz-12 GHz sensor	\$500.00
GENERAL MICROWAVE 476/4240A Power Meter & Sensor, 0.01-18 GHz, -35 to +10 dBm	\$300.00
HP 435A/8481A Power Meter, 10 MHz-18 GHz, -30 to +20 dBm	\$900.00
HP 435A/8482H Power Meter, 0.1-4200 MHz, -10 to +34 dBm	\$950.00
HP 8477A Power Meter Calibrator, for HP 432 series	\$500.00
HP Q8486A Power Sensor, 33.0-50.0 GHz, WR22, for 435/6/7/8	\$1,500.00
HP R486A WR28 Thermistor Mount, 26.5-40 GHz, for 432 series	\$350.00

RF MILLIVOLTMETERS

RACAL 9303 TRMS Level Meter, 10 kHz-2 GHz, -77 to +23 dBm, GPIB	\$875.00
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AMPLIFIERS, MISCELLANEOUS

BOONTON 82AD-opt.01A Modulation Meter, AM, FM, 10-1200 MHz, GPIB	\$900.00
HP 346B-001 Noise Source, 10 MHz-18 GHz, 15 dB ENR, N(m) output	\$900.00
HP 465A Amplifier, 20/40 dB, 5 Hz-1 MHz, 1/2 Watt/50 Ohms	\$125.00
HP 8447A-001 Dual Amplifier, 0.1-400 MHz	\$450.00
HP 8447E Amplifier, 22 dB, 0.1-1300 MHz, +13 dBm output	\$750.00
HP 8901A Modulation Analyzer, 150 kHz-1300 MHz	\$3,000.00
HP 8901B-1, 2, 3 Modulation An., 0.15-1300 MHz, rear input, COXO, ext.LO	\$4,500.00
HP 8970A Noise Figure Meter	\$6,000.00
HUGHES 1177H01F000 TWT Amplifier, 2.0-4.0 GHz, 10 Watts output	\$1,500.00
HUGHES 1177H02F000 TWT Amplifier, 4.0-8.0 GHz, 10 Watts output	\$2,500.00
HUGHES 1277H02F000 TWT Amplifier, 4.0-8.0 GHz, 20 Watts output	\$2,750.00
HUGHES 8020H02F000 TWT Amplifier, 4.0-8.0 GHz, 20 Watts output	\$2,750.00
MICROWAVE SEMI CORP MC5112 Noise Source, 25.5 dB ENR, 1.0-12.4 GHz, N(m), +28 VDC	\$275.00
ROHDE & SCHWARTZ ESH2 Test Receiver, 9 kHz-30 MHz	\$6,000.00

COAXIAL & WAVEGUIDE

AMERICAN NUCLEONICS AM-432 Cavity Backed Spiral Antenna, LHC, 2-18 GHz, TNC(f) "NEW"	\$95.00
BIRD 8329-310 30 dB Attenuator, 2000 Watts, DC-1 GHz, LC(f)/N(f)	\$650.00
FXR/MICROLAB S3-024 Triple Stub GR 874-LT, Constant Impedance	\$125.00
Trombone Line, 0-44 cm, DC-2 GHz	\$400.00
GR 900-Q GR900 14mm Interseries Adapters	\$125.00
HP 11590A-001 Bias Network, 1.0-18.0 GHz, APC7	\$450.00
HP 11612A Bias Network, 45 MHz-26.5 GHz, APC3.5	\$550.00
HP 11691D Directional Coupler, 22 dB, 2-18 GHz	\$450.00
HP 11692D Dual Directional Coupler, 22 dB, 2-18 GHz	\$800.00
HP 774D Dual Directional Coupler, 20 dB, 215-450 MHz	\$275.00
HP 777D Dual Directional Coupler, 20 dB, 1.9-4.1 GHz	\$275.00
HP 778D-011 Dual Dir. Coupler, 20 dB, 0.1-2.0 GHz, APC7/N(f)/f	\$450.00
HP 8470B Crystal Detector, 10 MHz-18 GHz, neg. pol., APC7	\$250.00
HP 8472A Crystal Detector, 10 MHz-18 GHz, neg. pol., SMA	\$150.00
HP 8494G-002 Programmable Step Attenuator, 0-11 dB, DC-4 GHz, SMA	\$400.00
HP 8495G-002 Programmable Step Attenuator, 0-70 dB, DC-4 GHz, SMA	\$300.00
HP 8495H-002 Programmable Step Attenuator, 0-70 dB, DC-18 GHz, SMA	\$400.00
HP 8497K-004 Programmable Step Attenuator, 0-90 dB, DC-26.5 GHz	\$750.00
HP K422A WR22 Flat Broadband Detector, 18.0-26.5 GHz	\$350.00
HP K532A WR42 Frequency Meter, 18.0-26.5 GHz	\$450.00
HP K870A WR42 Slide Screw Tuner, 18.0-26.5 GHz	\$275.00
HP K914B WR42 Moving Load, 18.0-26.5 GHz	\$350.00
HP Q752D WR22 Directional Coupler, 20 dB, 33-50 GHz	\$650.00
HP R350B WR28 Variable Attenuator, 0-20 dB, 26.5-40 GHz	\$375.00
HP R422A WR28 Flat Broadband Detector, 26.5-40 GHz	\$400.00
HP R532A WR28 Frequency Meter, 26.5-40 GHz	\$500.00
HP R752A WR28 Directional Coupler, 3 dB, 26.5-40 GHz	\$450.00
HP R914B WR28 Moving Load, 26.5-40 GHz	\$300.00
HP V365A WR15 Isolator, 25 dB, 50-75 GHz	\$900.00
HP V752D WR15 Directional Coupler, 20 dB, 50-75 GHz	\$650.00
HP X870A WR90 Slide Screw Tuner	\$150.00
HUGHES 4511H-2000 WR28 Isolator, 25 dB, 26.5-40 GHz	\$450.00

HUGHES 45712H-1000 WR22 Frequency Meter, 33-50 GHz	\$900.00
HUGHES 45721H-2000 WR28 Precision Rotary Vane Atten., 0-50 dB, 26.5-40 GHz	\$1,200.00
HUGHES 45732H-1200 WR22 Level Set Attenuator, 0-25 dB, 33-50 GHz	\$250.00
HUGHES 47316H-1111 WR10 y Tunable Detector, 75-110 GHz, positive polarit	\$600.00
HUGHES 47323H-1211 WR19 Flat Broadband Detector, negative, 40-60 GHz	\$650.00
HUGHES 47374H-1000 WR15 SPST PIN Switch, 250 MHz speed, 60-62 GHz response	\$375.00
KAY 442D Step Attenuator, 0-101 dB, 75 ohms, BNC	\$100.00
KRYTRON 1818 Directional Coupler, 16 dB, 2-18 GHz, SMA(f)	\$200.00
M/A-COM 31-39-300/10 WR19 Directional Coupler, 10 dB, 40-60 GHz	\$450.00
MIDWEST MICROWAVE 3537 DC Block, 0.1-12.4 GHz, SMA(m/f) "NEW"	\$40.00
MINI-CIRCUITS ZFDC-20-4 Directional Coupler, 19.5 dB, 1000 MHz, SMA(f)	\$25.00
NARDA 2571 Level Set Attenuator, 0-17 dB, 2-8 GHz, SMA(f)	\$100.00
NARDA 26298 20 dB Attenuator, 150 Watts, DC-1 GHz, N(f)	\$200.00
NARDA 3000-SERIES Directional Couplers	\$150.00
NARDA 3024 Bi-Directional Coupler, 20 dB, 4-8 GHz	\$300.00
NARDA 3090-SERIES Precision High Directivity Couplers	\$225.00
NARDA 368NM Coaxial High Power Load, 500 Watts, 2.0-12.4 GHz, N(m)	\$400.00
NARDA 369BNF High Power Termination, 175 Watts, 0.7-18 GHz, N(f)	\$325.00
NARDA 3753B Coaxial Phase Shifter, 0-55 deg./GHz, 3.5-12.4 GHz	\$1,250.00
NARDA 4000-SERIES SMA Miniature Directional Couplers	\$75.00
NARDA 4203-6 Directional Coupler, 6 dB, 2-18 GHz, SMA(f)/f	\$225.00
NARDA 4245-10 Directional Coupler, 10 dB, 4-12 GHz, SMA(f)	\$100.00
NARDA 4799 Level Set Attenuator, 0-15 dB, 4-18 GHz, SMA(f)	\$135.00
NARDA 5070-SERIES Precision Reflectorometer Couplers	\$300.00
NARDA 765-20 20 dB Attenuator, 50 Watts, DC-5 GHz, N(m/f)	\$135.00
NARDA 766-10 10 dB Attenuator, 20 Watts, DC-4 GHz, N(m/f)	\$100.00
NARDA 768-20 20 dB Attenuator, 20 Watts, DC-11 GHz, N(m/f)	\$125.00
NARDA 792F Variable Attenuator, 0-20 dB, 2.0-12.4 GHz	\$375.00
NARDA 794FM Direct Reading Variable Attenuator, 0-40 dB, 4-8 GHz	\$375.00
OMNI-SPECTRA 2085-6010-00 Crystal Detector, 1-18 GHz, negative polarity, SMA(m/f)	\$50.00
PAMTECH KYG1014 WR42 Junction Circulator, 18.0-26.5 GHz	\$250.00
SONOMA ENG. S-4901 WR15 Junction Isolator, 57-59 GHz, 30 dB isolation	\$125.00
SONOMA ENG. S-4906 WR15 Junction Isolator, 60-62 GHz, 30 dB isolation	\$125.00
SONOMA ENG. S-4907 WR15 Junction Isolator, 62-64 GHz, 30 dB isolation	\$125.00
SONOMA SCIENTIFIC 21A3 WR42 Circulator, 20 dB, 20.6-24.8 GHz	\$75.00
SPACEK LABS DQ-1 WR22 Flat Broadband Detector, 33-50 GHz	\$400.00
SPACEK LABS K-2X Frequency Doubler, 9.0-13.25 GHz in / 18.0-26.5 GHz out	\$350.00
SPACEK LABS KA-3X Frequency Tripler, 8.33-13.33 GHz in / 26.5-40.0 GHz out	\$350.00
TRG B528 WR22 Direct Reading Phase Shifter, 0-360 deg, 33-50 GHz	\$1,250.00
TRG V551 WR15 Frequency Meter, 50-75 GHz	\$600.00
TRG W551 WR10 Frequency Meter, 75-110 GHz	\$750.00
WAGELINE 100080 WR28 Terminated Crossguide Coupl., 30 dB	\$200.00
WEINSCHEL 1515 Power Divider, 2-Way, DC-18 GHz, SMA(m/f)	\$125.00
WEINSCHEL DS109 Double Stub Tuner, 1-13 GHz, N(m/f)	\$150.00
WEINSCHEL DS109LL Double Stub Tuner, 0.2-2.0 GHz, N(m/f)	\$150.00

COMMUNICATIONS

HP 59401A HP1B Bus Analyzer	\$700.00
TEK 1410R NTSC Gen., w/SPG2 sync. generator, TSG7 color bars	\$800.00
TEK 1411R PAL Gen., w/SPG12 sync; TSG11 color bars; TSG13 linearity	\$750.00
TEK 1411R PAL Test Gen., w/SPG12, TSG11, TSG13, TSG15, TSG16	\$1,000.00
TEK 1411R PAL Test Gen., w/SPG12, TSG11, TSG13, TSG15, TSG16	\$1,100.00
TEK 1411R-opt.04 PAL Test Gen., w/SPG12, TSG11, TSG13, TSG15, TSG16	\$1,400.00
TEK 147A NTSC Test Signal Generator, with noise test signal	\$800.00
TEK 148 PAL Insertion Test Signal Generator	\$700.00
TEK 1750 NTSC Waveform / Vector Monitor	\$2,250.00
TEK 520A NTSC Vectorscope	\$750.00
TEK 521A PAL Vectorscope	\$750.00

MISCELLANEOUS

P.A.R. 5101 Lock-in Amplifier, 5 Hz-100 kHz	\$650.00
P.A.R. 5206-95-98 Two-Phase Lock-in Amp., 2 Hz-100 kHz, GPIB	\$1,500.00
TEK 5209 Lock-in Amp., 0.5 Hz-120 kHz, 1 Hz dynamic reserve	\$2,500.00
TEK TM5006 5000-series 6-slot Programmable Power Module	\$600.00
TEK TM504 500-series 4-slot Power Module	\$175.00
TEK TM506 500-series 6-slot Power Module	\$250.00
TEK TM515 500-series 5-slot Traveller Power Module	\$275.00

MAYHEM and MADNESS

WOW! SUPER COVERT "BODY CAM" PINHOLE CAMERA Now available in WIRED or WIRELESS version!

Super stealth, Super small, Super lightweight. Operates from 9VDC. Wireless model transmits on channel 59 cable with 100mW of power! Provides a range of up to 1500 feet or more with a good receiving antenna. Bow tie antenna with balun and "F" connector included. Size: 1.5"W x 2"H x 1"D. Commercially made and BRAND NEW! The best "plug and play" unit available. Both models include the excellent GM1000-PH camera shown below.

BC1000W, Wired....\$169 BC1000TR, WIRELESS....\$299

WORLD'S SMALLEST 100mW VIDEO TRANSMITTER,

Incredibly only 0.98" x 0.8" x 0.037" 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 and 3' F cable for TV Included. Perfect with our GM1000A cameras. Both will fit in a cig. pack...with the battery! TVX-100...\$199. with GM1000A-PH \$279.



CHECK THIS! ULTRA MINI and WEATHERPROOF

Our "LIPSTICK" camera sets new standards. Sleek black anodized, aluminum, housing is O-Ring sealed & RAINPROOF. Adjustable tilting mount included. Specs: 1/3" CCD, 380 Lines resolution, 0.3 Lux sensitivity, AGC, Auto Shutter. Operates on 9 to 12VDC @100mA, 3.7mm, 90° FOV lens. A real glass lens. NTSC video out. 1/2" once! SENSITIVE to IR. Ultra small Size only: 23mm diam. X 50mm long. With 36" leads. GM-200KSTD...\$119 pwr. adapter...\$4.95



"EMBEDDABLE", PINHOLE LENS, "BULLET CAM" it's INCREDIBLE !

So tiny you can install it right into a door with merely an 0.9" diameter hole. Sleek black anodized, extruded aluminum housing. Similar construction as the lipstick camera above only smaller! 1/3" CCD, 410 Lines Res., 0.3 Lux sens., AGC, Auto Shutter. Power from 9 to 16VDC @100mA, 250k PIXELS, 90° FOV Pinhole lens. A real glass lens. Std. NTSC video out. 1/2" once! SENSITIVE to IR. Size only 23mm Diam. x 35mm long. With 36" leads. Think of the places you could put this little jewel. GM-200KPH lens...\$129

NEW 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". 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...\$85 GM-1000A-STD/Audio...\$95
GM-1000A-PINHOLE...\$85 GM-1000A-PH/Audio...\$95
GM-1000A-C-MOUNT...\$85 GM-1000A-CMNT/Audio...\$95

C-Mount f2.0 Lenses	Micro Lenses for GM1000 series
4mm, 80°.....\$24	2.5mm, 150°.....\$22
8mm, 40°.....\$24	4.3mm, 78° f1.8.....\$22
12mm, 28°.....\$24	5mm, 70°PH.....\$22

WEATHER RESISTANT Camera Enclosure

Solid, extruded aircraft aluminum. Glass window. Strain reliefs for cables. Size: 3.5"W x 3.7"H x 1.4"L.
Our Price.....\$59
with 110V HEATER...\$79



Brand New, Video Motion Sensor.

Model VM10. Attach to any standard video signal and you've got an electronic "watchman" diligently watching the entire scene. Or any adjustable sized area within the scene. Such as a doorway or even a drawer or cabinet. A state of the art security aid. The unit will close a contact when it senses a change. Use it to turn on a VCR or call the hounds. Auto or manual reset. Compact, ac powered. Adjustable sensitivity. Video loop through jack. **NEW VM-10.....\$189.**

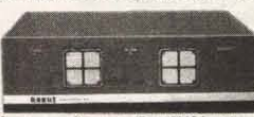
DELUXE TELECONFERENCE 4-WAY MIC w/amp

We can't tell you the big name brand. Contains four noise cancelling mics, in a N-S-E-W configuration. With line level, low noise amps inside the charcoal grey domed housing. Operates 9-12VDC at 30mA. Size: 6" D x 1" H Super high quality. **TELMIC-1 ...\$29**



VIDEO QUAD, 4 CAMERAS on ONE MONITOR

ROBOT Model 850 B&W Quad Compressor. Allows the display and recording of up to four standard video signals on one monitor or VCR at the same time. With a four way split screen. Four BNC inputs with individually adj. gain for each channel. Dual outputs, one quad one switched full screen. Alarm input is TTL compatible. Alarm outputs N/O and N/C screw term. Compact 11.25"W x 13" D x 3.5" H, ac powered. Used in excellent condition. **Regular price \$500. THIS MONTH ONLY....\$169.**



Please fax us your list of unique surplus material.

4 HEAD TIME LAPSE VCR, Records 24 + HOURS!



Used, depot refurbished, late model VICON model 424's at only 1/3 of the regular price. On screen programming, time/date stamp, audio, index search, power loss recovery and alarm inputs. They are in excellent working condition. **Limited Quantity, VICON 424.... \$499**

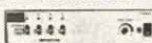
SEE IN TOTAL DARKNESS! NOT 6 LED's, NOT 12, NOT 24! OUR IR FLOOD has 168 LED's !!

Powerful, not power hungry. Projects up to 50 feet. 24V wall adapter incl. Size: 4.5"Wx6.6"Hx1.5"D Commercially made and BRAND NEW! LEDIR.....\$179ea.



NEW! 4 CHANNEL, VIDEO AUTO SWITCHER

Model GM34. Connect to any four standard video signals and they will be sequentially output to the dual rear panel BNC outputs. Front panel has user adjustable, variable dwell time from 1 to 15 sec per channel. Auto or manual switching with channel bypass. Compact only 8.6"W x 3.7" D x 1.75" H, ac powered. Video loop through jack. **GM-34...\$89**



16 CHANNEL DIGITAL VIDEO MULTIPLEXER, allows real time, multi-camera recording to tape.

NEW! NTA QUAD A TRUE multiplexer! American Dynamics model 1484SL-16. allows recording of up to 16 cameras on one video tape. Video loss detection and pre-loss frame memory. Manual or auto camera selection. Bring your surveillance system up to commercial standards. Can be rack mounted. A quality unit. Very limited quantity available. **Order #1484SL-16.... \$799ea.**



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 x 0.71"
Shown Actual Size



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.

FREE ARGON LASER? 16mW Brilliant Tourquoise Blue, SPECTRA PHYSICS, 161B with POWER SUPPLY

Our low price is like paying for the power supply and getting the laser FREE! The 488nm, TEM₀₀ mode is nearly 10X brighter than a 16mW HeNe! This is the laser you always wanted but couldn't afford. Perfect for that kick butt light show! All are in good, plug and play condition. Standard 115VAC operation. Integral fan cooling. We priced the whole system for less than others charge for the power supply alone. Why spend more? Always in demand. Limited Qty. **New Price...\$5K+ SALE... THIS MONTH ONLY...\$799 Complete**



10V @ 2.5 AH, SEALED LEAD ACID, SUPER DEAL

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



CHECK THIS! ULTRA MINI, WEATHERPROOF and COLOR too!

NEW "COLOR LIPSTICK" camera . For those applications that must have color, this unit is for you. Satin black anodized, aluminum, housing is O-Ring sealed & RAINPROOF. Adjustable tilting mount included. Specs: 1/3" CCD, 400 Lines resolution, 1 Lux sensitivity, AGC, Auto Shutter. Operates on 12VDC @180mA, 4.3mm, 78° FOV lens. A real glass lens. NTSC video out. Size only: 32mm diam. X 65mm long. With 24" leads terminated with RCA jack and DC barrel jack. Ready to go! Super nice! **SPECIAL this MONTH, GM-400K....\$279 pwr. adapter...\$4.95**



STATE of the ART COLOR MICRO CCD CAMERA!

New. For size sensitive color applications now you have a choice. Not a CMOS camera! Key specifications include: 1/3" CCD, 400 Lines resolution, 1 Lux sensitivity, Auto white balance, AGC, Auto Shutter, 12VDC @180mA, 4.3mm, 78° FOV lens, A real glass lens. NTSC video out. Size only: 30mm sq X 36mm deep. Pinhole version is only 21mm deep! Maybe the smallest, high performance color camera. **SPECIAL this MONTH, GM-500-STD or PINHOLE....\$279**



ESOTERIC OPTOELECTRONICS for those in the know!

Toshiba LINEAR COLOR CCD type TCD2301 C (shown left) Features a 3648 X3 element 3 line image sensor. Designed for high end page scanner. No data on driver board. Complete specs. for chip included. **SPECIAL.... \$39 or 2 for \$49**

BURLE PHOTOMULTIPLIER TUBE, Model 931B

New. Boxed. Shown right. Side window type, 300-600nm. Data sheet supplied. Data avail. on Burle website. Reg. price \$85ea. **SPECIAL this MONTH....\$39ea.**



TWO MINI C-MOUNT CAMERAS, The 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\$119ea. GM410 less lens...\$169ea.**

Fast Lenses for Low Light or General Purpose Normal Light

16mm, f1.6, 15° FOV\$39	4mm, 80° FOV\$24
8mm, f1.3, 30° FOV\$49	8mm, 40° FOV\$24
4mm, f1.4, 56° FOV\$49	12mm, 28° FOV\$24



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

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. **650nm \$69, 635nm \$99**

HITACHI HV-C10, 3-CCD COLOR CAMERA. 3 x 1/2" micro lens CCD using an f1.4 prism, 681 x 582 pixels, 700 lines res. 510 lines via RGB out. 56dB s/n, 15 lux sens. Electronic shutter to 1/2000, RS-232 control. Bayonet lens mount. Comp. or Y/C out. RGB, VA-C10 adapter. Digital Instruments microscope lens, power supply and cable incl. REG. \$6000 **SPECIAL \$1495.00**



CO2, 50Watt CW, SEALED GLASS LASER HEAD

with Integral Hard Sealed Mirrors, NEW! High quality water cooled heads, originally designed for a medical application. Size: 4.4"L x 3.2"D. Power required, 30KV trigger with 15-20KV @ 7 to 20mA operating current. These are not toys. Perfect for engraving, cutting and drilling many materials. Always a sellout. **Ltd qty....\$995ea.**

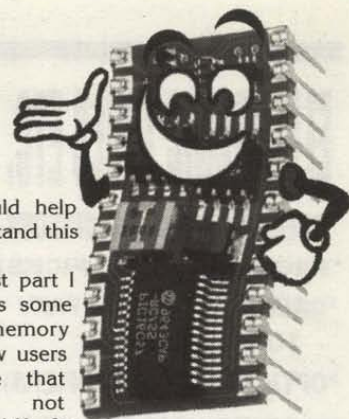
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STAMP APPLICATIONS

by Jon Williams



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

Building A Custom Digital Thermometer

I've always wanted to build a stand-alone, graphing thermometer but, until recently, I was not able to do it with the BASIC Stamp. Once again, serial peripherals — coupled with the strength of the PBASIC language — allow the seemingly impossible to come true.

Not that this project wasn't without its challenges; believe me, it was. Due to the low pin count, I decided to build it in a Stamp 1. Wow, was it a lot of work! There were several moments during the software development that I nearly gave up and punted to the Stamp 2. The struggle, however, was worth it in the end. I managed to squeeze ("crowbar") would be the more accurate term here) all the features I wanted into the BS1. There are a cou-

ple of danger points along the way. I will explain the choices I made as we work through the program so there are no surprises should you decide to build your own.

Okay, let's jump into it. Strap on your seatbelts — this could be a wild ride.

The Project

My goal was to build a digital thermometer that displays the current temperature, recorded high, recorded low, and a graph of the last hour's worth of readings. For the display, I chose the Scott Edwards Electronics G12864 graphical LCD (refer to the March '98 edition of this column for details on the G12864). This LCD lets me display text and graphics, which meets my needs for the digital display and the graph of recent temperatures.

To measure temperature, I chose the Dallas Semiconductor DS1620 digital thermometer — a thermometer on a chip. Scott wrote about the DS1620 in this column back in April '95, so I won't go into all of the details. Even if you don't have that issue, analysis of this program and my

notes should help you understand this chip.

The last part I needed was some external memory — even new users are aware that there is not enough RAM for the Stamp to store 90 minutes worth of temperatures. Thankfully, Solutions Cubed builds a neat little device called the RAMPack B (herein referred to as RAMPack). The RAMPack can store up to 32K of data and needs only a single pin to communicate with the Stamp. The base unit comes with a socketed 8K RAM chip, which is plenty for this project, as I ultimately needed to store just 90 minutes of temperatures.

The serial peripherals make the hardware side of this project very simple; only five of the Stamp's pins are used (refer to Diagram 1). As I've already mentioned, it was the software that was a real bear. What I'm about to take you through is my design ideas and how I actually managed to make it all work.

Program Analysis

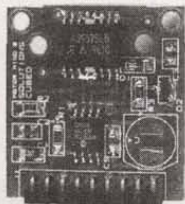
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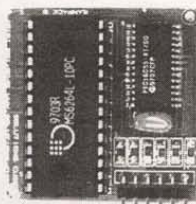
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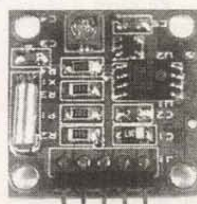
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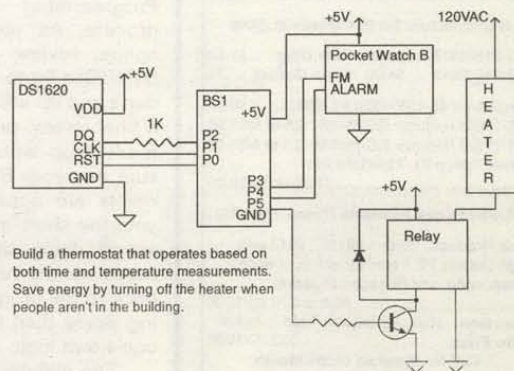
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framework of the program. Among
them:

- Initialization
- Get the current temperature
- Record high/low
- Display digital temperatures
- Record historical
- Graph historical temperatures

All of this was built around a synthesized clock. I had no need for a real-time clock, and yet, I wanted my graph to have a time-based orientation. I decided that I would read and display the temperatures approximately every second, then draw the temperature graph every minute. The graph scrolls from right to left, that is, the most recent temperature is displayed on the right edge. When the graph is updated, the left-most value is lost due to the circular nature of the external memory buffer (more on this later).

In the beginning, there are the SYMBOLs. I've commented many times about using them and I'll do so again. Use them! End of commentary. Even in simple programs, SYMBOLs will make your program easier to read and maintain. This program would be a nightmare to analyze without the use of SYMBOLs.

You'll notice that Pin0 gets two definitions: one called DQ and the other called DQpin. This is necessary to change the direction on this pin, which is used to communicate data to and from the DS1620. The definition DQpin allows us to set the direction of the pin (input or output). The definition DQ allows us to send and receive bits of data.

The rest of the definitions are very straightforward and intended to make the program easier to read and maintain. You beginners might be wondering how I knew what SYMBOLs I'd need before I actually started into the heart of the program. I didn't — no one does. Programming is an iterative process. As your program takes shape, review and update your SYMBOLs list to make sure that you don't end up with mystery code. As a final review, print your listing and mark it up with a red pen. Make sure that your SYMBOLs and comments are appropriate. I promise you, the short amount of time you spend doing this editing will be made up the next time you come back to the program. There is nothing worse than trying to figure out one's own logic ...

The initialization section of the code is pretty simple. First, we start with Dirs and Pins. You'll notice that Pin7 (used to talk to the RAMPack) is set as an output and initially set HIGH. This is a requirement of the RAMPack.

Our next step is to set up the DS1620 digital thermometer. Since the BS1 does not have SHIFTIN and SHIFTOUT in its vocabulary, we have to synthesize them. That is the purpose of the subroutines called

Listing 1
Nuts & Volts: Stamp Applications, May 1998

```

-----[ Title ]-----
File..... RAMTEMP.BAS
Purpose... Measure, store and display 90 temperature readings
Author.... Jon Williams
E-mail.... jonwns@aol.com
WWW..... http://members.aol.com/jonwns
Started... 28 MAR 98
Updated... 5 APR 98

-----[ Program Description ]-----
Digital thermometer that displays current, high and low temperatures, and
a graph of the last 90 temperature readings (-one per minute)

Temperature read from a Dallas Semiconductor DS1620
Temperatures stored in a Solutions Cubed RAMPack B
Temperatures and graph displayed on a SEETRON G12854 graphic LCD

G12864 Configuration Switch Settings:
1 : Off (Run)
2 : Off (2400 baud)
3 : On (BL On) - do not power from Stamp (use separate supply)
4 : Off (Esc)
5 : Off (Protect EE - must be On to download custom graphics)
6 : On (Screen 2)

-----[ Revision History ]-----
5 MAR 98 : Version 1.0 complete

-----[ Constants ]-----
I/O pins
SYMBOL DQ = Pin0 ' needs to match DQpin definition
SYMBOL DQpin = 0 ' DS1620 data I/O
SYMBOL CLK = 1 ' DS1620 Clock input
SYMBOL RST = 2 ' DS1620 Reset input
SYMBOL LCDpin = 6 ' serial connection to G12864
SYMBOL RAMPin = 7 ' serial connection to RAMPack B

DS1620 commands
SYMBOL TEMPR = $AA ' Read temperature
SYMBOL THW = $01 ' Write TH (high temp register)
SYMBOL TLW = $02 ' Write TL (low temp register)
SYMBOL THR = $A1 ' Read TH
SYMBOL TLR = $A2 ' Read TL
SYMBOL START = $EE ' Start temperature conversion
SYMBOL STOP = $22 ' Stop temperature conversion
SYMBOL CFGW = $0C ' Write configuration register
SYMBOL CFGR = $AC ' Read configuration register

RAMPack commands
SYMBOL WrByte = $00
SYMBOL RdByte = $01

G12864 controls
SYMBOL Esc = 27
SYMBOL ClrLCD = 12 ' Clear LCD text screen
SYMBOL PosCmd = 16 ' Position cursor
SYMBOL TPosC = 65 ' temperature locations in G12864
SYMBOL TPosH = 97
SYMBOL TPosL = 113
SYMBOL X1 = 101 ' X1 = 37
SYMBOL X2 = 190 ' X2 = 126
SYMBOL White = 64 ' Ink colors
SYMBOL Black = 65

SYMBOL OneSec = 895 ' *tuned* PAUSE value

-----[ Variables ]-----
SYMBOL cmdByte = B0 ' command sent to DS1620
SYMBOL loTmpC = B0 ' lo byte of temperature
SYMBOL hiTmpC = B1 ' high byte (sign) of temperature
SYMBOL tempC = W0 ' temperature (needs 9 bits)
SYMBOL tempF = B2 ' temperature in Fahrenheit
SYMBOL tHigh = B4 ' highest temperature reading
SYMBOL tLow = B5 ' lowest temperature reading
SYMBOL secs = B6 ' seconds counter
SYMBOL mins = B7 ' minutes counter
SYMBOL shift = B3 ' loop counter
SYMBOL x = B3
SYMBOL addrLo = B8 ' RAM address
SYMBOL addrHi = B9
SYMBOL y = B10 ' graphing coordinate

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

-----[ Initialization ]-----
Init: Dirs = %10000111 ' setup I/O pins
Pins = %10000000

' initialize the DS1620
HIGH RST ' alert the DS1620
    
```

```

cmdByte = CFGW
GOSUB CmdOut
cmdByte = $00000010
GOSUB CmdOut
LOW RST
PAUSE 10
HIGH RST
cmdByte = START
GOSUB CmdOut
LOW RST

' prepare to write config
' use with CPU; free run mode

' wait 10 ms for EEPROM write
' alert the DS1620

' start continuous conversion
' end DS1620 commo

' clear RamPack storage area
PAUSE 500
FOR addrLo = 0 TO 89
  SEROUT Rampin,T2400,($55,WrByte,$00,addrLo,$00)
  PAUSE 10
NEXT addrLo

tLow = 255
' initialize low temp

'-----[ Main Code ]-----
Main: HIGH RST
      cmdByte = TEMPR
      GOSUB CmdOut
      GOSUB TempIn
      LOW RST

      ' alert the DS1620
      ' prep for temperature read

      ' get temp from the DS1620
      ' end DS1620 commo

      ' convert to Fahrenheit
      ' (32 to 120 deg F)
      tempF = loTempC * 9 + 325 / 10 MAX 120

      IF tempF <= tHigh THEN ChkLow
      tHigh = tempF
      ' update new high temp

      IF tempF >= tLow THEN ShoTemp
      tLow = tempF
      ' update new low temp

      ShoTemp: SEROUT LCDpin,N2400,(PosCmd,TPosC,#tempF)
               SEROUT LCDpin,N2400,(PosCmd,tPosH,#tHigh,PosCmd,tPosL,#tLow)

               PAUSE OneSec

               secs = secs + 1 // 60
               IF secs > 0 THEN Main
               ' update seconds
               ' check for minutes update

Main2: mins = mins + 1 // 90
       ' record the latest temp
       SEROUT Rampin,T2400,($55,WrByte,$00,mins,tempF)
       PAUSE 10
       GOSUB ShGrph
       secs = secs + 10
       GOTO Main
       ' update temperature graph
       ' make-up for graphing delay

'-----[ Subroutines ]-----
' Send command to DS1620
' 8-bit command is sent LSB -> MSB

CmdOut: OUTPUT DQpin
        FOR shift = 1 TO 8
          LOW CLK
          DQ = Bit0
          HIGH CLK
          cmdByte = cmdByte / 2
          NEXT shift
          RETURN
        ' make DQ an output
        ' shift eight bits
        ' output LSB of cmdByte
        ' shift cmd for next bit

' Retrieve temperature from DS1620
' Data comes in LSB -> MSB in 9 bits
' - 1 bit for sign
' - 8 bits for temp (in 2's compliment format if negative)

TempIn: INPUT DQpin
        FOR shift = 1 TO 9
          tempC = tempC / 2
          LOW CLK
          Bit8 = DQ
          HIGH CLK
          NEXT shift
          RETURN
        ' make DQ an input
        ' shift temp bits
        ' get data bit

' Get last 90 readings from RamPack
' Draw temperature graph on G12864

ShGrph: addrLo = mins
        FOR x = X2 TO X1 STEP -1
          ' clear the current display line
          SEROUT LCDpin,N2400,(Esc,"I",White,Esc,"L",x,125,x,66)

          ' get reading from RAMPack
          SEROUT Rampin,T2400,($55,RdByte,$00,addrLo)
          SERIN Rampin,T2400,tempF

          IF tempF = 0 THEN nxtAddr
          ' calculate top of line and graph the temperature
          y = 122 - tempF / 2 + 64
          SEROUT LCDpin,N2400,(Esc,"I",Black,Esc,"L",x,125,x,y)

          ' update RAM address pointer (with wrap-around)
          nxtAddr: addrLo = addrLo + 89 // 90
          NEXT x
          RETURN

```

CmdOut and TempIn. CmdOut sends an eight-bit command to the DS1620. In our case, we're going to configure it for use with a CPU. TempIn is used to retrieve the nine-bit temperature value from the DS1620.

Now for our first of many choices. The DS1620 has a temperature range of -55C to +125C (-67F to +257F). Since I'm using my thermometer indoors, I'm going to ignore the sign bit and limit my range to positive Centigrade values. At zero degrees Centigrade, this means that my lowest recordable temperature is 32 degrees Fahrenheit. No problem; if it ever gets that cold in my home, I won't be here! I limit the high temperature to 120 degrees Fahrenheit. This keeps it in line with my graphic scale and, once again, it is well beyond expected norms.

With the DS1620 initialized, it's time to clear our external memory buffer. If we don't, we might end up with trash in the display until we've had 90 readings. You might be wondering why the RAMPack doesn't clear the RAM during its initialization. The reason is that it's compatible with NV (non-volatile) RAM modules. If you were using NVRAM in a project, you certainly wouldn't want to lose that data every time you started your program. Note that when writing values to the RAMPack, you've got to pause just a bit to allow the RAMPack's processor to save your data.

Sending data to the RAMPack is very simple with the SEROUT command. The first byte sent is always \$55. This allows the RAMPack to detect the Stamp's baud rate. After the synchronization byte, we'll send the command (\$00 to write a byte, \$01 to read), then the high and low bytes of the address for our data. Since our buffer is only 90 bytes, our high address byte is set to \$00. When using the RAMPack to store more than 256 bytes of data, you'll need to make use of the addrHi variable. The write command requires one more parameter: the data. Since we're clearing the buffer at this point, we simply write a zero.

The last thing that we need to do in the initialization section is preset the low temperature value, in this case 255 (for a byte-sized variable). This is necessary because the program logic will only record the low temperature if it is less than the last known low. If we didn't take this step, the Stamp's internal initialization would cause this value to be zero and we'd never see anything lower.

Okay, now the going gets a little rougher. We're into the core. Actually, the first part is pretty easy; we retrieve the temperature from the DS1620. Remember that the temperature is returned in

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Centigrade and, living in the United States, I want to display Fahrenheit.

If you look at the conversion code, it probably looks familiar, but not quite right. It deserves a little explaining. The general formula for converting Centigrade to Fahrenheit is $F = C * 9 / 5 + 32$. "Okay, so where do the 325 and 10 (in the source code) come from?" you ask. The DS1620 has a resolution of 0.5 C (0.9 F). I considered this enough to worry about, so I do my conversion in tenths, then divide by 10 to get the final value. Bit0 of the raw temperature is equal to 0.5 C. Since the LSB of the whole part of the temperature is in Bit1, the whole value has been multiplied by two. Multiplying by the raw value by five, then, produces a value that is in tenths-of-a-degree Centigrade. "So where did that five go?" Continuing with the conversion equation, you'll see that we're eventually going to divide by five. This five (the divisor) cancels the first five that was used to convert to tenths.

Since we're working in tenths, we have to change the constant 32 to 320. You may be wondering, then, why the code says 325. The

reason is rounding. Since the Stamp uses integer math that truncates numbers (no rounding), we need to do the rounding manually. This is an old programmers' trick for rounding up: Convert your value to tenths, add five, then divide by 10. Now you know where the 10 came from. The last part — MAX 120 — limits the value to our usable range.

After we've converted our temperature reading, we update the high and low values. This is very easy. If the new temperature is higher than the highest recorded value, record a new high. If the temperature is lower than the lowest recorded value, record a new low. Now you can see why we initially set the recorded low to a large value.

With all the temperatures recorded, we send them in text form to the LCD. Notice that I used two lines of code to send the temperatures. I started with three (for neatness) but, during the "crowbar" stage of the program I was forced to consolidate the last two commands to save code space.

The next step is to pad the loop with a PAUSE so that it runs about once per second. I use the constant, OneSec, which is something less than 1000 (the PAUSE value for one second). This is for readability. Even a casual programmer will figure out that I want this loop to run once per second. If I use the value of 1000, however, the loop will be longer because of all the statements that need to be executed.

How did I arrive at the final

value of OneSec? With a stopwatch. I started with an initial value of 1000 and ran the program. The timing was accomplished by inserting a temporary PULSOUT command to blip an unused output (monitored with a logic probe). I measured the actual time for 20 of these "blips," then scaled OneSec accordingly. Once this was done, I removed the PULSOUT command as it was no longer needed.

Moving on, we process our synthesized clock. The first thing we do is update the seconds value. Remember the purpose of the modulus (//) operator: it returns the remainder of a division and, when used like this, limits the range of a value. In our case, the seconds will be limited from 0 to 59. When the seconds value is zero, we've had a new minute, so we update minutes in the same fashion. The minutes, however, are allowed a range of zero to 89. This was the largest practical value I could display graphically on the LCD.

When the minute is updated, we put the last temperature reading into the RAMPack. Earlier, I referred to the external memory as circular. The reason for this is that the minutes value is used as the address pointer for temperature storage. Since the minutes wrap from 89 to zero, we have a circular buffer (it wraps back onto itself) that stores the last 90 minutes worth of temperatures.

With the new temperature recorded, it's time to update our graph. Remember that we want to display the last recorded temperature on the far right. The easiest way to do this is to draw our graph from right-to-left, starting with the last recorded temperature and working backwards.

We start by setting our memory pointer to the current minutes value. Next, we loop through our X-axis, going backwards so that our

graph is drawn from right to left. The first part of the loop clears the current X value by drawing a clear line the full span of the graph. Then we get a temperature reading from the RAMPack. With the temperature in hand, we need to calculate the top of the line.

The size of the G12864 allowed me to display temperatures at a resolution of two degrees per pixel. The bottom of the line is at 61. The nature of Stamp 1 mathematics (strictly left-to-right evaluation) caused me to rearrange the formula. I had to multiply 61 by two since the pixel-scaling division would affect it. Don't forget that we add 64 to numeric values when sending them to the G12864 so that we can send them as one byte. Now that we know the location for the top of the line, we change the LCD ink color back to black and draw the line.

The last step in the loop is to update our address pointer. Once again, we take advantage of the wrap-around nature of the modulus operator. This technique allows us to display the last 90 temperature readings in one loop.

Back to the main body, we have to make up for our time away to keep our clock in sync. Drawing lines on the G12864 takes a fair amount of time. Since the graph draws so slowly, I used my stopwatch to time it, and updated the seconds value accordingly. With the graph complete, we start the whole process over.

Wrap-Up

This project bit me — bit me hard. Honestly, I went in a little cavalier figuring it would take me just a couple of hours to write the code. It actually took about 12. Why? Well, the program barely fits, that's why. And that was after a lot of work. When a program is tight, we're sometimes forced to resort to all sorts of experiments. I found, for example, that a simple rearrangement of the main loop saved several bytes of code with no functional change. This is where science becomes art and we find new tricks for our bag. I used STMPSIZE (see last month's column) every step of the way to monitor my progress.

For you newcomers, don't be frightened by my last statements. As my friend Roger says, sometimes "it's harder than it looks." Most Stamp 1 programs will NOT be this hard, I promise. When things do get tough, don't despair. Just break down your program into the smallest practical chunks and attack them one at a time. Perseverance pays off — I now have my graphing thermometer!

You can download RAMTEMP.ZIP from my ftp directory. It contains the source code and graphics files for the G12864. Happy Stamping. NV

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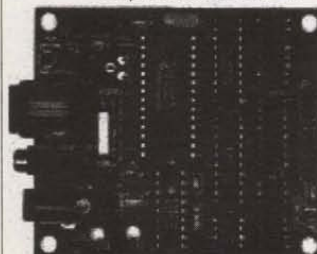
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Nuts & Volts Magazine/May 1998

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 online at QandA@nutsvolts.com, or by snail mail at Nuts & Volts Magazine, 430 Princeland Ct., Corona, CA 91719.

What's Up:

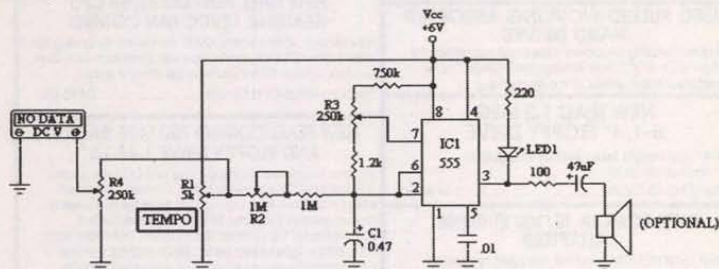
This month's circuits includes a digital metronome, quiz game timer/stop watch, and a motor speed controller with thermal cutoff for wood stove or fireplace. Learn how to "program" the LM3914 for different voltage ranges, and the inside scoop on a two-meter receiver IC. Two TV fixes, finding old schematics, and a handful of latch circuits.

And The Beat Goes On ...

Q. Hello, my name is Kirk McWilliams, a professional drummer and an amateur electronics tinkerer. What I'm trying to do is build a portable metronome that would have a digital readout of the beats-per-minute. The pulses would be seen by a flashing "bright" LED. I'd love to be able to set up about 20 pre-set tempos that are used every night for quick access, but just an adjustable rotary control would be great if a keypad pad is too expensive.

Kirk McWilliams
via Internet

A. When I was a kid, my mother decided that I should take accordion lessons (don't laugh) at a time when the traditional metronome was a flashing neon light. Nowadays, I pick my guitar to the tempo of a beat box. So the idea of building a digital metronome intrigued me. I looked at several options, including some complex programmable digital pulse generators, and finally decided on this simple analog design.



At the heart of the circuit is a 555 chip configured as a voltage-to-frequency converter. By tying the trigger pin (pin 2) to the threshold input (pin 6) we have created an astable multivibrator. Capacitor C1 is the timing element. When the voltage across the C1 exceeds 2/3 of Vcc, it toggles the output (pin 3), forcing it low and lighting the LED. At the same time, it turns on an internal transistor, whose collector is on pin 7, that discharges C1 and forces the cycle to repeat itself. This is the operation of an ordinary 555 astable oscillator, where C1 receives its charging current from one source: Vcc. In our design, C1's charging current comes from two sources, Vcc and the input current generated by R1. The Vcc current is fixed whereas the input current is adjustable via R1. The higher the input voltage, the greater the charging current, and the faster C1 charges, which, in turn, increases the flash rate. Since the input voltage is directly proportional to the flash rate, you can use an inexpensive DVM (digital voltmeter) to display the tempo. And that's it ... almost. Now it has to be calibrated, which can be tricky. First, rotate R1 so that it outputs zero voltage. Now adjust R3 until the LED quits flashing. Now advance R1 to the point where the LED begins to flash. This will be about 50 beats-per-minute (a church waltz). R2 sets the beat rate. Using the values shown, the tempo ranges from about 50 to 240 beats per minute. (You can determine the beat rate with a wristwatch by counting the number of times the LED flashes in a minute.) There's some interaction between R2 and R3, so you may have to go back and forth a bit before it settles in. Finally, adjust R4, the DVM's range, so that the display reads the same as the flash rate. The DVM can be any cheap 3-1/2 digit panel voltmeter. Many of our advertisers sell them (about \$10.00), or you can buy one from Radio Shack. Presets are easy: simply replace R1 with a bank of trimmer pots and switches. While the 555 timer isn't voltage sensitive, the DVM is, so the +6-volt line has to be regulated. I suggest using a nine-volt battery and a six-volt regulator IC, like the 78L06.

Sam's To The Rescue ...

Q. I have a Lafayette Comstat 25B citizens-band transceiver. I need the pinout connections for the AC and DC power cables that connect to the eight-pin octal power plug on the radio. I'd also like to locate a complete schematic for the radio.

Richard Jewell
Beauty, KY

A. You can find everything you ever wanted to know about this transceiver in Sam's Photofact CB-33 (800-428-7267; <http://www.hwsams.com>). Originally devoted to just TV repair, Sam's expanded their collection of schematics to CB radio and other electronic devices in the early 70s. So, if you have an old TV or CB that needs attention, I suggest Sam's first. The catalog is free, as is the phone call. The specialty books run about \$20.00 each and the TV folders range from \$14.00 to \$44.00. Some of the circuits go back as far as 1947.

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... Again

Q. I have a 27" Philips color TV, model 27J233 SB02. When I turn it on, the picture is in B & W only. After a couple of hours, the colors appear and stay on until I change channels, then it goes B & W again. I'm suspicious of the crystal oscillator or the tuner, but I don't have a schematic! I need some help on what to tackle first.

**Guillermo
via Internet**

A. This sounds like a signal strength problem. To prevent the colors from drifting, the chroma circuit has a trigger voltage that must be exceeded before it turns on the color, hence B & W. I believe that after a couple hours of use a burst of color information is sufficient to trigger the chroma and provide a color picture. When you change channels, the signal drops out and you go back to black and white. You could try adding an antenna amplifier to the tuner and see if that helps. If not, the problem is probably in the chroma circuit. I can't locate an exact schematic for this set, but I believe you'll find a similar circuit in the Sam's Photofact 2831 folder under the model number 27K241B101/B102.

Latch Me In

Q. In reference to a circuit you printed a while back (Jul. '97), please publish a "latch" circuit that is correct.

**Howard Bard, Jr.
Chula Vista, CA**

A. Sure. Here's a half dozen circuits that are guaranteed to grab your attention.

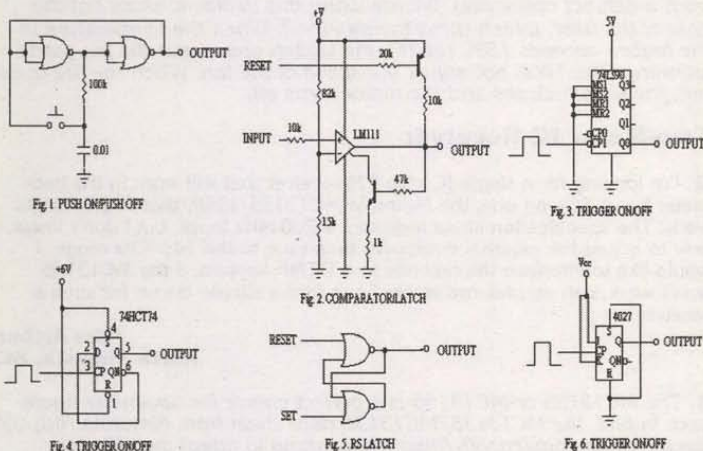


Figure 1 is a push off/push on toggle switch that uses a double-backed feedback loop to alternate states. The 0.01 uF capacitor is critical to the circuit, but it can be any value from 0.01 to 1 uF. Figure 2 is a comparator latch. When the input voltage exceeds the trigger level, the output goes high and stays high even if the input voltage drops below the trigger level. Figure 3 uses an old staple of the industry, a 7490/74LS90 counter, where we take the on/off output from

the first flip-flop. It alternates between on and off with each input pulse. Ditto for Figure 4, except that it uses the much faster 74HCT74 dual flip-flop IC. Figure 5 is a simple set/reset trigger and Figure 6 is the same as Figure 3 and Figure 4, but with a CMOS logic chip.

Programmable Digital Stopwatch

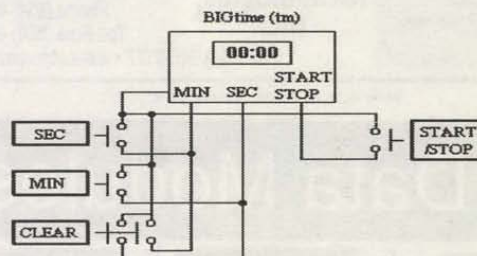
Q. I was approached by our local Cub Scouts to build a programmable countdown game timer for use in a quiz bowl. The countdown time must be programmable from 45 seconds to one hour, and it needs three buttons: one to start/restart the count, one to stop the count, and one to clear the count. The output should be a seven-segment display. Any ideas on how to best accomplish this?

**J. Murphy
via Internet**

Q. I would like a time-lapse circuit that can be switched off and on without losing count. It would be started by the power-on switch (initialized at 'zero-time') and allowed to count until I toggled it to stand-by with a momentary switch; the device would then suspend counting, but not reset. At the touch of another momentary switch, it would resume counting. Ideally, the counter would measure hours, minutes, and seconds. Unfortunately, I don't know how to make it.

**A. N. Gerken
via Internet**

A. First, I wouldn't re-invent the wheel by starting from scratch. What I'd do is go down to your favorite department store and mosey over to the kitchenware section. Here you'll find a good assortment of kitchen cooking timers — including some with digital readout. An excellent timer for your application is the "BIGtime"™ which I purchased from Macy's for \$20.00. This timer has a large 0.75-inch LCD readout and will count up or down to 99 minutes, 59 seconds. You can use the timer as-is in its original case, or remove it and replace the buttons with controls of your own (all the parts are mounted on a single circuit board). Here's how to wire external switches to the "BIGtime" timer; other digital timers are similarly modified.



Thermostatically-Controller Blower

Q. We have a wood stove for auxiliary heat which has a blower located in a shroud on the rear to circulate the heated air. When we bought the house, both the blower motor and thermostat were "crispy critters." In order to get things going, I replaced the thermostat with a DPDT (double-pole, double-throw) switch and the blower with a Dayton/Grainger 3M778A single-phase shaded-pole, 1550 RPM 1/20 HP motor. The new

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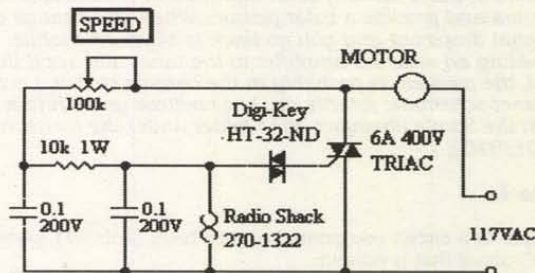
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blower sounds like a Channel 5 news helicopter on take-off and runs all night long, even well after the fire is out. I'd like to be able to adjust the speed of the fan for various levels of firebox heat and replace the DPDT switch with a thermostat. I have assorted surplus relays which I can't identify and an old TV chassis that might yield parts. I'd love to teach my daughter how to make something useful out of Dad's old junk, especially to make this project work.

Ray Harvey
Nashville, TN

A. Cool, a possible future female engineer! First, the motor speed controller. Here's a simple circuit you can make using a Radio Shack triac and parts you'll find in your junk box.



This is a straightforward dimmer/controller — with one exception: the addition of a thermal protector switch. This switch is designed to open when its temperature exceeds 128°C and is used in coffee makers to prevent runaway heating that can cause a fire (it can be salvaged from a defunct coffee pot). We are using this device to short out the gate of the triac, which turns the motor off. When the temperature in the firebox exceeds 128°C (262°F), the switch opens and the fan starts spinning. The 100K pot adjust the speed of the fan. When the fire goes out, the switch closes and the motor turns off.

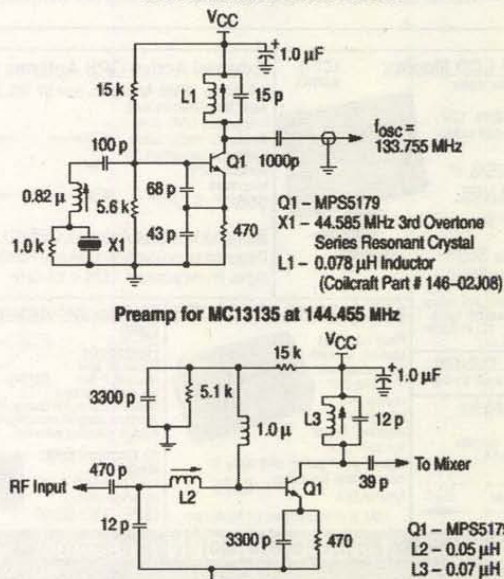
Two-Meter IC Receiver

Q. I'm looking for a single IC chip FM receiver that will work in the two-meter band. I found one, the Motorola MC13135/136P, that I think might work. The specification sheet indicates a 200-MHz input, but I don't know how to adjust the external components to tune to the 145-MHz range. I would like to interface the receiver to a DTMF keypad. If the MC13135 won't work, can you tell me where I can find a simple circuit for such a receiver?

Mike Arthur
North Augusta, SC

A. The MC13135 or MC13136 is a perfect choice for two-meter operation. In fact, the MC13135/MC13136 data sheet from Motorola (<http://sps.motorola.com/cgi-bin/msg>) shows how to adapt the chip for 144.455 MHz. For your convenience, I've posted the data sheet on our web site (<http://www.nutsvolts.com>) under the name MC13135r.PDF (you'll need Acrobat Reader to view it). Meanwhile, here's an excerpt from that data sheet showing the part values for two-meter reception.

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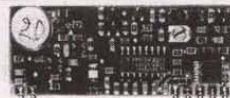
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Damper Diode For TV Flyback

Q. I have a Commodore 10845-D1 color monitor that failed. I traced the problem to a shorted diode in the HV section of the circuit. I suspect it's a damper diode, but my local jobber can't find a cross-reference to its number, which is either C06-15 or CD6-15. I replaced the diode with three 1400V, 1A diodes of the 1N4007 variety and it powers up okay, but I'm worried about reliability. Can you come up with an exact replacement for this diode?

Corby Dawson
Lompoc, CA

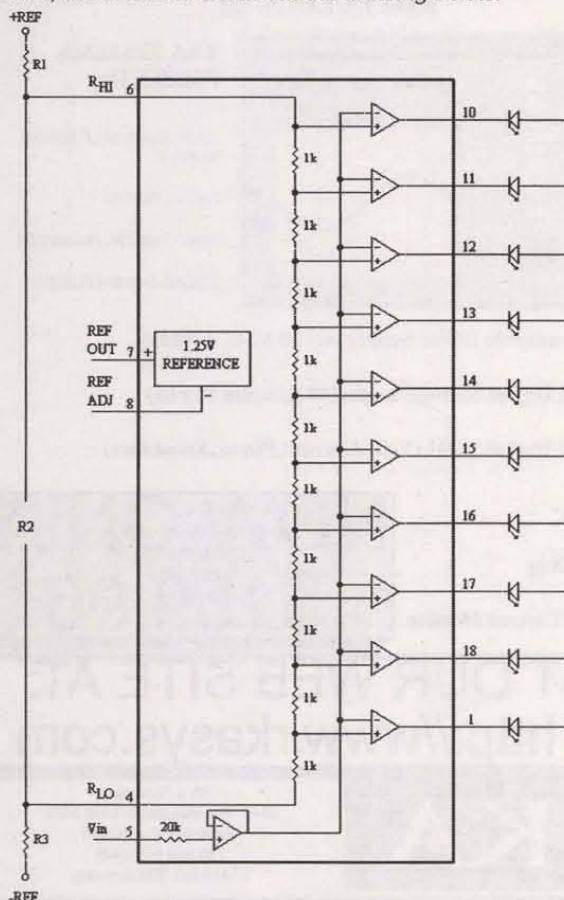
A. You're quite astute in identifying this as a damper diode. What you missed is that because it's in the flyback portion of the circuit it has to have a fast recovery time. Let's say the horizontal frequency is running at 18 KHz (monochrome PC). If we run that number through the $t = 1/f$ formula, we come up with a repetition rate of 55 μ s. The switching speed of the 1N400x series is 4 ms, which means it can't reverse polarity fast enough to squelch the flyback voltage. Yes, the diodes will work for a while, but within a short time (about a week) they'll short out, too. The part you're looking for is a 2000V, 500 ns fast-recovery diode, like the ECG 525 or its equivalent. BTW, the original part number is C06-15, and is listed in the NTE cross-reference guide (1-800-683-6837; <http://www.nteinc.com>).

LM3914 Secrets Revealed

Q. Can you stand just one more question about the Battery Gas Gauge (Jul. '97) project? What I want to do is add an external battery pack to my Timex/Sinclair Z88 computer using Rayovac's new Renewable Alkaline batteries. I've already worked out the design, including a reverse-protection diode, but I'd like to monitor the batteries' condition so that they don't discharge too deeply (unlike NiCds, Rayovac's Renewable Alkaline batteries thrive on shallow discharge). I've eyed the schematic and see there are upper and lower limit controls, but they don't fall in the range that I want, which is six volts center scale. Perhaps you can tell me and other readers how to adjust the resistor values for use with other voltage ranges. Timex/Sinclair Still Lives!

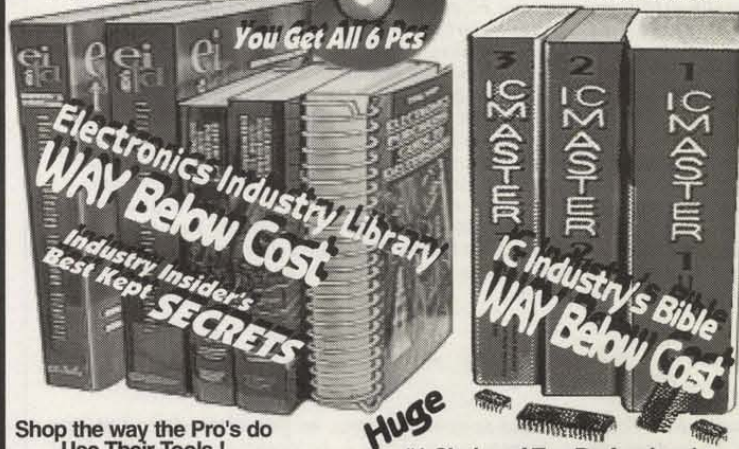
David S. Lambert
Auburn, IN

A. Sure I can, and it gives me a reason to fully disclose the hidden secrets of the LM3914. Check out the drawing below.



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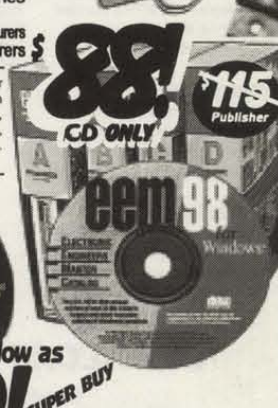
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Nuts & Volts Magazine/May 1998 23

Notice that inside the chip there are 10 comparators attached to 10 1K resistors. The 10 resistors are wired in series so that they produce a voltage divider — called a voltage ladder. Let's say we put five volts across this ladder (pin 6 to pin 4). This results in a voltage tap in increments of 0.5 volts at each intersection — five volts divided by 10 resistors equals 0.5, or $5V/10 = 0.5V$. That's to say, the first tap is 0.5V, the second is 1.0V, the third is 1.5V, and so forth. Now if we attach the non-inverting input of the 10 comparators to each of these taps, we have an LM3914. As the inverting voltage (-) of each comparator exceeds its tap voltage, the comparator flips its output from off to on. As you can see, the voltage across the ladder determines at what point the LED triggers; the maximum voltage you can apply is V_{cc} , the minimum is 200 mV. Now, sharpen up your pencil, because it's math time. If you want to have the LEDs scale in the range between five volts to seven volts, you need to drop two volts across this 10k ladder, which we'll call R2. Let's assume that the V_{cc} is your seven-volt battery. Using this scenario, R1 equals zero ohms, because it doesn't have to drop any volts. R3, on the other hand, has to drop five volts. Let's use simple fractions to unravel this mystery. If we have to drop two volts across R2 and 5 volts across R3, then we have a ratio of 2/5. Simply put

$$\frac{R2}{R3} = \frac{2V}{5V} = \frac{10K \text{ (fixed)}}{25K}$$

Notice that I've only used simple fractions, as you often do in cooking when increasing or decreasing a recipe — no complex equations. That means R3 should be a 24K resistor (actually, R2 can range from 8K to 15K with 12K nominal, which means a part of R3 should be adjustable to compensate for the variance). So, why do so many LM3914 circuits seem so complicated? Because of the 1.25-volt reference. Very often, this ultra-stable voltage source (available at pins 7 and 8) is used to bias the resistor ladder above ground and expand the scale of the voltage display. I don't have the time or space to go into the particulars on how this is done, but suffice it to say that a resistor-balancing act with pin 4 (RLO) can put you in about any range and sensitivity you wish. For more information, download the LM3914 data sheet from the National Semiconductor Web site at <http://www.national.com>. Here you will find all the equations you ever need for the LM3914 chip — period. What I've done here is to

keep it as simple as possible. Too many equations take all the fun out of experimenting, just like too many chefs spoil the broth.

Disk Repair Revisited

Q. In a recent column (Nov. '97) you had a "Reader's Tip" from Don Pomeroy about resurrecting a dead hard disk using a simple Debug routine. I thought it was Holy Grail because both of my hard disks had just recently failed. But when I ran the program, I got the message "Write protect error writing fixed disk" followed by "Invalid drive specification" when I tried to format them. I ran my system through Check-It 4, and it found no controller errors, so I don't get it. Is there a typo in the program? I hope to hear from you before I throw these drives into the Gulf of Mexico.

Joe Yurko
Cape Coral, FL

A. No, there's no typo in the program, which is reprinted below.

```
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
```

But there's no guarantee, either, that it's a cure all. Sometimes it works, but often it doesn't (been there, tried it). This routine only fixes problems with disk size/type in Sector 1, nothing else. Have you tried the Seagate program mentioned in the Sept. '97 column? You can find it on our Web site (<http://www.nutsvolts.com>) under the name SGATFMT4.ZIP. It does a medium-level format of your hard disks and does a lot more than the simple Debug routine. However, the fact that both hard disks died at the same time leads me to suspect you had a virus infection that unformatted the disks. So if you are able to recover the hard disks, they may not stay that way if the virus is still present. Given the size of the two drives you're worried about, 81 MB and 125 MB, I suggest you feed them to the sharks and buy a new 5.2 GB hard disk (about \$180.00).

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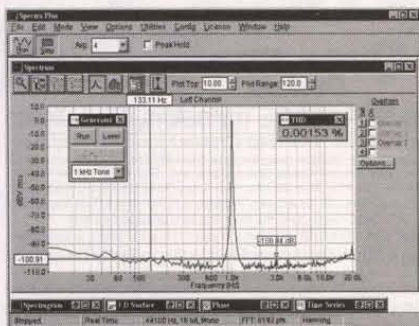
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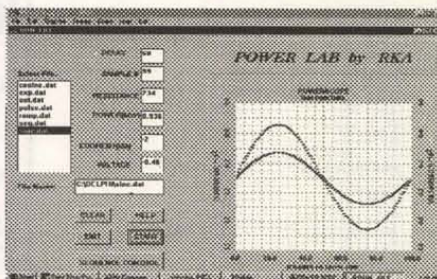
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Events CALENDAR

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MAY 1-2

LA - BATON ROUGE - Hamfest & Computer Show. Fri. 5pm-9pm. Sat. 8am-4pm. Herb Ramey W5LSU, 504-654-6087. E-Mail: W5GIX@aol.com Web: <http://members.aol.com/w5gix/index.html>

MAY 1-2-3

CA - VISALIA - International DX Convention. Rick Samoian W6SR, 714-993-0713 or 310-616-3912

MAY 2

AL - MOULTON - Hamfest. H. A. Alexander Park. 9am-5pm. Lee Creuser N8MHC, 205-584-0111. E-Mail: N8MHC@aol.com

AZ - SIERRA VISTA - Cochise ARA & SE Hamfest. Ronald Slominski KC7QXJ, 520-378-3018

CA - BAKERSFIELD - Computer Show. Kern Co. Fairgrounds. MarketPro 415-456-6730. Web: <http://marketpro.com>

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

CO - COLORADO SPRINGS - Pikes Peak RAA Hamfest. Phil Pearsall KC5LXC, 719-531-5319. E-Mail: pearsall@msn.com

CO - GRAND JUNCTION - Western CO ARC Hamfest. Diana Dodd KB0REW, 970-243-7441

IN - FT. WAYNE - Computer Show. Memorial Coliseum. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

KY - LOUISA - Big Sandy ARC Hamfest. The Fallsburg Community Ctr. 9am-4pm. Fred Jones W4SWF. E-Mail: W4swf@fothills.net

KY - OWENSBORO - ARC Hamfest. George Stokes KD4CKT, 202-683-2169. E-Mail: w4nho@occ-uky-campus.mci.net

MD - FREDERICK - Computer Show. Frederick Fairgrounds. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

MD - GRASONVILLE - Anne Arundel RC & Kent Island ARC Hamfest. Glenn Durbin WN3G, 410-643-1125. E-Mail: K3ORC@amsat.org or vtpilot@friend.ly.net

MI - CADILLAC - Hamfest. Cadillac Middle School. 8am-1pm. Dan KE8KU, 616-775-0998. E-Mail: ke8kud@juno.com

MN - DULUTH - Arrowhead RAC Hamfest. Bud Fisher KB0SBL, 218-879-9284. E-Mail: kb0sbl@cp.duluth.mn.us

NC - GASTONIA - ARC Hamfest. West Franklin Bldg. 2805 W. Franklin Blvd. Lynn Hedspeth KD4CDP, 704-735-2197. E-Mail: GAARC-Hamfest@simusa.sim.org

NH - SEABROOK - Computer Show. Seabrook Greyhound Racetrack. Northern Computer Shows 978-744-8440. E-Mail: inquiries@ncshows.com

NY - BUFFALO - Computer Show. Hamburg Fairgrounds. 9:30am-4pm. MarketPro 201-825-2229. Web: <http://www.marketpro.com>

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

NY - OWEGO - Hamfest. Marvin Park Fairgrounds, Rte. 17C. 8am-4pm. BARA, POB 853, Binghamton, NY 13902. E-Mail: owego98@ibm.net

Web: <http://www.wtsn.binghamton.edu/bara>

RI - SMITHFIELD - City Slickers Radio Operators. Frank Grzych KE1FJ, 401-231-3993. E-Mail: cobra@ibm.net

SC - ELKO - Tailgate Party. Rosewood Farm. 9am-4pm. Bill Wetzel W4OXA, 803-245-5522.

WI - CEDARBURG - Ozaukee RC Hamfest. Gabe Chido, 414-377-2784 or 414-284-3271

WI - SUPERIOR - Arrowhead RAC Hamfest. Jeff Daniels NOVQF, 218-485-8131

MAY 2-3

CA - VALLEJO - Computer Show. Solano Co. Fgrds. MarketPro 415-456-6730

FL - FT. LAUDERDALE - Computer Show. War Memorial Auditorium. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

FL - SARASOTA - Computer Show. Sarasota Municipal Auditorium. Frank Cox 941-954-0202

GA - LAWRENCEVILLE - Computer show. Gwinnett Fairgrounds. Georgia Mountain Productions 706-838-4827

GA - MACON - Computer Show. Macon Centreplex. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

PA - ALLENTOWN - Computer Show. Allentown Fairgrounds. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

PA - HARRISBURG - Computer Show. Farm Show Complex. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

TN - MEMPHIS - Computer Show. Agricenter Int'l. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

TX - ABILENE - Hamfest. Civic Center. Sat. 8am-

5pm, Sun: 9am-2pm. Peg Richard KA4UPA, 915-672-8889.

MAY 3

CA - LIVERMORE - Swapmeet. Las Positas College. Noel Ankam 510-447-3857

CA - SAN DIEGO - Computer Show. Scottish Rite Center. MarketPro 415-456-6730. Web: <http://marketpro.com>

IL - SANDWICH - Kishwaukee ARC Hamfest. Bob Yurs W9ICU, 815-895-3219. E-Mail: mailto:n9zna@aol.com

Web: <http://tbcnet.com/~jeonard/hamfest.htm>

MD - HAGERSTOWN - Hamfest. Junior College Athletic and Recreation Community Center. 8am-3pm. Donald Jones KB8WHW, 304-728-7769. E-Mail: kb8zqm@intrepid.net

MD - UPPER MERIDBORO - Computer Show. The Show Place Arena. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

ME - LEWISTON - Computer Show. Central Maine Civic Center. Northern Computer Shows 978-744-8440. E-Mail: inquiries@ncshows.com

NY - ROCHESTER - Computer Show. The Dome Center. 9:30am-4pm. MarketPro 201-825-2229. Web: <http://www.marketpro.com>

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

OH - TOLEDO - Computer Show. Great Hall at Stranahan Theater. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

PA - WRIGHTSTOWN - Warminster ARC Hamfest. Middletown Grange Fairgrounds, Penns Park Rd. 7am-1pm. Tony Simek N3YNH, 215-674-5218. E-Mail: Tsimek@aol.com

WV - RIPLEY - Jackson Co. ARC Hamfest. Gary Casto AG8RY, 304-372-2849. Web: <http://jackwv.simplenet.com/jcarc/index.html>

MAY 8-9

NH - ROCHESTER - HOSSTRADERS Hamfest. Joe Demaso K1RQG, 207-469-3492. E-Mail: k1rkg@aol.com

MAY 9

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves

CO - GRAND JUNCTION - Western CO ARC Hamfest. Diana Dodd KB0REW, 970-243-7441

NH - MANCHESTER - Computer Show. Center of NH Expo. Northern Computer Shows 978-744-8440. E-Mail: inquiries@ncshows.com

OK - EUFAULA - McIntosh Co. ARC & Pittsburg Co. ARC Hamfest. John Petersen KM5ES, 918-452-2279. E-Mail: km5es@eufaula.lib.ok.us

OR - HILLSBORO - Portland ARC Hamfest. Marilyn Lum KJ7AY, 503-236-4463. E-Mail: KJ7AY@juno.com

SC - GREENVILLE - Blue Ridge ARS Hamfest. Anderson County Fairgrounds. 8am-5pm. Gene Owensby WB4ZBZ, 864-476-2609

WA - STANWOOD - Stanwood-Camano ARC Hamfest. Vic Henry N7KRE, 360-387-7705

WI - MANITOWOC - Hamfest & Computer Swapmeet. Manitowoc County Expo Center. 8am-12pm. Glenn M. Debaker AA9MT, 920-684-7096. E-Mail: gdebaker@lakefield.net

MAY 9-10

CA - SACRAMENTO - Computer Show. Cal Expo. MarketPro 415-456-6730. Web: <http://marketpro.com>

FL - WEST PALM BEACH - Computer Show. South FL Fairgrounds. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

KY - LOUISVILLE - Computer Show. Commonwealth Convention Center. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

HANDY TESTER

Unique tester made by GB can test extension cords and christmas tree light strings, locate a break or where a burned out bulb is. Absolutely no connection is necessary. The unit uses a sophisticated sensor circuit to detect the presence of AC signals when the probe head is brought close. Can also show which side of an AC outlet is hot. Uses 2 small watch batteries (included). Small size tester with red led indicator and pocket clip. Brand new in retail packaging.

G9409 \$1.98 ea

THIN FILM ULTRA FLEXIBLE SOLAR MODULES

Produce electricity from the sun with these 1.5mil thick amorphous silicon cells. They are encapsulated in a clear flexible plastic film that allows them to be wrapped around a soda can without damage. Great for making solar battery chargers, solar powered robots, model planes, radios and various solar powered electronic projects. Brand new. Has copper side edges for soldering your hookup leads!

RATING	CURRENT	SIZE	PRICE
1.5VDC	30M	2 5/8" x 1 7/16"	G9416 \$5.95
3 VDC	30MA	4 7/16" x 1 7/16"	G9417 \$8.95

.22 FARAD 5.5VDC SUPER CAP

Great for robotics or memory backups. Many designs exist on the WEB for powering small robots by charging a small cap or several of these caps and then using an oscillator circuit to dump the caps energy into a tiny efficient pager motor. We have made a price breakthrough on this quality high capacitance capacitor. Will also power flashing LEDs, etc for a period of time after charging up. Size only 8MM Dia x 5MM high. Brand new!

G9430 \$1.49 ea

MURATA ULTRASONIC CERAMIC MICROPHONE

These are very sensitive to ultrasonic energy and are small (9MM dia x 7MM tall) in size. Type MA40S3R receivers by Murata feature a sensitivity of -67 dB at 40KHz. Capacitance 1600 pf, directivity 100°, range up 4 meters. Brand new!

G9425 \$1.98 ea 10 for \$16.00 Box of 80 for \$120.00

CAP SPECIAL

2200uf 35V Radial
G9436 4/\$1.00 100/\$22.00 1000/\$190.00

7.2VDC 2.2AH FAST CHARGE NICAD PACK

This brand new pack is made up of 6 fast charge 1.2V 2200 mah 1/2" size batteries connected in series with white vinyl shrink wrap. Each 1/2" D" has its own shrink on it and can be removed from the larger pack to give you an individual cell with tabs. Overall size of pack is 7 1/2" L x 1 1/4" W x 1 3/8" H.

G8597 \$8.00

OMRON GSP-1A 12VDC RELAY

Compact sealed relay features 5 amp 250VAC SPST contacts. Coil volt- age 12VDC. Size only 15/16" x 3/8" x 7/8". Prime with solder pins.

G9427 89¢ ea

SONY IR REMOTE

Brand new IR remote made for SONY Trinitron TVs. Works perfectly with the Sony IR module we sell (see below) which makes a great combo for all types of IR remote control projects! Remote uses 2 AA batteries (not included).

G9269 \$1.49 ea SALE

Expires 6-1-98

SONY IR MODULE

Makes IR detection a snap! Can light an LED or operate a relay over 20 ft away. Simple to use. (3 leads with hookup diagram) Matches the IR remote above perfectly! Type SBX1531

G8155 \$1.00 ea

Expires 6-1-98

SALE

GENERAL INSTRUMENT UNIVERSAL REMOTE XRC100

Controls almost all TV sets, cable boxes and VCRs in use today. Now you can eliminate the need for 2 or 3 remotes as the XRC100 allows you to control multiple devices from the same unit. Features extensive programming code list or use the electronic code search mode to program. Will even work on stand alone digital audio tuners. Brand new black color remote, operates on 2 AA batteries (not included). Size 8" x 1 3/4" x 1". Comes in manufacturer box with complete simple to use instructions.

G9418 \$7.95

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ELECTRONIC WIRELESS 2 DOOR ULTRA CHINE™ SIGNALING SYSTEM

This unique system requires no wires and features 2 distinct tones. Great for installing a doorbell on your front door and back door without wires. Each wireless door transmitter has its own distinctive tone so the receiver output sound tells you where your guest is. Receiver operates up to 100 ft away from the transmitters and produces pleasant electronic chime sounds when the wireless transmitter doorbell button is pushed. Receiver features red led, volume control and plugs into any AC outlet. The receiver also requires a 9V battery (not included) for backup if the power goes out. Each transmitter features attractive case with red doorbell button, red led and requires 9V battery (not included). Very simple to install just mount on the wall (no wires to run). Complete system comes with 1 receiver and 2 transmitter doorbells. Has dip switch type code settings so you can buy multiple systems (without interference). Brand new in retail blister pack.

G9424 \$14.95

Events CALENDAR

MD - TIMONIU - Computer Show. MD State Fairgrounds. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

NY - STONY BROOK - Computer Show. SUNY Stony Brook. 9:30am-4pm. MarketPro 201-825-2229. Web: <http://www.marketpro.com>

NY - WHITE PLAINS - Computer Show. The Westchester County Ctr. 9:30am-4pm. MarketPro 201-825-2229. Web: <http://www.marketpro.com>

OH - SHARONVILLE - Computer Show. Sharonville Conv. Ctr. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

PA - KING OF PRUSSIA - Computer Show. Valley Forge Convention Center. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

TN - NASHVILLE - Computer Show. TN State Fairgrounds. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

MAY 15

OH - KETTERING - Annual Banquet. Alex's Continental Restaurant. Robert Dingle KA4LAI. Southwest OH Chapter, 1117 Big Hill Rd., Kettering, OH 45429-1201

MAY 15-16-17

OH - DAYTON - Hamvention. Dick Miller N8CBU. 937-276-6930. E-Mail: chair@hamvention.org Web: <http://www.hamvention.org/>

MAY 16

CA - FRESNO - Computer Show. Fresno Frgrds. MarketPro 415-456-6730 Web: <http://marketpro.com>

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

MA - WESTPORT - Computer Show. White's Convention Center. Northern Computer Shows 978-744-8440. E-Mail: inquiries@ncshows.com

MN - WILLMAR - Hamfest & Electronics Swapmeet. 9am-2pm. Steve Gardner WB0MAO, 320-235-1560. E-Mail: WOSW@AMSAT.ORG

NY - BROOKVILLE - Computer Show. CW Post College. 9:30am-4pm. MarketPro 201-825-2229. Web: <http://www.marketpro.com>

OH - NILES - Computer Show. Eastwood Expo Center. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

PA - YORK - Computer Show. Holiday Inn Holiday & Conference Ctr. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

SC - ANDERSON - Lake Hartwell Hamfest. Sadlers Creek State Park. 864-225-0567

TX - HONDO - Medina Co. ARC Hamfest. Ray Martinez N5VRE, 830-931-3307. E-Mail: n5vre@stic.net

VA - ANNANDALE - Computer Show. Northern VA Community College. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

MAY 16-17

FL - JACKSONVILLE - Computer Show. Morocco Shrine Auditorium. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

GA - KENNESAW - Computer Show. Outlet Mall, I-75 @ Exit 117. Georgia Mountain Productions 706-838-4827

VA - HAMPTON - Computer Show. Hampton Coliseum. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

MAY 17

CA - STOCKTON - Computer Show. San Joaquin Co. Frgrds. MarketPro 415-456-6730. Web: <http://marketpro.com>

DE - NEWARK - Computer Show. University of DE. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

MA - CAMBRIDGE - Flea Market. Kendall Square area. MIT. Nick Altenbernd KA1MQX, 617-253-3776. Web: <http://web.mit.edu/wlms/www/swapfest.html>

MD - NEW CARROLLTON - Computer Show. Ramada Conference & Exhibition Ctr. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

MI - FLINT - Computer Show. Holiday Inn, Gateway Centre, US 23 @ Hill Rd. Exit. Five Star Productions 810-890-0988

NH - PORTSMOUTH - Computer Show. Yoken's. Northern Computer Shows 978-744-8440. E-Mail: inquiries@ncshows.com

NY - Poughkeepsie - Computer Show. Mid-Hudson Civic Center. 9:30am-4pm. MarketPro 201-825-2229. Web: <http://www.marketpro.com>

PA - ERIE - Computer Show. Erie Civic Center. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

MAY 22-23

MS - PASCAGOULA - Hamfest. Jackson County Fairgrounds. Fri. 5pm-9pm, Sat. 8am-3pm. Charles Kimmerly N5XGI, 228-826-5811

MAY 23

CA - YUBA CITY - Computer Show. Yuba-Sutter Frgrds. MarketPro 415-456-6730. Web: <http://marketpro.com>

CT - VERNON - Natchaug ARC Hamfest. Wayne Rychling N1GJS, 860-487-1921. E-Mail: warych@neca.com

NC - DURHAM - Hamfest. South Square Mall, 8am-3pm. Rodney Draughon AE4JW, 910-364-7420

OH - DAYTON - Computer Show. Montgomery Co. Fairgrounds. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

MAY 23-24

FL - FT. MYERS - Computer Show. Harborside Conv. Complex. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

MD - GAITHERSBURG - Computer Show. Montgomery County Fairgrounds. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

NJ - SOMERSET - Computer Show. Garden State Exhibit Center. 9:30am-4pm. MarketPro 201-825-2229. Web: <http://www.marketpro.com>

PA - ALLENTOWN - Computer Show. Allentown Fairgrounds. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

PA - MONROEVILLE - Computer Show. Pittsburgh Expo Mart. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

VA - NORFOLK - Computer Show. Norfolk Scope. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

WY - RAWLINS - Carbon County ARS Hamfest. Ken Fults KC7RZL, 307-324-6067

MAY 24

CA - SAN DIEGO - Computer Show. Scott's Rite Center. MarketPro 415-456-6730. Web: <http://marketpro.com>

CA - SANTA ROSA - Computer Show. Sonoma Co. Frgrds. MarketPro 415-456-6730. Web: <http://marketpro.com>

IL - CHICAGO - ARC Hamfest. 8am-3pm. DeVry Institute of Technology, 3300 N. Campbell. George Sopocko WA9JEZ, 773-545-3622

MD - WEST FRIENDSHIP - Hamfest. Howard Co. Fairgrounds. 8am-2:30pm. 301-879-2785. E-Mail: FSARC@aol.com

OH - COLUMBUS - Computer Show. Veterans Memorial. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

MAY 25

CA - MODESTO - Computer Show. Centre Plaza at Double Tree. MarketPro 415-456-6730. Web: <http://marketpro.com>

MD - SALISBURY - Computer Show. Wicomico Youth & Civic Ctr. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

NJ - FAIRFIELD - Computer Show. The Fairfield Radisson. 9:30am-4pm. MarketPro 201-825-2229. Web: <http://www.marketpro.com>

PA - READING - Computer Show. Sheraton Berkshire. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

WV - CHARLESTON - Computer Show. Charleston Civic Ctr. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

MAY 29-30

NE - SOUTH SIOUX CITY - Midwest/Dakota Div. Convention. Mike Nickolaus NF0N, 402-494-6070. E-Mail: nf0n@avalon.net Web: <http://www.pionet.net/~k0brd/hamboree/>

MAY 29-30-31

NY - ROCHESTER - Atlantic Division Convention. Harold Smith K2HC, 716-424-7184. E-Mail: rochfst@frontiernet.net Web: <http://www.rochesterhamfest.org>

MAY 30

CA - STOCKTON - Computer Show. San Joaquin Co. Frgrds. MarketPro 415-456-6730. Web: <http://marketpro.com>

CO - LOVELAND - Superfest Swapmeet. Larimer County Fairgrounds, 700 S. Railroad. Michael Robinson N7MR, 970-282-1167

ME - PORTLAND - Computer Show. Expo Center. Northern Computer Shows 978-744-8440. E-Mail: inquiries@ncshows.com

NJ - TEANECK - Computer Show. Marriott Glenpointe. 9:30am-4pm. MarketPro 201-825-2229. Web: <http://www.marketpro.com>

PA - LEBANON - Computer Show. Lebanon Valley Expo Ctr. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

MAY 30-31

CA - VENTURA - Computer Show. Ventura Co. Frgrds. MarketPro 415-456-6730. Web: <http://marketpro.com>

FL - MELBOURNE - Computer Show. Melbourne Auditorium. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

IN - INDIANAPOLIS - Computer Show. IN State Fairgrounds. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

OR - SEASIDE - SEAPAC Ham Conv. Seaside Convention Center. Randy Stinson KZ7T, 503-297-1175. Web: <http://www.easystreet.com/~otvarc>

TN - KNOXVILLE - Computer Show. TN Valley Fairgrounds. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

MAY 31

CA - SACRAMENTO - North Hills RC Hamfest. Bob Naylor AC6HF, 916-966-3654. E-Mail: ac6hf@juno.com Web: <http://www.ns.net/~NHRC>

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

CANADA - QUEBEC - SOREL-TRACY - Hamfest. Jean A. Gadoury VE2UL. E-Mail: jgadoury@sorel-tracy.qc.ca

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

MD - BOWIE - Computer Show. Bowie State University. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

NJ - WESTFIELD - Computer Show. Westfield Armory. 9:30am-4pm. MarketPro 201-825-2229. Web: <http://www.marketpro.com>

PA - WILKES BARRE - Computer Show. Genetti's Best Western. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

VA - ROANOKE - Computer Show. Roanoke Civic Center. 9:30am-4pm. MarketPro 301-984-0880. Web: <http://marketpro.com>

JUNE 1998

JUNE 5-6-7

TX - ARLINGTON - West Gulf Division Convention. Tom Gentry K5VOU, 972-442-1721

JUNE 6

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

CANADA - QUEBEC - MONTREAL - ARC Hamfest. James Hay VE2VE, 514-697-7205.

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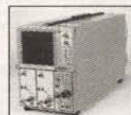
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Frequency: 500KHz to 512MHz. Indicates to 1024MHz. Requires external frequency doubler for 1024MHz (supplied with unit). Readout can be used as a frequency counter. Accuracy: 6.5 digits expandable to X10 and X100. Output: -145dBm to +19dBm (0.5 to 512MHz). Modulation: AM, FM, pulse, 400 and 1KHz, 1mV to 1V internal. Has input and output of modulation sources. PRICE: \$1,095

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TEK MODEL 7603N



Oscilloscope: Mil Spec AN/USM-281C, 8x10 CM display, 100MHz response which accepts standard 7000 series plug-ins. Vertical Plug-in: 2 ea. 7A15 (AM-6565), frequency BW 75MHz, maximum sensitivity 5mV/DIV. Horizontal Plug-in: 1 ea. 7B53 (TD-1085), triggering to 100MHz, minimum, sweep time 50 NS/DIV, has delayed sweep capacity. Includes cover, probes, accessories. Price: \$395

AN/URM-120 50 OHM THRU-LINE RF WATTMETER



Frequency range: 2MHz to 1000MHz. Power range: 10 watts to 1000 watts. USWR: 1.08 to 1. Uses three plug-in coupler elements (included). CU-753 2 to 30MHz 50 to 100 watts CU-754 25 to 250MHz 10 to 500 watts CU-755 200 to 1000MHz 10 to 500 watts. Connector: Type N. Case included. Size: 7"Wx6-5/8"Hx7-1/5"D. Weight: 6.5 lbs. Price: \$395

WATKINS JOHNSON VHF/UHF RECEIVER

TYPE WJ-8628-4 20-512 (1400) MHz



Plug-in module requires main frame (not supplied). Multimode bandwidth and detection. Can be set to auto scan tuning. Price: \$12,500.00

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Front panel voltage and current meters. Convection-cooled, no blower. Voltage adjustable from 0 to 60 VDC at a maximum current of 4A. Regulation 0.015% or 1mV. Line or load. Series/parallel operation. Remotely programmable by voltage or resistance. Less than 500uV RMS ripple. Constant current/constant current. NEW Price: \$395

Events CALENDAR

E-Mail: jrhay@haya.qc.ca

ME - HERMON - Pine State ARC Hamfest. Hermon High School. 8am-1pm. Roger Dole KA1TKS, 207-848-3846

MI - GRAND RAPIDS - Annual Hamfest. Hudsonville Fairgrounds, off I-96 x-way. Randy N8KQX, 616-532-5450

NC - CHARLOTTE - Hamfest & Computer Fair. Roll-A-Round Skate Ctr., 8830 E. Harris Blvd., 7:30am-12:30pm. Charlotte ARC, PO Box 33582, Charlotte, NC 28233. E-Mail: w4cq@qsl.net
Web: http://members.aol.com/w4cbj/w4cq
TN - NASHVILLE - ARC Hamfest. TN State Fairgrounds. 8am-5pm. Bob Malone WB5ZDS, 615-865-6225

JUNE 6-7

CA - SACRAMENTO - Computer Show. Cal Expo. MarketPro 415-456-6730
Web: http://marketpro.com

WA - DRYDEN - Apple City ARC Hamfest. Greg Johnson WA7TSP, 509-663-1081.
E-Mail: g.c.johnson@mail.sprint.com

JUNE 7

CA - LIVERMORE - Swapmeet. Las Positas College. Noel Anklam 510-447-3857

CA - SAN DIEGO - Computer Show. Scottish Rite Center. MarketPro 415-456-6730.
Web: http://marketpro.com

CT - NEWINGTON - AR League Hamfest. Newington High School, Willard Ave. Rte. 173. 9am-1pm. Ralph Borriello N1VIM, 860-828-1695.
E-Mail: r.borriello@snet.net

IL - PRINCETON - Starved Rock RC Hamfest. Debbie Burton N9DRU, 815-795-2201.
E-Mail: dbkatz@mtco.com

Web: http://www.prairienet.org/srrc/

IN - WABASH - County ARC Hamfest. 4-H Fairgrounds, State Rd. 13N. Don Spangler W9HNO, 219-563-8487.
Web: http://www.netusa.net/~grziota/

MA - TAUNTON - Computer Show. Holiday Inn. Northern Computer Shows 978-744-8440.
E-Mail: inquiries@ncshows.com

NY - QUEENS - Hamfest. NY Hall of Science Parking Lot, Flushing Meadow Corona Park, 47-01 111th St. Stephen Greenbaum WB2KDG, 718-898-5599 only.
E-Mail: WB2KDG@bigfoot.com

OH - MEDINA - Two Meter Group Hamfest. Medina County Fairgrounds Community Center, 735 Lafayette Rd. 8am-3pm. Mike Rubaszewski N8TZY, 330-273-1519. E-Mail: N8TZY@aol.com

PA - BUTLER - Hamfest. Butler Farm Show Grounds. 8am-4pm. George Artnak N3FXW, 412-854-5593. Web: http://www.users.sgi.net/~wolfie/

VA - MANASSAS - Ole Virginia Hams ARC Hamfest. Prince William County Fairgrounds, Rte. 234. Mary Lu Blasdel KB4EFP, 703-369-2877

WI - JUNCTION CITY - Swapfest & Auction. US Army Reserve Ctr. John Feltz W9JN, 715-457-2506. E-Mail: jfw9jn@tzn.net

JUNE 12-13

GA - ALBANY - ARC Hamfest. Arthur Shipley N4GPJ, 912-439-7055

JUNE 12-15

NY - ELLENVILLE - Chaverm Int'l Convention. Fallsview Hotel, Arnold Harber W2GDS, 732-222-3009. E-Mail: w2gds@juno.com

JUNE 13

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves

CANADA - ONTARIO - FERGUS - Guelph & Kitchener-Waterloo ARCs Hamfest. Bill Smith VE3WHS, 519-821-6642.
E-Mail: smith.ve3whs@sympatico.ca

Web: http://www.kwarc.org/leamarket
KY - PADUCAH - ARA Hamfest. Executive Inn Convention Ctr. 8am-3pm. Craig Martindale WA4WBQ, 502-444-6822

MA - DENNIS - Cape Cod Tailgate Swapfest. 8am-3pm. Don Haaker WA1AIC, 508-760-1571

NH - SEABROOK - Computer Show. Greyhound Racetrack. Northern Computer Shows 978-744-8440. E-Mail: inquiries@ncshows.com

NY - CORTLAND - Skyline ARC Hamfest. Andrew Slauch KB2LUV, 607-753-0597.
E-Mail: sany@sanypis.com

JUNE 13-14

GA - DALTON - Computer show. North GA Fairgrounds. Georgia Mountain Productions 706-838-4827

JUNE 14

IL - WHEATON - Six Meter Club of Chicago Hamfest. DuPage County Fairgrounds, 2015 Manchester Rd. Joseph Gutwein WA9RUJ, 630-963-4922

KY - ERLANGER - Ham-O-Rama '98. Lions Park. 8am-3pm. Robert Blocher N8JMW, 513-797-7252 eves. E-Mail: kroad@tso.cin.tx.net

MI - FLINT - Computer Show. Holiday Inn, Gateway Centre, US 23 @ Hill Rd. Exit. Five Star Productions 810-890-0988

NH - MANCHESTER - Computer Show. Holiday Inn Expo Center. Northern Computer Shows 978-744-8440. E-Mail: inquiries@ncshows.com

NY - BETHPAGE - Hamfest. Briarcliffe College, 1055 Stewart Ave. 9am-2pm. Richie Selzer N2WJL, 516-520-9311. E-Mail: N2WJL@juno.com

Web: http://www.limarc.org
OH - SUFFIELD - Hamfest. Wingfoot Lake Park, 10 miles east of Akron. Ken Phillips K8CHE, 330-733-5795.

TN - KNOXVILLE - Hamfest & Electronics Flea Market. Northern Guard Armory, 3330 Sutherland Ave. 9am-4pm. David Bower K4PZT, 423-974-5064. E-Mail: d.bower@eeec.org

Web: http://www.kormet.org/rack

JUNE 19-20-21

GA - ATLANTA - Hamfest '98. Greg Barrett N5BDJ, 770-649-1467.
E-Mail: gbjb@mindspring.com

Web: http://www.saf.com/arc

JUNE 20

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

MI - MIDLAND - Hamfest. Midland County Fairgrounds, 8am-1pm. Jeff Weinberg 517-636-0643 (w) 517-839-9371 (h). E-Mail: w8cq@byethis.com

NH - NASHUA - Computer Show. Sheraton Tara. Northern Computer Shows 978-744-8440.
E-Mail: inquiries@ncshows.com

NJ - DUNELLEN - Raritan Valley RC Hamfest. Columbia Park. 7am-2pm. Bob Pearson WB2CVL, 908-846-2056.
RWPEARSON-WB2CVL@WORLDNET.ATT.NET

VA - BLUEFIELD - Hamfest. Brushfork Armory. Don Williams WA4K, 540-326-3338.
E-Mail: wa4k@sara.org

Web: http://www.inetone.net/erarc/hamfest/
WV - BLUEFIELD - Hamfest. Brushfork Armory. Don Williams WA4K, 540-326-3338.
E-Mail: wa4k@sara.org

Web: http://www.inetone.net/erarc/hamfest/
JUNE 20-21

GA - KENNESAW - Computer Show. Outlet Mall, I-75 @ Exit 117. Georgia Mountain Productions 706-838-4827

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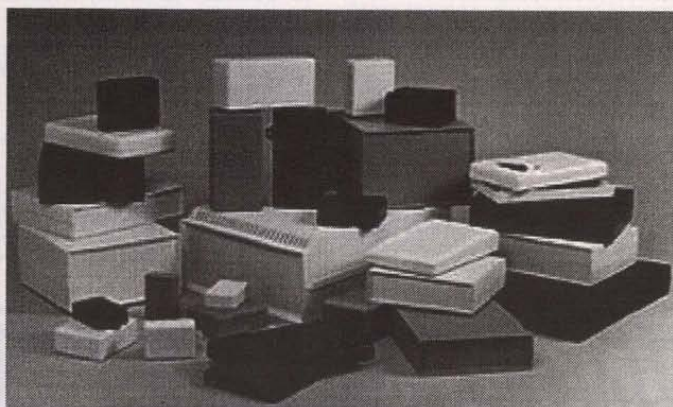
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Events CALENDAR

JUNE 21

IN - CROWN POINT - Lake Co. ARC Hamfest. Lake Co. Fairgrounds. Malcolm Lunsford W9MAL, 219-769-3925. E-Mail: w9mal@cris.com
MA - CAMBRIDGE - Flea Market. Kendall Square area. MIT. Nick Altembernd KA1MQX, 617-253-3776. Web: <http://web.mit.edu/wlrmx/www/swapfest.html>
MD - FREDERICK - ARC Hamfest. Eric Gammeter N8AAY, 301-865-0865
MI - MONROE - Monroe Co. Radio Comm. Assn Hamfest. Fred VanDaele KA8EBI, 313-242-9487
OH - MACEDONIA - Cuyahoga ARS Hamfest. Rich James N8FIL, 1-800-404-2282. <http://www.cars.org>

JUNE 27

FL - FT. MCCOY - ARC Hamfest. Tom Bench KT4VF, 352-546-3967. E-Mail: w4frc@qsl.net Web: <http://www.qsl.net/w4frc>

JUNE 28

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

JULY 1998

JULY 4

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
PA - DILLSBURG - Harrisburg RAC Hamfest. Monaghan Fire Hall, 245 W. Siddonsburg Rd. Michael Kalbaugh N3HLK, 717-232-6087. fabinfo@fabral.com n3njb@juno.com

JULY 5

PA - WILKES-BARRE - Murgas ARC Hamfest. Robert J. Michael WB3FAA, 717-288-3532

JULY 11

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves
IN - INDIANAPOLIS - Central Division Convention. Rick Ogan N9LRR, 317-251-4407
MO - KANSAS CITY - PHD ARA Hamfest. Bob Roske WA0CLR, 816-436-0069. E-Mail: wa0clr@juno.com Web: <http://www.tfs.net/~caltman/phdara/phdara.htm>
NC - SALISBURY - NC Alligator Group Hamfest. Civic Center. 8am-1pm. Walter Bastow N4KVF, 704-279-3391. E-Mail: alligator@juno.com
OK - ALTUS - Altus Area ARA Hamfest. Ronald Hughes KB5JVC, 580-482-7994
WA - KENNEWICK - Tri Cities ARC Hamfest. Dick N7WLD, 509-783-3479. E-Mail: dick.goranson@kcc-computers.com
WI - OAK CREEK - Swapfest. American Legion Post 434, 9327 S. Shepard Ave. 7am-2pm. 414-762-3235

JULY 12

IL - PEOTONE - Kankakee ARS Hamfest. Don Kerouac K9NR, 815-939-7548. E-Mail: K9nr@juno.com Web: <http://www.geoci>

ties.com/CapeCanaveral/Hangar/5711/
MA - SWANSEA - Computer Show. Venus DeMilo. Northern Computer Shows 978-744-8440. E-Mail: inquiries@ncshows.com
MI - FLINT - Computer Show. Holiday Inn, Gateway Centre, US 23 @ Hill Rd. Exit. Five Star Productions 810-890-0988
NJ - AUGUSTA - Sussex Co. ARC Hamfest. Dan Carter N2ERH, 973-948-6999. E-Mail: scarcnj@qsl.net Web: <http://www.qsl.net/scarcnj/>
NY - ALEXANDER - Genesee Radio Amateurs Hamfest. David Carlson KA2OQZ, 716-786-3622. E-Mail: carlson@frontiernet.net Web: <http://www.frontiernet.net/~wittman/wittman/GRAM>
PA - KIMBERTON - Mid-Atlantic ARC Hamfest. Bob Haase W3SA, 610-293-1919
PA - PITTSBURGH - North Hills ARC Hamfest. Northland Public Library, 300 Cumberland Rd., 8am-3pm. Bob Ferrey, Jr. N3DOK, 412-367-2393. E-Mail: n3dok@pgh.net Web: <http://nharc.pgh.pa.us>

JULY 17-18-19

MT - EAST GLACIER - MT State Convention. Gerry Leach VE6BVZ, 403-285-5547. E-Mail: leachg@cadvision.com

JULY 18

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
NC - CARY - Swapfest. Cary Community Ctr., 404 N. Academy. Cary ARC, PO Box 53, Cary, NC 27512
NH - SEABROOK - Computer Show. Greyhound Racetrack. Northern Computer Shows 978-744-8440. E-Mail: inquiries@ncshows.com
TX - TEXAS CITY - Tidelands ARS Hamfest. Carl W. Steele Jr. WA5WVP, 409-948-0308

JULY 19

IL - SUGAR GROVE - Fox River Radio League Hamfest. Waubesa Community College. James Von Olnhausen 630-897-3042. E-Mail: n9uzc@amsat.org
MA - CAMBRIDGE - Flea Market. Kendall Square area. MIT. Nick Altembernd KA1MQX, 617-253-3776. Web: <http://web.mit.edu/wlrmx/www/swapfest.html>
MA - WORCESTER - Computer Show. Worcester Centrum Centre. Northern Computer Shows 978-744-8440. E-Mail: inquiries@ncshows.com
MO - WASHINGTON - Zero Beaters ARC Hamfest. Bernie E. Hillerman Park. 6am-2pm. Keith Wilson K0ZIH, 314-629-2264. E-Mail: n0mfd@amsat.org URL: <http://zbarc.usmo.com>
NY - FARMINGVILLE - Radio Central ARC Hamfest. Jo Ann Colletti N2IME, 516-399-1877. Web: <http://www.li.net/~n2mqd>
OH - VAN WERT - Hamfest. County Fairgrounds, US 127 S. Louie Thomas WD8LLO, 419-238-2812. E-Mail: barnesl@bright.net Web: <http://www.bright.net/~barnesl/w8fy.htm>

JULY 24-25

FL - MILTON - Milton ARC Hamfest. Mark

Continued on page 76

Converters ★ Remotes ★ Converters ★ Remotes ★ Converters ★ Remotes

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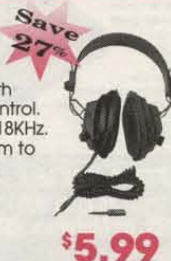


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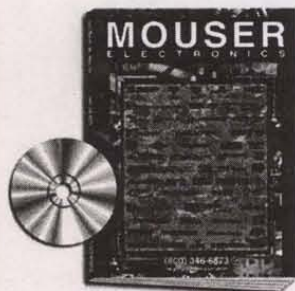
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Some Measurement Tricks

by Joseph J. Carr

Lord Kelvin once said something to the effect that we really don't understand a phenomenon until we can measure it and apply numbers to it.

Measurements are part of our very existence in the modern world. Indeed, if we rename the human species, let's call ourselves "homometricus."

In electronics, we make measurements with a variety of devices including voltmeters, ohmmeters, oscilloscopes, frequency counters, and dozens of other instruments. We also use electronic instruments to measure other things like temperature, pressure, force, and so forth. We have a variety of sensors available, and they can be integrated with a variety of electronic analog and digital circuits. Although measurements are all over the place, only a few of us are aware of some of the techniques of measurement.

George was probably one of the best physics teachers in the country. Indeed, he was even voted "best" by an education organization at one time. "Doc George" did not really have a doctorate, but he did teach freshman physics for many, many years. He was especially famous for his classroom experiments. They were always instructive, but one was a bit destructive. He sometimes illustrated Pascal's principle by placing a sealed barrel of water on the lecture stage. A hose ran out the top of the barrel, through the back window, up the side of the physics building, through a fourth floor window where a graduate student stood waiting. Water filled the entire length of the hose.

At the professor's signal, the grad student would jam a slip fit wooden dowel in the exposed end of the hose and then smack it very hard with a rubber mallet. The force imparted by the mallet was transmitted through the hose to the barrel, and the barrel would then explode. After a big "Whump," the water splashed all over the front row of students, and flooded the stage. I understand that he did that performance for a number of years until the stage's wood floor rotted out from all that water.

If you are interested in radio, then you would love George's rope demonstration of standing waves!

George ruled over the Physics I and Physics II laboratories with an iron hand. A kindly hand, but iron none the less. He insisted on students using a bound laboratory notebook, and following proper procedure. If you made a mistake due to sloppiness, then he would take a bright red magic

marker and "X" out your lab work and make you do it over. Ouch! Did I get hollered at a lot. When he wasn't hollering (with a twinkle in his eye), George imparted a few tips about measuring things. Although the examples here are mechanical, they apply to all forms of measurement, including electronic measurements.

Averaging Measurements

All measurements have variation. That is, error will be found in all measurement processes. If you use a voltmeter to measure exactly the same voltage time and time again, then you will find some variation. It might take a high resolution meter to see the variation in some cases, but it's there nonetheless.

One way to handle this problem is to take multiple measurements, and then average the results. Let's say you are measuring the DC voltage from the output of a magnetometer. Five successive measurements (we assume the actual voltage did not change) are 2.476V, 2.474V, 2.476V, 2.473V, and 2.475V. What is the most likely value of the actual voltage? We can't know for sure, but the most probable voltage is the average:

$$\frac{2.476V + 2.474V + 2.476V + 2.473V + 2.475V}{5} = 2.4748 \text{ Volts}$$

Whether or not we have a legitimate right to claim the voltage is really 2.4748 volts, depends in part on the resolution of the voltmeter used to make the measurements.

By the way, it isn't correct procedure to measure the voltage once and write down the value five times to make the "average" calculation. Don't laugh, I've seen it done!

One two-way radio technician I know uses a digital frequency counter (DFC) to measure the frequency of transmitters. He takes three or four measurements by depressing the microphone button successive times, and then writing down the readings from the DFC. He would average the values to determine the "correct" value.

Figures 1 through 4 show a way to average readings without

adding to the amount of work required to weigh two samples. By the way, I am going to talk about weights, even though many people would measure mass. They are the same measurement, even though mass and weight are different. Weight is, after all, the force of attraction between the item being weighed and the earth's gravitational field. Believe it or not, there is such a thing as a "gram-force" measurement, and some strain gauges are calibrated in terms of gram-force. It is a force, not a mass. But a gram is a mass, you say? Well, one-gram force is the force of gravity on a one-gram mass (about 980

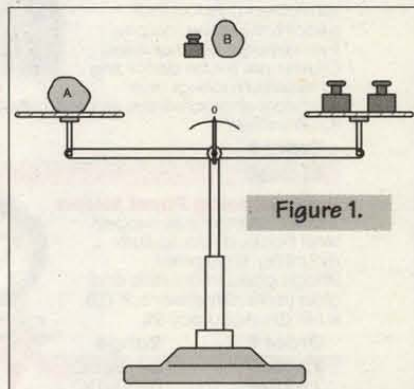


Figure 1.

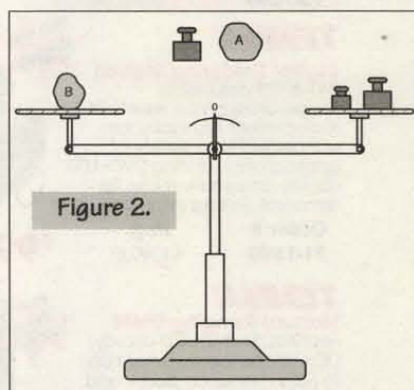


Figure 2.

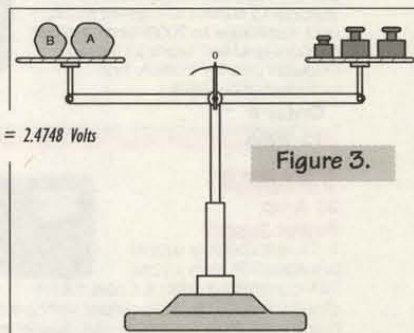


Figure 3.

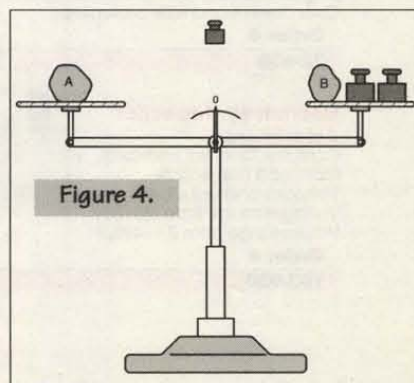


Figure 4.

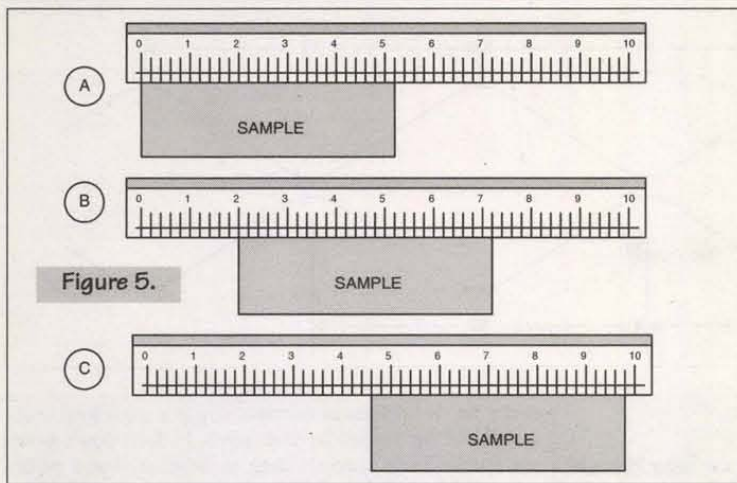


Figure 5.

dynes).

Let's say ol' George had two mineral samples, and wanted to weigh both of them. He might use a platform balance. This type of scale is a nulling instrument consisting of two pans on opposite ends of a long bar. The bar is mounted at the center on a fulcrum. When the weight on the sample pan is equal to the weight on the other pan, then the pointer is in the middle (zero). Actually, if we have weight W_1 on one pan, weight W_2 on the other pan, and L_1 and L_2 are the distances from the fulcrum point to each weight, then the null or balance condition will exist whenever $W_1 \times L_1 = W_2 \times L_2$.

To make the measurement, George might place sample "A" on the sample pan, and then add weights to the other pan until balance is achieved (Figure 1). He would then add up all the little standard weights on the pan and assert that this figure is the weight of sample "A."

He would then remove the sample and weights. The second sample ("B") is then placed on the sample pan, and enough standard weights are added to the other pan to balance the pointer (Figure 2). He may then assert that the value of "B" is the sum of the standard weights needed to balance the weight of "A."

He made two measurements and produced two results. Suppose we wanted to make multiple measurements and then average the results? George liked that kind of measurement. One way is to weigh each sample twice, and then take the average:

$$\bar{A} = \frac{A_1 + A_2}{2}$$

and,

$$\bar{B} = \frac{B_1 + B_2}{2}$$

That's essentially the same as my buddy clicking the two-way radio mic button twice and then averaging the frequency measurements. But that also takes four measurements to get two samples or "A" and "B" (A_1, A_2, B_1 , and B_2). Figures 3 and 4 show a better way.

In Figure 3, we see both samples being weighed on the same platform. This produces a sum (S) weight of $S = A + B$. In Figure 4, on the other hand, sample "A" is on the left pan, and sample "B" is on the right pan with

enough extra weight to balance the scale. This measurement produces a difference (D) weight of $D = A - B$. We now have two measurements, $S = A + B$ and $D = A - B$. Now let's do a little arithmetic:

$$\frac{S+D}{2} = \frac{(A+B) + (A-B)}{2} = \frac{A+A}{2} = \bar{A}$$

and,

$$\frac{S-D}{2} = \frac{(A+B) - (A-B)}{2} = \frac{B+B}{2} = \bar{B}$$

Two measurements, but the end result is the average of two measurements for each "A" and "B." Neat,

huh?

Another method for averaging measurements is shown in Figure 5. Here we are measuring the length of a sample using a ruler. The problem is that the marks on the ruler are not entirely uniform, so there will be a small amount of variation depending on where on the ruler the measurement is made. George's idea is to make multiple measurements (Figure 5 shows three, George would have liked to get more data). The points where the ends of the sample are located are jotted down, and then their differences found.

Note in Figure 5A that the "0" mark is used. This is only done when the mark is not at the very end of the ruler. Wear and tear can obscure the zero point. It is done in this case because there is a small bit of uncalibrated space to the left of the zero mark. The sample is then moved to different portions of the ruler (Figures 5B and 5C). If the points are designated "left" (L) and "right" (R), then the average can be calculated:

Measurement	Difference
L1 R1	R1 - L1
L2 R2	R2 - L2
L3 R3	R3 - L3

The average of the three measurements is:

$$\text{Length} = \frac{(R1 - L1) + (R2 - L2) + (R3 - L3)}{3}$$

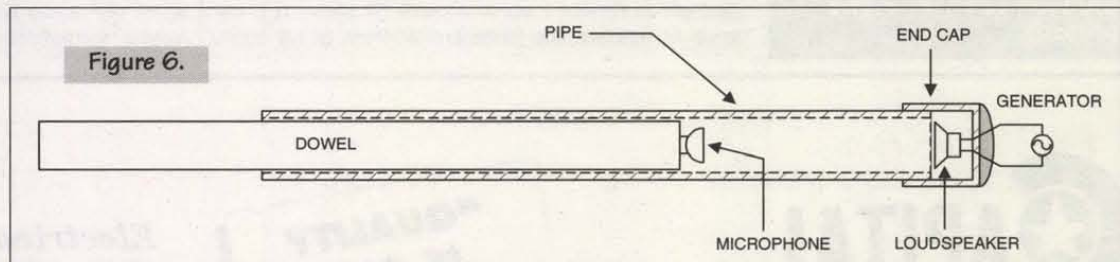


Figure 6.

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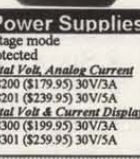
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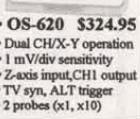


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More about measurement, including some of the arithmetic of measurement, can be found in my book *The Art of Science*. It is available at 1-800-247-6553, or on the web through Amazon Books (<http://www.amazon.com>).

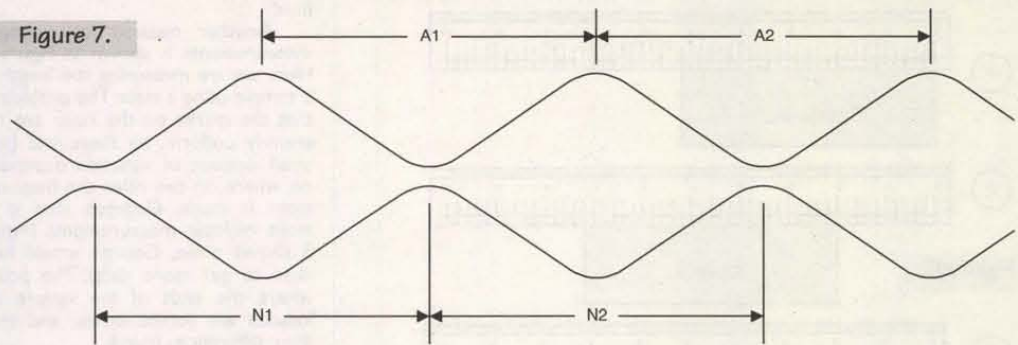
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When you send me an E-Mail please, spell the E-Mail address correctly. The correct address is CARRJJ@AOL.COM. That's a "C," an "A," plus two "Rs," and to "Js." It seems that a number of people have been using a variation on the address, and receiving a lot of my E-Mails is annoying the daylight out of a seventh-grade middle school girl somewhere out there in cyberspace. She expressed her distress rather forcibly, and even got a little rude. She did, however, apologize for her statements, and accepted my apology for any E-Mails that she received. I love hearing from readers, but if you did not get a response, then maybe the young lady received it instead. **NV**

Connections ...

I can be reached by snail mail at P.O. Box 1099, Falls Church, VA 22041, or via E-Mail at CARRJJ@AOL.COM (and please get it right ... please).

Figure 7.



Want To Get Rich?

A year or two ago, I saw a piece on *Sixty Minutes* about a scam originating in Nigeria. Later on, a friend of mine got the same solicitation (but was too smart for it). Recently, I got mine. The deal varies from one letter to another, but they have the same basic elements. Someone in Nigeria (my letter is signed by "Mr. Uyi Oghafua") sends a letter to a US address claiming to be an official of a company or the government.

My letter was supposedly from someone in the Nigerian National Petroleum Corporation. They want to establish a long-term business relationship with me. There is supposedly a huge amount of money in some kind of "floating suspense account" in the Central Bank of Nigeria. In my case, it was \$30-million US dollars. All they need to get access to the money (for which service I am to receive 30 percent) is my account number, the name and address of my bank,

and a bit of additional information. In a pig's eye!

Don't be fooled by this scam. In fact, don't ever send your bank account data to anyone. If you need to transfer money from bank to bank, then your regular banker can tell you how to go about it (indeed, they can do it for you). The reason I bring this attempted scam up in my column is simple: they used my ham radio call sign and the P.O. box number (see below) ... which I used almost exclusively for reader mail. This tells me that some other ham operators, or others who might be listed in databases or mailing lists as electronics enthusiasts, might receive similar letters.

These scams prey on people by appealing to their greed. I try to follow the TANSTAAFL principle (There Ain't No Such Thing As A Free Lunch!). Or, as the post office ad about mail order scams says it: "If an ad seems too good to be true, then it ain't." (Well, maybe I paraphrased it a little bit.)



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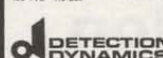
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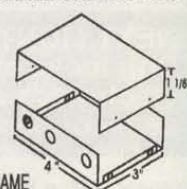
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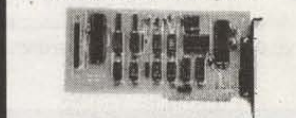
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Home Automation

At one time, "home automation" meant being able to control a light from more than one switch. These days, the concept has exploded into everything from conventional power control to home theater to security alarms to

voice recognition devices to portable remotes to networking your toaster with your hot tub to disabled aides to home energy audits.

We first looked at some HA basics way back in RESBN41 .PDF, and saw related alarm and

NEXT MONTH:
Don looks at offshore electronics and foreign semiconductors.

security stuff in RESBN42.PDF. A lot has happened since then, so a fresh update would seem appropriate.

Here's a summary of today's major league players ...

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Home Automator

Jeff Anderson's *Home Automator* is a good labor-of-love magazine and can often be your best starting point. This pub has recently gotten improved and reformatted. Typical coverage might include temperature tracking, internet resources, X-10 module reviews, and occupancy "people detectors."

Website is www.HomeAutomator.com. It does give you lots of listings for suppliers, hardware, software, FAQs, users, and newsgroups.

Circuit Cellar

For working circuits of embedded controller hardware and controlling software, Steve Ciarcia's *Circuit Cellar* magazine is hard to beat. While the PIC is fast becoming the HA controller of choice, a wide range of designs can be found here. Steve also runs his *Micromint* for ready-to-run hardware, software, and kits.

His website is www.circuitcellar.com. Additional PIC info can be found at www.tinaja.com/piclib/01.html.

Other Magazines

There are bunches of other useful magazines. Such as ...

Audio Video Interiors. A competitor to *Home Theater*, they call themselves the home theater authority. \$23.95.

Electronic House. Useful control for smart homes, from economical up to extravagant. Has stories on residential lighting. Subs are \$23.95 per year.

HA Pro. Industrial trade journal calls themselves the essential magazine for home automation professionals.

Home Automation. An older monthly newsletter with a strong focus on both environmental and on new assistive technology products.

Home Automation News. Member newsletter from the *Home Automation Association*. Also has a Products and Services directory.

Home Power. By Richard and Karen Perez. Lots of real world stuff here on energy efficiency, off grid living, and alternate lifestyles.

Home Theater. Monthly newsstand magazine on big screen video, high-quality surround sound, and similar goodies. \$3.95 per copy.

Intelligence Report. Pricy newsletter about HA technology development, business stats, and key players. \$299.00.

Interactive Home. Another expensive newsletter on HA inter-

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Updated 2nd edition of Don's classic on setting up your own technical or craft venture. \$18.50

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PostScript: A Visual Approach	\$22.50
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Thinking in PostScript	\$22.50
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Security Sales. Trade journal reports on developments and tech

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SOME HOME AUTOMATION RESOURCES

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- **X-10 Powerhouse Applications Manual**
 - **X-10 Technology Guide**
- Additional info on many of these titles can be picked up with use of my <http://www.tinaja.com/amlink01.html>.

Online Resources

An outstanding starting point is the HA "links to links" site you'll find at infinet.com:80/~dhoehnen/ha/list.html.

That HTI News is an online ezine from Home Toys. You find this one at www.hometoys.com. They have a new shareware library, link library, tips and tricks, plus review archives.

Electronic House Online is the ezine side of Electronic House magazine. Recent issue topics included whole house audio, pollution management, and surge suppression. Automation University has a network for dealers, owners, and builders interested in HA services at set-net.com.

A Mac control site is www.shed.com. For any of you that came in late, the X-10 is an older one-way powerline control system. It has lots of low-cost appliance, lamp, motor, and security modules. The big advantage is that you simply plug stuff in. Or swap out ordinary switches. X-10 is also older, rather slow, has no confirmation, and is of limited reliability.

User support for the X-10 appears at electronichouse.com/pc.B.x10.3.html, while the actual X-10 page is found at www.x10.com/homepage.htm.

Some useful tech reprints appear at www.acces.com/home.htm. The Home Team has a fine Internet HA directory and a resource guide up for you at www.hometeam.com/index2.html. Included are scads of links to home networks, general tutorials, control standards, lighting and appliances, plumbing controls, and more.

Needless to say, all those "usual suspects" of Hotbot, Inference, Deja News, and Alta Vista can quickly find you just about everything online.

aspects of the alarm manufacturing industry. Free to qualified subscribers.

Books

There's not a whole lot of books on home automation, and some of them are showing their age. Here is my choice for a good current selection ...

- **American Electrician's Handbook**
- **Approaching Home Automation**
- **Automated Home Control**
- **Automation Tips & Tricks I & II**
- **Building Interiors, Plants & Automation**
- **CE Bus User's Guide**

- **Complete Guide to Home Automation**
- **Ergonomic Living ... User Friendly Home**
- **The Household Web**
- **Leviton Decora Home Control Manual**
- **Smart House Wiring**
- **Understanding & Installing Home Systems**
- **Understanding & Reducing your Electric Bill**
- **X-10 Applications Manual**
- **X-10 Automated Home Control**
- **X-10 Creative Ideas**
- **X-10 Hacker's Secrets**
- **X-10 Installer's Guide**

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TEK 465B 100 MHZ OSCILLOSCOPE	\$450.00	WAVETEK 175 WAVE FORM GENERATOR	\$250.00
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HP 8601A 110 MHZ SWEEP/SIGNAL GENERATOR	\$400.00	HP 3456A MULTIMETER	\$450.00
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Analog Input - 8 input pins. 12-bit plus sign self-calibrating ADG. Returns results in 1mV steps from 0 to 4095. Software programmable alarm trip-points for each input. DIP switch addressable; stack up to 16 modules on same port for 128 single-ended or 64 differential inputs. **\$49**

Home Automation (X-10) - Connects between a TW523 and your serial port. Receive/transmit all X-10 commands with your home-brewed programs. Full collision detection with auto re-transmission. **\$39**

Caller ID - Decodes the caller ID data and sends it to your serial port in a pre-formatted ASCII character string. Example: "1231 08:45 850-863-5723 Weeder, Terry <CR>". Keep a log of all incoming calls. Block out unwanted callers to your BBS or other modem applications. **\$35**

Touch-Tone Input - Decodes DTMF tones and sends them to your serial port. Keep a log of all outgoing calls. Use with the Caller ID kit for a complete in/out logging system. Send commands to the Home Automation and/or Digital I/O kits using a remote telephone. **\$34**

IR Remote Control Receiver

Learns and responds to the data patterns emitted by standard infrared remote controls used by TVs, VCRs, Stereos, etc. Lets you control all your electronic projects with your TV remote. 7 individual output pins can be assigned to any button on your remote, and can be configured for either "toggle" or "momentary" action. **\$32**

50 MHz Freq Counter

Reads frequency from 1Hz to 50MHz and displays up to 7 digits on a 16 character LCD. Auto-range feature provides floating decimal point and automatic placement of suffix (Hz, KHz, or MHz). Microcontroller based provides for very small parts count. **\$48**

DTMF Decoder/Logger

Keep track of all numbers dialed or entered from any phone on your line. Decodes all touch-tones and displays them on a 16 character LCD. Holds the last 240 digits in a non-volatile memory which can be scrolled through. Connect directly to radio receiver's speaker terminals for off-air decoding of repeater codes, or numbers dialed on a radio program. **\$55**

Telephone Call Restrictors

Two modes of operation; either prevent receiving or placing telephone calls (or call prefixes) which have been entered into memory, or prevent those calls (or call prefixes) which have not been entered into memory. Use touch-tone phone to program. Block out selected outgoing calls. Bypass at any time using your password. **\$35** Block out selected incoming calls. Calls identified using Caller ID data. **\$46**

RESOURCE BIN

Use all those convenient button links at www.tinaja.com/webwb01.html.
The main newsgroups include ...

- alt.home.automation
- comp.home
- comp.home.automation
- alt.energy.homepower
- alt.home.theater.announce
- alt.home.theater.marketplace
- alt.home.theater.misc

A well done FAQ, X-10 data bases, sourcecode, components, plus lots of other home automation stuff is found at web.cs.ualberta.ca/~wade/HyperHome.

Manufacturers

A sampler of several of the more important home automation product manufacturers might include ...

- Activehome
- Advanced Control Technologies
- AMP Building Systems
- CSA Audio
- Custom Solutions
- Dancraft
- Enviromatics
- Hause
- Home Automated Living
- Home Automation
- iButton
- IBM Home Director
- IntelliSystems
- Integrated Homes
- Interactive Technologies
- JDS Technologies
- Leviton
- Lucent
- Magic Castle
- Marrick
- MoTron
- Phast
- Powerline Control Systems

- Residential Control Systems
- Sentinel Systems
- Silent Master
- Stanley
- Unity Systems
- Wadsworth Electronics
- Windland Electronics

Distributors

Most home automation products are resold through national or local distributors. Three of the high profile nationals include *Home Controls Inc.*, *Bass Electronics*, and *Home Automation Systems*. All do offer glossy catalogs and extensive web sites.

Use these for wish books.

A friendly and very knowledgeable distributor is *Worthington*, while that *Advanced Services* is a mom and pop store who seem to have the finest reputation in the industry.

Some other distributors include ...

- Advanced Services
- EES Home Automation
- Futureworks
- Home Controls
- Richardson Electronics
- Security Store
- WatchGuard

A Challenge

As I see it, the "next big thing" in HA should be effective home energy management. Things like turning on a hot tub "just in time" can dramatically cut your monthly power bill. So can finding out your exact operating cost of an old refrigerator or whatever. Or finding the payback time to upgrade to a scroll compressor in your old air conditioning system.

What can be done here?

I've been playing with the DT500 power monitor from *Digitest Services*. You plug an appliance or whatever into it, key in your power

cost, and it accurately tracks your current, watts, and your total monthly operating costs. More in MUSE123.PDF.

But what is really needed is an "electrician free" scheme to remotely sense current; a family of wireless remote devices that let you find out how much power an appliance (or your whole house) is using. In several forms.

One style would be a plug-in adaptor that could go between the appliance and its 110 or 220 outlet. A second would be a clamp-on beastie useful for monitoring the current in a wire. Used in bunches, this one sure could double as monitors to find maddeningly intermittents in a heat pump or whatever.

A third would be a tennis ball shaped *isopod* that you would simply (but carefully!) glomp onto your incoming power wires right at the entry weatherhead.

Your host computer might then interrogate all of the current monitors as needed to perform an entire home energy audit. Or else treat problem loads one-on-one.

Only the current would have to be reported remotely. Power could be determined by measuring the voltage and its phase at the audit computer itself. The isopods could either auto report every now and then, or else speak when spoken to.

Four obvious sources for bits and pieces on isopod parts are *Micron*, *Dallas*, *Amecon*, and *Maxim*. More on isopods themselves in HACK47.PDF, EMERGOP3.PDF, RESBN46.PDF, and in HACK65.PDF.

Isopod consulting services are available per the details you'll find at <http://www.tinaja.com/info01.html>.

This Month's Contest

Once again, I have a hollow feeling that I may have missed out on one or two of the biggies here. So, for our first contest this month, just tell me about any home automation

resource I don't already know about. Or else tell me how you would build up a wireless current sensor or what you would do with it. Lots of new opportunities here.

There should be a largish pile of my new *Incredible Secret Money Machine III* 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.

Let's hear from you.

For More Help

Additional hot linked HA content is found in www.tinaja.com/resbn01.html, while HA book access links are found at www.tinaja.com/amlink01.html. The HA magazine sources can be reached through www.tinaja.com/webwb01.html. Customized and personal consulting services for HA or nearly any other technical topic are reachable by way of www.tinaja.com/info01.html. NV

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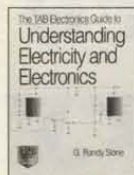
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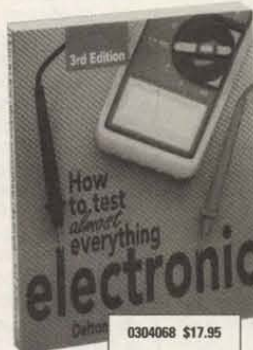
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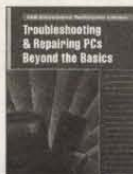
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Software Wizardry

By Harry L. Helms

Interactivity is becoming ever more important on Web pages. Sometimes it is a necessity (such as for on-line commerce) while in other situations it helps a Web page stand out from the competition. Animated graphics are an example of the latter, as are buttons to play sounds and animations.

One way to add interactivity is through JavaScript, the overwhelming favorite scripting language for Web pages. JavaScript programs (more accurately, they're "scripts" instead of programs) are embedded in HTML pages and run inside a JavaScript-enabled browser like Netscape or Internet Explorer. JavaScript code is interpreted line-by-line instead of compiled.

JavaScript can be used for a lot of interesting applications like clock displays, playing sounds, calculators, warning and message boxes, etc. However, it is not up to big tasks such as accessing and manipulating databases or handling on-line mer-

chandise orders. It also lacks features like strong data typing often needed for serious programming.

Java, on the other hand, is a serious programming language derived from C and C++. You can do almost any task you want using Java. Java "applets" also execute inside a Java-enabled browser like Internet Explorer and Netscape, and are also downloaded over the Web with the HTML pages containing them. But Java currently has one big disadvantage — Java applets are slow to download and execute.

Java applets are comparatively large files to download compared to JavaScript (JavaScript programs are just ASCII text) and Java is also an interpreted language. As a result, Java applets are mainly used for relatively simple applications like animated graphics. The true potential of Java — the ability to deliver such applications as databases, spreadsheets, word processors, etc. via the Web — is going unrealized because of its slow download and execution speed.

Server-Side Programming

A computer accessing HTML pages containing JavaScript and Java is called a client; the computer at the other end supplying such files is called a server. A server is typically a big, beefy computer with lots of memory and processing power, and it uses a heavy duty operating system like Unix.

JavaScript and Java run on the client computer over the Web connection. Early in the development of the Web, it was realized that the powerful server computer could handle most computing tasks far better than client computers. Soon after the introduction of JavaScript and Java, there was a flurry of interest in developing "client side" interactive applications using them. But as the limitations of client side computing have become clearer — especially as more demanding forms of interactivity are introduced — there has been a renaissance in "server side" computing. Indeed, more than a few people feel the real future of Java lies as a server side programming language rather than in creating

applets downloaded to the client computer.

Server side computer programming is, in many ways, actually easier than most client side programming. There are also plenty of server side programs and scripts available — often for free — that can be easily adapted to add interactivity and functionality to your Web pages. In fact, the odds are that you can get an "off-the-shelf" server side program to do almost any task you want to perform on your Web site.

Understanding CGI

So how does a client PC use a program residing on a distant server without actually downloading it? The secret is a protocol known as the common gateway interface (CGI).

A "protocol" is simply a set of rules and standards used to control how two or more computers communicate with each other and exchange files. For example, that "http" before Web addresses stands

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for "hypertext transport protocol." The CGI protocol defines how external programs, like a JavaScript routine in a Web page's HTML, can communicate with programs on a Web server. For example, a Web page might have a JavaScript program that allows users to enter their name and E-Mail address into text fields. CGI will allow that data to be transferred to a database program residing on a distant server. By the same token, CGI will allow items from the server's database program to be sent to a Web page on a client

computer and then displayed in the HTML.

CGI programs usually reside in a separate directory on the server. The most common name for this directory is "cgi-bin," although "cgi" and "bin" are also used. CGI programs must be configured for the operating system used by the server. Fortunately, configuration does not involve extensive rewriting and alteration of the programs; instead, it usually involves setting the value of a few variables and specifying file paths. Figure 1 shows the location of

a cgi-bin directory on an actual server.

The term "CGI programs" refers to programs residing on a server and accessed through the CGI protocol. However, there is no such thing as the "CGI programming language." CGI programs can be written in several different languages. C and C++ are often used, and Java is becoming increasingly popular. (Indeed, the biggest Web-based use of Java in a few years might well be as a CGI language.) And even Visual Basic can be used to create CGI programs on a server using Windows NT as an operating system.

The most widely used CGI programming language is Perl (Practical Extraction and Report Language). Perl has many powerful searching, pattern matching, and text manipulation features along with basic mathematical computation abilities. Perl is an interpreted language, like JavaScript, and for this reason you may hear such terms as "Perl scripts" and "CGI scripts" used. Because it is interpreted, a Perl CGI program will not execute as rapidly as a CGI program written in C or Java. However, most CGI applications — like database access or on-line ordering — do not need maximum speed.

A server must have a Perl interpreter installed in order to run Perl programs. There are two Perl interpreters in use today, revision 4 and

revision 5. A revision 5 interpreter is fully capable of running revision 4 programs, while a revision 5 program running on a revision 4 interpreter may cause a system crash. The system operator of a server can tell you which interpreter is installed.

A useful CGI application usually includes more than just the program itself. Several supporting files, like HTML templates and configuration data, are included in the cgi-bin directory housing the program.

Linking to CGI Programs

Linking from a client to a CGI program on a server is done in much the same way that ordinary Web pages are requested by and delivered to a client. The GET method is used to make requests for the CGI program on a server, just like it is used to request ordinary Web pages from a server. The POST method is used to send data from the client to the server. When the request and/or data is received by the server, it generates a HTML document and delivers it, like any other Web page, to the client. The link from client to server is made by specifying the URL on the server where the desired CGI program resides; this is the same way you link from one Web page to another.

You can see the POST method in action when you search for a particular topic using a Web search engine

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Software Wizardry

like Yahoo. The POST method produces a URL in your browser's address line similar to other URLs, but with the data being sent to the server embedded in the URL. Figure 2 shows an example of this. Look

for CGI programming is Perl (practical extraction and report language), created originally by Larry Wall to facilitate report writing on Unix systems. Larry has graciously made Perl widely available with few restric-

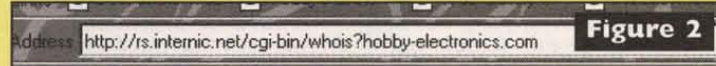


Figure 2

carefully at the URL; notice the words following the question mark (?) in the URL? The question mark defines the start of the data being sent to the server (in this case, search words for "hobby electronics").

There are a couple of other ways that a server can send data to a client. One is with command line arguments in the server program. However, this is seldom done. More common is the use of environmental variables. The values of these variables are set by the server program and are accessible by the client PC. Environmental variables give information about the server itself (domain name or IP address, server software being used, etc.), information about cookies being sent to the client, and information about the visitor to the site, such as "echoing" the visitor's IP address.

Most CGI programs have several configuration variables whose values are set according to the server it is running on and the desired program performance. For example, you might want to set the paths where different files are located, set the initial value of a visitor counter, enter allowable passwords, exclude visitors from certain domains, etc.

About Perl

The most widely used language

tions; you can get a copy of the latest Perl development system from www.perl.com/latest.html.

Perl is an interpreted language, not compiled. Perl programs are ASCII text files that are interpreted line-by-line, so you can develop functioning programs using an ordinary text editor. A big disadvantage of Perl is its relatively slow speed. All interpreted languages are slower than compiled languages, and the Perl interpreter is a large program that must be loaded each time a Perl program executes on the server. If rapid execution is required in your CGI program, then a language like C++ is better suited.

However, Perl is fast enough for most applications, especially those involving sending and receiving text information from a server. And Perl has some impressive text-processing capabilities that make it superior to languages such as C++ or Java for text manipulation.

Perl has a similar syntax to many other popular programming and scripting languages. Each line in a Perl program ends with a semicolon (;) and curly brackets { and } are used to group statements together. A full set of arithmetic and equality operators (+, -, *, /, >, <, etc.) is included. Available statements include if, for, while, and until, and these work pretty much the same way they do in C, Pascal, Basic, etc.

Perl's data types are simple: numeric (any number data); string (any collection of characters); and array (a list of numeric or string data). Variable names may begin with a \$ (a single value variable), @ (an array), or % (an associative array where data is stored in pairs). If a variable name does not begin with a character, it is a "handle" identifying a file name used for program input or output.

Like other languages, Perl comes with built-in functions to perform numeric calculations and interact with the computer system. Perl also lets you create subroutines to perform certain tasks and call those subroutines as needed throughout the program.

The big difference between Perl and other programming languages — and the biggest source of confusion for most newcomers to Perl — involves regular expressions. A regular expression is a string that is used to define a search pattern. A regular expression is contained within a pair of slashes, as in `/regularexpression/`. The format for using a regular expression is as follows:

```
if ($fullname =~ /Harry/) { print
    "They found a distinguished author's
    name!" }
```

In the example above, Perl will search the string variable \$fullname for the regular expression "Harry." If it does find a match for the regular expression in the variable, it will cause the server to return a HTML page containing the phrase "They found a distinguished author's name!" to the client PC.

Perl allows you to include metacharacters in a regular expression. For example, using the

metacharacter `?` in the regular expression `/Hae?rry/` will cause either "Harry" or "Herry" to be a match for the expression. Other metacharacters will return a match only for whole words, for a range of characters, or ignore the case of characters during a search.

The power of metacharacters make Perl an ideal language to use for applications like Web site search engines or text-entry database searching, since metacharacters can be used to compensate for misspellings or variations in the spelling of a term. The absence of metacharacters can also be used to force the exact spelling and case of a term to be used. This is especially useful for passwords.

Free Perl Programs!

One of the really terrific things about Perl is that numerous scripts have been written and made freely available for others to use! You can download and use these scripts just as they're written or you can modify them for your particular needs. This is easy to do since the Perl scripts are ASCII text, making them easy to view and alter with any ordinary text editor.

The place to start is www.scriptarchive.com, home of "Matt's Script Archive." This is an advertising-supported site offering Perl scripts for visitor counters, guestbooks, site searches, etc. Another useful resource is www.cgi-resources.com, which has tons of links to Perl script sources, tutorials on Perl and CGI, etc.

Even if you're not a programmer, you can add impressive interactivity to your Web site through CGI and Perl. Why not give it a try? **NV**

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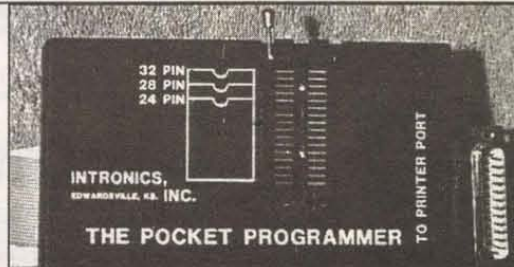
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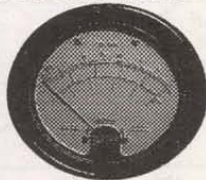
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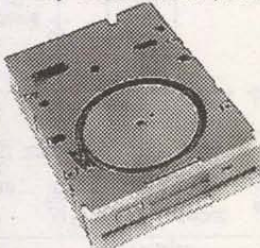
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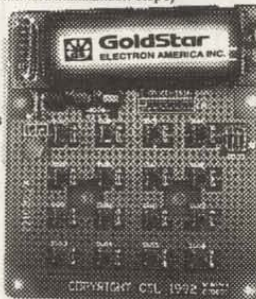
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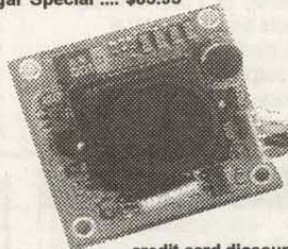
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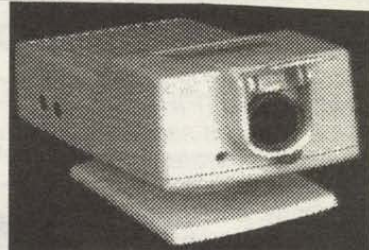


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SECURITY ELECTRONICS SYSTEMS AND CIRCUITS

Part 4

by Ray Marston

Ray Marston looks at practical visible-light optoelectronic security circuits in this fourth episode of this series.

Optoelectronic circuits — which respond to either visible or invisible (usually infrared) light levels — are widely used in modern domestic and commercial security systems.

Optoelectronic security circuits come in three basic types, the first of which is the simple 'visible-light-level' type that reacts when a light level goes above or below a preset value.

The second type is the light-beam alarm, which reacts when a person, object, or animal breaks or reflects a projected visible or infrared (IR) light beam.

The third type is the passive infrared (PIR) detector, which is sensitive to the heat-generated infrared light radiated by the human body, and thus reacts when a human or other large warm-blooded animal comes within the sensing range of the PIR detector.

A range of practical optoelectronic circuits of the 'visible light' type are described in this month's part of this series; practical IR 'light-beam' and PIR circuits will be described in next month's episode.

VISIBLE-LIGHT-LEVEL CIRCUITS

LDR BASICS

Most optoelectronic circuits

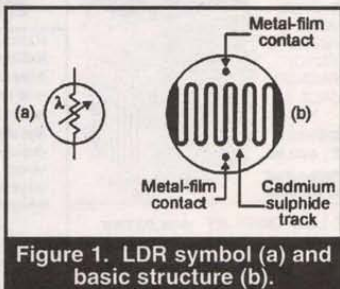


Figure 1. LDR symbol (a) and basic structure (b).

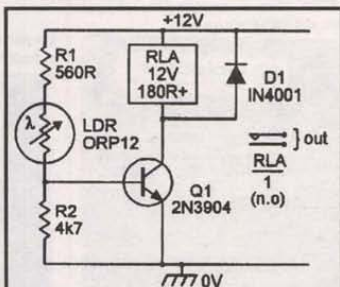


Figure 3. Simple non-latching light-activated relay switch.

that are designed to respond to normal visible light use a cadmium sulphide (CdS) LDR (light-dependent resistor) as their light-sensing element or photocell. Figure 1 shows an LDR's circuit symbol and basic construction, which consists of a pair of metal film contacts separated by a snake-like track of light-sensitive cadmium sulphide film; the structure is housed in a clear plastic or resin case.

Figure 2 shows the typical photoresistive graph that applies to an LDR with a face diameter of about 10mm; the LDR acts as a high resistance (typically hundreds

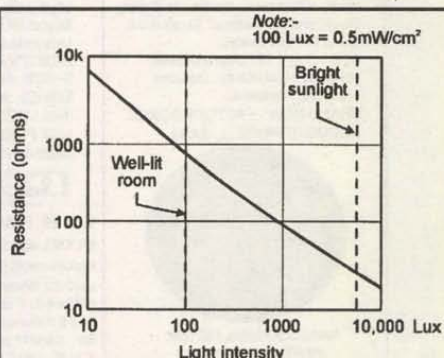


Figure 2. Typical characteristics curve of an LDR with a 10mm face diameter.

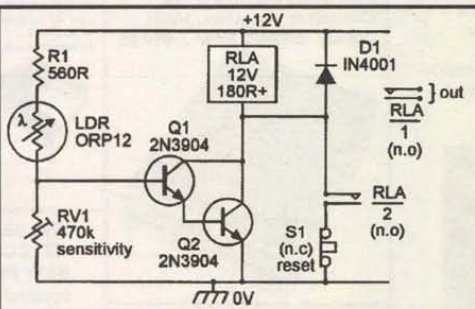


Figure 4. Sensitive self-latching light-activated relay switch.

of kilohms) under dark conditions, falling to about 900R at a light intensity of 100 Lux (typical of a well-lit room) or about 30R at 8000 Lux (typical of bright sunlight).

Note that although most of the practical circuits shown throughout

SIMPLE RELAY SWITCHES AND ALARMS

The simplest 'visible-light-level' security circuits are the types that are designed to activate when the light level goes through a large change, such as from near-dark to a moderately high level, or vice versa. Some circuits of this type function as 'light-activated' units that switch on a relay or safety mechanism or sound an alarm when light enters a normally dark area such as the inside of a storeroom, wall safe, or security case, etc.

Other circuits are designed as 'dark-activated' units, and activate when the light level drops well below some nominal value. Figures 3 to 7 show some simple circuits of these types.

The Figure 3 circuit is that of a simple non-latching, light-activated relay switch. Here, R1-LDR and R2 form a potential divider that controls the base-bias of Q1. Under dark conditions, the LDR resistance is very high, so negligible base-bias is applied to Q1, and Q1 and relay RLA are both off.

When light enters the normally dark area and falls on the LDR face, however, the LDR resistance falls to a fairly low value and base-bias is applied to Q1, which thus

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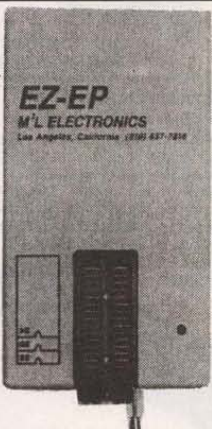
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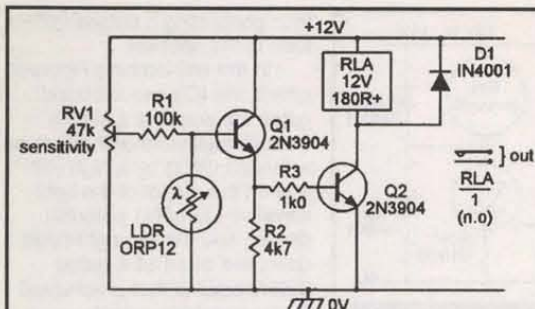


Figure 5. Simple dark-activated relay switch.

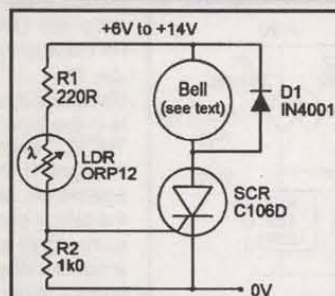


Figure 6. Simple light-activated alarm bell.

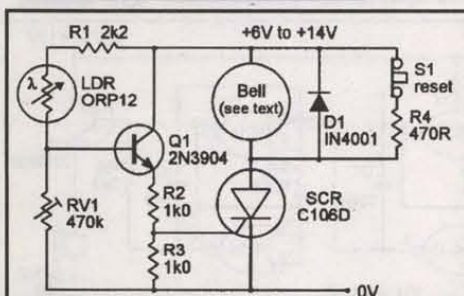


Figure 7. Improved light-activated alarm bell with self-latching facility.

turns on and activates the relay and its RLA/1 contacts, which can be used to control external circuitry. The relay can be any 12V type with a coil resistance of 180R or greater.

The simple Figure 3 circuit has a fairly low sensitivity, and has no facility for sensitivity adjustment. Figure 4 shows how these deficiencies can be overcome by using a super-alpha-connected pair of transistors in place of Q1, and by using sensitivity control RV1 in

place of R2; this circuit can be activated by LDR resistances as high as 200K (i.e., by exposing the LDR to very small light levels), and draws a standby current of only a few microamps under 'dark' conditions.

The diagram also shows how the circuit can be made to give a self-latching action via relay contacts RLA/2; normally-closed push button switch S1 enables the circuit to be reset (unlatched) when required.

Figure 5 shows an LDR used in a simple dark-activated circuit that turns relay RLA on when the light level falls below a value that is pre-set via RV1. Here, R1 and LDR act as a

potential divider that is fed with a pre-set DC voltage from RV1 and generates an output voltage that rises as the light level falls, and vice versa.

This generated voltage is buffered by emitter follower Q1 and is used to control the relay via common-emitter amplifier Q2 and current-limiting resistor R3. Thus, when the light level falls below the pre-set value, the R1-LDR divider's output voltage reaches a large enough level to activate both Q1

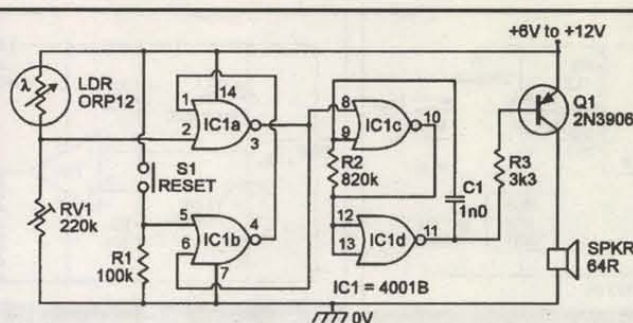


Figure 9. Self-latching light-activated alarm gives monotone output.

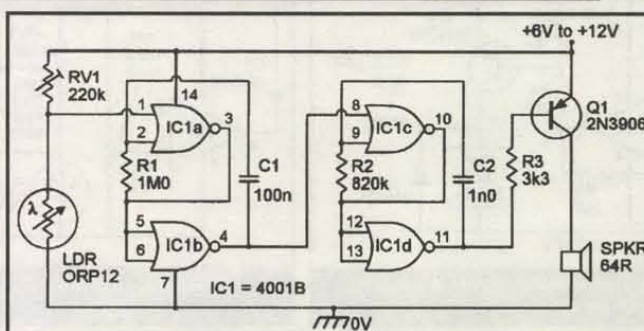


Figure 8. Non-latching light-activated alarm with pulsed-tone output.

and Q2, and the relay turns on.

Figures 6 and 7 show simple SCR (silicon controlled rectifier) circuits that — under the light-sensitive 'alarm' condition — activate an ordinary self-interrupting electro-mechanical alarm bell. This bell must (when the specified C106D SCR is used) consume an operating current of less than 2A, and the circuit's supply voltage must be at least 1V greater than the bell's nominal operating voltage.

The Figure 6 circuit is a simple non-latching one, in which the alarm bell is wired in series with an SCR that receives its gate drive from the positive supply rail via the R1-LDR-R2 potential divider. Thus, under dark conditions, the LDR resistance is very high, so negligible gating voltage appears across R2, and the SCR and alarm are both off.

When light enters the normally dark area and falls on the LDR

drops to zero). Consequently, the alarm bell automatically turns off when the light level falls back below the SCR's 'trip' level.

The Figure 6 circuit has a fairly low sensitivity and has no facility for sensitivity adjustment. Figure 7 shows how these deficiencies can be overcome by using RV1 in place of R2 and by using Q1 as a buffer between the LDR and the SCR gate; this circuit can be activated by LDR resistances as high as 200K (i.e., by exposing the LDR to very small light levels).

This diagram also shows how the circuit can be made self-latching by wiring R4 across the bell so that the SCR anode current does not fall to zero as the bell self-interrupts. Switch S1 enables the circuit to be reset (unlatched) when required.

SIREN-OUTPUT ALARMS

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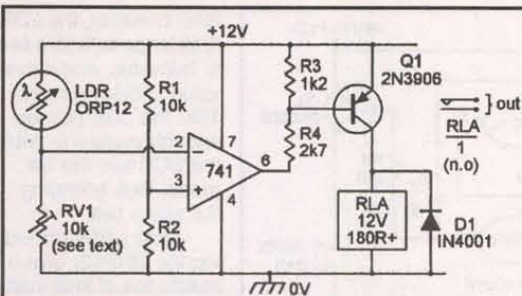


Figure 10. Precision light-activated relay switch.

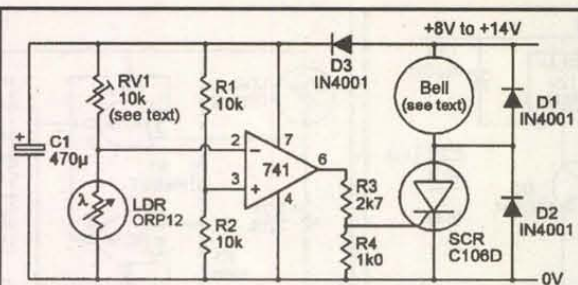


Figure 13. Precision light-activated alarm bell.

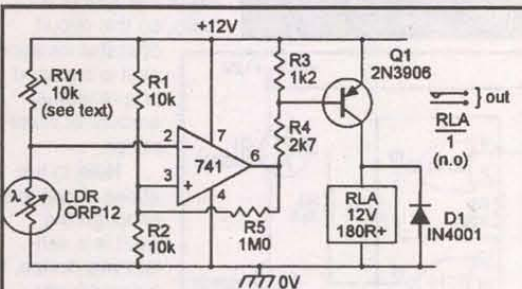


Figure 11. Precision dark-activated switch, with hysteresis.

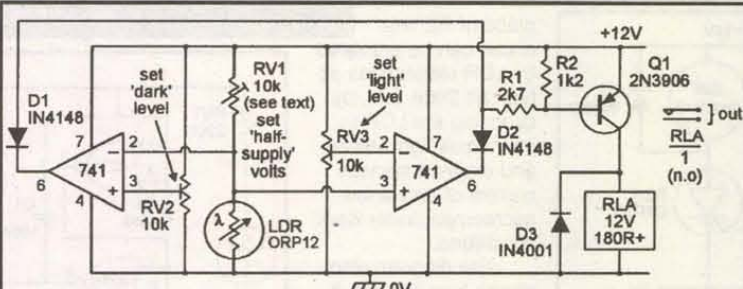


Figure 12. Combined light/dark-activated switch with a single relay output.

designed to give either alarm-bell or relay outputs. In some applications, an electronic 'siren sound' output may be preferable, and Figures 8 and 9 show low-power (up to 520mW) speaker-output circuits of this type. The Figure 8 circuit gives non-latching operation and develops a pulsed-tone output signal. The Figure 9 circuit gives self-latching operation, and develops a monotone output signal. Both circuits are designed around a 4001B CMOS IC.

In the Figure 8 circuit, the IC's two left-hand gates are wired as a low-frequency (6Hz) gated astable

multivibrator that is activated via the light-sensitive LDR-RV1 potential divider, and the two right-hand gates are wired as a gated 800Hz astable that is activated by the 6Hz astable.

Under dark conditions, the LDR-RV1 output voltage is high and both astables are gated off, and the circuit consumes a fairly low standby current, but under bright conditions the LDR-RV1 output voltage is low and both astables are activated, with the left-hand astable gating the 800Hz

thus generating a pulsed 800Hz tone in the speaker.

In the self-latching Figure 9 circuit, the IC's two left-hand gates are wired as a simple bistable multivibrator that can be activated (SET) by a high voltage on the output of the light-sensitive LDR-RV1 potential divider, and the two right-hand gates are wired as a gated 800Hz astable that is activated by the bistable's output.

Under normal dark conditions, the output of the LDR-RV1 divider is low, the bistable output is in the high 'RESET' state, thus gating the astable off, and the circuit consumes only a small standby current. When the LDR is exposed to light, however,

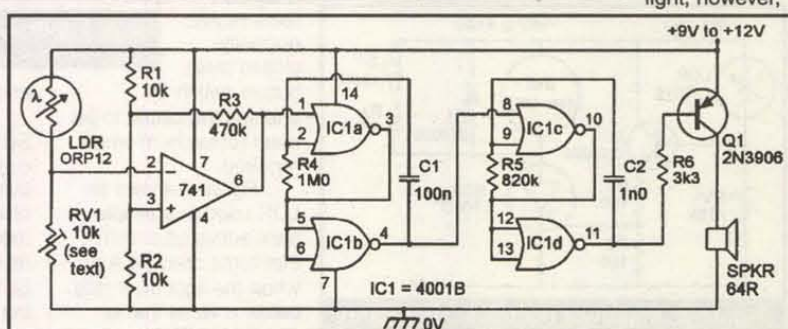


Figure 14. Precision light-activated pulsed-tone alarm with hysteresis.

astable on and off at a 6Hz rate,

the LDR-RV1 junction goes high, flipping the self-latching bistable into the SET mode, in which its output goes low and gates on the 800Hz astable, thus generating a monotone speaker signal.

Once it has been activated, the circuit can only be turned off again by removing the LDR's illumination and briefly closing RESET switch S1, at which point the bistable output resets to the high state and the astable is gated off again.

Note that the trigger points of the Figures 8 and 9 circuits occur at the point at which the LDR-RV1 junction voltage swings above or below IC1's 'transition' voltage value, which lays somewhere between one-third and two-thirds of the supply voltage value.

In practice, the light-trigger points of these circuits are not greatly affected by supply voltage variations. Also note that, when using the output stages shown in the diagrams, these two circuits each give maximum output powers of only 520mW into the 64R speakers, but that these powers can be boosted to as high as 13.2 watts by replacing the Q1 output stages with the power-boosting cir-

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cuts shown in Figures 21 or 22 in last month's Part 3 of this series.

PRECISION RELAY-SWITCHING CIRCUITS

The relay-switching circuits of Figures 3 to 5 are fairly sensitive to variations in supply voltage and temperature, and are not suitable for use in precision light-sensing application. Figure 10 shows a very sensitive light-sensitive relay-driving circuit that is not influenced by such variations, and is thus suitable for use in many precision light-sensing applications, and which turns the relay on when the light level rises above a pre-set value.

In this case, LDR-RV1 and R1-R2 are connected in the form of a Wheatstone bridge, and the op-amp and Q1-RLA act as a highly sensitive balance-detecting switch. The bridge balance point is quite independent of variations in supply voltage and temperature, and is influenced only by variations in the relative values of the bridge components.

In Figure 10, the LDR and RV1 form one arm of the bridge, and R1-R2 form the other arm. These arms can actually be regarded as potential dividers, with the R1-R2 arm applying a fixed half-supply voltage to the non-inverting input of the op-amp, and with the LDR-RV1 divider applying a light-dependent variable voltage to the inverting terminal of the op-amp.

In use, RV1 is adjusted so that the LDR-RV1 voltage rises slightly above that of R1-R2 as the light intensity rises to the desired trigger level and, under this condition, the op-amp output switches to negative saturation and thus drives RLA on via Q1 and biasing resistors R3-R4. When the light intensity falls below this level, the op-amp output switches to positive saturation and, under this condition, Q1 and the relay are off.

The Figure 10 circuit is very sensitive and can detect light-level changes too small to be seen by the human eye. The circuit can be modified to act as a precision dark-activated switch (which turns the relay on when the light level falls below a pre-set value) by either transposing the inverting and non-inverting input terminal connections of the op-amp, or by transposing RV1 and the LDR.

Figure 11 shows a circuit

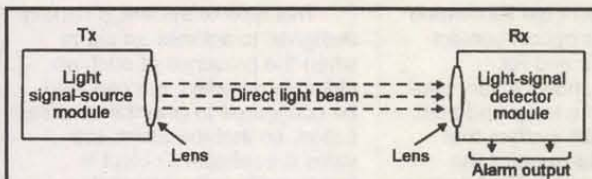


Figure 15. The basic elements of a direct-light-beam type of alarm system.

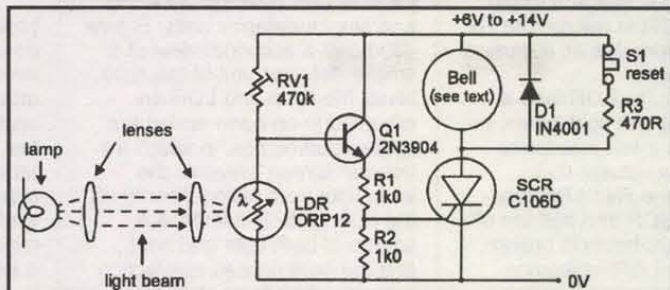


Figure 16. Simple direct-light-beam alarm with alarm bell output.

using the latter option. This diagram also shows how a small amount of hysteresis can be added to the circuit via feedback resistor R5, so that the relay turns on when the light level falls to a particular value, but does not

matic lighting-control circuits). The hysteresis magnitude is inversely proportional to the R5 value, being zero when R5 is open circuit.

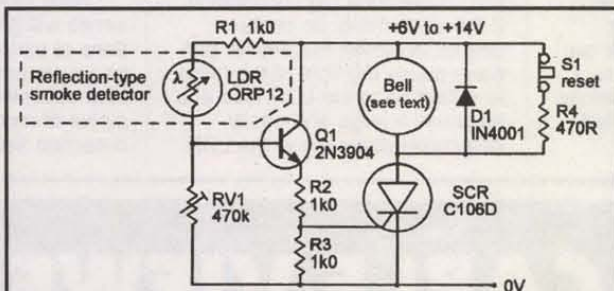


Figure 19. Smoke alarm with alarm bell output.

turn off again until the light level rises a substantial amount above this value (this action helps prevent spurious switching due to passing shadows, etc., in auto-

roughly half-supply volts appear on the LDR-RV1 junction when the LDR is illuminated at the mean or normal intensity level. RV2 can then be pre-set so that RLA turns on when the light

Figure 12 shows how a precision combined light/dark-activated switch (which activates a single relay if the light intensity rises above one pre-set value or falls below another pre-set value) can be made by combining the 'light' and 'dark' switch circuits of Figures 10 and 11.

To set up this circuit, first pre-set RV1 so that

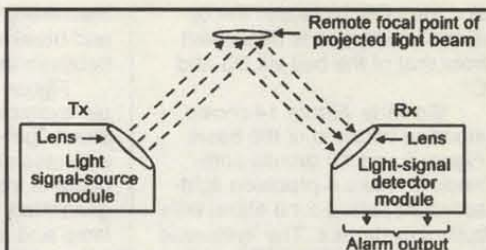


Figure 17. The basic elements of a reflected-light-beam type of alarm system.

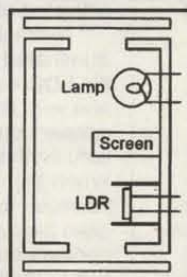


Figure 18. Sectional view of a reflection-type smoke detector.

intensity falls to the desired dark level, and RV3 can be pre-set so that RLA activates when the light rises to the desired 'bright' level.

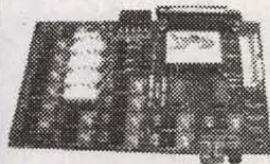
Note in the Figures 10 to 12 'precision' circuits that the basic RV1 value should be roughly double that of the LDR resistance value at the desired 'trigger' light levels, so that RV1's slider is reasonably close to its central position under this condition. Thus, the RV1 value may have to be reduced below 10K if a cir-

cuit is set to trigger under very bright conditions, or may have to be increased above 10K if used to trigger under very dark conditions.

PRECISION ALARM-SOUNDING CIRCUITS

The basic op-amp based precision circuits of Figures 10 to 12 can easily be used in conjunction with some of the alarm-bell activator or siren-sound generator circuits already shown in this article, to make various precision alarm-sounding circuits. Figure 13, for example, shows modified versions of the basic Figure 6 and 10 circuits combined to make a precision light-activated alarm bell circuit that can easily be changed into a dark-activated unit by simply transposing RV1

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and the LDR. Note that the op-amp's supply line is decoupled from that of the bell via D3 and C1.

Similarly, Figure 14 shows modified versions of the basic Figure 8 and 10 circuits combined to make a precision light-activated pulsed-tone alarm with built-in hysteresis. The hysteresis is controlled by R3, which can have its value altered to obtain different hysteresis values, or can be removed if hysteresis is not needed.

LIGHT-BEAM ALARM CIRCUITS

SIMPLE VISIBLE-LIGHT DESIGNS

A light-beam alarm system consists of a focused light-beam transmitter (Tx) and a focused light-beam receiver (Rx), and may be configured to give either a direct-light-beam or a reflected-light-beam type of optical contact operation.

Figure 15 shows the basic elements of a direct-light-beam type of alarm system, in which the sharply focused Tx light-beam is aimed directly at the light-sensitive input point of the Rx unit, which (usually) is designed to activate an external alarm or safety mechanism if a person, object, or piece of

machinery enters the light-beam and breaks the optical contact between the Tx and Rx.

Figure 16 shows a very simple example of a lamp-and-LDR direct-light-beam system that activates an alarm-bell if the beam is interrupted. The beam is generated via an ordinary electric lamp and a lens, and is focused (via a 'collector' lens) on to the face of an LDR in the remote Rx unit, which operates as a dark-activated alarm.

Normally, the LDR face is illuminated by the light-beam, so the LDR has a low resistance and very little voltage thus appears on the RV1-LDR junction, so the SCR and bell are off. When the light-beam is broken, however, the LDR resistance goes high and enough voltage appears on the RV1-LDR junction to trigger the SCR, which drives the alarm bell on; R3 is used to self-latch the alarm.

Figure 17 shows the basic elements of a reflected-light-beam type of alarm system, in which the Tx light-beam and Rx lens are optically screened from each other but are both aimed outwards towards a specific point, so that an optical link can be set up by a reflective object (such as metallic paint or smoke or fog particles) placed at that point.

This type of system is usually designed to activate an alarm when the presence of such an object is detected, but can also be configured to give the reverse action, so that the alarm activates if a reflective object is legally or illegally removed.

Units of the Figure 17 type were once widely used in conjunction with reflection-type fog and smoke detector units; Figure 18 shows a sectional view of a smoke detector unit of this type. Here, the lamp and LDR are mounted in an open ended but light-excluding box, in which an internal screen prevents the lamp-light from falling directly on the LDR face. The lamp is a source of both light and heat, and the heat causes convection currents of air to be drawn in from the bottom of the box and to be expelled through the top. The inside of the box is painted matt black, and the construction lets air pass through the box but excludes external light.

Thus, if the convected air currents are smoke free, no light falls on the LDR face, and the LDR presents a high resistance. If the air currents do contain smoke, however, the smoke particles cause the light of the lamp to reflect on to the LDR face and so cause a large and easily detectable decrease in the LDR

resistance.

Figure 19 shows the practical circuit of a reflection-type smoke alarm that can be used with this detector; the circuit acts in the same way as the improved Figure 7 light-activated alarm circuit.

IR LIGHT-BEAM ALARMS

Simple lamp-and-LDR light-beam alarms of the types described in the last section have several obvious disadvantages in most modern security-alarm applications. Their light-beams are, for example, clearly visible to an intruder, the transmitter's filament lamp is unreliable, and the systems are (because the transmitter's filament lamp consumes a lot of power) very inefficient.

In practice, virtually all modern light-beam security systems operate in the invisible infrared (rather than visible light) range, and use one or more pulse-driven IR LEDs to generate the transmitter's 'light-beam,' and use matching IR diodes or transistors to detect the beam at the receiver end of the system.

Next month's episode of this series will give detailed descriptions of various modern IR light-beam security systems, and will also describe the operating principles of modern PIR body-detection security devices. NV

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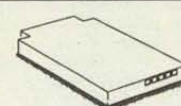


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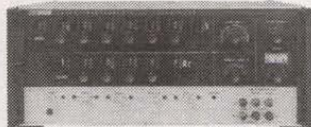
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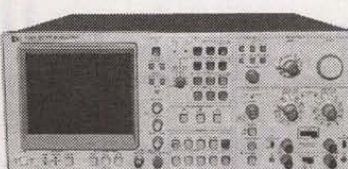
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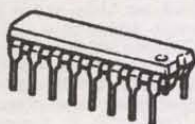
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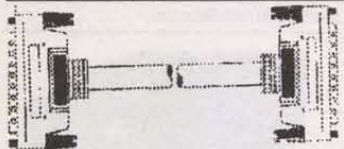


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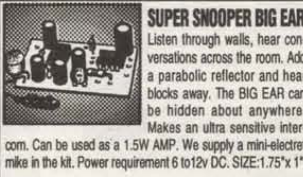
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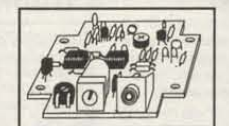
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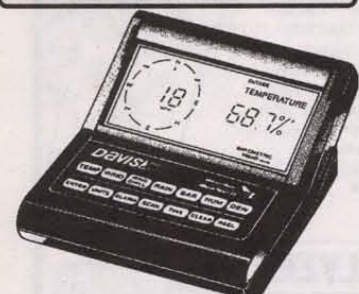
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Nuts & Volts Magazine/May 1998 **55**

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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 99.9 μ F,
1% of full scale ± 1 digit to 99.9 μ F.
Display: 3 digit LED.
Unit: pF, nF, μ F, mF, Overflow indicator.

AUTO DISTORTION METER

DM-3104A \$799.95
DISTORTION MEASURE
Range: 0.01% to 30%
0.1/0.3/1/3/10/30/60 ranges.
Freq: 400Hz-10KHz, 1KHz (10%HPF).
Input: 3mV-100V, Ratio mea. 20dB.
Auto. Freq. Switching Range:
Fundamental Freq. = (fo) ± 10 Hz.
Band Rejection: >80dB at (fo) ± 5 %; >70dB at (fo) ± 10 %.
Harmonic Accuracy: ± 0.5 dB, 1.8(fo)-20KHz.
LEVEL MEASURE Range: 0-100V; 0.3/1/3/10/30/100V;
Freq Response: ± 0.5 dB/20-50KHz; ± 1 dB/20-100KHz.
DM-3204 \$1,599.00 dual channels; Spec see DM-3104A.

WOW-FLUTTER METER

WF-3103A \$699.95 Freq. Range: 3KHz-10% JIS/CCIR,
3.15KHz-10% DIN.
Measure: 0.3/1/3/10% full scale.
Accuracy: ± 5 % of full scale.
WF-3105A \$799.95 digital display
Function: L/N/WOW/Flutter/WT.D.
Freq Counter: 10Hz-9.99MHz.
Indication: CCIR/DIN/JIS.

EFRATOM FRK-L rubidium oscillators! 10MHz sinewave output, 0.5Vrms. Long term stability: $<1 \times 10^{-10}$ /month. Includes optional Mdl. EEK-10 heatsink and I/O connector. Used, with fresh NIST traceable calibration certificates, only \$500 ea. Full specifications and picture at our website. (Quantities available.) **Fluke 5101B opt. 005 multi-calibrator**, DC/AC voltage and current plus resistance, \$2,400. ESI RS925 8 decade plus variable resistance standard, 0.01W to 1.1MW, \$1,350. **General Radio 1863 megohmmeter**, 50KW to 20TW, \$550. **General Radio 1862C megohmmeter**, 500KW to 2TW, \$300. 60 day guarantee. **Lehman Scientific**, 1-800-784-8680. Visa/MC. www.lehmanscientific.com

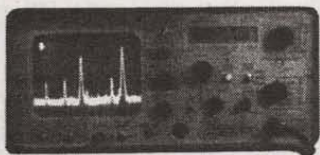
HP 7475A, 6 pen plotter, HP/IB or RS232 available, carousel included. (If you run Windows 95 you have the driver!) \$85. **HP 7470A**, 2 pen plotter, HP/IB or RS232 available, \$65. **HP 8640B Opt 01/02/03 signal generator**, 0.5 to 1024MHz, very good condition, fully checked out! \$1,750. **HP 3312A function generator**, 0.1Hz to 13MHz, \$500. **HP 8558B/853A spectrum analyzer**, 0.1-1500MHz w/digital storage display. Excellent condition, \$2,650. **Sencore SC61 waveform analyzer**, DC 60 MHz, oscilloscope plus digital readout of frequency, P-P volts, Delta volts, Delta time, etc. Comes with 2 brand new Sencore probes! Fully checked out and guaranteed, \$750. **Lehman Scientific**, 1-800-784-8680. Visa/MC. www.lehmanscientific.com



TEK 577D2/177 curve tracer \$850 in good condition. **CUSHMAN CE-24A** selective level meter 1KHz-3.2MHz, -80 to 20dBm, .003uV sensitivity with 50 ohm input \$150. **TEK PS 283** tripple output power supply, new in a box \$375. 10 day money back guarantee. For more great deals on test equipment please call 650-244-9438 or visit our web site: <http://www.odulo.com/corp/equiptek>

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DEC EQUIPMENT WANTED!!! We are buying DEC systems, boards, terminals, drives and peripherals. Also Scientific Micro Systems (SMS), DSD, Datability, Dialog, other DEC compatibles, and Computer Output Microfilm (COM) units. Please call for a quote or fax us your equipment list. We buy, sell, and trade. **KEYWAYS, INC.**, 937-847-2300 OR fax 937-847-2350.



ENGINEER TESTED: SPECTRUM ANALYZERS. Frequency counters, frequency standards, meters, scopes, generators, and more. **VISA, MASTERCARD, AMEX.** More information: [HTTP://TECH-SERVICES.COM](http://TECH-SERVICES.COM) "Performance-tested." Calibrated. Warranted. Gary N6ZD.

POOR MAN'S Spectrum Analyzer/Monitor Receiver Kit. 2 to 1,700 MHz. Basic kit only \$78. Now available with switched resolution filters, tracking generator and direct digital frequency readout. Works with ANY scope or IBM compatible computer. Send stamped envelope for details. Science Workshop, Box 310B, Bethpage, NY 11714. <http://www.science-workshop.com>

WE WANT to buy your excess test and measurement equipment. We will pick up and pay at time of pick up. Metrowest Technologies, phone 508-478-7613, fax 508-634-3806. Web: WWW.metrowesttech.com

METROWEST TECHNOLOGIES: Want to buy a piece of equipment but not sure of its capabilities? We will fax copy of catalog page(s) to you for review. Phone 508-478-7613, fax 508-634-3806. Web: WWW.metrowesttech.com

TEKTRONIX EQUIPMENT: Curve tracers, logic analyzers, scopes, etc. Metrowest Technologies, phone 508-478-7613, fax 508-634-3806. Web: WWW.metrowesttech.com

Synthesized FM Stereo Transmitter

Microprocessor controlled for easy frequency programming using DIP switches, no drift, your signal is rock solid all the time - just like the commercial stations. Audio quality is excellent, connect to the line output of any CD player, tape deck or mike mixer and you're on the air! Foreign buyers will appreciate the high power output capability of the FM-25; many Caribbean folks use a single FM-25 to cover the whole island! New, improved, clean and hum-free runs on either 12 VDC or 120 VAC. Kit comes complete with case set, whip antenna, 120 VAC power adapter - easy one evening assembly.

FM-25, Synthesized FM Stereo Transmitter Kit \$129.95



Tunable FM Stereo Transmitter

A lower cost alternative to our high performance transmitters. Offers great value, tunable over the 88-108 MHz FM broadcast band, plenty of power and our manual goes into great detail outlining aspects of antennas, transmitting range and the FCC rules and regulations. Connects to any cassette deck, CD player or mixer and you're on the air, you'll be amazed at the exceptional audio quality! Runs on internal 9V battery or external power from 5 to 15 VDC, or optional 120 VAC adapter. Add our matching case and whip antenna set for a nice finished look.

FM-10A, Tunable FM Stereo Transmitter Kit \$34.95
CFM, Matching Case and Antenna Set \$14.95

RF Power Booster Amplifier

Add some serious muscle to your signal, boost power up to 1 watt over a frequency range of 100 KHz to over 1000 MHz! Use as a lab amp for signal generators, plus many foreign users employ the LPA-1 to boost the power of their FM Stereo transmitters, providing radio service through an entire town. Power required: 12 to 15 volts DC at 250mA, gain of 38dB at 10 MHz, 10 dB at 1000 MHz. For a neat, professionally finished look, add the optional matching case set.

LPA-1, Power Booster Amplifier Kit \$39.95
CLPA, Matching Case Set for LPA-1 Kit \$14.95
LPA-1WT, Fully Wired LPA-1 with Case \$99.95



Micro FM Wireless Mike

World's smallest FM transmitter. Size of a sugar cube! Uses SMT (Surface Mount Technology) devices and mini electret condenser microphone, even the battery is included. We give you two complete sets of SMT parts to allow for any errors or mishaps-build it carefully and you've got extra SMT parts to build another! Audio quality and pick-up is unbelievable, transmission range up to 300 feet, tunable to anywhere in standard FM band 88 to 108 MHz. 7/8" w x 3/8" h x 3/4" d.

FM-5 Micro FM Wireless Mike Kit \$19.95



Crystal Controlled Wireless Mike

Super stable, drift free, not affected by temperature, metal or your body! Frequency is set by a crystal in the 2 meter Ham band of 146.535 MHz, easily picked up on any scanner radio or 2 meter rig. Changing the crystal to put frequency anywhere in the 140 to 160 MHz range-crystals cost only five or six dollars. Sensitive electret condenser mike picks up whispers anywhere in a room and transmit up to 1/4 mile. Powered by 3 volt Lithium or pair of watch batteries which are included. Uses the latest in SMT surface mount parts and we even include a few extras in case you sneeze and lose a part!

FM-6, Crystal Controlled FM Wireless Mike Kit \$39.95
FM-6WT Fully Wired FM-6 \$69.95

WANTED: WESTERN electric test equipment. Tube-type only please. Freq. measurement sets, oscillators, amplifiers, coils, transformers, parts, tubes. **Free offer, Great Wireless Museum** 1-800-653-6427.

POCKET TESTBENCH, tiny, portable, inexpensive RS-232 instrument. Oscilloscope, logic, spectrum, counter, generator modes. Oricom Technologies, 303-444-9776 (www.sni.net/~oricom).

SPECTRUM ANALYZERS: HP 3580A 5Hz-50KHz, built-in tracking generator, 85+ dB dynamic range, 2-trace digital storage, with opt. manual. \$625-\$775 depending on options. Precision, 508-988-5233, E-Mail: jbau@dsrt.com

RAMSEY Super Pro FM Stereo Radio Transmitter

A truly professional frequency synthesized FM Stereo transmitter station in one easy to use, handsome cabinet. Most radio stations require a whole equipment rack to hold all the features we've packed into the FM-100. Set frequency easily with the Up/Down freq buttons and the big LED digital display. Plus there's input low pass filtering that gives great sound no matter what the source (no more squeals or swishing sounds from cheap CD player inputs). Peak limiters for maximum punch in your audio - without over modulation. LED bargraph meters for easy setting of audio levels and a built-in mixer with mike and line level inputs. Churches, schools and colleges find the FM-100 to be the answer to their transmitting needs, you will too. No one offers all these features at this price! Kit includes cabinet, whip antenna and 120 VAC supply.

We also offer a high power export version of the FM-100 that's fully assembled with one watt of RF power, for miles of program coverage. The export version can only be shipped outside the USA, or within the US if accompanied by a signed statement that the unit will be exported.

FM-100, Professional FM Stereo Transmitter Kit \$299.95
FM-100WT, Fully Wired High Power FM-100 \$429.95

AM Band Radio Transmitter

Ramsey AM radio transmitters operate in the standard AM broadcast band and are easily set to any clear channel in your area. Our AM-25, 'pro' version, fully synthesized transmitter features easy frequency setting DIP switches for stable, no-drift frequency control, while being jumper settable for higher power output where regulations allow. The entry-level AM-1 uses a tunable transmit oscillator and runs the maximum 100 milliwatts of power. No FCC license is required, expected range is up to 1/4 mile depending upon antenna and conditions. Transmitters accept standard line-level inputs from tape decks, CD players or mike mixers, and run on 12 volts DC. The Pro AM-25 comes complete with AC power adapter, matching case set and bottom loaded wire antenna. Our entry-level AM-1 has an available matching case and knob set for a finished, professional look.

AM-25 Professional AM Transmitter Kit \$129.95
AM-1 Entry level AM Radio Transmitter Kit \$29.95
Cam Matching Case Set for AM-1 \$14.95

Tone-Grabber Touch Tone Decoder / Reader

Dialled phone numbers, repeater codes, control codes, anywhere touch-tones are used, your TG-1 will decode and store any number it hears. A simple hook-up to any radio speaker or phone line is all that is required, and since the TG-1 uses a central office quality decoder and microprocessor, it will decode digits at virtually any speed! A 256 digit non-volatile memory stores numbers for 100 years - even with the power turned off, and an 8 digit LED display allows you to scroll through anywhere in memory. To make it easy to pick out numbers and codes, a dash is inserted between any group or set of numbers that were decoded more than 2 seconds apart. The TG-1 runs from any 7 to 15 volt DC power source and is both voltage regulated and crystal controlled for the ultimate in stability. For stand-alone use add our matching case set for a clean, professionally finished project. We have a TG-1 connected up here at the Ramsey factory on the FM radio. It's fun to see the phone numbers that are dialed on the morning radio show! Although the TG-1 requires less than an evening to assemble (and is fun to build, too!), we offer the TG-1 fully wired and tested in matching case for a special price.

TG-1, Tone Grabber Kit \$99.95
CTG, Matching Case Set for TG-1 Kit \$14.95
TG-1WT, Fully Wired Tone Grabber with Case \$149.95
AC12-5, 12 Volt DC Wall Plug Adapter \$9.95

ENGINEER TESTED: Frequency counters, frequency standards, meters, scopes, generators, etc. **VISA, MASTERCARD, AMEX.** More information: [HTTP://TECH-SERVICES.COM](http://TECH-SERVICES.COM) "Performance-tested." Calibrated. Warranted. New & used. Gary N6ZD.

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HP 3314A function generator \$2,950. Metrowest Technologies, phone 508-478-7613, fax 508-634-3806. Web: WWW.metrowesttech.com

The Cube World's Smallest TV Transmitter

Perfect video transmission from a transmitter you can hide under a quarter and only as thick as a stack of four pennies - that's a nickel in the picture! Transmits color or B&W up to 150' to any TV tuned to cable channel 59 with a solid 20 mW of power. Crystal controlled for no frequency drift with performance that equals law enforcement models that cost hundreds more! Deluxe model includes sound using a sensitive built-in mike that will hear a whisper 15 feet away! Units run on 9 volts and hook-up to most any CCD camera. Our cameras shown below have been tested to mate perfectly with The Cube and work great. Fully assembled.

C-2000 Video Transmitter Cube \$89.95
C-3000 Video and Audio Transmitter Cube \$149.95



CCD Camera Interface Board

Here's a nifty little kit that eases hook-up of your CCD camera module to any video monitor, VCR or video input TV set. The board provides a voltage regulated and filtered source to power the camera (CCD Cameras require a stable source of power for best operation), sensitive electret condenser mike for great sound pick-up and RCA Phono jacks for both audio and video outputs. Runs on 11 - 20 VDC

IB-1 Interface Board Kit \$14.95



CCD Video Cameras

If you're looking for a good quality CCD board camera, Class A CCD arrays, not the off-spec arrays that are found on many other cameras. You see, the Japanese suppliers grade the CCDs at manufacture and some manufacturers end up with the off-grade chips due to either cost constraints or lack of buying 'clout'. These cameras have nice clean fields and excellent light sensitivity, you'll really see the difference, and if you want to see in the dark, these are super IR (Infrared) sensitive! Available with Wide-angle (90°) or super slim Pin-hole style lens. Both run on 3 VDC and produce standard 1 volt p-p video. Add one of our transmitter units for wireless transmission to any TV set, or add our Interface board (below) for Audio sound pick-up and direct wire connection to any video monitor or TV video/audio input jacks. Fully assembled.

CCDWA-2 CCD Camera, wide-angle lens \$99.95
CCDPH-2 CCD Camera, slim pin-hole lens \$99.95
IR-1 IR Illuminator Kit \$24.95

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WANTED: CRT for HP 1980A/B scope HP P/N 5083-5652, Stoddart NM-22A RFI receiver, Tek 570 VT curve tracer, Sencore PA81 audio analyzer. Jeff Kyle 903-527-4196, 4268 FM 36 S., Caddo Mills, TX 75135.

WANTED! ELECTRONIC test equipment. We pay top dollar for used scopes, generators, analyzers from HP, Tektronix, and others. Call Charles at Metric for immediate quotation. 1-800-432-3424 Fax: 510-264-0886.

LOWEST PRICES! Check out Metric's "Current Specials" at <http://www.metric.com>. Great deals on top quality refurbished test equipment. Call 1-800-432-3424 for a free catalog.

TEKTRONIX 495P 100Hz-1.8GHz spectrum analyzer, 10Hz to 3MHz ResBW, GPIB, intelligent markers w/signal processing, counter w/overlaid timebase, etc., excellent cond. \$6,500. See www.test-equipment.net or call 732-445-4915.

EFRATOM FRS-C miniature late 10MHz rubidium atomic frequency standards, \$500, 2"x3"x4". 212-243-7964 or <http://www.vigilante-electronics.com>

BOONTON 260-A Q-meter with 513-A Q standard, manual, LN \$250 50 lbs. Clemens SG-83C standard signal generator 50KHz-54MHz, microvolt calibrated, new \$200 15 lbs. U-ship John Clemens 314-961-7228.

TEST EQUIPMENT for sale/wanted: RF, Microwave, video and fiber optic. Cable TV, Broadcast TV, satellite and related industries. Wavetek, Tektronix, Hewlett Packard and other manufacturers. Spectrum analyzers, signal level meters, sweep systems, TDRs, OTDRs, and much more. PTL Test Equipment, Inc. Phone 561-747-3647 FAX 561-575-4635.

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HP 8558B 182T S/A .1-1500MHz, \$1,490; 141T/8555A/8552B/8445B S/A automatic preselector, \$1,890; 140T/8553B/8552A/8445A 110MHz S/A w/tracking generator/counter, \$999; 8443A w/cable and manual, \$350; transistor devices dynamic loads: DLVP 50/300/3000A 3KW, \$2,200; DLVP 130/110/1000 1KW, \$1,200; HP R8486A unused, \$1,590; HP Q8486A unused, \$1,390; HP 435B/8484A/8481A in inst. case opt., \$1,375; Tek 1502 TDR opt. 4 \$945; Tek 2721/2722 cable sweeping system, \$4,300. Parker Test Equipment, 530-622-7007, fax 530-642-8868. E-Mail: parkrtst@jps.net

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DESOLDERING STATIONS: Ungar 2000 \$150, Sylvania \$150, Hakko \$200, Pace MBT210 readout \$600. Desolder pencils: Pace SX25 \$75, Ungar 4088AS \$100, 70 watt for Pace \$50. Soldering: Weller WTCP \$45, EC2000ESD \$100. Smd hot air: Raychem \$200, Hakko 850 \$650, Nu Concepts \$750. 600 watt iron \$100. Jim 310-515-2058.

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EQUIPMENT MANUALS we have 1000's of service and operators manuals for all types of test and measurement equipment from 1950 to present. All test equipment manufacturers are represented. Call, write, or fax your want list. Please include mfg's manual P/N unit serial numbers if known. **Manuals Plus**, Box 549, TAD #601, Tooele, UT 84074. 435-882-7188, FAX 435-882-7195.

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SPECTRUM ANALYZERS: HP 8565A 22GHz, \$3,200; HP 3582A 25KHz, \$1,800; Tektronix 1.8GHz 7L13, \$1,300; Tektronix 5MHz digital storage, phase lock 7L5, \$1,100. Metrowest Technologies, phone 508-478-7613, fax 508-634-3806. Web: WWW.metrowesttech.com

TEKTRONIX TRACKING generator: TR503 1.8GHz for 492, 494, 496 spectrum analyzers, \$750. Metrowest Technologies, phone 508-478-7613, fax 508-634-3806. Web: WWW.metrowesttech.com

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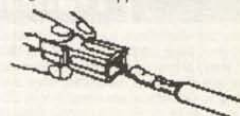


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Much lighter than a heavy jam box with really good sound! This tiny radio (1.5"x1.06"x0.38")

has a seek button, reset control, and an on/off switch. Personal listening has never sounded better! Ideal for ballgames, studyhall, and workouts. Battery and nugget style earphones included.

self-mating quick disconnect connectors \$5.95/pair

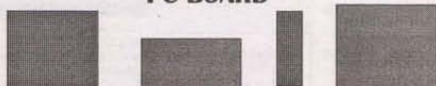
These connectors will handle up to 60A and take 6-12 gauge wire. Each connector has grooves so several can be linked, allowing you to configure your own multi-pin block. The connectors are self-mating and we sell them in pairs, one black and one red. Great for audio, ham, and other high current applications!



Keychain Keyless Remote Switch \$19.50

Like the keychain remote switches used on many auto alarms, this remote unit includes one keychain remote transmitter and a receiver box. Connect your light, robot, or other application to the receiver box, and control it from across the room with the press of a button! What a great idea for the automated house of the new millennium!!! These units may have been previously installed, but look great and work well too. Receiver box measures approx. 4-7/8" x 2-5/8" x 7/8". Features changeable security codes - requires 12 VDC diagram and instructions included

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Perfect for use with TEC-200 film!

PHOTON II MICROLIGHT

The popular photon microlight has been improved. These super-bright (better than 8 candellast) LED lights are visible over a mile away. The LED is secured in a tough ABS case and offers a squeeze button for quick use, and a constant on slide switch for prolonged lighting needs. The lithium batteries last a very long time (10 year shelf life!) and are included. The light won't burn out because it is an LED! Specify your choice of five incredible bright colors. Great for home or office use, popular with fire and rescue professionals, pyrotechnicians, stage performers, and dimly lit restaurant patrons. **PHOTON II** microlights include a keyring and come in ruby red (\$13.50), amber yellow (\$13.50), sapphire blue (\$17.50), diamond white (\$17.50), and emerald green (\$17.50). Includes two replaceable 2016 lithium batteries.



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mini-spray

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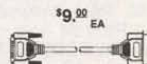


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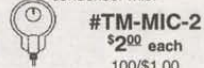
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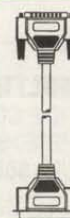
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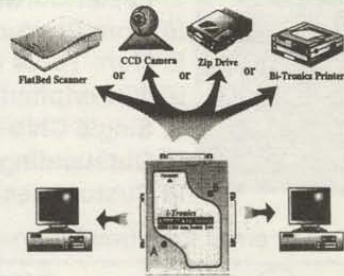
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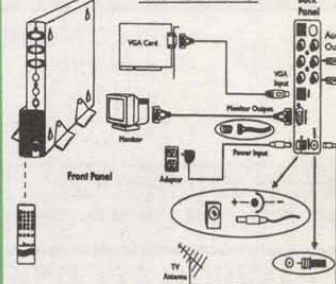
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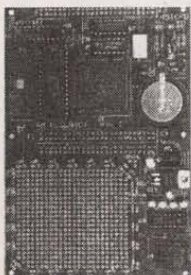
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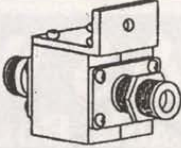
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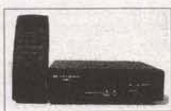
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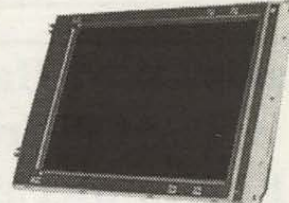
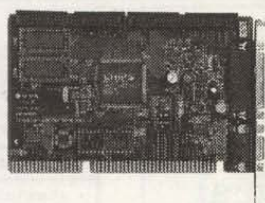
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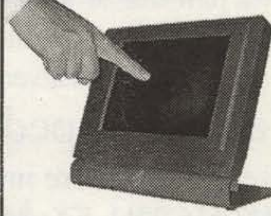
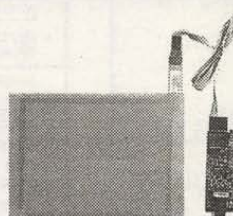
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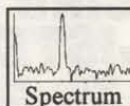
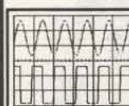
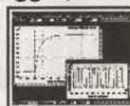
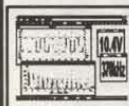
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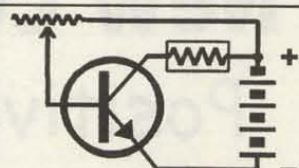
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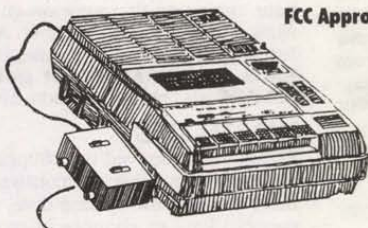
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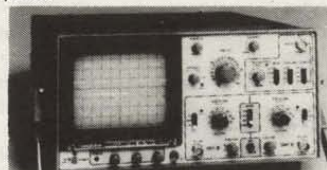


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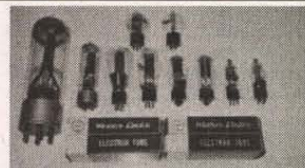


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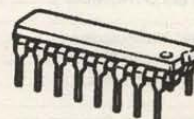
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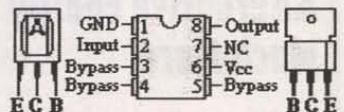
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Fuke 893AP, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553AU, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893AQ, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553AV, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893AR, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553AW, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893AS, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553AX, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893AT, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553AY, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893AU, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553AZ, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893AV, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553BA, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893AW, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553BB, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893AX, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553BC, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893AY, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553BD, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893AZ, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553BE, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893BA, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553BF, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893BB, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553BG, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893BC, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553BH, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893BD, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553BI, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893BE, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553BJ, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893BF, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553BK, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893BG, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553BL, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893BH, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553BM, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893BI, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553BN, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893BJ, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553BO, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893BK, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553BP, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893BL, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553BQ, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893BM, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553BR, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893BN, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553BS, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893BO, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553BT, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893BP, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553BU, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893BQ, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553BV, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893BR, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553BW, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893BS, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553BX, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893BT, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553BY, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893BU, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553BZ, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893BV, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553CA, RF Plug-in (for 140 Series Mainframes)	\$425
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Fuke 893BX, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553CC, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893BY, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553CD, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893BZ, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553CE, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893CA, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553CF, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893CB, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553CG, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893CC, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553CH, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893CD, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553CI, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893CE, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553CJ, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893CF, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553CK, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893CG, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553CL, RF Plug-in (for 140 Series Mainframes)	\$425
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Fuke 893CJ, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553CO, RF Plug-in (for 140 Series Mainframes)	\$425
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Fuke 893CP, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553CU, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893CQ, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553CV, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893CR, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553CW, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893CS, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553CX, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893CT, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553CY, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893CU, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553CZ, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893CV, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553DA, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893CW, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553DB, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893CX, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553DC, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893CY, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553DD, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893CZ, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553DE, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893DA, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553DF, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893DB, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553DG, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893DC, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553DH, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893DD, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553DI, RF Plug-in (for 140 Series Mainframes)	\$425
Fuke 893DE, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, 0.1VDC, 0.5VAC, 1uV Resolution	\$100	HP 8553DJ, RF Plug-in (for 140 Series Mainframes)	\$425
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11683A, Range Calibrator for HP Power Meters	\$550
11720A, Pulse Modulator, 2-18GHz	\$550
11729C, Carrier Noise Test Set w/Opt. 130	\$16,500
16510B, 80 Channel, 25MHz	
State & Timing Module	\$1000
16522B, Logic Analyzer w/Oscilloscope	\$4000
3311A, Function Generator, 0.1Hz-1MHz	\$225
3312A, Function Generator, 1Hz-13MHz	\$700
3314A, Function Generator, 0.01Hz-19.99MHz	\$2800
3325A, Synthesizer/Function Generator	\$1800
3335A, Synthesizer/Level Gen., 200Hz-80MHz	\$5000
334A, Distortion Analyzer	\$250
339A, Distortion Analyzer	\$1200
3455A, Digital Voltmeter	\$400
3456A, Digital Multimeter, 6.5 Digits	\$800
3457A, Multimeter	\$2000
3478A, Digital Multimeter	\$700
3488A, Switch Control	\$1000
3551A, Transmission Test Set	\$950
3562A, Dynamic Signal Analyzer	\$9250
3562A, Dynamic Analyzer w/Opt. 063	\$11,500
35677A, S-Parameter Test Set	\$2700
3575A, Phase Gain Meter 1Hz-13MHz	\$1000
3581C, Selective Voltmeter	\$800
3582A, Spectrum Analyzer, 0.2Hz-25.5KHz	\$2500
3586B, Selective Level Meter	\$750
3586C, Selective Level Meter	\$800
3779D, Multiplexer Analyzer	\$2500
3852A, Data Acquisition/Control Unit	\$1800
4193A, Vector Impedance Meter	\$7500
4342A, Q-Meter	\$1800
435A, Power Meter	\$150
435B, Power Meter	\$500
436A, Power Meter w/Opt. 022	\$1200
4935A, Transmission Impairment Test Set	\$1500
w/Opt. 001	
5314A/O1/02, Universal Counter	\$225
5316B, Universal Counter	\$1000
5328B, Universal Counter	\$1000
5334A, 100MHz Universal Frequency Counter	\$1000
5334B, Universal Counter	\$1000
5335A, Frequency Counter, Opt. 10/20	\$1200
5340A, Frequency Counter, 10Hz-18GHz	\$800
5340A, Frequency Counter w/Opt. 01/02/011	\$1350
5354A, Frequency Converter	\$800
5355A, Frequency Converter	\$1000
5356A, Converter Head	\$950
54100A, Digitizing Oscilloscope	\$3000
54201A, Digitizing Oscilloscope, 300MHz	\$2500
54201D, Digitizing Oscilloscope	\$2850
6002A, Opt. 01, Power Supply, HP-IB,	
0-50V/0-10A	\$700
6034A, DC Power Supply, 0-60V, 0-10A	\$1350
6186C, DC Power Supply, 0-300V, 0.100 MA	\$850
6227B, Dual Power Supply, 0-25V/0-2A	\$600
6291A, DC Power Supply, 0-40V, 0-5A	\$650
6469C, DC Power Supply, 0-36V, 0-300A	\$3000
6623A, Triple Output Power Supply	\$2800
7090A, Measuring Plotter	\$1200
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8011A, Pulse Generator w/Opt. 001	\$500
8012B, Pulse Generator	\$750
8013B, Pulse Generator	\$750
8165A/O02, Programmable Signal Source w/AM	\$2200
8192A, Data Analyzer	\$1500
8350A, Sweep Oscillator Mainframe	\$2500
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83540A, RF Plug-in, 2.0-8.4GHz	\$3000
83540A/O02, RF Plug-in, 2-8.4GHz	\$3500
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8411A/O18, Frequency Converter, 11 to 18GHz	\$500
8501A, Storage Normalizer	\$1000
853A/8558B, Spectrum Analyzer,	
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853A/8559A, Spectrum Analyzer, 10MHz-21GHz	\$4750
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8640B, Signal Generator, Opt. 1, 2	\$2200
8654A, Signal Generator, 10-520MHz	\$600
8656A, Signal Generator, 100KHz-900MHz	\$2500
8671B, Synthesized Signal Gen., 2-18GHz	\$6500
8672A, Synth. Signal Gen., 2.0-18.0GHz	\$10,500
8684A, Signal Generator, 5.4-12.5GHz	\$2350
8746B, S-Parameter Test Set, 5-12.4GHz	\$700
8756A, Scalar Network Analyzer	\$1500
8757A, Scalar Network Analyzer, 10MHz-60GHz	\$5000
8770A, Arbitrary Waveform Synthesizer	\$3000
8901B, Modulation Analyzer	\$5000
8903B/O01, Audio Analyzer	\$3000

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8904A/O01/003, Multifunction Synthesizer	\$2800
8970A, Noise Figure Meter	\$5000

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2337, 100MHz Oscilloscope w/DMM	\$1650
2432A, 300MHz Digital Storage Oscilloscope	\$3000
2445, Four Channel 150MHz Oscilloscope	\$1800
466, 100MHz Storage Oscilloscope w/DMM4	\$800
475, 200MHz Oscilloscope	\$650
475A, 250MHz Oscilloscope	\$800
485, Oscilloscope, 350MHz	\$900
494AP, Programmable Spectrum Analyzer,	
10KHz-21GHz	\$16,000
520A, Vectorscope	\$400
7A42, Four Channel Amplifier Plug-in	\$650
7D20, Programmable Digitizer	\$400
7L5/L3, Spectrum Analyzer, 20Hz-5MHz,	
w/Opt. 025 Tracking Generator	\$1850
7L12, Spectrum Analyzer, 100KHz-1.8GHz	\$1500
7L13, Spectrum Analyzer, 1KHz-1.8GHz	\$1800
7L18, Spectrum Analyzer Plug-in, 1.5-18GHz	
Capable of 60GHz with Mixers	\$2500
7S12, TDR/Sampler	\$450
AA5001, Programmable Distortion Analyzer	\$1700
AM503, Current Probe Amplifier	\$400
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CSA803, Sig. Analyzer w/(2) SD22 & (1) SD42	\$15,000
R2246, 4 Channel Oscilloscope, 150MHz	\$1650
SG5010, Programmable Oscillator	\$3000
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MISCELLANEOUS

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DC-1040MHz	\$1850
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California Inst. 4503L, AC Power Source	\$5000
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Fluke 5100B/O5, Multifunction Calibrator	\$3500
Fluke 5101B/O3, Calibrator	\$4500
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Fluke 5440B, Precision DC Voltage Calibrator	\$4500
Fluke 752A, Reference Divider	\$3000
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Gen-Rad 1482E, Standard Inductor, 1mH	\$350
Gen-Rad 1482L, Standard Inductor, 100mH	\$350
Gen-Rad 1482P, Standard Inductor, 1 Henry	\$400
Gen-Rad 1633A, Incremental Inductance Bridge	\$1700
Kikusui PAD16-10L, Power Supply, 16V, 10A	\$300
Kikusui PLZ700W, Electronic Load	\$850
Krohn-Hite 3202/R3202, Tunable Filter/	
Rack Version	\$500/\$350
Krohn-Hite 3342, Tunable Filter	\$1000
Marconi 2019A, Signal Gen., 80KHz-1040MHz	\$2750
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Phillips PM5715/11, 50MHz Pulse	
Generator (New)	\$1300
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8 Digit, 120MHz	\$1300
Sorenson DCR300-33T, DC Power Supply	
300V/33A	\$2750
Sorenson DCS40-25, DC Power Supply, 40V/25A	\$750
Stanford SR400, Photon Counter	\$1850
Trans Devices DLR400 15 3500A, Dynamic Load	\$1500
Valhalla 2703, AC Voltage Standard	\$2350
Wandell Goltzman SPM19, Level Meter,	
50Hz-25MHz	\$2750
Wavetek 178, Automatic Synthesizer	\$1850
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Wavetek 3000, Signal Generator, 1-520MHz	\$900
Wavetek 3000-200, Signal Generator	\$900
Wavetek 3001, Signal Generator 1-520MHz	\$1000
Wavetek 801, Pulse Generator, 5Hz-50MHz	\$800
Wavetek 802, Pulse Generator,	
5Hz-50MHz w/Delay	\$600
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Meter	\$3750
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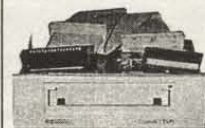
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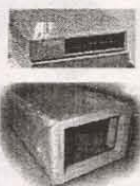
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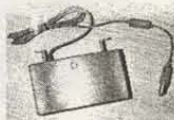
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JULY 24-25-26

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JULY 25

NC - WAYNESVILLE - Western Carolina ARS

Hamfest. Thomas Queen K4BNP, 704-258-2639

OH - CINCINNATI - OH-KY-IN ARS Hamfest.

Dana Laurie WA8M, 513-761-7388

JULY 26

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.

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ME - PORTLAND/WESTBROOK - Computer

Show. Verrillo's Convention Center. Northern

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E-Mail: inquiries@ncshows.com

OH - PAULDING - Hamfest. Park Lane Center,

Fairgrounds Rd. Jerry KB8MAF, 419-399-4507.

E-Mail: JLRHOD@BRIGHT.NET

AUGUST 1998

AUGUST 1

CA - SANTEE - ARC of El Cajon Ham, Computer

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KY - BOWLING GREEN - KY Colonels ARC

Hamfest. Leon Garrett K4CIT, 502-842-5307

NC - HIGH POINT - ARC Hamfest. Mark

McMahan KB4MFP, 910-887-3039

OH - COLUMBUS - Voice of Aladdin ARC

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AUGUST 2

NH - PORTSMOUTH - Computer Show. Yoken's.

Northern Computer Shows 978-744-8440.

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AUGUST 8

CA - FONTANA - Inland Empire ARC Amateur

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School. Bill 909-822-4138 eves

AUGUST 9

NH - MANCHESTER - Computer Show.

Holiday Inn Expo Center. Northern

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AUGUST 15

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GA - ALBANY - Computer & Electronics

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NH - SEABROOK - Computer Show.

Greyhound Racetrack. Northern

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AUGUST 16

MA - CAMBRIDGE - Flea Market.

Kendall Square area. MIT. Nick

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Web: http://web.mit.edu/w1mx/www

/swapfest.html

MA - TAUNTON - Computer Show.

Holiday Inn. Northern Computer Shows

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MI - FLINT - Computer Show. Holiday

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AUGUST 23

IL - GLEN ELLYN - Computer Show &

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NH - NASHUA - Computer Show.

Sheraton Tara. Northern Computer

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AUGUST 29

ME - LEWISTON - Computer Show.

Civic Center. Northern Computer Shows

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AUGUST 30

NH - DURHAM - Computer Show.

Whittemore Center @ UNH. Northern

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SEPTEMBER

SEPTEMBER 5

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SEPTEMBER 12

CA - FONTANA - Inland Empire ARC

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SEPTEMBER 19

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SEPTEMBER 20

MA - CAMBRIDGE - Flea Market.

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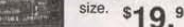
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OCTOBER 1998

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OCTOBER 17

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OCTOBER 18

IL - PALATINE - Computer Show & Sale.
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NOVEMBER

NOVEMBER 7

CA - SANTEE - ARC of El Cajon Ham,
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NOVEMBER 7-8

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CA - FONTANA - Inland Empire ARC
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NOVEMBER 21

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NOVEMBER 27-28

MI - FLINT - Computer Show. Holiday
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NOVEMBER 29

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 IL - GLEN ELLYN - Computer Show &
 Sale. College of DuPage. Main Area of
 Phys Ed Bldg. Corner of Park Blvd. &
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DECEMBER

DECEMBER 5

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DECEMBER 12

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DECEMBER 19

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Motherboards for the Pentium® II Processor

BCM 600 - 150-200 MHz, Intel 440FX Chipset, PCI/ISA	\$199
Supremicro AT or ATX 150-200, Intel 440FX, PCI/ISA	\$219
Tyan Titan Pro - Single/Dual processor PCI/ISA, AT or ATX \$209/\$279	
Intel PR440FX - Dual Pro, UW SCSI, 10/100 LAN, Audio, ATX	\$449

Motherboards for the Pentium® III Processor

BCM 632 - Intel 440LX Chipset, PCI/ISA/AGP/DIMMs, ATX \$179	
Intel 4440LX - Intel 440LX, PCI/ISA/AGP/DIMMs, Audio, ATX	\$199
Intel SE440BX - Intel 440BX, PCI/ISA/AGP/DIMMs, Audio, ATX	\$229
Asus P2L97/P2L97S - Intel 440LX, PCI/ISA/AGP, ATX, SCSI \$179/\$229	
Supremicro P6SL/SL-440LX, Single/Dual P2, 2940UW SCSI \$249/\$349	
Supremicro P6SBS/DBS-440BX, Single/Dual P2, 3940UW SCSI \$349/\$449	
Soltek SL618-440LX, PCI/AGP/ISA-AT FORM, SIMM/DIMM \$179	
Soltek SL678-440BX, PCI/AGP/ATX Form Factor	\$189

Closeout boards for the Pentium® Processor

Tyan Tomcat III - Intel 430HX, Single or Dual Processor	\$99/\$129
Tyan Titan III/Titan VX - Intel 430FX/VX, 256K Cache	\$79
Iwili Triton with onboard Adaptec Wide SCSI2	\$189
Triton Chipset - Up to Pentium 200 Mhz	\$59

Memory/Microprocessors

30 Pin SIMM Modules	
1M x 9 SIMM/SIPP	\$8/\$10
4M x 9 SIMM	\$23
72 Pin SIMM Modules	
4M NonParity/EDO/Parity	\$12/\$12/\$25
8M NonParity/EDO/Parity	\$18/\$18/\$35
16M NonParity/EDO/Parity	\$25/\$25/\$49
32M NonParity/EDO/Parity	\$55/\$55/\$79
64M EDO/Parity	\$169/\$189
168 Pin DIMM Modules	
16M SDRAM 10 ns	\$35
32M SDRAM 10 ns	\$49
64M SDRAM 10 ns	\$109
128M SDRAM 10 ns	\$219
Microprocessor Chips	
Pentium® II-400/350 Mhz	\$899/\$749
Pentium® II-333/300 Mhz	\$599/\$449
Pentium® II-266/233 Mhz	\$349/\$249
Pentium® Pro 200 Mhz -256K	\$429
Pentium® Pro 180 Mhz/150 Mhz	\$199/\$149
Pentium® 233 MMX/200 MMX	\$149/\$119
Pentium® 200 Mhz/166 MMX	\$149/\$109
Pentium® 166 Mhz/133 Mhz	\$89/\$80
AMD K6 - 233/200 MMX	\$159/\$139
Pentium® II/Pro/Pentium® Fans	\$20/\$15/\$8

CD-ROM/Modems/Sound

CD-ROM Drives	
Mitsumi EIDE 4X, 145 ms	\$34.99
Toshiba EIDE 32X, 85 ms	\$79.99
Panasonic SCSI2 8X, 145 ms	\$79.99
Toshiba 32X SCSI2, 80 ms	\$109.99
Plextron 32X SCSI2, 80 ms	\$229.99
Mitsumi 2X/8X CD-Writer	\$249.99
HP CD-ReWriter EIDE/Ext Parallel	\$399/\$489
Teac 4X/12X CD-Writer SCSI2	\$449.99
Plextron 4X/12X CD-Writer SCSI2	\$489.99
Creative Labs DVD2 Encore Kit	\$299.99
Modems	
56K X2 Compatible with Voice	\$69.99
USR Sportster 56K Int/Ext	\$149/\$159
USR 56K Voice Int/Ext	\$159/\$179
USR 56K Courier Int/Ext	\$175/\$205
(\$30 Rebate on USR 56K Modems!)	
Sound Cards	
Ensoniq PCI 3D Sound Card	\$49.99
Diamond Monster Sound MX80	\$89.99
Creative Sound Blaster 16 PNP	\$49.99
Creative Sound Blaster 64 Value	\$79.99
Creative Sound Blaster 64 Gold	\$169.99

Enhanced IDE & SCSI2 Hard Drives

Enhanced IDE and Ultra DMA Drives	
1.75 Gig Seagate, 12.5 ms access	\$124.99
2.14 Gig Seagate, 12 ms access	\$129.99
2.14 Gig Western Digital, 10 ms access	\$139.99
2.14 Gig Quantum Fireball Ultra DMA, 9 ms	\$149.99
2.55 Gig Maxtor Diamondmax, 9 ms access	\$159.99
3.1 Gig Western Digital, 11 ms access	\$169.99
3.2 Gig Seagate Medalist Ultra DMA, 10 ms	\$159.99
3.2 Gig Quantum Fireball Ultra DMA, 9 ms	\$179.99
4.0 Gig Western Digital, 10 ms access	\$189.99
4.3 Gig Seagate Ultra DMA, 12 ms	\$179.99
4.3 Gig Quantum Fireball Ultra DMA, 9 ms	\$199.99
5.0 Gig Micropolis Mustang, 9 ms access	\$209.99
5.1 Gig Western Digital, 10 ms Ultra DMA	\$219.99
6.4 Gig Quantum Fireball, Ultra DMA, 9 ms	\$259.99
6.4 Gig Seagate Medalist Ultra DMA, 11 ms	\$249.99
6.4 Gig Western Digital, 10 ms Ultra DMA	\$259.99
6.5 Gig Seagate Medalist Pro, 7200 RPM, 9 ms	\$299.99
8.4 Gig Quantum Fireball, Ultra DMA, 9 ms	\$329.99
9.1 Gig Seagate Medalist Pro 7200 RPM	\$429.99
SCSI2 Drives	
2.1 GB Quantum Fireball Ultra SCSI, 9 ms	\$219.99
1.1 GB Quantum Atlas Ultra Wide, 9 ms	\$229.99
3.2 GB Quantum Fireball Ultra SCSI, 9 ms	\$269.99
4.3 GB Quantum Fireball Ultra SCSI, 9 ms	\$299.99
4.5GB Seagate Hawk Ultra/Ultra Wide 7200RPM	\$319/\$369
4.5 GB Seagate Barracuda Ultra/Ultra Wide, 7.9 ms/\$499/\$549	
6.4 GB Quantum Fireball Ultra SCSI, 9 ms	\$389.99
8.7 GB Micropolis Tomahawk Ultra SCSI2, 8 ms \$429.99	
9.1 GB Micropolis Tomahawk UW SCSI2	\$449.99
9.1 Gig Seagate Barracuda Ultra Wide 7.9 ms	\$749.99
9.1 Gig IBM Deskstar Ultra Wide 7 ms	\$729.99
9.1 Gig Seagate Cheethat Ultra/Ultra Wide	\$949/\$999
23.2 Gig Seagate Elite Ultra/Ultra Wide	\$2199.99

SVGA Cards and Accelerators

Trident PCI with 2M DRAM / AGP with 4M	\$39 /\$79
Diamond Stealth 3D, 2M/4M DRAM PCI	\$59/\$79
ATI Video Xpression 2M PCI	\$49
Diamond Monster 3D II-8M/12M 3DFX Voodoo2 Chipset	\$229/\$299
Matrox Mystique 220 PCI with 4M RAM	\$119
Matrox Millennium II PCI/AGP 4M/8M WRAM	\$159/\$239
Matrox Millennium II Rainbow Runner/TV Tuner	\$199/\$99
ATI Xpert @ Work/Xpert @ Play AGP 4M (8M + \$50)	\$159/\$179
Diamond Viper 330 Pro AGP with 4M RAM	\$159
ATI All in Wonder Pro PCI/AGP 4M/8M	\$219/\$269

TECH FORUM

This is a READER TO READER Column. All questions AND answers will be provided by *Nuts & Volts* readers and are intended to promote the exchange of ideas and provide assistance for solving problems of a technical nature. All questions submitted are subject to editing and will be published on a space available basis if deemed suitable to the publisher. All answers are submitted by readers and **NO GUARANTEES WHATSOEVER** are made by the publisher. The implementation of any answer printed in this column may require varying degrees of technical experience and should only be attempted by qualified individuals. Always use common sense and good judgement!

QUESTIONS

I am a part-time musician and I like to practice by playing along with records. My 33-1/3 RPM turntable has a speed control that allows me to "tune" the records to my guitar. A speed change of just 1/3 RPM is enough to change the playback key by a half-note.

Unfortunately, most music these days is being released on CDs. I need a way of varying the speed of a CD player, by perhaps one to two percent. Any suggestions on how to do this? I would be glad to buy a new CD player, if it had this feature.

5981 T. J. Hutchinson
Merritt Island, FL

I have an old Z88 made in Scotland that works. It has new AA batteries.

How do I connect it to my IBM 486 or my PowerMac 7200 and, with what cable, in order to download notes of ASCII type? Do I need software and where can I get it?

5982 David McGuire
San Francisco, CA

I am a motorcycle rider and came across a faulty voltage regulator. I wish to examine its components, however, they are buried in a dark green, or near black epoxy. Does anyone know of a product to remove the epoxy-like material without disturbing the board and its components?

5983 Jeff "Bobo" Itter
Barrington, IL

I have an Emperor CB/Ham radio rig. This radio is capable of transmitting from 26.500.0 to 30.199.9 MHz. I am currently using it with a Wilson 1000 antenna magnet mount.

I have a few questions regarding the radio's scan. The problem that I have with its scan is that when I go into the 28.000.0 to 30.199.9 band range, my scan jumps from 1:5 to 3+ when I transmit anywhere in that band range. As long as I stay in the range of 26.500.0 to 27.999.9 my scan stays around 1:5 \pm 3 or so.

What can I do to get the scan 1:5 or lower across the entire band range of the radio when I transmit?

I have added 50' of extra RG-80 cable to the antenna line, and the

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scan has dropped from 1:5 to 0 on the entire AM side, and from 3+ to about 2 on the FM side.

Will adding another 50' of cable to the antenna line help any in dropping the scan further down on the FM band side? The reason I'm asking is because, I am wondering if it is normal to have to do this.

5984 Arnaud C. Milner

I'd like to be able to input a color camera's signal in a computer's printer port (like it was done for a BW camera in the Aug. '97 issue).

I would also like to display the picture on the screen and "AND" it with different colors (e.g., if ANDed a scene using a 7-UP can in it with green, I'd only have the 7-UP can left in the scene. Or, if I ANDed a robot's purple claw with a purple screen only the claw would be visible). This would make it easier to pick out appropriate objects — for a robot claw to pick up.

I could then use the RS232 output to control the motion of the claw. But how do I input the color signal and how do I code the computer to do what I want?

5985 Greg Moran
Riverside, CA

I'm wondering if there is a rule of thumb or chart that can be used to determine the maximum current that can be passed through a wire of a given gauge?

I know that the heat input can be determined by V^2/R , but I can estimate the amount of heat dissipated — it varies depending on many conditions. I end up just blindly choosing a wire that "looks okay," then see whether it works.

5986 Thomas Ng
San Jose, CA

Concerning the answer to #39811 published in *Nuts & Volts*, April '98: When applying the charged capacitor to the Ni-Cad (in order to burn out "whiskers"), is polarity important?

If so, is it positive-to-positive and negative-to-negative, or vice versa?

5987 Richard Herman
Costa Mesa, CA

I have a National Semiconductor MM5450 LED display driver, but I

need to know which pins go to A, B, C, etc., segments of a seven-segment LED. All I know is PIN 9 to 16 goes to one LED, but I don't have any orientation information.

5988 Frank Thompson
Reno, NV

In trying to connect a system directly to the parallel port of my PC, I tried cutting a working (DB25-Cent 36) printer cable in two, then substituting my own hardware for the printer (using C' inportb[] and outportb[] commands, not printf[]). Both the wiring and the software behaved badly.

However, when I replaced my system (and its 1/2 cable) with a complete printer cable and used a DVM on the Centronic's pins, everything worked.

Evidently, there is more to the parallel cable than I thought.

Is there some reference that I can use for learning the details behind a standard parallel cable?

5989 Thomas Ng
San Jose, CA

ANSWERS

ANSWER TO #29812 - FEB. 1998

As your video camera requires 7.2 volts power, we can assume that your original battery pack is made up of six 1.2-volt Ni-Cad cells connected in series. This means that your minimum required voltage is about 6.6 volts.

Forget about 1N5400 diodes and zener diodes. Sooner or later, metal migration at their junctions due to high dissipations will eventually damage them, no matter what you do. The answer to your problem is the fixed, three-terminal regulator.

Unfortunately, three-terminal regulators are not offered at the seven-volt level, however, it's easy to trick a common five-volt regulator into delivering seven volts. Take a trip down to Radio Shack and pick up a 7805, +5V regulator (#276-1770), a standard green LED (#276-304 or equivalent), and two 1 uF tantalum capacitors (#272-1434). Also pick up some heatsink grease (#276-1372) and a TO-220 insulating kit (#276-1373) for the 7805.

Select a suitable aluminum

ANSWER INFO

- Include the question number that appears directly below the question you are responding to.
- Payment of \$25.00 will be sent if your answer is printed.
- In most cases, only one answer per question will be printed.
- Your name, city, state, and E-Mail address, (if submitted by E-Mail), will be printed in the magazine, unless you notify us otherwise with your submission.
- Due to space limitations, we can not reprint the original questions with the answer. The question number and the issue it appeared in are printed above the answer.
- Unanswered questions from a past issue may still be responded to.
- Comments regarding answers printed in this column may be printed in the Reader Feedback section if space allows.

QUESTION INFO

TO BE CONSIDERED FOR PUBLICATION

All questions should relate to one or more of the following:

- 1) Circuit Design
- 2) Electronic Theory
- 3) Problem Solving
- 4) Other Similar Topics

INFORMATION/RESTRICTIONS

- No questions will be accepted that offer equipment for sale or equipment wanted to buy.
- Selected questions will be printed one time on a space available basis.
- Questions may be subject to editing.

HELPFUL HINTS

- Be brief but include all pertinent information. If no one knows what you're asking, you won't get any response (and we probably won't print it either).
- Write legibly (or type). If we can't read it, we'll throw it away.
- Include your Name, Address and Phone Number. Only your name will be published with the question, but we may need to contact you.

heatsink, such as a flat or finned piece of at least five-square inches, and mount the regulator in the center using the insulating kit per its instructions. Use heatsink grease on both sides of the mica insulator. Note that the tab of the 7805 is also connected to its ground terminal, which must be isolated from the heatsink.

Mount a solder lug on the heatsink about 1/2" away from the 7805's center lead, which is normally the device ground terminal. Tie the anode (+) lead of the green LED to the 7805's ground terminal with the

ANSWERS TO #39814 - MAR. 1998

On the Deskjet IIID check the settings from the Start menu, click on settings, then click on printer. Using the right mouse button, open the printers window, and verify the correct printer driver is installed, and that it is set as default.

If everything appears okay, then try installing the printer again. It would appear the wrong printer driver is being used, or it may be corrupted in Windows.

The control characters being sent to the printer are not what it expects. The resultant print of the E or 4 indicates the printer is receiving improper data for its initialization. This usually occurs only on the first page of any document.

Ed Pruitt
Keller, TX

ANSWERS TO #39814 - MAR. 1998

Your printer problem involves set-up strings. The string to reset the printer is escape E, and it is probably entered incorrectly in one of several places. If you are using DOS, it is in each application. In Windows, it is in the printer setup.

Also, if it is a network printer, the print job is likely to have a set-up string, have MIS delete and recreate the print job. If the printer is local to one machine, check the setups for the correct string or delete it if your applications don't change the printer set-up.

On a network printer, your local machines should not need a printer set-up string.

Mike Beaver
Los Altos, CA

cathode (-) lead going to the heatsink solder lug.

Referring to the 7805's pinout diagram, connect the positive lead of one 1 uF tantalum capacitor to the input lead and another 1 uF unit to the output lead.

The negative leads of the capacitors are connected to the heatsink solder lug along with the LEDs cathode lead. This lug becomes the common negative input/output connection from your battery to your camera. The positive input from your bat-

tery goes directly to the input lead of the 7805 regulator.

The positive voltage output comes directly from the output lead on the 7805, which should now be right around seven volts. This occurs because the current from the ground terminal of the regulator to the ground (negative) lug is fixed at about five milliamps. This is enough current through a green LED to produce a drop of about two volts across the LED, thus raising the output voltage to the required seven volts, referred to the ground lug.

The 7805 regulator is fully protected and supplies a maximum current in excess of two amps. If you find that you need more current, substitute an LM323 five-volt regulator, which can supply up to four amps. If the regulator runs hot, increase the size of the heatsink.

Skip Campisi
S. Bound Brook, NJ

ANSWER TO #3986 - MAR. 1998

Laptop memory vendors advertise in the *Computer Shopper* and may have the right stuff for an older machine. Also, I think *Nuts & Volts* has carried an ad for Heath-Zenith parts suppliers in the past.

Laying out and etching a board, even if the Heath-Zenith folks can provide a schematic is probably prohibitively expensive, compared with the cost of a later model, more capable machine.

Dean Carpenter
via Internet

ANSWER TO #3984 - MAR. 1998

A low-cost solution is an off-the-shelf incandescent lamp dimmer which can vary the power delivered to the resistive load of a soldering iron quite easily. They seem to be rated at about 600 watts which should be adequate for most soldering irons.

Put a small 120-volt bulb on the output as a visual power indicator and/or put a knob and dial plate on the dimmer to indicate the power settings.

Dean Carpenter
via Internet

ANSWER TO #3982 - MAR. 1998

The trick in successfully "cleaning up" old records is to remove the effect of dirt build-up and, nicks and scratches to the media caused by years of use or abuse.

These show up in the uncleaned output as pops, clicks, and other sound artifacts.

Adaptec Inc. (www.adaptec.com for product and dealer) makes a software product called Spin Doctor that lets you remove unwanted pops, static, hiss, and clicks from LPs.

It is available with the Easy CD Creator Deluxe Edition software package from Adaptec.

Spin Doctor digitally processes

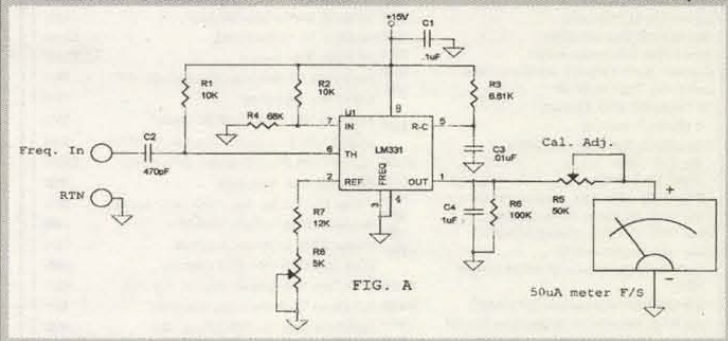
ANSWER TO #29811 - FEB. 1998

A fairly accurate (depending upon the linearity of the meter) analog frequency meter can be made using a frequency-to-voltage converter IC.

National Semiconductor makes

the LM331 frequency-to-voltage, voltage-to-frequency converter. See schematic for a typical application.

Kevin Goodwin
Oceanside, CA



the audio, detects the characteristic signatures of unwanted noises, and attenuates the noise signal while maintaining audio quality.

One nice feature is that it allows you to listen to the before and after audio and, if you like what you hear, you can write it directly to the CD for playing in a standard CD player.

Of course, you can send it to the audio output jack for recording on conventional magnetic tape.

The software also works with other audio sources such as LP, cassette, eight-track, or even CD. You will need a PC with Win 95 or NT and a high-quality sound card for best results.

Chris La
via Internet

ANSWER TO #39812 - MAR. 1998

The ZN414Z is available from: **Farnell Components**, Center Two Building, 102 Corporate Blvd., West Columbia, SC 29169. **1-800-718-1997, 1-800-718-1998** fax.

Also, **Oatley Electronics** (Australia) sells an MK484 part, which they claim is the same as a ZN414.

Oatley Electronics, P.O. Box 89, Oatley NSW 2223, Australia. E-Mail: oatley@world.net Web: <http://www.oatley.com.au/~oatley>

ANSWER TO #39815 - MAR. 1998

HP 2686 switch settings:
JP2 serial port configuration
RS 232 pin pairs 1 & 3 jumpered
RS 422 pin pairs 2 & 4 jumpered

SW1

SW1-1 on (serial port),
off (opt Centronics port)

2	3	4	Baud
off	off	off	300
off	off	on	600
off	on	off	1200
off	on	on	2400
on	off	off	4800
on	off	on	9600 (default)
on	on	off	19200

SW1-5 on (autocontinue on print

& data errors), off (default) flash upon error wait for operator action.

SW1-6 on X-ON every second while printer waiting for data, off (default) X-ON sent when printer needs more data.

SW1-7: AUTO SELECT MODE (2686D only) on powers up in auto-select mode, off (default) powers up with auto-select off.

SW1-8 on (default) DTR pin 20 high when printer ready, off DTR pin 20 low when printer ready.

My information states that this printer uses a null-modem cable for serial operation and the use of a normal serial printer cable could cause damage to the printer and/or computer.

Ed Bell
Miami FL

ANSWERS TO #3989 - MAR. 1998

If you read the product description a bit more closely, you will find that all enameled magnet wire is made from pure copper.

Check out page 163 in the current '98 Radio Shack catalog for their magnet wire selection (#278-1345) and read their description.

Another good source of magnet wire in various sizes is: **Marlin P. Jones**, 1-800-652-6733.

Skip Campisi
S. Bound Brook, NJ

ANSWERS TO #3989 - MAR. 1998

A source for enameled copper wire (specifically for coils) is **Farnell Components**. They can be reached at 1-800-718-1997.

Douglas Mooney
Bronx, NY

ELECTRONIC TEST EQUIPMENT BOUGHT & SOLD

Altec 360D11, Frequency Syn., 01-2GHz	\$1,000	HP 86290B, RF Plug-in, 2-18GHz	\$1,400
Argosystems AS210, Frequency Calibration System	\$2,000	HP 8640B/01, Signal Gen., 5-512MHz AM/FM	\$1,000
Balco 911A, Frequency Response Analyzer (unused)	\$400	HP 8660A/86601A/86632A, Freq. Syn.	\$1,000
Ball Etlarom PC-10, Rubidium Standard	\$800	HP 8743, Reflection Transmission Test Set	\$300
Bird 4381, RF Power Analyzer, Opt. 832	\$300	HP 8755C, Network Analyzer Plug-in	\$500
Boonton 102B, Signal Generator, 45-520MHz	\$650	HP 8757A/001, Network Analyzer, Opt. 001	\$5,000
Boonton 42B, Microwattmeter, 2MHz-7GHz	\$300	HP 8821A, Medium Gain Bank Amp	\$150
Boonton 518-A4, Q Standard	\$250	HP 8901A, Modulation Analyzer	\$2,500
Boonton 82AD, Modulation Meter	\$650	HP 8903A, Audio Analyzer	\$2,000
Bruel & Kjaer 1612, Bandpass Filter	\$250	Keithley 192, Programmable DMM, 6.5 Digits, HP/IB	\$600
Cushman CE24B, Frequency Selective Voltmeter	\$500	Keithley 614, Electrometer	\$700
Datron 1062, Digital Multimeter	\$300	Krohn-Hite 3202, Filter, LP, HP, BP, Unused	\$350
DR Thiedig MILLI-T02, Ohmmeter,		Leeds & North 1091, Capacitor Decade, .001uF-1uF	\$150
1 Milliohm-2 Terrahms	\$400	Marconi 2022A, Signal Generator, 10KHz-1GHz	\$2,000
Eaton 380K11, Synthesizer, 1-2000MHz		PMI 1018B, Peak Power Meter	\$350
Opt. 01, 03, 183	\$2,500	Polarad 1105 E-L, Sig. Gen., 1020A Mod., 8-2.4GHz	\$300
ESI 296, Auto LCR Meter	\$800	Polarad 1207, Signal Source 3.8-8.2GHz	\$200
HP 8445B, Spectrum Anyz., Automatic Pre-Selector	\$300	Polarad SPNH, Generator 20Hz-20KHz	\$450
Fuke 3330B, DC Voltage, Current Calibrator	\$400	Racal Dana 1515, Delay Pulse Generator	\$500
Fuke 335A, DC Voltage Standard, 0-1100VDC	\$600	Racal Dana 1992, Frequency Counter, High Stab.	\$500
Fuke 515A, Portable Calibrator	\$800	Racal Dana 9082P, Signal Gen. 1.5-520MHz	\$800
Fuke 5200A, Programmable AC Voltage Standard		Racal Dana 9303, True RMS RF Level Meter	\$650
HP/IB	\$1,200	Racal Dana 9515, Universal Counter, HP/IB, Opt. 41	\$200
Fuke 6080A/AN Frequency Syn., 5-1024MHz	\$5,000	Sanders 5440C, Noise Figure Mtr., 10KHz-40GHz	\$400
Fuke 9010A, Micro-System Troubleshooter Opt. 001	\$450	Senorec TF30, Super Cricket Transistor Tester	\$200
Fuke A55, Thermal Converter	\$200	Tek 11302, Scope, 500MHz w/(2) 11A71 Plug-ins	\$1,400
General Microwave 478A, Peak Power Meter	\$700	Tek 1241A, Logic Analyzer, with Accessories	\$650
General Radio 1433G, Decade Resistor	\$350	Tek 1410, Syn. Generator SPG2, Color Bars TSG7	\$650
General Radio 1433G, Decade Resistor, 1.111111m.	\$300	Tek 1502, TDR	\$800
General Radio 1531, Strobosc.	\$150	Tek 178, Linear IC Test Fixture, For 577	\$300
General Radio 1538-P4, High Intensity Flash Capacitor	\$50	Tek 2230, Storage Scope, 100MHz, Dual Trace	\$2,200
General Radio 1633-A, Incremental Inductance Bridge	\$500	Tek 2235, Scope, 100MHz Dual Trace	\$750
General Radio 1650A, Impedance Bridge	\$200	Tek 2336, Scope, 100MHz, Dual Trace	\$800
Gigatronics 600/6-12, Synthesized Source	\$1,000	Tek 2432, Scope, Digital, 300MHz, 4 Channel	\$3,000
Gigatronics 900/2-18, Sig. Gen. Sweeper, 2-18GHz	\$5,000	Tek 2465, Scope, 300MHz, 4 Channel	\$2,500
Goldstar OS-7040-A, Scope, 40MHz, Dual Trace	\$200	Tek 318, Logic Analyzer, with Pods & Acc.	\$500
Gould 4500, Digital Storage Scope, 35MHz	\$300	Tek 464, Scope, 100MHz Dual Trace, Storage	\$400
Guideline 9154C, Transvolt Standard Cell	\$300	Tek 465, Scope, 100MHz Dual Trace	\$400
Hitachi V-212, Scope, 20MHz, Dual Trace	\$200	Tek 465M, Scope, 100MHz Dual Trace	\$400
HP 1124A, 100MHz Active Divider Probe, Unused	\$100	Tek 466, Scope, 100MHz Dual Trace, Storage	\$600
HP 11638A, Calibration Kit, Type N	\$600	Tek 475, Scope 200MHz, Dual Trace	\$600
HP 11664A/01, Detectors, .01-18GHz	\$200	Tek 475A, Scope 250MHz, Dual Trace	\$650
HP 11665B, Modulator	\$250	Tek 485, Scope 350MHz, Dual Trace	\$700
HP 11712A, Service Kit for 8670 Series Inst.	\$500	Tek 49201/02, Spectrum Analyzer	\$5,500
HP 15453A, Pod Set for 8170A	\$200	Tek 49201/02/03, Spectrum Analyzer	\$6,000
HP 1630G, Logic Analyzer, 65 Ch. 100MHz	\$600	Tek 49202, Spectrum Analyzer	\$5,000
HP 16500A, Mainframe, 16510A, 16530A, 16531A,		Tek 496P, Programmable Spectrum Analyzer	\$5,000
16520A, 16521A	\$3,000	Tek 577/177, Curve Tracer	\$1,000
HP 16510B, Logic Analyzer Card, 16500A System	\$1,000	Tek 5003, Power Module	\$300
HP 16530A/16531A, Digital Scope Card, 16500A System	\$1,000	Tek 624, XY Monitor	\$200
HP 1741A, Scope, Storage, 100MHz	\$450	Tek 7D20, Programmable Digitizer PI	\$600
HP 1742A, Scope, 100MHz Dual Trace, DMM	\$400	Tek 7S12/S6, TDR Sampler	\$800
HP 1744A, Scope, Storage, 100MHz, Dual Trace	\$500	Tek AA5001/TM5003, Distortion Analyzer	\$1,000
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HP 3325A/01/02, Function Gen. Opt. 01/02	\$2,000	Tek DC504, Counter/Timer TM500	\$100
HP 334A, Distortion Meter	\$200	Tek MR501, XY Monitor Scope	\$200
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HP 3580A, Spectrum Analyzer, Opt. 02	\$800	Tek P6201, FET Probe, 1GHz	\$200
HP 3581C, Selective Level Meter	\$500	Tek PG508, Pulse Generator, 50MHz	\$300
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HP 5004A, Signature Analyzer	\$100	Tek SG502, Sig. Gen. 5Hz-50KHz TM500 Sys.	\$200
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HP 5335A, Frequency Counter, 11 Digit, Opt. 010/040	\$800	Texascon SSG2000, Freq. Syn., 100KHz-2GHz,	
HP 5340A, Frequency Counter, 18GHz	\$800	AM, FM	\$1,800
HP 5340A/011, Frequency Counter, LEDs, HP/IB	\$1,200	Vu-Data 5110, Semiconductor Tester, In/out Circuit	\$150
HP 5342A, Frequency Counter, 18GHz	\$1,800	Wavetek 1045/14139, Power Meter	
HP 5385A, Frequency Counter, Opt. 004	\$800	1MHz-18GHz Opt. 01, 05	\$800
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HP 54200A, Digital Storage Scope,		Wavetek 1910, XY Monitor, Dual Trace	\$600
Dual Trace, 200MG/S	\$1,000	Wavetek 3000, Signal Gen., 1-520MHz, AM, FM	\$600
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.0001-50MHz	\$1,600	Wavetek 907, Signal Generator, 7-11GHz	\$600
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HP 8350B, Sweep Oscillator Mainframe	\$4,000	Wiltron 560-97A50, SWR Autotester, .01-18GHz	\$500
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HP 86222A, RF Plug-in, .01-2.4GHz	\$1,000		
HP 86222B/H6F, RF Plug-in, .01-4GHz	\$1,000		
HP 86241A, RF Plug-in, 3.2-6.5GHz	\$400		
HP 86260A, RF Plug-in, 12.4-18GHz	\$400		
HP 86290A, RF Plug-in, 2-18GHz	\$1,200		

ANSWERS TO #39816 - MAR. 1998

The linemans test set is a basic telephone handset. The battery type is unknown, but the two buttons on the side are "mute." Simply mutes the microphone so the operator can mute what he says, or in case of wind noise or other background noise, muting the local microphone will decrease the noise you hear repeated back, or sidetone. In noisy locations, it enables the user to hear the other end better.

The G/S is a ground start button. It is used to apply a ground to the tip side of the line to start the ground start circuit. This feature was typically used on pay phones, and PBX lines. The tip side of the line had to be momentarily grounded to start the dial tone.

This ground was typically provided by the payphone when it had a coin dropped, or applied from the PBX when an outside line was requested. Often there was a resistor in the ground line, and current had to be within certain limits to provide the start function.

Some PBXs may still use this system, but most payphones have gone to more sophisticated signaling.

Obviously, ground start was too easy to defeat on the payphones, so was abandoned several years ago. Metro tel can be located at: <http://members.aol.com/metrotel-co/handheld.htm>

Their description of the 911G is as follows:

Compact test set is line powered with tone/pulse dialing, mute, loop and ground start, monitor/talk, polar-

ity indicator, belt clip, and radial. Cordset is sold separately.

There is no mention of a battery, but other models have a speaker phone audio boost and this may be an option, and the battery is to power the audio boost. Unfortunately there is no further description on their web site at this time. Is it possible the connector you are wanting to connect the battery may be the connector for the cordset?

Ed Pruitt
Keller, TX

ANSWERS TO #39816 - MAR. 1998

I do not know the battery type for your Butt Set (telephone linesmen phone), but I can answer the rest of your questions.

The battery voltage is probably around 45 volts and is used for "talk battery." Depending on the model you have, it might be turned on and off with the MUTE switch.

As an example, if you connect your butt set to a regular phone, both phones will act totally dead. But if you supply talk battery then you can use the two phones to talk.

Linesmen use this when they are splicing cable so they can talk to each other. The MUTE switch might also just turn off the microphone in your butt set.

The G/S switch stands for Ground Start. Some phone circuits, such as payphones require a ground to "start" the circuit and give you dial tone.

Randy Boettjer
Oakview, CA

between the emitter of Q2 and R1 with your timing cap. The voltage across that cap will increase in a linear fashion until the circuit saturates near the supply voltage.

You will also have to add switches to reset the voltage on the cap and turn off the current source until you're ready to start timing and you may need to deal with turn on transients depending on the accuracy you looking for.

However, I would think you could find a whole stop watch for the \$10.00 your willing to spend on the display. I got mine for free for filling out a survey at an auto race.

Tom Tillander
Bay Village, OH

ANSWER TO #49820 - APR. 1998

Motorola has several StarTac cellular phones on the market. Not all models have the vibrating ringer feature.

Current models that have it are models 6500, 8500, and 8600.

The models 6000 and 3000 do not offer the vibrate feature in the interest of cost.

Early model 8000 phones (one of the first StarTacs to hit the market, no longer available) were not supposed to have this feature, but most actually did.

To check yours, try pressing the FCN button and then the "B" key.

Usually this key has the word "vibe" printed on it under the number. If your phone supports the vibrator

feature, you will have just toggled the audible ringer off, and the vibrator on. Repeat the procedure to switch back.

On some early StarTacs, this method does not work.

In this case, you will have to find the feature in the feature menu/ringer options section.

Press the FCN button and then the Smart Button (located on the left side between the volume controls) to get into the feature menu.

Press one of the volume control buttons until you get to the ringer options menu. Press STO to select. Press the volume key to scroll through the options — ring only, ring and vibrate, vibrate only, or silent. Press the Smart Button to store your selection.

Larry Block
Scarsdale, NY

ANSWER TO #49818 - APR. 1998

I believe that BSR was bought out or otherwise taken over by a/d/s.

Here is their contact information: a/d/s, One Pro-gress Way, Wilmington, MA 01887. Ph: 978-658-5100, Fax: 978-658-8498.

If you have Internet access, their web page is located at <http://www.ads.adst.com/>. If worse comes to worse, I have a BSR EQ-3000 I'm trying to get rid of. I'm sure we could find a price fair to both of us.

John Cosimano
via Internet

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ANSWER TO #49815 - APR. 1998

If you still have all of the programs that came with the card (I looked on the SB website, they don't have it) there is a program called READ.EXE.

If you load the SBTalker driver (there is a batch file that shows how), this program "says" whatever you send it on the command line. This means you can "pipe" a program's output, or redirect a text file into READ and it will be said.

Now, with QBASIC (I'm not sure about GWBASIC), you can use the SHELL command to first load the driver; then send a string to READ via the command line.

It goes something like this:

```
SHELL "SBTALKER /dBLASTER" 'loads the speech driver
a$ = "READ " + "This is the Sound Blaster talking."
SHELL a$
SHELL "REMOVE" 'removes the speech driver
```

You'll need the READ, SBTALKER, and REMOVE programs in the path or the directory of the BASIC program.

I've made a program that "says" the current time using this technique. Contact me and I'll send it to you.

Amos Bieler
2812 E. Rockaway St.
Springfield, MO 65802-2702

ANSWER TO #4989 - APR. 1998

The ALPHA Series of Amps is made by Arcam, a Subsidiary of Audiophiles Systems, Ltd. The contact information is as follows: **Audiophile Systems, Ltd.**, 8709 Castle Park Drive, Indianapolis, IN 46256. Main Phone: **317-849-5880**, Hi-Fi Consumer Line: **1-888-ARCAM-LTD**, FAX: **317-841-4107**. E-Mail: aslinfo@aslgroupp.com

They also have a Web site at: <http://www.aslgroupp.com/>

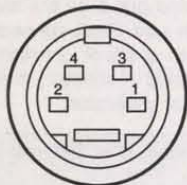
By contacting the consumer line they should be able to direct you to the closest authorized repair center in your area.

Wesley Miller
Camp Hill, PA

ANSWER TO #4983 - APR. 1998

Detailed information on the S-Video (also known as S-VHS or Hi-8) can be found on the Internet at: http://www.bbc.co.uk/aberdeen/eng_info/s-video_connector.shtml

The connector is a four-pin mini-DIN:



Pinout, signal, and impedance are as follows:

Pin	Signal
1	Ground (Luma)
2	Ground (Chroma)
3	Luminance
4	Chrominance
Signal level	Impedance
1V including sync.	75 ohms
0.3V burst	75 ohms

Joe Grand

ANSWER TO #49819 - APR. 1998

The problem is that the op-amp you are using isn't designed to operate from a single-ended power supply like that used in a digital logic circuit. This dual 741-type op-amp is

designed to operate with a dual power supply (positive and negative outputs with respect to ground).

A better choice (depending upon what you are using the op-amp to do) would be the LM358. It is designed to operate from a single-ended 3- to 32-volt power supply.

In this design, since you are interfacing with digital, this op-amp should work fine, in other designs use caution when using this op-amp as a voltage follower, it doesn't perform well with supply voltages close in magnitude to the maximum output voltage.

Vinny Worley
Fenelon, PA

ANSWER TO #49812 - APR. 1998

No, shielding the speaker cabinet will not reduce the noise you are hearing in the speakers.

The speakers are simply the load for the circuit. They shouldn't be able to introduce noise into your amplifier circuit if the amplifier is designed and built correctly.

The noise you hear is being induced somewhere in the amplifier circuit. What kind of enclosure do

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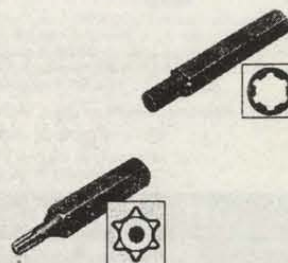


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you have the circuit in? Use a metal box, and connect it to the ground of the input, also connecting this box to earth ground is a good idea. The metal box functions as a shield for the circuit.

Also, be sure that you are using shielded cables to connect the amplifier to its signal source.

Vinny Worley
Fenelton, PA

ANSWER TO #49811 - APR. 1998

Based on experience, my advice is unless you are an expert and have a good signal generator, scope, and frequency counter, don't mess with the tuned circuits.

Barring immersion or mildew, if it worked at one time, it is unlikely that the coils have changed with time. It is more likely that one or more coils in the front end may be burned out from nearby lightning, or the TRF tube may be bad.

Inspect the coils carefully for signs of damage. Check continuity and go over all soldered connections in case of a bad joint.

If you have to rewind a coil, a new one can be layer-wound with plastic

food wrap between layers. Unwind the old one, counting the turns and noting the position of the tap, if any. Put coil dope on each layer.

To loosen a slug, try soaking in

benzene/naphtha paint thinner. If you have to go to alcohol or lacquer thinner, the coil form could be damaged.

Note — a scope probe will totally detune a tuned circuit. Make an EF

probe and put it on the tap, not on the high side. Don't connect a tuned circuit to a signal generator without an isolating resonator, it can upset the signal generator.

ANSWER TO #4988 - APR. 1998

While working on a frequency counter project, I tried several input circuits such as a transistor amplifier, a high-speed comparator IC, and Schmitt Trigger inverters, but I found that the frequency count would often change when the input was reduced to a low level.

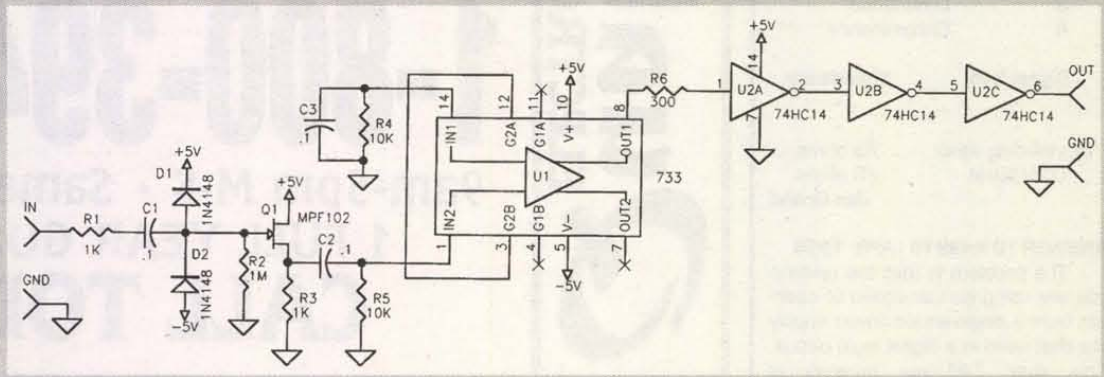
The one circuit that I did find to work satisfactorily uses a high-impedance source follower input coupled to a 733 video amplifier IC with a gain of 100 set by connecting pin 3 to pin 12.

After the signal is amplified, it is fed into Schmitt Trigger inverters for squaring.

Although the circuit is relatively simple, it does require a split power supply of +5 and -5 volts. Please note that the power connection to pin 5 of the 733 is -5 volts and not ground or common as shown by the triangle symbol.

Resistor R1 and diodes D1 and D2 may be eliminated if the input level will not exceed five-volts p-p.

Tom Fattarusio
El Cerrito, CA



ANSWERS TO #49813 - APR. 1998

I'm not quite sure what your application is, but 12-volt remote control units are readily available! Check page 47 of the April '98 *Nuts & Volts* for an advertisement for **Visitect, Inc. [510] 651-1425**. They have miniature transmitters and receivers.

Also, most automotive alarm companies offer some sort of "keyless entry" unit that can be easily adapted to be used as a remote switch. They typically cost between \$20.00 to \$50.00 US.

If you can't find one at your local auto accessory shop, send me an E-Mail at tcdwireless@aol.com.

Another thing that comes to mind is a garage door control transmitter and receiver. They are typically powered by 12-volt "wall wart" transformers.

Larry Block
Scarsdale, NY

ANSWERS TO #49813 - APR. 1998

Home Automation Systems sells a radio-controlled switch with two outputs. Its part number is HAS-7378. It comes with a two-button keychain remote.

They also have a more advanced unit with a four-button remote. Its receiver has six outputs, any four of which can be triggered by any of the four buttons on the remote, and you can use multiple remotes.

It has programmable output timing and behavior, selectable for each output. The part number is HAS-7446.

Both units run on 12 volts, and have security-code rotation to prevent cloning of the remote. Note, however, that the receiver outputs can only switch 200 milliamps. If you need to drive high-current loads, you'll want to add some automotive relays.

Home Automation Systems can be reached at **1-800-762-7846**. If you have web access, the following URL has photos of both units along with a link to their online ordering system: <http://www.smarthome.com/7446.html>

Dean A. Cuadra
Santa Monica, CA

ANSWERS TO #49813 - APR. 1998

A current sale flyer from JC Whitney lists a \$29.99 automotive remote keyless system consisting of two very small two-channel keychain transmitters and one 12-volt receiver module.

While this system is designed to repair/replace an existing remote electric door and trunk lock system, you should be able to easily adapt it to any other remote-controlled switching application. The catalog number for this item is 38EB2164Y. You can reach **JC Whitney** at **312-431-6102** or on the web at www.jcwhitneyusa.com

John McMichael
Laramie, WY

ANSWERS TO #49813 - APR. 1998

Jameco Electronics has just what you're looking for. Their "Infrared and RF Code Lock Transmitters and Receivers" kit requires 12V and transmits using either RF or IR:

Part No.	Description	Price
117647	two-channel transmitter (RF)	\$15.95
117647	two-channel transmitter (RF)	\$15.95
117655	one-channel receiver (RF)	\$29.95
134543	one-channel transmitter (IR)	\$17.95
134551	one-channel receiver (IR)	\$34.95

Jameco can be reached at: **Jameco Electronic Components, 1355 Shoreway Road, Belmont, CA 94002-4100. 1-800-831-4242 (voice), 650-592-8097 (voice), 650-592-2503 (fax).**

Joe Grand

Beware of harmonics. With an inexpensive signal generator, a tuned circuit will show several resonant frequencies. Actually they are all the

same frequency, that of the tuned circuit itself.

Ralph Condet
Dearborn, MI

ANSWERS TO #49816 - APR. 1998

A software package that will calculate many electronic equations, including air core inductance given the length, radius, and wire gauge (or windings per inch) is ELCAD.

The program is supplied on a 3.5-inch 1.44 MB diskette for the IBM PC using Windows 3.1 or 95.

It sells for \$14.95 postpaid USA from F.N.C. Corp., 350 Adam Drive, South Elgin, IL 60177. Phone: (847)695-1210.

Fred Blechman
West Hills, CA

ANSWERS TO #49816 - APR. 1998

There is a program called

Inductor Design Calculator, written in Basic by David E. Powell. It was published in the Nov. '88 issue of *Radio-Electronics* magazine.

It will take several variables such as coil diameter, coil length, wire gauge, and number of turns to calculate inductance. Also, for a given inductance, coil diameter, coil length, and wire gauge, the number of turns required will be calculated.

This program is available from the *Electronics Now Magazine* FTP site on the Internet: <ftp://ftp.gernsback.com/pub/EN/> under the file name of COILS.BAS

Kevin Goodwin
Oceanside, CA

Scott Edwards Electronics

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COD825S	25 Pin Socket	.55	.52	.47
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COD837S	37 Pin Socket	.89	.85	.77
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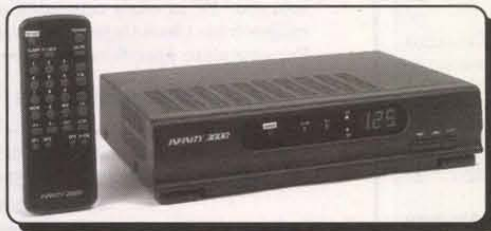
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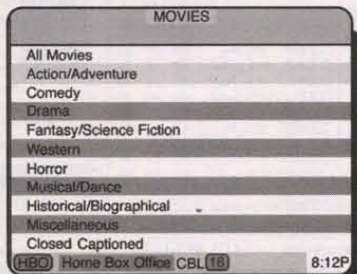
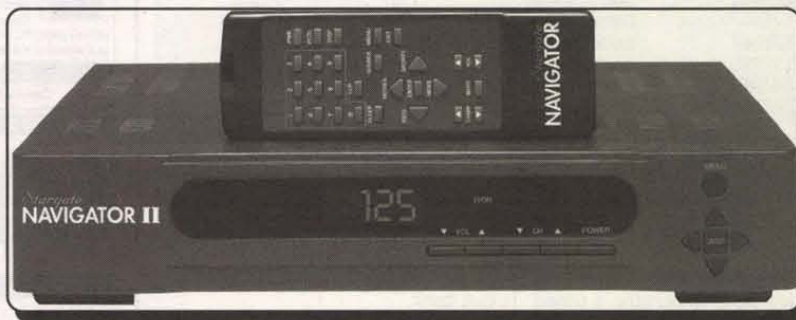
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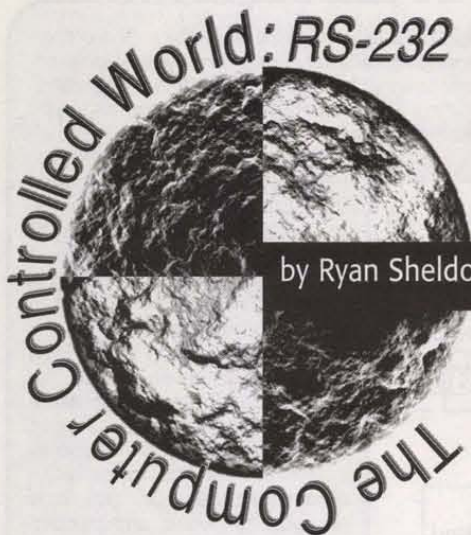
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Naked Data

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

Explore the power of wireless data communications using inexpensive off-the-shelf hardware.

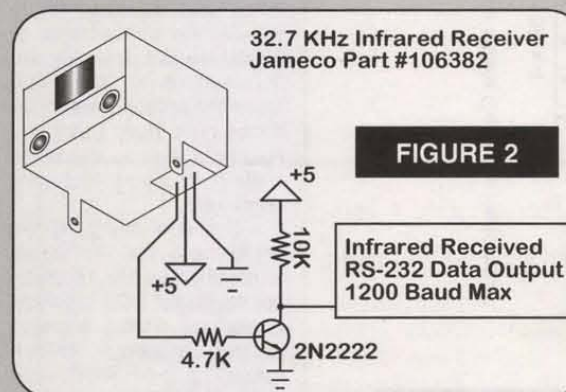
I thought the title might grab your attention. And I bet you want to know what "Naked Data" is all about ... right? Well, as much as I hate to disappoint my loyal readers, nobody's getting naked for this article. (Hey, take it up with the N&V editors ... I did my best, something about "must be electronically-related.")

Anyway, this month I wanted to share a few cheap ways of transmitting data to multiple remote devices, that is, naked data. I will explore two methods of transmission: Infrared (IR) and Radio Frequency (RF). Here's the catch ... the data rate is slow, but it's cheap (very cheap). Perfect for computer or remote control applications of all types.

So, if you ever wanted to make anything remote-controlled, here's how to do it. So stay tuned, your computer-controlled world is just about to become a whole lot more exciting.

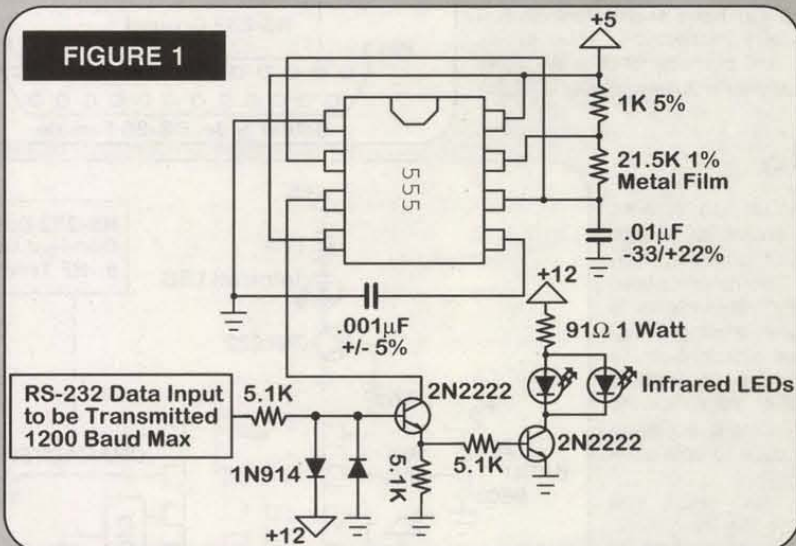
Data Rates

For both methods described in this article, data communication will be limited to 1200



baud. But don't worry, we're not trying to transmit a file, just send a few simple commands to control a few remote devices. And, by the way, 1200 baud is equal to 120 characters per second (1200÷10 [1 start bit + 8 data bits + 1 stop

FIGURE 1



bit = 10)). Plenty fast for controlling a few remote relay drivers, a couple of LCD displays, and anything else you may want. Using this system, up to 16 different devices can be remotely-controlled in any combination.

Background

Those of you who have been reading my articles know I'm bent on controlling the world from my PC. And, with that in mind, you can expect this article to fit seamlessly with previous articles. For those of you who haven't been following along, here's how to get up to speed: Read the Dec. '97 issue "RS-232 Relays," the March '98 issue "Opening Windows to the World," and the April '98 issue "Character LCD Networkability." These articles highlight the specifics of each device of interest, letting us focus in on naked data (also

Ming RF Transmitter
Digi-Key Part # TX-99V3-ND

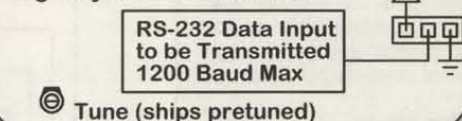


FIGURE 3

known by the layman as wireless communications).

What to Expect

The purpose of this article is to teach you how to transmit RS-232 data using common off-the-shelf wireless communications products. What this means to you is that you will NOT be able to control your VCR (or your favorite R/C car) with the transmitters. But, you will learn enough in this article to build your own transmitters and receivers. And, if you were so inclined, you could add your custom

receiver into your existing VCR to control it. But the important thing to keep in mind is that RS-232 data is being transmitted. Numerically speaking, a number from 0 to 255 gets transmitted and decoded using your choice of transmitters and receivers.

Controlling Your TV and VCR

I know somebody is going to call me with this question, so in a desperate attempt to defray the number of unnecessary phone calls, here's my prerecorded answer. I do not yet know of a simple, inexpensive way to control your TV or VCR from a computer using RS-232 communications or any other means, nor do I have any special leads on anybody who does.

But I promise to write an article on this topic as soon as I have done my homework on this. Please contact me if you have such information. I would be very interested to know what's available, and perhaps write a Windows 95 application for a new piece of hardware.

Reliability

RF noise and sunlight can hinder reliability in both methods of wireless RS-232 communication. Fortunately, when digital is married with analog, reliability is less of a problem. I'll show you how to packetize your RS-232 transmissions and add simple software noise rejection to your control application.

Trust me, once you actually see this thing work, you will be stunned at its reliability, simplicity, versatility, and low cost. But, just for the record, I would never advocate its use in ANY form of life-saving device, so please use good judgement in your application.

The Parts

Less than \$80.00 in parts will cover both projects (infrared and RF). All parts are easily obtained from Digi-Key, Jameco, or myself. Bluntly speaking, infrared is cheaper than RF.

So, if line-of-site works, infrared will definitely do the trick (up to about 35 feet). But if your application involves transmitting commands to different rooms in your house, RF is the only way to go (and my personal preference).

Diagram Organization

The first four diagrams in this article illustrate two generic transmitters and two generic receivers (IR and RF, respectively). Use the

appropriate transmitter to speak to the corresponding receiver. There are several different devices that can be connected to these transmitters and receivers depending on what you want to do in your application.

For instance, if you want to send simple RS-232 commands from one computer to another, you would connect the RS-232 port of the computer to one of the transmitters. The receiving computer would then connect to the appropriate receiver.

You may want to build a handheld remote control for sending data to your computer. If so, you can connect the keypad chip to an RF receiver, or use its built-in infrared modulator for IR communications. Or, you may not want to involve any computers in your application. If so, you can use the keypad chip for data transmission to your choice of receivers.

The point being, these devices are modular and the chips were designed to maintain compatibility regardless of your application. You can choose a transmitter, a receiver, a transmitting source, and a receiving source to perfectly match your application.

Reality Check

Tom (a close friend of mine) and I hooked up a RF transmitter to his computer. We connected the RF receiver to an RS-232 networkable character LCD display controller (like the one found in last month's "Character LCD Networkability" article).

We put the computer in a continuous loop, sending commands to reboot the display and send a couple of lines of text. We managed a reliable 300 feet of communications through walls using a full-wave antenna. We then went to his back yard to see what kind of distance was available to us without the obstructions of his house. Occasionally, we achieved up to about 400 feet if the antenna was positioned just right (and you hold your arm to the north while putting your foot on a dead tree).

The cool thing is, we could have just as easily transmitted text to 16 different character LCD modules of various display sizes to various locations (which makes a nice local area message paging system). But the point is, the ability to network these devices adds a tremendous amount of flexibility to any communications application. It has been my experience that

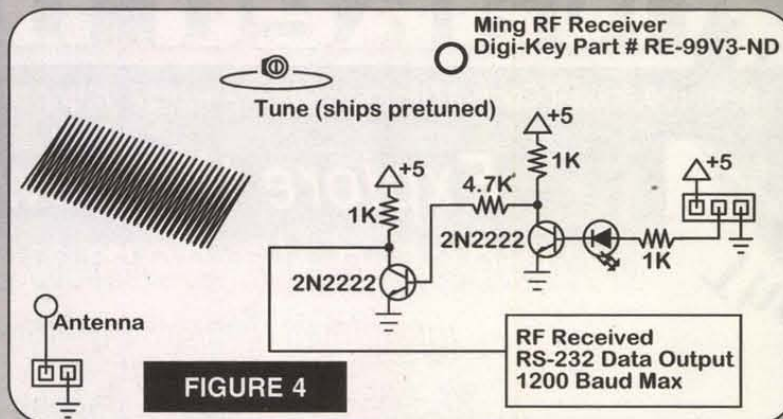


FIGURE 4

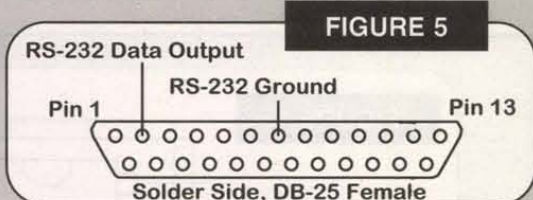


FIGURE 5

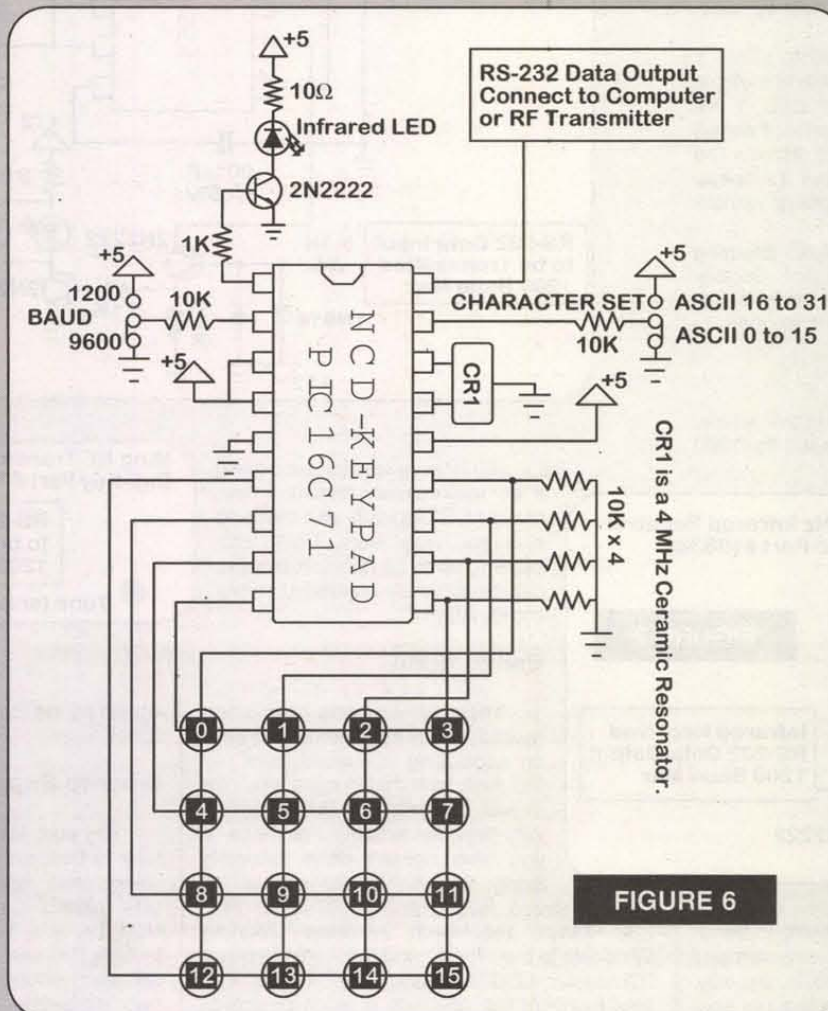
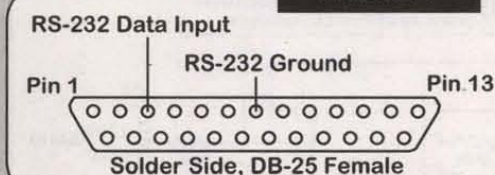


FIGURE 6

hardware and software should maintain modularity. This universal approach to communications allows uninhibited room for future growth of both software and hardware. And, since the

FIGURE 7



transmitting and receiving devices support native RS-232 communications, each device is ready for direct interface to a computer, a transmitter, or a receiver. So, in terms of flexibility, this is about as good as you're going to get.

Common Communications

IR and RF communications are both very popular in all types of commercial products. Some form of IR communications is found in just about everybody's home in the form of a TV, VCR, or stereo. RF, while mostly found in garage door openers and toy cars, is also perfectly suited for transmitting data. I have seen some real nice packet radio systems that offer long distances and reliable communications, but the problem is, they are often too expensive.

As promised, both communications systems outlined in this article offer low-cost solutions to wireless communications. The next few sections offer a quick look at what is required for using these various forms of wireless communications. I think you'll find the circuit diagrams very simple.

Infrared Communications

The IR Transmitter shown in Figure 1 has a very simple principle of operation. The 555 timer is configured into a 32.7 KHz oscillator using a precision 21.5K resistor and the .001

and .01 μ F capacitors. The oscillator is RS-232 gated using a common 2N2222 transistor. When RS-232 pulses activate the base of the gating transistor, the modulated signal is permitted to travel to the base of the second 2N2222 transistor used to drive two LEDs.

You will notice the LEDs are driven at 12 volts using only a 91 Ω one-watt resistor. Because the driving signal is modulated, the LEDs may be driven at high voltages without burning up. Driving the LEDs near their limit provides a safe, highly-efficient signal effectively blanketing the room with infrared. You may expect a highly reliable infrared data transmission up to 35 feet away using this circuit. Note that the transmission will become more directional with distance so, at 35 feet, you'll probably have to aim directly at the receiver. This circuit should NOT be used with the keypad chip. The keypad has an integrated infrared modulator. Use only the infrared receiver (Figure 2) to demodulate the signal.

The IR Receiver shown in Figure 2 consists of little more than a 32.7 KHz infrared

demodulator and an inverter/buffer stage. All the difficult work is done within the demodulator. Since the signal is inverted (normally high, active low), a 2N2222 is used to invert the signal to normally low, active high. The signal from most demodulators is typically very weak, so the 2N2222 also serves as a signal buffer. The demodulator is readily available from Jameco (1-800-831-4242) for \$2.79 at the time of this writing.

RF Communications

The RF Transmitter shown in Figure 3 is manufactured by Ming Microsystems and is readily available from Digi-Key (1-800-344-4539). This tiny little transmitter requires very little standby current and ships pretuned and RS-232 ready as shown in the diagram. I have no idea how it works, other than to say that it probably employs some form of frequency shift keying (FSK) on the AM band. At the time of this writing, this transmitter sold for \$10.00 each in quantities of one from Digi-Key.

The RF Receiver shown in Figure 4 is also

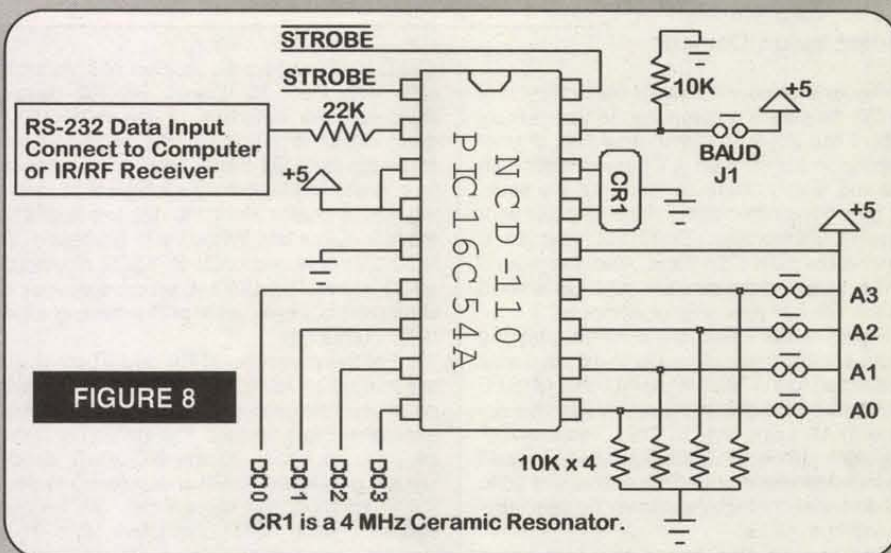


FIGURE 8

CR1 is a 4 MHz Ceramic Resonator.

FIGURE 9

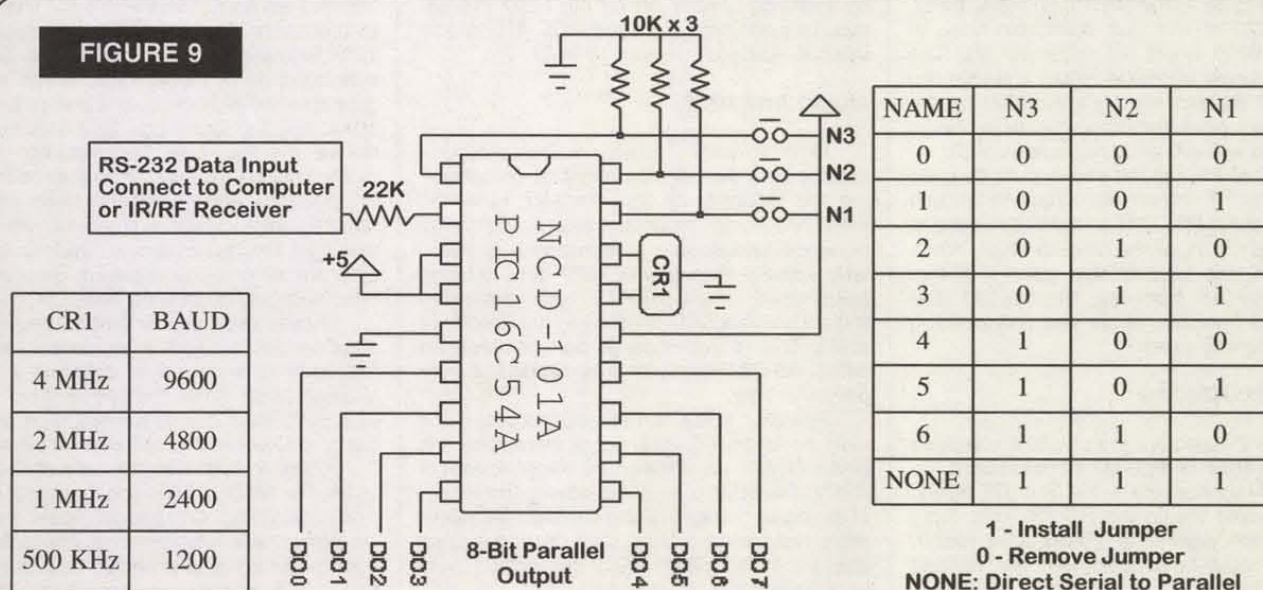


FIGURE 10

ASCII Input:
RS-232 Data Input
Connect to Computer
or IR/RF Receiver

Logic Level Output can be used to
Drive the Gate of a FET to Software
Control an LED or EL Backlight.

Contrast Adjust

10K

47µF 25V

MAX680

47µF 25V

Component Side of an LCD
Display Shown at Right.

18

ASCII INPUT

22K

+5

NCD-LCD II
PIC16C54A

CR1

10K

1200
9600 BAUD

+5

J4
J3
J2
J1

10K x 4

CR1 is a 4 MHz Ceramic Resonator.

communications protocols of the NCD-110 series interface processor.

Figure 10 illustrates the use of the NCD-LCD for controlling up to 16 character LCD displays via remote communications. I would highly recommend the use of RF communications when speaking to this device due to the fact that several bytes of data are required to fill the display, and that RF communications are immune to someone walking in front of the signal.

Software

Very little software is required for remote communication to multiple devices. In fact, all the driver software provided on my web site can be transmitted via wireless communications by simply dropping the baud rate down to 1200 baud. The rest of the code can remain in tact with no additional modifications.

If you are a Visual Basic programmer, you will find it possible to build a sophisticated graphical user interface with very little programming. See the March '98 issue "Opening Windows to the World" for explicit details on using the serial port under Visual Basic 4 for Windows 95. I have to say from personal experience, that there is a rush of adrenaline when a button on a computer screen is clicked for the first time, taking control of your world from a user-definable GUI.

For the minimalist programmer, you can download programming examples from my web site at <http://members.aol.com/ncdcat>. I will provide a few QBasic examples for you to follow that will show you the basics of RS-232 communications. Note that this code is easily ported to Visual Basic or just about any other language that supports RS-232 communications. Also note that these programs assume you are using COM 2. Remember that these two methods of remote data transmission have a maximum throughput of 1200 baud.

Example Data Transmission

The program example in Listing 1 demonstrates how to open your serial port and transmit all 256 ASCII characters under QBasic.

Example Data Reception

The program example in Listing 2 waits for the reception of an ASCII character. This program will appear to lock the computer until an ASCII character is received. The ASCII value of the received characters is displayed directly on the screen. Keep in mind the difference between ASCII characters and ASCII values. An ASCII character consists of letters and symbols while an ASCII value is the corresponding number for each of the symbols, ranging from 0 to 255. For example, the ASCII value of 65 is displayed on the screen as the ASCII character "A." Similarly, the ASCII value of the ASCII character "B" is 66.

I would again like to encourage readers to contact me by phone at (404) 244-2432 or E-Mail me at ncdryan@aol.com with technical questions. If I'm not around, please leave a message. Your call will be returned. The NCD-LCDII interface processor is only available from National Control Devices, (404) 244-2432, <http://members.aol.com/ncdcat/>.

National Control Devices is owned by Ryan Sheldon, who actively supports the research and software developments for the Language Research Center, Georgia State University.

```
`Open COM2 for RS-232 communications
OPEN "com2:1200,N,8,1,CD0,CS0,DS0,OP0" FOR RANDOM AS #1
`Count Through ALL 256 ASCII Characters
FOR N = 0 to 255
```

```
`Send Each ASCII Character
PRINT #1, CHR$(N);
```

```
NEXT N
`Close the Serial Port
CLOSE #1
```

LISTING 1

```
`Open COM2 for RS-232 communications
OPEN "com2:1200,N,8,1,CD0,CS0,DS0,OP0" FOR RANDOM AS #1
```

```
`Setup Infinite Loop DO
`Wait for an ASCII character to be received
IN = ASC(INPUT$(1, 1)) ]
`Print Received Character
PRINT IN LOOP
```

```
`Close the Serial Port
CLOSE #1
```

LISTING 2

```
`Open COM2 for RS-232 communications
OPEN "com2:1200,N,8,1,CD0,CS0,DS0,OP0" FOR RANDOM AS #1
`Count Through ALL 256 ASCII Characters
FOR N = 0 to 255
```

```
`Send Each ASCII Character
PRINT #1, CHR$(0); : REM Send Initialization Byte
PRINT #1, CHR$(80); : REM Send Command Byte
PRINT #1, CHR$(N); : REM Send Data Byte
PRINT #1, CHR$(13); : REM Send Termination Byte
```

```
NEXT N
`Close the Serial Port
CLOSE #1
```

LISTING 3

Applications

If you have two computers in your office, try running the transmission program on one computer and the reception program on the other. As data is counted on the transmitting computer, it will be sent and displayed on the receiving computer. You can hardwire the computers together by simply connecting the grounds of both computers, and connecting the data output of the transmitting computer to the data input of the receiving computer. Similarly, you can send commands to remote computers or other devices via wireless communications as outlined in this article.

Software Control of the NCD-101A

The NCD-101a has a very particular protocol that consists of a four-byte transmission. The example program in Listing 3 counts from 0 to 255

on the screen and in binary on the outputs of the NCD-101A following this four-byte protocol.

NCD-101A and KEYPAD Compatibility

Because four transmissions are required for a single byte of data, this interface processor is not compatible with the transmissions generated by the keypad chip. The NCD-101A can be configured as a direct serial-to-parallel converter, which is capable of receiving characters generated by the KEYPAD chip.

Next month, I would like to introduce you to RS-232 controlled video text overlay generators. So watch for an easy-to-build circuit and Visual Basic source code that lets you display text of multiple colors on a standard composite video display. And if you hadn't guessed, the video text overlay generator is fully RS-232 networkable with all the other projects you've seen up to this point. **NV**



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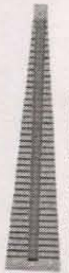
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98W003 \$79.95



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LB-14 - 1/4 Watt \$4.39 each
LB-18 - 1/8 Watt \$4.39 each



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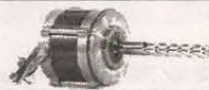
PB114A - 1" x 3" x 2" \$2.20
PB114B - 0.8" x 4.25" x 2.188" \$2.50
PB114C - 1.563" x 3.875" x 2.938" \$3.00
PB114D - 2.313" x 5.875" x 3.938" \$5.00

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98B004 \$19.95



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Has 2" long by 0.25" dia. lead screw. 12VDC (black wire is ground). Warner Electric SM-024-003-RT.
98M002 \$1.95 each



REMOVABLE HARD DRIVE

Syquest SO555 44MB removable SCSI cartridge hard drive. (Removed during upgrade)
97C024 \$9.95 each



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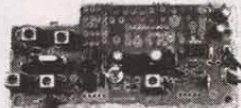


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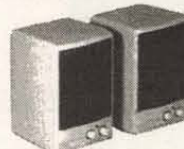
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Six foot cable with DB-25M to 36-pin Centronics right-angle connector.
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92A001 \$4.95 each



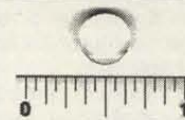
SPLITTER/COMBINER

Mini Circuits Labs. #ZSC2-1W-1. 1-650 MHz "BNC" connectors.
92J052 \$29.95 each



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by Karl Lunt

We have a winner!

T

ed Griebing won the first annual Northwest Regional of the Trinity College Fire-Fighting Home Robot Contest, held March 28, 1998 at Renton Technical College in Renton, WA. Because of the short notice, only Ted and

Gary Teachout had running robots, though several other teams demonstrated machines that were almost ready for prime-time. Still, it was a hard-fought contest, and everyone involved deserves credit for their hard work and ingenuity. Congratulations to all!

Writing for a magazine always has a time-warp effect to it. I have to turn in copy so far in advance that the national event, to take place April 19, 1998 at Trinity College in Hartford, CT, will be over by the time you read this. I, of course, don't know what happened, but if Ted and Gary enter the national contest, I trust they will do well.

But getting to the Northwest Regional, run by the Seattle Robotics Society (SRS), required some serious robo-skill on the part of all the entrants. Though the contest has been held at Trinity College for the previous four years, only one person I know of in the Puget Sound area had ever built a robot that actually competed. So nearly everyone in the SRS was starting cold on a very challenging event.

I began on my own design a few months ago but, given my limited attention span and busy schedule, did not complete my machine. Recent columns have described some of the problems involved in making the small progress I did make, but finishing a real contender for this event means overcoming many more difficulties than I faced. I got my first glimpse at the different robot designs when the SRS held a practice session during the March meeting.

Practice day

I've long wished I could adequately convey what it's like to attend an SRS meeting. Phrases like "a robotics meeting" or "lots of interesting people" don't cut it. I just can't describe a classroom at Renton Technical College filled with over 60 robot builders and a dozen or so machines, plus the assorted test gear, laptops, cabling, frames, data books, and other hoohaw needed to support the gathering.

Kevin Ross, our able president, keeps a lid on the entropy for an hour or two, and we spend the time exchanging questions, answers, tips, and information on robot building. But like a wound-up spring, this somewhat formal side of the meeting contains lots of potential energy waiting for a

release, and when Kevin closes the meeting and what we call the "tech session" begins, the chaos is amazing.

The first thing that goes is your hearing; the noise of 30 simultaneous discussions and a dozen robots revving up will deafen you. Forget about talking; shouting is the only way of being heard by any-

driven eclipse camera and had it all set up at the meeting; naturally, he took some time to run it through its paces for the crowd.

Rick built his camera drive to satisfy a quest; he wanted to take many pictures, as in 100 or more, throughout a total solar eclipse. Since such an eclipse usually lasts about three and a half minutes, that averages a frame every two seconds. Obviously, we're talking a motor-driven film pack with about 250 frames of 35mm film in it, but that's the easy part.

The tricky bit involves tracking the sun as the earth rotates on its axis. If you don't compensate for the rotation, the very long exposures necessary during totality will be complete failures. But just rolling with the globe isn't enough. Rick wanted the camera's shutter under computer control, so he wouldn't even have to use a shutter cable or touch the camera during the eclipse.

There were other design constraints, as well. Total solar eclipses, for some perverse reason, usually offer the best view far from your back porch. Rick

not only had to make his rig battery powered, but it had to collapse down small enough that he could easily pack it onboard airplanes and into the hinterlands.

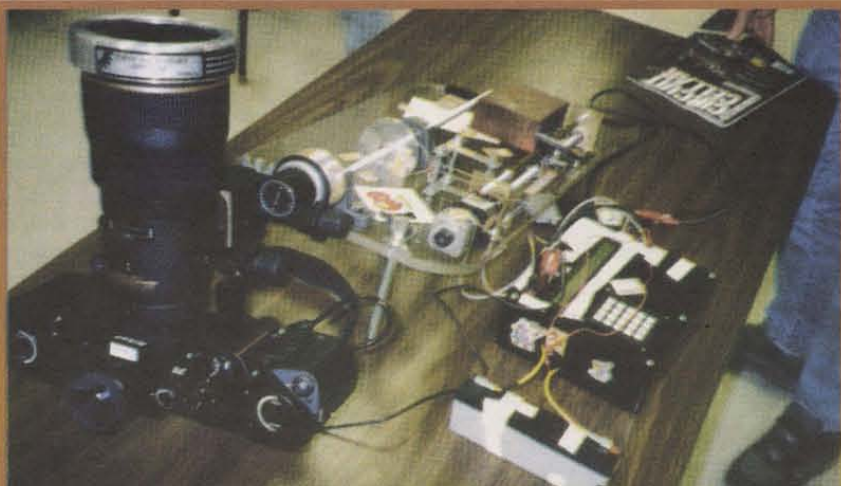
Rick got the drive system put together in time to head out for this year's hinterlands, the southern tip of the island of Aruba. He could have caught last year's eclipse, but ended up passing; possibly the mechanism wasn't ready for prime time, but more likely the notion of February in Siberia made the trip less appealing. Whatever... he day of the 1998 solar eclipse found Rick hunkered down in a World War II bomb crater on Aruba, waiting for the sun to hide. The bomb crater actually worked to Rick's advantage, since the prevailing trade winds

would have kept the camera shaking had he not been sheltered from them.

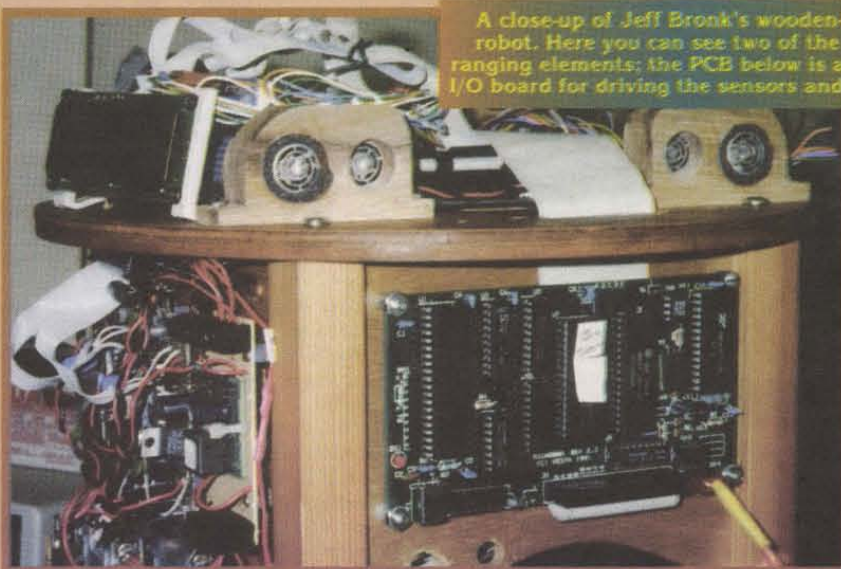
I can't imagine what the tension must have felt like. It's one thing to build a robot, bring it to a Saturday meeting, and have a wheel fall off. Okay, the bloody thing didn't work this time, but next month, you'll come back with an extra \$2.00 of hardware and everything will go smoothly.

But filming a solar eclipse means you get exactly one chance every year or so, some place hell and gone from home, with who knows how much money tied up in the effort. If the robot doesn't work this

AMATEUR ROBOTICS



Rick DeWitt's solar eclipse tracking camera, ready for action. The chassis to the right of the camera platform holds a 68hc11 computer for controlling the camera's motion and shutter.



A close-up of Jeff Bronk's wooden-frame robot. Here you can see two of the sonar ranging elements; the PCB below is a surplus I/O board for driving the sensors and motors.

one more than a foot away.

The white boards at the front of the classroom immediately draw several crowds as people grab markers and begin sketching motor control circuitry or sensor designs. Other crowds drift through the room in a tidal pattern, moving from one robot to another, checking out what cool additions the builder made since the previous meeting or examining the design of a new machine.

One very popular robot at our March meeting had nothing whatever to do with the Fire-Fighting contest. Rick DeWitt had built a marvelous motor-

time, it'll probably take a year to recover from the financial shock. Well, I've got good news and bad news, Rick's drive mechanism worked perfectly, but the film jammed. Rick plans to hit Europe next year for that solar eclipse, and we wish him the best of luck. Although Rick didn't end up with any solar eclipse pictures to pass around, the SRS members enjoyed looking at the design of his camera drive mechanism.

Rick built the drive system onto a 1/2-inch thick sheet of clear plastic, about one foot wide and 18 inches long. He started with a small stepper motor coupled to a 100:1 planetary gearhead purchased from Sterling Industrial. The gearhead's output shaft is connected to a 1/2-20 threaded rod, which is, in turn, threaded through a zero-backlash drive nut fastened to a homemade bracket. He fastened a wire to this bracket, then ran the wire through a complex pulley system that not only provided even more speed reduction, but damped out any vibration or backlash from the motor's stepping. Power for the motor and electronics comes from a pair of 12 VDC, 2.3 Ahr gel-cell batteries.

To control this whole mechanism, Rick wired up a New Micros' 68hc11 single-board computer, complete with a two-line LCD display and a small keypad. He wrote his own software, using 68hc11 assembly language, to control the drive's tracking speed and direction and to work the camera's shutter. The computer provides some very sophisticated features, including displays of current position and step rate. Rick plans to add even more capability,

demonstrated works in progress that had a lot of promise. Jeff Bronk made a wood-frame robot, sporting a pair of 12 VDC gearhead motors and two 12 VDC gel-cell batteries. The brains of this machine uses a V20 single-board computer, complete with 256K of EPROM and 128K of RAM. A serial port hooked to his computer provides on-the-fly debug capabilities during test runs. The robot carries a large complement of I/O, built around three 8255 parallel port chips. He also added eight channels of eight-bit A/D, and finishes with five sonar sensors, used for wall detection. For flame detection, Jeff's machine relies on an amplified photosensor with a custom baffle.

Another entrant, fielded by a three-man team of Martin Calsyn, David Buckley, and Mike Begley, relies on several processors for handling low-level tasks, all controlled by a larger, main computer.

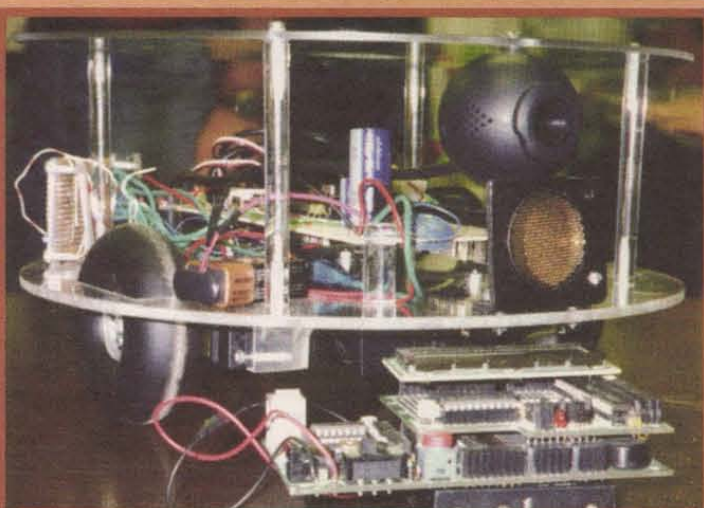
Their machine, built on a round, clear plastic frame of two levels, uses an MIT 6.270 board with a 68hc11 MCU as the main computer. A PIC 16C74 MCU handles all low-level sensor tasks and controls the two Hobbico CS-72 133 oz-in R/C servo motors that provide locomotion.

A second 68hc11 board controls the robot's vision system, based on a hacked PC color QuickCam camera. This 68hc11 board emulates a PC's parallel port, controlling the QuickCam and collecting its data. To improve the camera's capabilities, the team removed the IR filter from the front of the camera; they warned that you need to be very careful doing this surgery, as the camera is very easy to destroy.

Jim Wright is the only SRS member with previous Fire-Fighting contest experience. He fielded an entry in last year's event; he figures he probably tied for 14th place "along with about 50 other robots." Jim built this year's entrant around one of Bill Harrison's Mini-Sumo robot designs. Jim's robot uses a pair of hobby servo motors powered by four AA batteries and controlled by a BASIC Stamp. Once it locates the flame, the robot turns on a small fan, powered by a separate pair of 9 VDC alkaline batteries, to put out the fire.

Gary Teachout has earned a reputation for clever, robust designs built around simple technology, and his Fire-Fighting robot design keeps with that trend. He started with a 68hc11 BOTBoard-2, then added some external analog multiplexors to create 32 eight-bit analog ports, all driven by the 68hc11's original complement of eight analog ports. He wired IR phototransistors to every one of these analog inputs, and used some very clever optics and baffling to create the necessary sensors.

His wall detection scheme relies on the sharp delineation between the maze's white walls and black floors. Three vertical arrays of four phototransistors are mounted to look right, left, and forward. Each array is positioned in front of a small lens, so each sensor in the array "sees" a different section of the floor ahead. For each of the three arrays, Gary's firmware turns on an IR LED, reads a phototransistor, turns off the LED, and takes a second reading. By analyzing the difference reported by each sensor



Here's an entrant built by a three-man team; the robot sports sonar and a color QuickCam. The PCB on the table in front is an MIT 6.270 computer that controls two other, smaller computers.

in an array, his firmware can resolve the distance to the white wall to within 1/2".

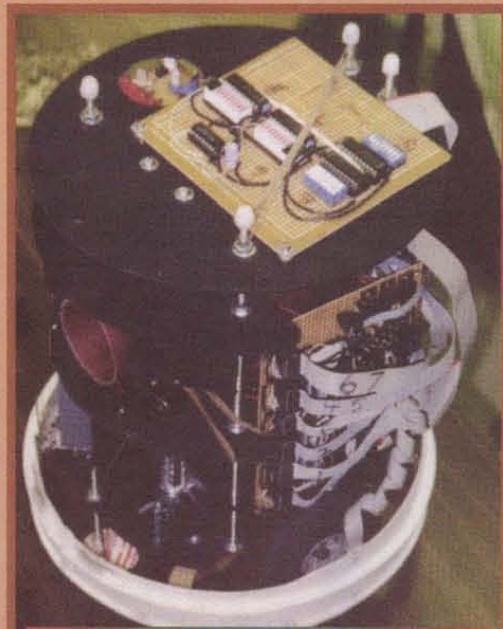
Gary's flame detection system also relies on IR and clever optics. He created two arrays of eight phototransistors each, and mounted each array in a separate, light-tight baffle. The baffles' openings — a 1/4" wide slit — are aligned looking forward, aimed so the two arrays converge on a point about 10 inches in front of the robot. To detect and range on the candle's flame, Gary's firmware reads and records the light level detected by each phototransistor. The code then finds the phototransistor in each array that reports the brightest light and compares that level to the level reported by the adjacent sensors. If the delta between these two (or three) sensors is great enough, his firmware assumes that the bright spot is caused by the flame. When both arrays indicate seeing the candle at the same time, the robot is correctly positioned in front of the candle. To extinguish the flame, Gary's robot turns on a small fan to blow out the candle.

Ted Griebing based much of his design on elements from the modern classic *Mobile Robots* by Joe Jones and Anita Flynn. If you don't have a copy of this book in your library, by all means stop by the Mondotronics web site at www.robotstore.com and check it out.

Ted's robot design used a BOTBoard with a 68hc811e2, a pair of motors and gearheads from some HiTec hobby servos, and an L293 motor driver circuit from the *Mobile Robots* book. Ted did all of his firmware in assembly language, so he was able to cram a lot of functionality into his machine, but he still only had 2K of code space available. Getting a complete Fire-Fighting robot into just 2,000 bytes is very impressive.

Ted's robot included a small electronic compass module, like the unit I described a couple of columns ago. Ted was able to use the compass and the known configuration of the room layout to aid his robot's navigation. Whether intentional or not, each of the four rooms in the maze has a doorway on a different compass heading. Ted's firmware could detect when the robot crossed the white line marking a doorway, and use the compass' reading to verify which room it was about to enter, thus getting a new navigational fix at each doorway.

For flame detection, Ted used two sensors working in unison. The main sensor was a Hamamatsu UVtron (R2868) coupled with the matching electronics board (C3704). The small board generates the needed 350 VDC used to drive



Second place went to Gary Teachout's robot LC, shown here with its white bumper skirt in place. The board on the right side of the frame handles some of the I/O; the round nozzle on the left side is the fan for blowing out the candle flame.

such as syncing the shutter operation to the published time scale of the eclipse. He might even add a backlight to his LCD display; it gets dark during a total eclipse, and right at the most critical part of this year's shoot, it got so dark he couldn't read the display.

Practice robots

But the focus of the March meeting was trial runs of the Fire-Fighting robots, in preparation for the contest the following week. Several people

the sensor, and also conditions the signal for use by his 68hc11. The second sensor in the pair was a Radio Shack IR photodetector, mounted in a small brass tube to restrict the field of view. Working together, these sensors gave a reliable indication that the robot was aimed at the candle. To judge when the robot was within the required one-foot distance, Ted's robot used down-looking photodetectors that picked up the one-inch wide white border around the candle. Finally, the robot's firmware activated a small fan to put out the fire.

The big day

The regional contest took place on the Saturday after the March meeting. It turned out that despite many long nights of work, most of the contestants did not have robots capable of running the entire contest. Only Ted Griebeling and Gary Teachout had machines they felt could compete, and even Ted's robot was a little dicey. In fact, he was busily rewriting portions of the operating

A mini-sumo fire-fighter? Jim Wright built this small, servo-powered robot from one of Bill Harrison's mini-Sumo frames. The board at the front of the robot holds the blower fan and a small sensor.

code during the test runs that morning. Normally, this is a sure invitation to disaster, but as events proved, Ted was able to pull off the changes cleanly.

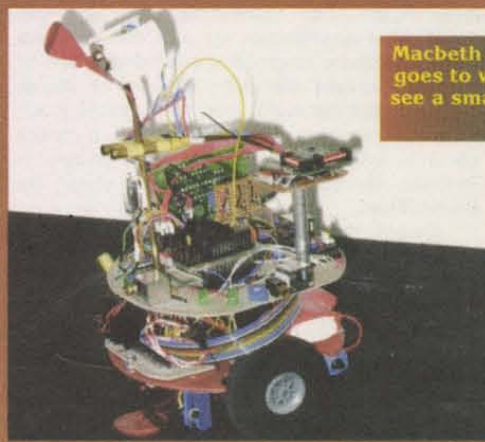
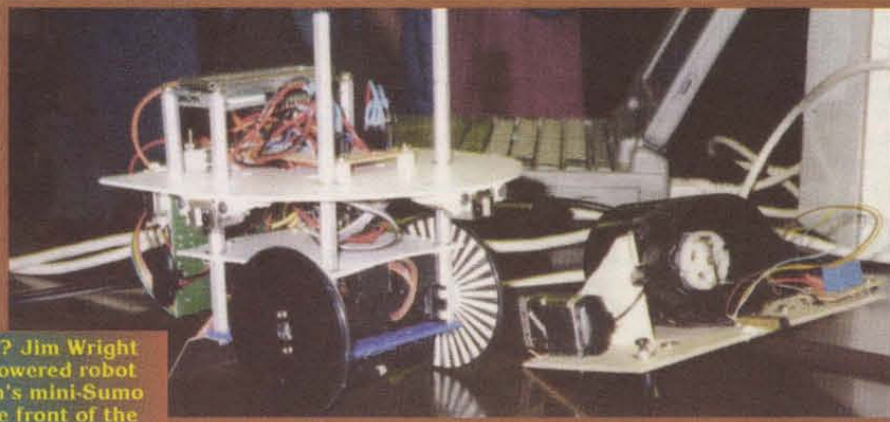
The contest opened with Gary's robot, LC. The candle location for each run was determined by random draw from a program running on Kevin Ross' laptop, and Gary's first draw put the candle in the nearest room. Kevin said "Go!", the robot scurried down the hall, turned the corner, and put out the flame; the whole run was over in just 19.29 seconds. After snuffing the fire, the robot turned around and made its way back to the starting point, earning Gary a nice 10% bonus. Gary's second draw put the candle in a more difficult location, in a room farther away from the starting point. Even so, the robot performed perfectly. It moved down the hall, swept through the first room, rolled over to the second room, found the flame, put it out, and returned home; time for this round was 32.53 seconds.

Gary kindly allowed Ted some extra tweaking time on his code, and now it was Ted's turn. Like Gary, Ted's first run had the candle placed in the nearest room, and Ted's machine, Macbeth, made short work of the task, snuffing the candle in just 22.46 seconds. Macbeth was not programmed to return to the starting point, however, so Ted didn't get the 10% bonus. It wasn't until after Ted's first run that we remembered he had signed up for non-dead-reckoning mode, a format that rewards you with a huge 30% bonus if your robot can navigate without dead-reckoning navigation.

Next came Gary's third and final run. This time random chance put the candle in the fourth and last room of the robot's search pattern, ensuring that this run would be the most difficult. Still, the robot needed only 43.18 seconds to complete the task, and it returned to home base as usual; an impressive performance for the little machine. What's more, putting out the candle in all three runs netted an additional bonus for reliability.

Ted's second run again drew a very favorable placement, with the candle back in the first room. This run looked just like the first one, and the robot

put out the candle in 22.42 seconds, a time nearly identical with its first run. But this time the non-dead-reckoning ramps were in place, and the performance meant a huge bonus for navigation. The third wasn't really necessary, as Ted's first two times, coupled with his navigation bonus, ensured victory, but we wanted to watch his 'bot strut its stuff one more time. This time, the draw put the candle in the fourth room, just like Gary's final draw. Macbeth had a little more trouble, taking over 50 seconds to do the job. This included a timing error on my part while running the stopwatch, plus a five-point penalty assessed when Macbeth skimmed a wall. But, like Gary's LC, Macbeth put the candle out



Macbeth in action! Ted Griebeling's 68hc11-based robot goes to work, on its way to a first-place finish. You can see a small electronic compass module mounted on the upper-right section of the frame.

a 68hc11e0 MCU, RS-232 level shifting circuitry,

and a Xicor X68C75 8K EEPROM memory device. This may be the ideal low-end combination, since the 68C75 not only provides a bunch of non-volatile memory, it restores the 16 I/O lines normally lost in memory expansion designs. What's more, the Xicor device's two eight-bit ports can both be configured as input ports, an improvement over the 68hc11's original port B, which is an output-only port. Note, however, that the Xicor port arrangement does not replace the 68hc11's port B and port C exactly. The ports exist at different memory locations and the port set-up differs from that provided by Motorola's 68hc24 Port Replacement Unit — the chip normally used for this purpose. Still, it's a big win over losing the ports entirely.

The board's design includes a dual-row 50-pin male header giving access to all 68hc11 and 68C75 I/O and control lines, making it easy to add this board into any project. Even cooler, the connector form-factor matches that of the 50-pin dual-row receptacle (surprise!), allowing you to plug the 'C75 board into your prototyping board. Imagine the projects you could prototype with a plug-in 68hc11 computer, complete with 8K of memory!

I've had problems in the past using the Xicor chip, so I was a little skeptical when I first powered up the Adapt-11C75. Long-time readers of this column will remember my last interaction with the smaller version of this chip, the X68C64. This device is similar to the 'C75, but lacks the I/O ports. The problem with both chips involves Xicor's vision of how an embedded firmware designer should use the memory in the device. Xicor embeds two chunks of 68hc11 code in memory space of each device; you use this code and a serial terminal to write your application firmware into the chip's EEPROM.

Obviously, this is a poor solution. The Xicor code must be left untouched or you lose the ability to download future firmware. So right off, you've lost

in all three runs.

This was an exciting contest, and the crowd of some 60 people really enjoyed watching these two machines duke it out for the title. Gary and Ted deserve high praise for their excellent designs and for their very low scores in a difficult contest. The other entrants who had not finished their robots in time vowed to get their 'bots done in time for a return match, to be held in August. Congratulations to all involved!

I'll include one other note here. Many members in the SRS contributed behind the scenes to making this an excellent first pass at the Fire-Fighting contest. Lance Keizer, Keith Payea, Frank Haymes, Anne Wright, and Kevin Ross, among others, contributed to building three different versions of the maze layout before we were done. Kevin also did his usual yeoman's duty in organizing the contest and making sure everything happened when it should. These people, and others who I'm sure I've left out, helped make this event a success, and their efforts deserve recognition. Thanks to everyone!

ADAPT-11

Technological Arts of Toronto, Ontario,

528 bytes of code space for your application. Worse, the breaks occur in two places, so you have to tailor your code layout to leave gaps in the right spots.

I didn't like this design the first time I saw it, and I still don't like it. Technological Arts provides a utility called xload, intended to sidestep this problem and allow you to download your code directly into the Xicor device. Since their solution does not require the Xicor loader code, you can safely overwrite the Xicor code and use all 8K memory. Unfortunately, I was not able to get this program to work for me. But since I had already dealt with this problem, I had the solution at hand. I fired up my own Xicor loader program called — oddly enough — xload, and used it to download my test programs. Like the TA utility, my xload program takes over the whole download process, freeing up all of the Xicor EEPROM space. Both xload programs work by having you boot the 68hc11 in special bootstrap mode, then downloading a small talker program that knows how to write data to the Xicor EEPROM. You can get a copy of my xload utility by hitting my web page.

Once I cleared the hurdle of getting my code into the Xicor memory device, everything went as I expected. The X68C75 chip combined with a 68hc11e0 gives you a system with 8K of EEPROM and 512 bytes of static RAM. You can even substitute your own 68hc11e1 and use its 512 bytes of EEPROM, from \$b600 to \$b7ff, should you need a little more code space or data storage. Or, if you can get by with only 256 bytes of RAM, drop in your own 68hc811e2 to get a total of 10K of EEPROM.

TA has added a few nice touches to this board design. One element I like is their use of an on-board low-dropout +5 VDC regulator. Though the instructions recommend a supply of at least +8 VDC, I had no problems running on a set of four fresh C-cell alkaline batteries. If you intend to use your Adapt-11C75 in a prototyping breadboard, you can bypass the regulator and feed +5 VDC directly in from the prototyping leads.

I also like the row of tiny switches across the top of the board; "top" here assumes you have the board standing vertically in your breadboard. Besides the reset pushbutton, TA has included a write-protect switch for the EEPROM.

Finally, they've left a PCB pattern so you can install your own voltage reference chip, should you want to supply an analog reference other than +5 VDC to the 68hc11's A/D inputs. Note, however, that your options here are somewhat limited. The 68hc11 requires a minimum of 3 VDC between V_{rl} and V_{rh} for reliable operation. The Adapt-11 documentation suggests a voltage reference of 2.5 VDC as an alternative to the normal +5 VDC, but you could have problems with such a small V_{ref}.

Naturally, I have a few nits to pick. Although their user manual is filled with instructions and examples, it's a little dense and could use some simple graphics to break up the grey. The manual tries to cover all of the memory combinations possible with this board, often in the same paragraph, and it gets a little confusing trying to sort out what instructions apply to your board. I'd rather see one entire section devoted to downloading code into each of the major configurations. This might make the manual a little thicker, and some paragraphs might be exact duplicates of others, but it would make following the manual a lot easier. Lastly, TA

was kind enough to include a copy of my SBasic system in their software disk, but their version is quite a bit outdated. As they pointed out in their manual, you can hit my web site for the latest and greatest.

The Adapt-11C75, used with a properly working xload utility, makes an unbeatable tool for the amateur robotics builder. For \$87.00 each, the AD11C75-SP (starter package) gives you an assembled board with a 68hc11e0, Xicor X68C75, serial and power cables, a disk of free software, and manuals and data sheets. I consider this a good deal, and the board would make a great starting point for any robot. Recommended.

I'm outta here ...

This is my 69th Amateur Robotics column for *Nuts & Volts Magazine*, and it is my last. I can't believe that five-plus years can go by so quickly, or that the technology available to the robotics hobbyist could mutate so rapidly.

Five years ago, building hobby robots to most people meant big iron; windshield-wiper motors, large batteries, and power-hungry computers, if any computers at all. There was no BOTBoard, and if you needed a software tool to help you, you wrote it yourself or did without. Hobbyists labored alone, usually with no one to share ideas with, save disinterested co-workers or a bewildered spouse.

The Internet changed all of that. With modems and computers, people can easily share technology with other builders, without meeting, talking, or even living in the same country. Software tools that speed robot development are as close as a web page, and plans, schematics, and building tips fill web sites around the globe. The list of people who've contributed major tools to the hobby robotics community spans the world, and just in my few columns I've drawn on ideas from people in Australia, Germany, Canada, and all across the United States.

Despite the hundreds of cool machines I've seen (I've even designed a couple of them myself), I enjoy the people in this hobby the most. I'm constantly amazed at the level of creativity and intelligence displayed by robot builders. Twelve or 75, or any age in between, all who have built 'bots have had to overcome some serious technical hurdles, and the ingenuity used always surprises me. Usually coupled with that ingenuity is a drive to pull the all-nighter, a nearly senseless desire to get the next part of the robot finished, just so you can show it off at the meeting that morning.

Speaking of meetings, I can't thank those of the Seattle Robotics Society enough for their contributions — direct and indirect — over the years. Many of the projects you have read about in these columns were conceived, developed, tested, redesigned, or in rare cases, broken, by some of the brightest people I've ever had the pleasure of knowing: the SRS membership. From the campfire talks that spawned tiny4th and SBasic, to the spontaneous tech sessions that yielded new motor mounts or frame designs, the SRS gang keeps the pot stirred and the juices flowing. One Saturday robotics meeting is worth a month of long labor alone at my workbench, and I count myself lucky to be part of the group.

As usual, I have a boatload of projects in front of me, all of which would make terrific articles for the column. I'm closing in on a GameBoy powered robot, though it might mutate into a home-control system before it's done. The solar-powered robot with on-board battery charger needs development time; any solar project in Seattle takes three times as long to do as it would anywhere else, given our lack of sunshine. I still have to get my own beer from

the refrigerator, as the beer-fetcher 'bot exists only as a vague set of plans in my mind.

I'd love to spend some time working on the smallest robot I can make. Given my lack of motor skills, "small" likely won't be very small, but I'm sure I can beat my current personal record of slightly larger than a set of four penlights.

Another project before me is lighter-than-air robotics. Several people have built helium-lifted machines, and getting the most performance in the lightest weight sounds fascinating.

A related project would be an intelligent rubber-band-powered glider, capable of responding to radio or IR commands. As with the blimp-bot, keeping the weight down is crucial, but seeing such a plane stay aloft and under control would be dynamite.

Of course, there's the tree-climbing camera, an idea prompted by the squirrels playing in the fir trees in our backyard. I'd love to find out what they (the squirrels) look like in their own world.

Since I'm really a software person by trade, I've naturally got some software projects on my list as well. First in line is to clean up SBasic; it still has some irritating bugs in it. Once those are dealt with, I'd like to redo the code generator so it creates a second, intermediate file. This file would be machine-independent, and would be processed in a separate operation to get the final executable file. This would make it very easy for me to port SBasic to virtually any machine. Even more entertaining, I could then publish the format of the intermediate file, so other software types could create their own file processor. That way, anyone could develop an SBasic cross-compiler for any machine, without my getting involved at all. As you can see, I'm nowhere near running out of article ideas. But burnout is setting in, and I can tell it's time to head in another direction. I'll continue to write, however, and you may well see articles with my byline on them in future issues of *Nuts & Volts*.

I began this column over five years ago, to help people get started with robotics and to describe a project or two that I had done. The months sped by almost unnoticed, my time measured instead in completed robots, SRS meetings, and article deadlines. Along the way, I've met some terrific people, seen an army of highly cool machines, and heard from hundreds of very nice readers. Thinking back on all the letters and E-Mail from people trying to build their first 'bot, I can't help but wonder how their projects turned out. I know that many started robots, but I'll likely never know if they finished them.

This hobby has come so far in the last few years, and the pace of change is accelerating. The big boys have sent machines to Mars and to the oceans' depths. But for every Sojourner or Tiburon, there are thousands of almost-working robopets or nearly-finished maze-runners. To all of you struggling to get that frame finished or software stabilized, hang in there. The technology and the tools are out there, and with patience and persistence, you can build machines today that few hobbyists would have tried just a few years ago.

Time to go. In the immortal words of Lance Keizer, SRS stalwart and past president, "Keep on keeping on ..." **NV**

From the Editor ...

All of us at Nuts & Volts have thoroughly enjoyed working with Karl over the years, and have always appreciated his professionalism and timeless wit. Although Karl will no longer be regularly hosting our Robotics column, we look forward to receiving feature articles from him in the future, as his time permits.

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The TDS2020DC is under \$400.00 (100 quantity).

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GPIO BUS ISOLATOR



ICS Electronics announces a new GPIB Bus Isolator — the Model

4860 — that provides increased bus isolation and noise protection while expanding the number of devices beyond the specification limit of 14 devices.

The Model 4860 isolates instruments from the bus controller and lets instruments 'float' up to the potential of their test signals.

The 4860 uses advanced optical isolators and separate power supplies to achieve up to 2,500 volts of DC isolation between the main bus and the isolated bus. The optical isolators also provide 5000 V/msec of noise and 50V common mode isolation between the two buses.

The Model 4860 is 100% compatible with all IEEE-488 bus commands and does not require any programming changes. Smart logic in the 4860 recognizes which bus is connected to the bus controller-in-charge and to the active talker. Unlike earlier bus expanders, the 4860 does not have any internal switches.

Price starts at \$750.00 each.

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K232-ISOL is a new, cost-effective solution for optically isolating your RS232 interfaces. Simply plug the self-powered K232-ISOL converter into your PC's serial port to isolate and protect the computer from industrial control and instrumentation devices such as PLCs. No external power is required because K232-ISOL takes its

Robot Wars 1997: Snake

by Dan Danknick

"It's always easier to learn how to do something when there is a purpose," summarizes Mark Setrakian, Head Creature Mechanic at Rick Baker's Cinovation Studios. He is referring in part to his amazing robot creation, Snake: a 325 lb. expression of technical artistry, devoid of limbs or wheels, but quite capable of sending onlookers home with nightmares.



Constructed in 12 days amidst the UPS carrier strike, Mark designed Snake to change people's views on a robot. "It was hard work, but I get into that." Its predecessors consisted mostly of machined parts, but Snake relied heavily on welded ones. A metal supplier cut many of the parts to dimension while Mark fastened them in-house during the gaps between projects. "Due to the short development cycle, Snake was a challenge," he explains while commanding the three jaws to open wide for a picture.



Built in segments, Snake starts with a head followed by seven motile units and a tail. Each part of the robot is independent and contains its own batteries, radio receiver, power amplifier, and actuation system. It is the epitome of redundancy.



A custom animation encoder commands the motion; as Mark bends and twists it, the robot responds by mimicking the shape. "I can gang the segments to any zone of the controller on the fly," he explains while punching buttons on the most complex RC radio transmitter I have ever seen.



To understand how each segment functions, imagine a tripod with one fixed length leg and two that are adjustable. If you shorten both of the adjustable legs, the top of the tripod leans one way. If you lengthen both, the top leans the other. Now imagine all the combinations of this with seven tripods stacked on top of each other. You've just imagined this robot in action.

"I didn't expect it to work at all; seeing it twitch pathetically in the arena was cause for celebration," laughs Mark, reflecting on the first time he powered it up for the audience at Robot Wars 1997. "I love to entertain people in my way. I do it by building neat stuff and sharing it."



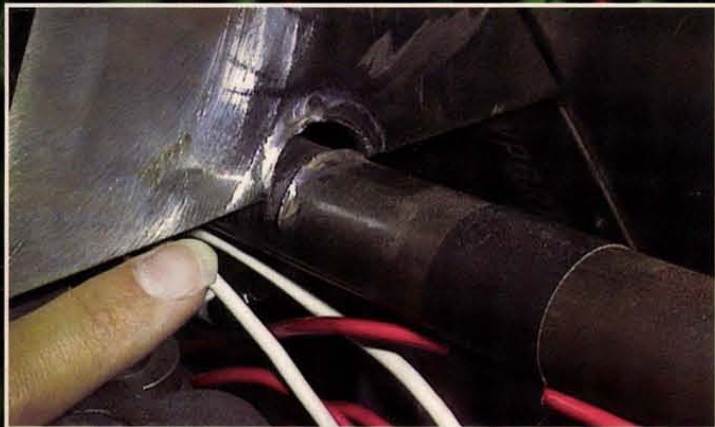
What kind of event would support such a machine? Why Robot Wars, of course, the brain child of former ILM employee Marc Thorpe. Competitors from around the world converged in San Francisco last August to pit their robots head-to-head. In this robot competition, fast maze-solving software won't help you advance through the finals, but 2 hp motors and the correct alloy of aluminum certainly might. Where spinning blades and high-speed ramming runs are the norm in battle, Snake poses a difficult question for a foe: where to start? "It's one huge target," commented one spectator.

But don't let its 13 foot length fool you. Every segment moves under the action of two ball screw linear actuators, each producing 500 lbs. of force from 20 Ni-cad cells. One second the machine looks like a giant beached Toblerone candy bar, the next it has formed a vertical ring, nose touching tail. Incoming invaders are either crushed, bitten (each of the three jaws also has an actuator), or engaged with the hammer drill in the tail.



"The building of robots is an art form; it requires the best of my aesthetic ability." As impressive as Snake looks, Mark is equally comfortable building robots from hobby servos, hot melt glue, and tongue depressors. "It's all about expression. My favorite robot building area is anywhere with raw materials."

What does Mark have planned for next year? "I'm going to tighten the whole design up and subtly alter the geometry of the actuators." The latter is necessary to reduce Snake's tendency to crack its frame. Given enough time and money, Mark would build "A six-legged walking robot motivated by powerful brushless motors with an onboard jet engine providing electricity."



To all aspiring robot builders, Mark offers this encouragement: "Make sure every single detail is nailed down. And don't worry about making a mistake. Recognizing it and starting over is a normal part of the process. It's only bad if you leave it." NV

For more information on the event, you can visit the Robot Wars website at <http://www.robotwars.com/>. A comprehensive analysis of the last two events is also available on competitor Andrew Lindsey's website at <http://www.cybercomm.net/~alindsey/>

Continued from page 95

New Products

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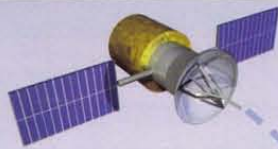
The SP-2A is DIP switch user-programmable for center voltages of 110, 115, 120, and 125 volts (50 or 60 Hz) and high/low protection limits of 30, 26, 22, and 19 percent of center voltage.

In addition, this model is user-programmable for under voltage turn-off delay times. All DIP switch settings are shown on a diagram attached to the underside of the case top cover plate.

Single quantity price is \$99.00 plus shipping and options are available.

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"My TV reception is so clear, you'd think I had a 50-foot antenna on my roof!"

Emerson's ingenious new antennas are hard to spot, easy to install and provide clear, powerful reception of broadcast signals...without rabbit ears.

by Hope Chapman



Replace your unsightly "rabbit ears" today!

I'm amazed at the way technology has improved television. Developments in electronic circuitry have resulted in TV sets that have sharper pictures, brilliant colors and clearer sound. From the smallest portables to wide-screen home theater systems, televisions continue to work better and better as optical innovations are introduced. Unfortunately, a television's picture is only as good as the broadcast it's receiving, and even the world's best televisions cannot make up for a weak or distorted signal. Antenna technology has not kept pace with television design, and the rabbit ears from the 1950's are not far removed from what's available today. Well, there's finally been a quantum leap in the design of antennas, and it's the result of two patented components developed by scientists. These improvements are the secret behind Emerson's revolutionary new antennas.

Picture imperfect. Cable subscription solves the problem of getting the signal to your television, but storms and other factors can result in cable outages. If you prefer not to pay the rising monthly fees for cable or live in an area where it's not available, your picture is likely to be weak, undefined and distorted.

One way to improve your reception would be to mount a large antenna on your roof. Unfortunately, most roof antennas are not particularly pleasing to the eye and may even be prohibited in the area where you live. Rabbit ear antennas don't improve your picture to any great degree and make your room look like something from an earlier decade. Most antennas need to be aimed at the source of the broadcast and require turning mechanisms to pick up the signal clearly.

Whether you live miles out in the country or in a concrete building next door to a broadcast tower, bad reception can rob you of the definition and color you were intended to see. The Optima antenna gives you the signal-grabbing power of a large antenna in an inconspicuous, low-profile size.

Stealth antenna. In the past, creating an antenna with optimal reception meant making it big, with a large amount of surface area. This resulted in products that were large and unsightly or small and ineffective. Either way, the aesthetic look of your room or house suffered. Research and development tended to focus on the television, not on signal reception...until now.

Recently, a brilliant scientist in Colorado developed an antenna that would maximize reception without being overly conspicuous. Emerson, a leader in electronic technology, has now made this innovation available to the public.

At a lab in Colorado, they developed two patented design improvements that made the Optima antenna possible. First, they created a flexible circuit board with a serpentine antenna, resulting in a large surface area confined to a small space. Second, they developed a technique that converts the copper shielding on the attached cable to an additional signal receiver that results in an antenna almost 10 feet long. This greatly enhances the antenna's reception power and allows you to tune the antenna by simply moving the cable! The antenna



Your neighbors won't know it's there unless you tell them.



Attention mini-dish owners. If you own a mini-dish satellite system, you are aware of the off-air issue and are probably wondering how you can pick up local broadcasts. After all, what good are hundreds of channels if you can't find out who won the local city council race? The Dishmate™ harnesses the same technological innovations as the Optima TV antenna to give you a powerful omnidirectional antenna that is virtually invisible. It is compatible with a variety of systems and is easy to install.



works best at a range of up to 30 miles from the signal source. We recommend an amplifier for reception up to 45 miles away. Ask your representative for details.

The handmade assembly is encased in aircraft-grade plastic and high-density foam. The weather-resistant cover is a neutral white and can be painted to match the color of the house or room. Plus, the omnidirectional design allows you to mount the unit anywhere you please. The Optima's universal design makes it adaptable to any component, and installation is a snap. So sit back, relax and enjoy the clearest picture you can get from your television.

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Nuts & Volts Magazine/May 1998 **99**

Build a Weather Station with PARALLAX and BASIC Stamp Computers

BASIC Stamp Computers

BASIC Stamps are a little solution for a big project. BASIC Stamps consist of a microcontroller, EEPROM, resonator and a few other components mounted on a small module the size of a postage stamp. The simple Parallax BASIC programming language commands include HIGH, LOW, INPUT, OUTPUT, IF, THEN, FOR, NEXT, TOGGLE, GOSUB, and GOTO. Check <http://www.parallaxinc.com> for a complete code listing and sample source code.

Build a Weather Station with your BASIC Stamp II

The following two code fragments show you how to measure wind speed and wind direction. Most anemometers produce a pulse with each rotation, and can be connected directly to a BASIC Stamp I/O pin. With 5 VDC applied to the wind vane, the 12-bit LTC 1298 A/D convertor (Parallax #27916 - \$26) returns a 0 to 5 VDC value that corresponds to a wind direction. Schematics and source code are available at <http://www.parallaxinc.com/stamps/anemometer.htm>

Get_Direction:

```
low CS
shiftout DAT,CLK,lsbfirst,[cfg\4]
shiftin DAT,CLK,msbpost,[AD\12]
high CS
```

return

..

..

Get_Speed:

```
high AN_PWR
count AN,2000,pulses
mph=pulses*/458/seconds
low AN_PWR
```

return

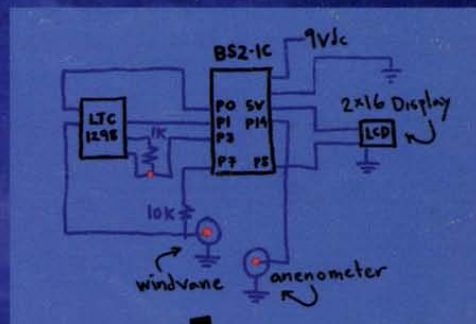
```
' Select A/D
' Send configuration
' Receive data
' Deselect A/D
```

```
' Turn on I/O pin
' Count pulses for 2000 ms
' Calculate wind speed
' Turn off I/O pin
```



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BASIC Stamp II Starter Kit (#27203) \$149

The BASIC Stamp II Starter Kit includes the BS2-IC module, carrier board, manual and application notes, software and serial cable. Free telephone and e-mail technical support is included with the purchase of every product.

BS2-IC Module (#BS2-IC - \$49)

BS2-IC module has 16 I/O lines, 2048 bytes EEPROM (program and data), 500 instr. max program length, and 50k baud serial I/O. Command set includes LOOKUP, LOOKDOWN, READ, WRITE, plus those identified above.

2-line x 16 character Serial LCD Display (#27910) \$54



LCD showing weather measurements. Use the BASIC Stamp's SEROUT instruction (requires one I/O line, ground and power) to communicate with the Serial LCD display.



Call and request our new product catalog!

Solutions Cubed Pocket Watch

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