

NUTS & VOLTS

M A G A Z I N E



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VOL. 18 NO. 9
SEPTEMBER 1997

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- Motherboard for the 486 Faithful -- All you need is the chip!
- "Baby AT" size 8.5" x 13", six 16-bit slots, two 8-bit slots
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- Eight 30-pin SIMM sockets, AMI BIOS
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- Unit inserts between handset and base of phone (Note, will not work with slim-line or other all-in-one-piece phones!)
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- Attractive off-white finish with grey grille-cloth

HSC#16884 **\$34.95**



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CONTENTS

VOLUME 18 NO. 9 SEPTEMBER 1997

ARTICLES

- THE UNIVERSAL LASER RECEIVER AND DECODER** Zachary Scott 18
Learn how to build a broad-based laser light receiver and decoder for an unbelievable price.
- DATA ENCRYPTION: WHY THE CONTROVERSY?** Jeff Stefan 26
This article explains the concepts and controversy behind data encryption and provides an encryption program for your own personal use.
- JUJUI! DISK-FIXING – LAST CHANCE FOR LOST DATA** Alan Johnson 32
Your floppy disk has crashed with valuable data. Before you throw it in the trash, there might be one last chance...
- ENCYCLOPEDIA OF ELECTRONIC CIRCUITS: THE CD-ROM OF 1,000 CIRCUITS – PART 1** TJ Byers 52
In this three-part series, TJ will show you how to use this CD to go from concept to copper, and build a karaoke amplifier in the process.
- DIGITAL VOLTMETER CAPACITANCE ADAPTOR** Fred Blechman 62
Use this inexpensive capacitance adaptor with a DVM or DMM to measure capacitor values from 20 pF to 2 uF.
- FLOAT YOUR PORTABLE** Gordon West 83
Keep your portable electronic equipment "in the bag" to protect it from the perils of water damage.
- USER'S GUIDE TO AUDIO POWER AMPLIFIERS – PART 2** Ray Marston 93
Take a look at nine popular audio power amplifier ICs with maximum output power ratings in the range from 325 mW to 5.5W in this second part of a five-part series.
- PRINTER PORT AUDIO ANALYZER** Robert Davis 106
The final installment of this three-part series on handy devices you plug in through your printer port.

COLUMNS

- AMATEUR ROBOTICS** Karl Lunt 69
Starting a robotics club, mini Sumos, and chocolate eclairs.
- OPEN CHANNEL** Joseph J. Carr K4IPV 85
Renewing your most renewable resource.
- RESOURCE BIN** Don Lancaster 103
Terribly tricky terrific toner techniques.
- SOFTWARE WIZARDRY** Harry Helms 9
Windows95 hot-rodming.
- STAMP APPLICATIONS** Jon Williams 41
Demystifying character-based LCDs.

DEPARTMENTS

- ADVERTISER'S INDEX** 112
- CLASSIFIED AD INFO** 112
- DEALER DIRECTORY** 34
- EVENTS CALENDAR** 78
- NEW PRODUCT NEWS** 98
- NV ADMART** 74
- ELECTRONICS Q & A** 72
- READER FEEDBACK** 5
- TECH FORUM** 90

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INDEX TO CLASSIFIED ADS

- 10. Ham Gear for Sale6
- 20. Ham Gear Wanted7
- 30. CB/Scanners7
- 40. Music & Accessories11
- 50. Computer Hardware11
- 60. Computer Software21
- 70. Computer Equip. Wanted24
- 80. Test Equipment24
- 85. Security47
- 90. Satellite Equipment56
- 95. Military Surplus Electronics56
- 100. Audio/Video/Laser56
- 110. Cable TV60
- 115. Telephone/Fax66
- 120. Components67
- 125. Microcontrollers68
- 130. Antique Electronics68
- 135. Aviation Electronics68
- 140. Publications68
- 145. Robotics76
- 150. Plans/Kits/Schematics76
- 155. Manuals/Schematics
Wanted82
- 160. Misc. Electronics For Sale82
- 170. Misc. Electronics Wanted88
- 175. BBS & Online Services89
- 180. Education89
- 190. Business Opportunities89
- 200. Repairs/Services92

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18889465931478580854784, 37778931862957161709568, 75557863725914323419136, 151115727451828646838272, 302231454903657293676544, 604462909807314587353088, 1208925819614629174706176, 2417851639229258349412352, 4835703278458516698824704, 9671406556917033397649408, 19342813113834066795298816, 38685626227668133590597632, 77371252455336267181195264, 154742504910672534362390528, 309485009821345068724781056, 618970019642690137449562112, 1237940039285380274899124224, 2475880078570760549798248448, 4951760157141521099596496896, 9903520314283042199192993792, 19807040628566084398385987584, 39614081257132168796771975168, 79228162514264337593543950336, 158456325028528675187087900672, 316912650057057350374175801344, 633825300114114700748351602688, 1267650600228229401496703205376, 2535301200456458802993406410752, 5070602400912917605986812821504, 10141204801825835211973625643008, 20282409603651670423947251286016, 40564819207303340847894502572032, 81129638414606681695789005144064, 162259276829213363391578010288128, 324518553658426726783156020576256, 649037107316853453566312041152512, 1298074214633706907132624082305024, 2596148429267413814265248164410048, 5192296858534827628530496328820096, 10384593717069655257060992657640192, 20769187434139310514121985315280384, 41538374868278621028243970630560768, 83076749736557242056487941261121536, 166153499473114484112975882522242672, 332306998946228968225951765044485344, 66461399789245793645190353008897088, 132922799578491587290380706017794176, 265845599156983174580761412035588352, 531691198313966349161522824071176704, 1063382396627932698323045648142353408, 2126764793255865396646091296284706816, 4253529586511730793292182592569413632, 8507059173023461586584365185138827264, 170141183460469231731687303702776544, 340282366920938463463374607405553088, 680564733841876926926749214811106176, 1361129467683753853853498429622212352, 2722258935367507707706996859244424704, 5444517870735015415413993718488849408, 10889035741470030830827987436977698176, 21778071482940061661655974873955396352, 43556142965880123323311949747910792704, 87112285931760246646623899495821585408, 17422457186352049329324779899164271008, 34844914372704098658649559798328542016, 69689828745408197317299119596657084032, 139379657490816394634598239193314168064, 278759314981632789269196478386628336128, 557518629963265578538392956773256672256, 1115037259926531157076785913546513345024, 2230074519853062314153571827093026680064, 4460149039706124628307143654186053360128, 8920298079412249256614287308372106720256, 17840596158824498513228574616744213440512, 35681192317648997026457149233488426881024, 71362384635297994052914298466976937602048, 142724769270595988105828596933953875204096, 285449538541191976211657193867907750408192, 570899077082383952423314387735815500816384, 114179815416476790484662877547163001636768, 228359630832953580969325755094326003273536, 456719261665907161938651510188652006547072, 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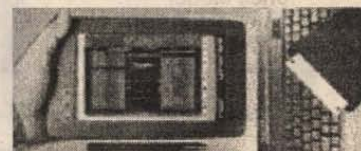
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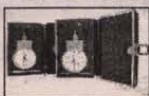
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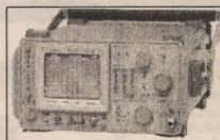
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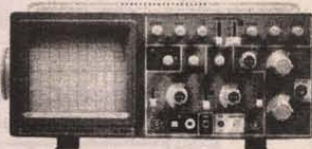
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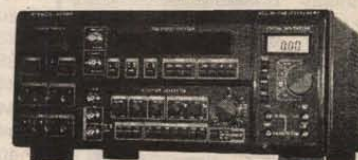
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Software Wizardry

By Harry Helms

Windows95 Hot-Rodding

While Windows95 has a much better user interface than previous versions of Windows, it is an even more complex operating system underneath. One big reason for this is that Windows95 supports far more features (like true multitasking and a new virtual file system) than previous versions of Windows, yet it tries to preserve full backwards compatibility with earlier editions of Windows and MS-DOS. Windows95 also supports new hardware like sound cards and upgraded display adapters, etc., and this adds to its complexity.

To get around configuration and installation problems, Microsoft built a wide array of default settings and values into Windows95. If you install Windows95 on a PC, or purchase a PC with Windows95 pre-loaded, these default settings will be the ones your PC will be running under. For most Windows95 users, these settings will work fine. However, you may have some requirements — like graphics-intensive applications — where the default settings don't give you the performance you need. Or you may be using some quirky software and hardware that doesn't run as well as you'd like — or maybe won't even run at all — with the default settings for various Windows95 functions.

I sometimes think Microsoft deliberately made Windows95 look more difficult "under the hood" than it actually is in order to deter casual users from tinkering with the operating system. However, as we'll see this month, it's actually easy to "fine-tune" Windows95 for substantially improved performance in many situations.

File Swapping and Memory Management

I don't know if anyone has ever done a formal survey to prove this or not, but I have a feeling that memory management, and especially how files are

swapped to and from the hard drive as part of managing virtual memory, is a major cause of Windows performance bottlenecks.

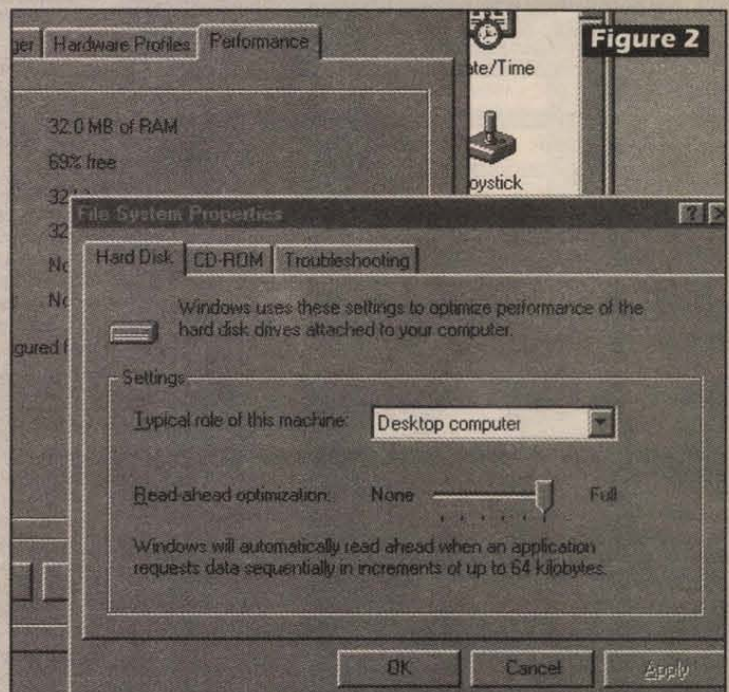
To adjust such parameters, click on the System icon in the Control Panel window. When the Systems Properties window is open, click on the Performance tab. Figure 1 shows what you will see next. At the bottom are three buttons for "Advanced Settings." Click the File System button, and you'll see the window shown in Figure 2.

As you can see in Figure 2, there is a drop-down menu next to the phrase "Typical role of this machine." This lets you choose between three different roles, namely desktop computer, mobile or docking system, and network server. Which one you select has a big effect on how Windows95 treats RAM and disk caching:

- The desktop computer setting reduces disk caching and allocates more RAM for programs.
- The mobile or docking system setting increases disk caching to reduce the amount of power consumed to access the hard drive (this is a big power drain in many notebook PCs).
- The network server sets up the largest cache size and allocates less RAM for programs.

The default setting is desktop computer, and many notebook PCs are shipped with that setting. If you have a notebook PC, you may be able to extend the time between battery recharges by selecting the mobile or docking system setting. If you have a PC with more than 16 megs of RAM, you may be able to increase performance by selecting the network server setting even if your PC is a stand-alone system. (That's what others claim, at least; I haven't been able to notice any change in my PC's performance with this setting.)

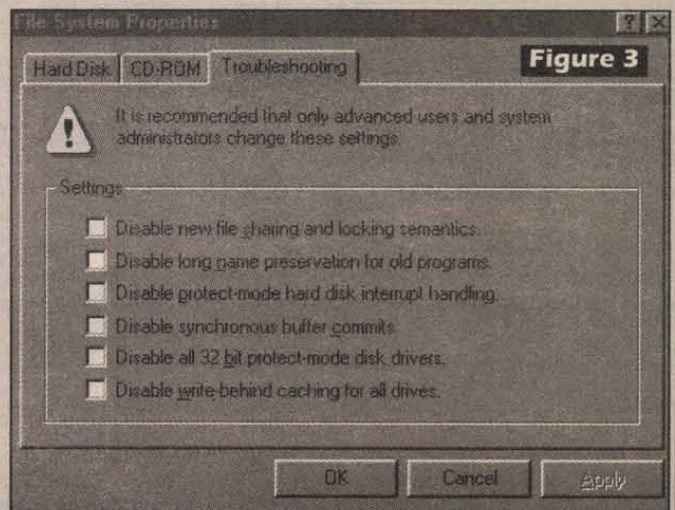
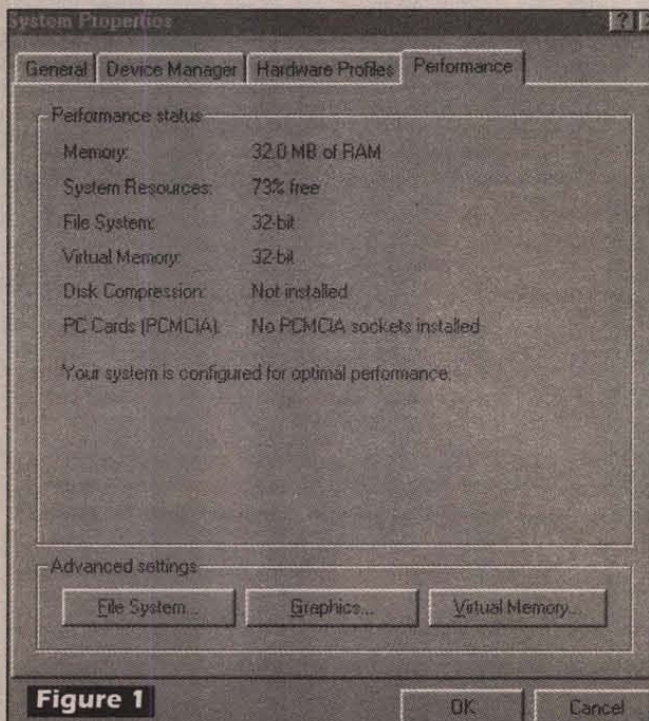
The read-ahead optimization default setting is full. However, if you are running Windows95 on a



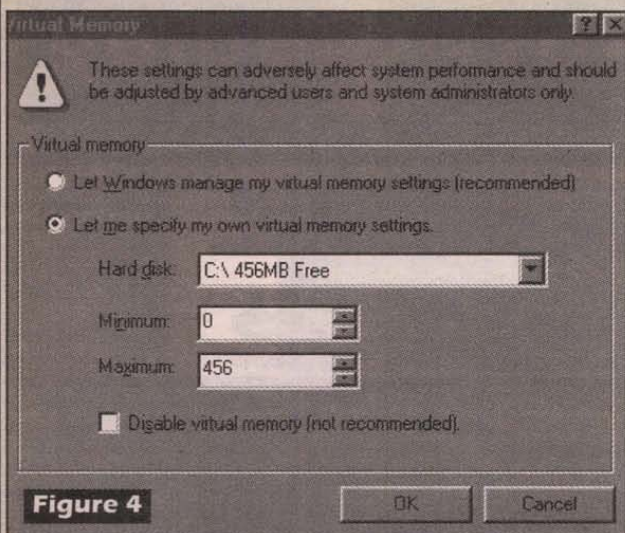
PC with just 8 megs of RAM, you might be able to somewhat improve performance by moving the setting one increment (the vertical lines under the slide bar) to the left.

If you click on the "Troubleshooting" tab of the File System Properties box shown in Figure 2, you'll see the list of selectable settings shown in Figure 3. These settings are not covered in most Windows documentation, but here is a summary of what they mean:

Disable new file sharing and locking semantics — The file share.exe is required by some older MS-DOS programs, but is not included with Windows95. If you have such a MS-DOS program, clicking this box will emulate the share.exe functionality. However, selecting this will cause problems using many other MS-DOS



Software Wizardry



earlier versions of Windows. If you use MS-DOS and 16-bit Windows programs in Windows95, Windows95 attempts to preserve all longer file names. However, some MS-DOS and 16-bit Windows applications may fail as a result. If this box is selected, Windows95 will not attempt to retain longer file names when used with non-Windows95 applications. All longer file names will be truncated to "8.3" format.

Disable protect-mode hard disk interrupt handling — Selecting this box will mean that Windows95 will not be able to intercept interrupts from the hard disk controller and bypass ROM routines that handle the interrupts. This degrades system performance, but may be necessary because most hard disk controllers are IDE-based. IDE is not Plug and Play compatible, and there may be resource conflicts between the hard drive controller and the rest of the system hardware.

Disable synchronous buffer commits — Selecting this means Windows95 will not wait for a signal from the hard drive after a write operation has finished writing buffers to the hard drive. Some specialized Windows95 software will require this box to be checked for proper operation. Unless the software vendor specifically states this box should be checked, however, it should be left blank.

Disable all 32 bit protect-mode disk drivers — Checking this box means that I/O operations to floppy disks are handled using the same 16-bit real-mode drivers used in Windows 3.1. Select this option if you are having trouble getting a 16-bit Windows application to read from or write to a floppy drive.

Disable write-behind caching for all drives — When this box is checked, data will be continuously written to the hard drive during an operation instead of cached. This greatly degrades performance, but can be useful if you are doing troubleshooting or diagnostic work and want to guard against the loss of any data.

Virtual Memory

To increase the amount of memory available to programs, Windows95 swaps data into and from RAM to the PC's hard disk. This process is known as virtual memory and the area on the hard disk used by virtual memory is known as a swap file. Windows 3.1 also supported virtual memory, but required users to specify the size of the swap file,

whether the file was temporary or permanent, etc. Windows95 has the capability of automatically managing the swap file through the

Virtual Memory box shown in Figure 4. To display this, click on the "Virtual Memory" button shown in Figure 1.

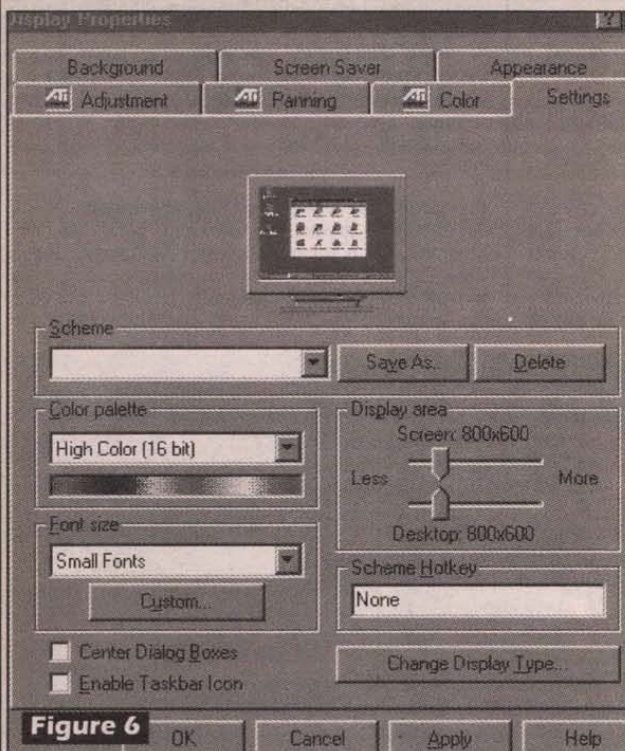
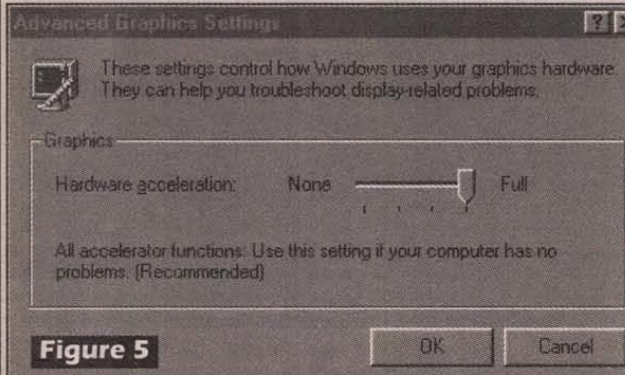
In most cases, the first option — let Windows manage my virtual memory settings (recommended) — is the one that should be selected. However, there may be situations where it is better to determine the settings yourself. For example, if your PC has more than one hard drive, you may want to use just one (usually the fastest or one with the most free space) to hold the swap file. You can do this if you have a large hard drive that holds a second compressed virtual hard drive (for example, my 2.5 gig drive is virtualized as separate C and D hard drives). You can also select this option if you have limited free space on your hard drive and need to set a limit on the maximum size of the swap file.

The last option — Disable virtual memory (not recommended) — is really dangerous. I'm surprised Microsoft didn't hide this option deep within Windows, like they did with the Registry Editor. If this option is selected, Windows95 is limited to just the amount of physical RAM in the PC and cannot use any swap file. In most cases, this means your PC will be completely inoperable. Unless you feel like living dangerously (or want to play a really nasty trick on an annoying co-worker), don't select this option!

Graphics and Video

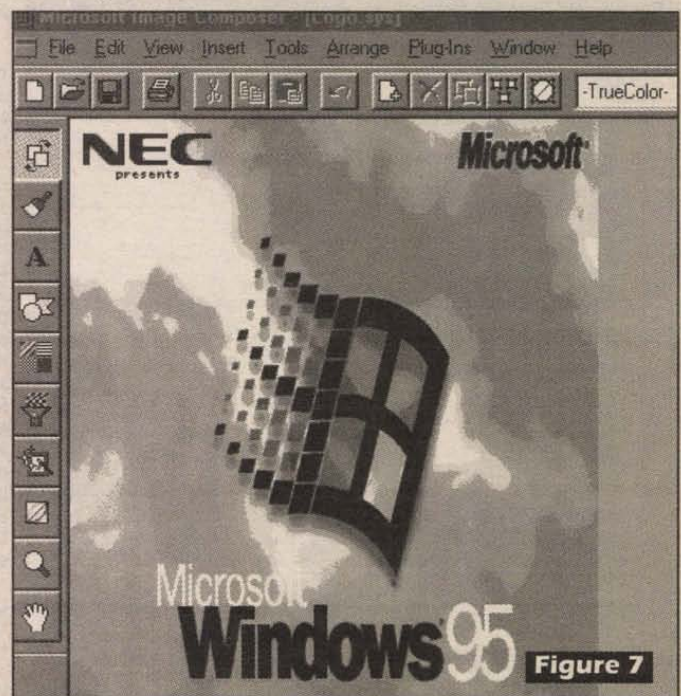
The middle button at the bottom of Figure 1 is labeled Graphics. If you click it, you see the box shown in Figure 5. Most video cards installed in Windows95 PCs have various accelerator functions, such as controlling how rapidly the mouse cursor can change position on your display. Depending on your system, monitor, and video card, you may not be able to fully use all available accelerations.

The slider bar in Figure 5 actually has four discrete positions. The full position is the default position, and means that all available hardware accelerations are used. Unless you are having problems with your display, this is the position you should use. The opposite position, None, means that none of the available hardware accelerations are used. This position should be used only if your display (or PC) is "locking up" or otherwise refusing to work correctly. The usual cause of this situation is using a non-standard video driver that is not supported by Windows95 or the wrong video driver for your



and Windows applications.

Disable long name preservation for old programs — Windows95 lets you use file names longer than the "8.3" format supported by MS-DOS and



Software Wizardry

particular display.

The first position to the left of Full should be used if you are using a pre-1996 video card and are experiencing problems with the mouse pointer on the display. (You might want to physically inspect the video card if this is happening; most of the cards have a controller chip manufactured by Western Digital.) The first position to the right of None should be used only if you are using a non-VGA driver under Windows95 and the display is locking up or otherwise malfunctioning.

Most Windows95 PCs come with the video display settings at the default's values of 256 colors and 640x480 resolution. These are the carry-over defaults from Windows 3.1, however, almost all Windows95 PCs have monitors and video cards capable of greater resolution. For example, the High Color setting supports up to 65,535 colors (depending on the card) and the True Color setting can support up to 16,700,000 colors (again, depending on the video card). The settings available on your PC can be selected by clicking on the Display icon in the Control Panel. Figure 6 shows what you will typically see after clicking the Display icon; the exact number of tabs you will see depends on the type of monitor and video card you use. Selecting the Settings tab will let you see the options shown in Figure 6.

When Windows95 was first introduced, the default setting of 256 colors was still used because system hardware and available memory was usually inadequate to support High Color or True Color. However, most new Windows95 PCs can easily support these enhanced resolutions. The results on images (especially JPEG files) saved as High Color or True Color can be really spectacular compared to 256 colors. In fact, the setting I normally use is High Color; I don't use the 256 color setting unless it is to examine how an image will look when viewed at that setting. Likewise, I normally set my monitor to 800x600 resolution unless I want to test how a Web page will look when viewed at a 640x480 setting.

Of course, there is no "right" or "wrong" setting for these display settings; you can use any combination of colors/resolutions that you like and that your system can support. Just keep in mind that you're not stuck with the default settings!

Cool Opening Screens

Ever get tired of that "Windows95" opening screen with the "clouds in the blue sky" background you see every time you start your PC? Well, you can easily substitute any opening screen you want!

Microsoft has named their opening screen

"logo.sys" and you can find it on the top level of your hard drive; it's a stand-alone file not part of any directory. While this file has a ".sys" attribute, it is just a 256-color bitmap (.BMP) file occupying a 320x400 area. You can open and edit this file using any program, like Paint, that allows you to edit bitmaps. Figure 7 shows the logo.sys file for one of my PCs that I opened with Microsoft's Image Composer, a more versatile graphics program than Paint.

You're not restricted to modifying the existing logo.sys file. You can create any new image, or import a photo, so long as you save it as a 320x400 bitmap with 256 colors. You can create custom opening screens for your business or have your girlfriend's face greet you each time you start your PC.

The one kicker here is that you can't save a bitmap as a .sys file from graphics programs like Paint. You'll have to use the Windows95 command prompt to add the ".sys" extension, since you can't change the file extension to ".sys" in Windows Explorer.

If you decide to use some of these hot-rodding tips, be sure to save your original configuration information or file (like logo.sys) on a floppy before making any changes. You should also have a Windows95 emergency boot disk ready just in case you need it (especially if you're playing around with virtual memory settings!). NV

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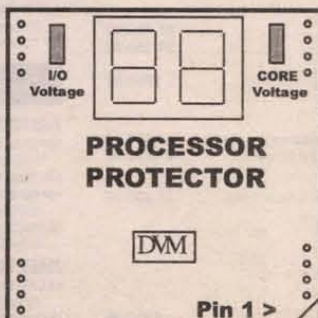
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TEK 7844 . 400 MHz Dual Beam	\$1,250.00
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TEK 7B80 400 MHz Delayed Time Base	\$175.00
TEK 7B85 400 MHz Delta Delaying Time Base	\$175.00
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STORAGE

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TEK 7633 100 MHz Storage Oscilloscope	\$1,000.00
with (2) 7A26, (1) 7B92A	

PROBES

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TEK 1101 Accessory Power Supply, for FET probes	\$250.00
TEK P6101A 34 MHz 1X Modular Probe, 2m length "NEW"	\$25.00
TEK P6108A 100 MHz 10X Modular Probe, 2m length "NEW"	\$50.00
TEK P6201 900 MHz 1X/10X/100X FET Probe	\$450.00
TEK P6202A 500 MHz 10X FET Probe	\$300.00
TEK P6701-opt.02 O/E Converter,	\$675.00
450-1050 nm/0.1 mW: DC-700 MHz, ST conn.	

CALIBRATION

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

WAVEFORM GENERATORS

FUNCTION

HP 3310A 5 MHz Function Generator	\$250.00
HP 3310B 5 MHz Function Generator,	\$325.00
monocycle & var. phase trigger	
KROHN-HITE 2000 30 MHz Function Generator	\$600.00
TEK DD501 Digital Delay & Burst Gen.,	\$275.00
for function & pulse gen's	
TEK FG501 1 MHz Function Generator, TM500 series	\$225.00
TEK FG502 11 MHz Function Generator, TM500 series	\$300.00
TEK FG503 3 MHz Function Generator, TM500 series	\$250.00
TEK RG501 Ramp Generator, TM500 series	\$225.00
WAVETEK 186 5 MHz Phase-Lock Function Generator	\$350.00
WAVETEK 23 12 MHz Synthesized Function Generator	\$1,100.00

PULSE

BERKELEY NUCLEONICS 7085B Digital Delay Generator,	\$900.00
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HP 2148-001 10 MHz Pulse Generator, 50 V/50 ohms,	\$2,000.00
counted burst opt	
HP 8005B 20 MHz Dual Output Pulse Generator	\$450.00
HP 8007B 100 MHz Pulse Generator	\$650.00
HP 8012B 50 MHz Pulse Generator, variable transition time	\$600.00
HP 8013B 50 MHz Dual Output Pulse Generator,	\$600.00
3.5 nS fixed Tr	
HP 8015A 50 MHz Dual Output Pulse Generator	\$700.00
HP 8015A-002,007 50 MHz Dual Output Pulse Gen.,	\$800.00
burst option	
HP 8080A/91A/92A/93A 1 GHz Single Channel Pulse Generator	\$950.00
HP 8111A-001 10 MHz Pulse/Function Generator,	\$1,650.00
burst mode option	
TEK PG501 50 MHz Pulse Generator, TM500 series	\$250.00
TEK PG502 250 MHz Pulse Generator, Tr<1nS,	\$600.00
TM500 series	
TEK PG505 100 kHz Pulse Generator, 80 V peak,	\$275.00
TM500 series	

PROGRAMMABLE

HP 8160A 50 MHz Programmable Pulse Generator, HP1B	\$2,000.00
HP 8165A-002,003 Prog. Signal Source, 1 mHz-50 MHz,	\$2,000.00
log sweep, rear out	
TEK AWG5102 Arb.Waveform Gen., 20 MS/s, 12 bits,	\$1,400.00
50ppm synthesis <1MHz	
TEK AWG5105-opt.02 Arbitrary Waveform Generator,	\$1,900.00
dual channel option	
TEK FG5010 Programmable 20 MHz Function Generator,	\$1,200.00
TM5000 series	
WAVETEK 288 20 MHz Synthesized Function	\$1,250.00
Generator, GPIB	

VOLTAGE & CURRENT

VOLTMETERS

HP 3456A 6-1/2 Digit Voltmeter	\$850.00
KEITHLEY 181 6-1/2 digit Nanovoltmeter,	\$1,200.00
10 nV sensitivity, GPIB	
SOLARTRON 7081 8-1/2 digit Voltmeter	\$3,900.00

CALIBRATION

FLUKE 343A DC Voltage Calibrator, 0-1100 V, 7 decades,	\$950.00
20 ppm acc.	
FLUKE 510A AC Reference Standard, 10 VRMS, 0-10 mA	\$450.00
FLUKE 515A Portable Calibrator, DC/AC/Ohms,	\$1,250.00
line & battery power	
FLUKE 5220A Transconductance Amplifier, DC-5 kHz, 0-20 A	\$3,750.00
FLUKE 720A Kelvin-Variety Voltage Divider, 7 decade	\$2,250.00
FLUKE 731B DC Reference Standard	\$400.00
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120-1200V/10 Hz-1 kHz	

VOLTAGE SOURCES

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

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
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compliance	
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IMPEDANCE & COMPONENT TEST

L.C.R.

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120 Hz/ 1 kHz/ 10 kHz, HP1B	
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0-35 V int. bias	

STANDARDS

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E.S.I. SR1050-10M Resistance Transfer Standard,	\$2,500.00
10 Megohms/step	
E.S.I. SR1050-1M Resistance Transfer	\$2,000.00
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GR 1406 Standard Air Capacitors, GR900 connector, 0.1% acc.	\$375.00
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GR 1432-U 4-Decade Resistor,	\$125.00
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GR 1433-J 4-Decade Resistor,	\$350.00
0-1,110 ohms, 1 ohm resolution	
GR 1433-L 4-Decade Resistor, 0-1,110 ohms,	\$350.00
10 ohm resolution	
GR 1433-N 5-Decade Resistor, 0-1,111 ohms,	\$400.00
0.1 ohm resolution	
GR 1433-Q 4-Decade Resistor, 0-1,111,000 ohm,	\$350.00
100 ohm resolution	
GR 1433-U 4-Decade Resistor, 0-111.0 ohms, 0.01 ohm resolution	\$350.00
GR 1433-X 6-Decade Resistor, to 111,111.0 ohms, 0.1 ohm res.	\$450.00
GR 1434-G 7-Decade Resistor, 0-1,111,111.0 ohms, 0.1 ohm res.	\$300.00
VALHALLA 2724A Programmable Resistance Standard,	\$1,675.00
0-11 Gigaohms, GPIB	

HI & LO RESISTANCE

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HP 4329A High Resistance Meter,	\$1,350.00
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VALHALLA 4150-ATC 4-1/2 digit Ohmmeter, 20 milliohms-	\$750.00
2 kilohms, 4-wire	

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.

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chart recorder	

SINGLE OUTPUT

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20 V 1.5 A / 40 V 0.75 A CV/CC	

HP 6201B 20 V at 1.5A CV/CC Power Supply	\$175.00
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HP 6261B-027 20 V at 50 A CV/CC Power Supply, 208 VAC line	\$675.00
HP 6263B 20 V at 10 A CV/CC Power Supply	\$400.00
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SOERSEN DCR 300-8A 300 V at 8 A CV/CC Power Supply,	\$950.00
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SOERSEN SRL 60-8 60 V at 8 A CV/CC Power Supply, low noise	\$750.00
TEK PSS01-1 Power Supply, 0-20 V, 2 mV res., 400 mA,	\$175.00
TM500 series	

MULTIPLE OUTPUT

HP 6237B Triple Output Power Supply, +/-20 V 0.5 A, +18 V 1 A	\$550.00
HP 6253A Dual Output 20 V 3 A CV/CC Power Supply	\$550.00
TEK PSS010 Programmable Triple Power Supply, TM5000 series	\$750.00
TEK PSS03A Dual Power Supply, TM500 series	\$200.00

MISCELLANEOUS

ACME PS2L-500 Programmable Load,	\$400.00
0-75 V / 0-75 A / 500 Watts max.	
HP 59501B HP1B Isolated DAC/Power Supply Programmer	\$175.00
KEPCO BOP 100-4M Bipolar Supply / Amplifier, 0-100 V, 0-4 A	\$1,000.00
TRANSISTOR DEVICES DAL-50-15-100 Programmable Load,	\$200.00
0-50 V, 0-15 A, 100 Watts max.	

TIME & FREQUENCY

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HP 5315A-002,003 100 MHz/100 nS Univ. Counter,	\$750.00
battery power, 1 GHz C-ch	
HP 5315B 100 MHz/ 100 nS Universal Counter	\$600.00
HP 5316A 100 MHz/100 nS Universal Counter, HP1B	\$700.00
HP 5316A-003 100 MHz/100 nS Universal Counter,	\$850.00
1 GHz C-channel, HP1B	
HP 5316A-003,006 100 MHz/100 nS Counter, 1 GHz C-ch,	\$1,000.00
offset/normalize	
HP 5316B 100 MHz/ 100 nS Universal Counter, HP1B	\$1,000.00
HP 5334A 100 MHz Universal Counter, HP1B	\$875.00
HP 5334B-010,060 100 MHz Universal Counter, HP1B, OCXO	\$1,000.00
HP 5335A 200 MHz Universal / Statistical Counter	\$1,200.00
RACAL 1996 200 MHz/1 nS Universal Counter,	\$1,000.00
1.3 GHz C-channel	
RACAL-DANA 1992-04 100 MHz/1 nS Univ. Counter,	\$750.00
1.3 GHz C-channel, OCXO	
TEK DC5004 Programmable 100 MHz/100nS Counter/Timer,	\$250.00
TM5000 series	
TEK DC5009 Programmable 135 MHz Univ. Counter/Timer,	\$500.00
TM5000 series	
TEK DC503A 125 MHz Universal Counter/Timer, TM500 series	\$350.00

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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
HP 652A Test Oscillator, 10 Hz-10 MHz	\$250.00
TEK SG5010 Programmable Oscillator, 10 Hz-163.8 kHz, TM5000 series	\$2,750.00
TEK SG502 Sine/Square Osc., 5 Hz-500 kHz, 70 dB step atten., TM500	\$200.00

MISCELLANEOUS

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, 61/21/24 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 11970A WR28 Harmonic Mixer, 26.5-40 GHz	\$1,100.00
HP 11970Q WR22 Harmonic Mixer, 33-50 GHz	\$1,400.00
HP 11971A WR28 Harmonic Mixer, 26.5-40.0 GHz, for 8569B	\$1,100.00
HP 11971K WR42 Harmonic Mixer, 18.0-26.5 GHz, for 8569B	\$1,100.00
HP 8406A Comb Generator, 1/10/100 MHz increments, to 5 GHz	\$450.00
HP 8444A-059 Tracking Generator, 0.5-1500 MHz, for 8554, 8568, etc.	\$1,250.00
HP 8445B Preselector, 1.8-18.0 GHz, for HP 8555A	\$650.00
HP 8565A Spectrum Analyzer, 10 MHz-22 GHz, 1 kHz min.res.bw.	\$4,500.00
HP 8565A-100 Spectrum Analyzer, 10 MHz-22 GHz, 100 Hz min.res.bw.	\$5,000.00
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 TR503 Tracking Generator, 0.1-1800 MHz, for 492/4/5/6	\$1,375.00
TEK WM782V WR15 Harmonic Mixer, 50-75 GHz	\$2,000.00

NETWORK ANALYZERS

HP 11664C Detector Adapter, for 8755/6/7	\$200.00
HP 11666A Reflectometer Bridge, 0.04-18.0 GHz, for HP 8755/6/7	\$1,100.00
HP 8505A Network Analyzer, 0.5-1300 MHz	\$3,750.00
HP 8755C(3) 11664A/182T Scalar Network An. w/3 detectors, 10 MHz-18 GHz & frame	\$1,750.00
HP 8756A(3) 11664A Scalar Network Analyzer, w/(3) detectors, 0.01-18 GHz	\$3,750.00
WAVETEK 1038D14A/H12V13x2 Scalar Network An, w/(3) 15882 WR28 detectors, 26.5-40 GHz	\$2,200.00

SIGNAL GENERATORS

FLUKE 6060A/AN Synthesized Signal Gen., 10 kHz-520 MHz, 10 Hz res., GPIB	\$2,000.00
FLUKE 6070A Synthesized Signal Generator, 0.2-520 MHz, 1 Hz res.	\$2,000.00
GIGATRONICS 600/10-18 Synthesized Source, 10-18 GHz, 1 kHz res., GPIB	\$2,600.00
GIGATRONICS 605/10-18 Synthesized Source, 10-18 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, opt.16, 14.16 Synthesized Source/Sweeper, 12-18 GHz, 1 Hz res., OCXO	\$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-001,002,003 Signal Gen., 0.5-1024 MHz, AM, FM, var. audio osc.	\$2,500.00
HP 8654A Signal Generator, 10-520 MHz, calibrated AM & uncal. FM	\$550.00
HP 8656A Signal Generator, 0.1-990 MHz, 100 Hz res, AM, FM, HPIB	\$2,900.00
HP 8660C/86603A-002 Synth. Sig. Gen., 1-2600 MHz, FM / Phase mod. w/86635A	\$4,500.00
HP 8671A-005 Synthesized CW Generator, 2.0-6.2 GHz, 1 kHz res., HPIB	\$6,000.00
ROHDE & SCHWARTZ SMGU Synthesized Signal Generator, 0.1-2160 MHz, 0.1 Hz res.	\$12,000.00

SWEEP GENERATORS

HP 8600A Digital Marker, for HP 8601A	\$400.00
HP 8601A Generator/Sweeper, 0.1-110 MHz, +20 dBm levelled	\$400.00
HP 8620C Sweep Oscillator Frame	\$550.00
HP 8620C-011 Sweep Oscillator Frame, HPIB programmable	\$675.00
HP 86222A-002 RF Plug-in, 10-2400 MHz, +13 dBm levelled, 70 dB atten.	\$1,600.00

HP 86230B RF Plug-in, 1.8-4.2 GHz, +10 dBm unlevelled	\$675.00
HP 86241A-001 RF Plug-in, 3.2-6.5 GHz, +8 dBm levelled	\$500.00
HP 86242D-004,008 RF Plug-in, 5.9-9.0 GHz, +10 dBm levelled	\$500.00
HP 86245A RF Plug-in, 5.9-12.4 GHz, +16 dBm levelled	\$1,100.00
HP 86250D RF Plug-in, 8.0-12.4 GHz, +10 dBm levelled	\$675.00
HP 86260A RF Plug-in, 12.0-18.0 GHz, +10 dBm unlevelled	\$800.00
HP 86260A-H04 RF Plug-in, 10.0-15.0 GHz, +10 dBm unlevelled	\$800.00
HP 86290A RF Plug-in, 2.0-18.0 GHz, +7 dBm levelled	\$1,750.00
HP 86290C RF Plug-in, 2.0-18.6 GHz, +13 dBm levelled	\$2,500.00
WAVETEK 962 Sweep Generator, 1.0-4.0 GHz, markers, +12 dBm unlvld.	\$1,750.00

POWER METERS

ANRITSU MP-81B/ML-83A Power Meter, 75-110 GHz (WR10), -20 to +20 dBm	\$2,500.00
ANRITSU MP-82B/ML-83A Power Meter, 90-140 GHz (WR8), -20 to +20 dBm	\$3,250.00
BOONTON 4200-01A,03&-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-18 GHz sensor	\$500.00
GENERAL MICROWAVE 476/4240A Power Meter & Sensor, 0.01-18 GHz, -35 to +10 dBm	\$375.00
HP 435A/8481A Power Meter, 10 MHz-18 GHz, -30 to +20 dBm	\$1,000.00
HP 435A/8482A Power Meter, 100 kHz-4.2 GHz, -30 to +20 dBm	\$1,000.00
HP 435A/8482B Power Meter, 0.1-4200 MHz, -15 to +34 dBm	\$1,150.00
HP 4486A WR42 Thermistor Mount, 18.0-26.5 GHz, for 432 series	\$350.00
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

BOONTON 9200A-01 RF Millivoltmeter, 10 kHz-1.2 GHz, GPIB	\$900.00
BOONTON 92B-opt.05 RF Millivoltmeter, 10 kHz-1.2 GHz, 75 ohm scale	\$500.00
RACAL 9303 TRMS Level Meter, 10 kHz-2 GHz, -77 to +23 dBm, GPIB	\$875.00

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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	\$3,750.00
HP 8901B-001 Modulation Analyzer, 150 kHz-1300 MHz, rear panel input	\$6,750.00
HUGHES 11770H1F000 TWT Amplifier, 20 Watts output, 1.4-2.4 GHz	\$1,750.00
M.P.D. LAB2-1020-2A Amplifier, 34 dB, 1.0-2.0 GHz, 2 Watts	\$800.00
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HP 8470B-012 Crystal Detector, 10 MHz-18 GHz, neg. pol., N(m)	\$250.00
HP 8491A-030 30 dB Attenuator, DC-12.4 GHz, 2 Watts, N(m/f)	\$50.00
HP 8494C-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 WR42 Flat Broadband Detector, 18.0-26.5 GHz	\$350.00
HP K532A WR42 Frequency Meter, 18.0-26.5 GHz	\$500.00
HP K870A WR42 Slide Screw Tuner, 18.0-26.5 GHz	\$275.00
HP K914B WR42 Moving Load, 18.0-26.5 GHz	\$425.00
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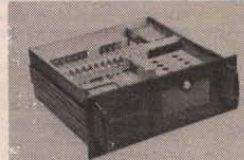
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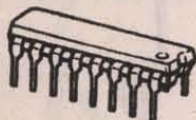
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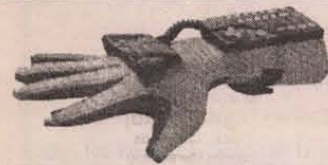
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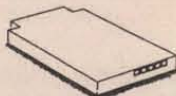
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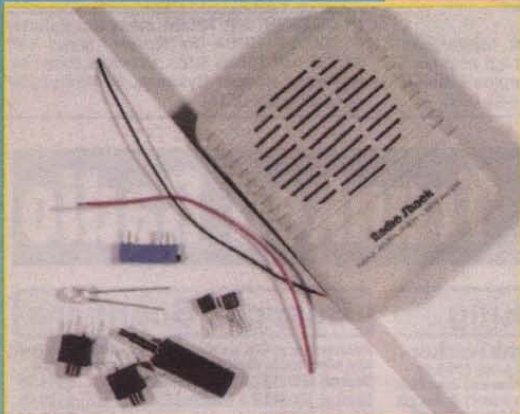


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The Universal Laser Receiver and Decoder

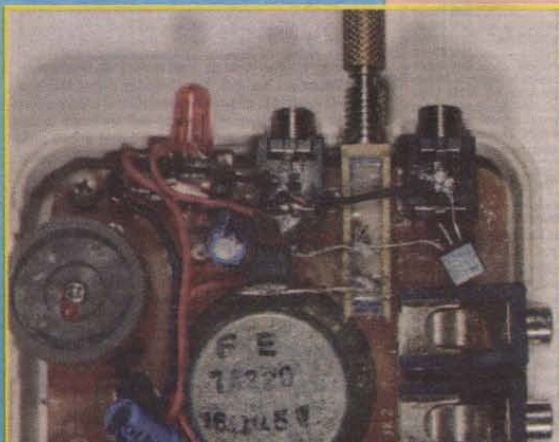
by Zachary Scott



The components needed for this project are easy to get and inexpensive: a mini amplifier, two audio jacks, two transistors, a potentiometer, and an LED. See text for specifics.



As you fit the jacks and trimmer, you will note a jumper wire that will need to be moved to the trace side of the board.



This is tight work, but once mounted, the components will fit neatly and snugly. Note that R-1 can be used with or without a panel adapter. Cut leads for short, direct connections and keep a low profile.

If there is one thing that every laser hobbyist or experimenter needs, it would be a laser light receiver that could decode or demodulate a beam. Something that would allow the user to do much more than simply put red spots on the wall.

use it on your bench, or from out of your shirt pocket in the field.

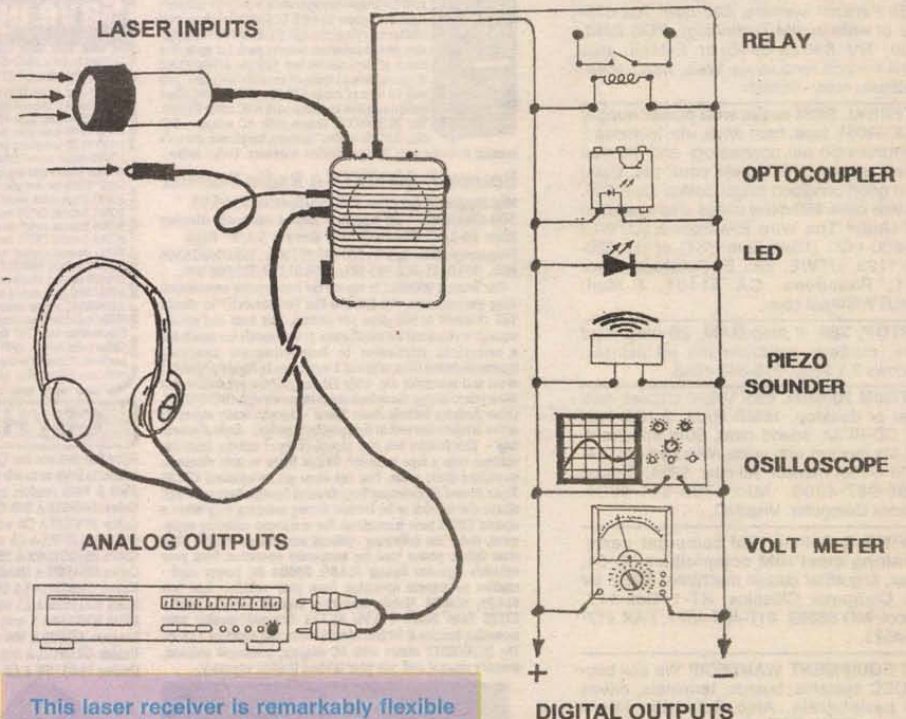
The good news is that anyone can build one of these without a shoebox full of exotic semiconductors and custom cut PC boards. All you need is a pocket amp, two transistors, three audio connectors, a

A description of how to build a broad-based laser light receiver and decoder.

This project is just the ticket to get you into new experimental laser projects. It is a small, inexpensive, and easy-to-build light receiver/decoder that will work with analog or digital laser signals. It also has outputs that let you interface with anything from headphones to computers. Its dual power supply and small size let you

potentiometer, and an LED. Best of all, you can build this hybrid laser receiver for less than \$20.00. Let's first cover the parts you'll need, then discuss how to assemble them.

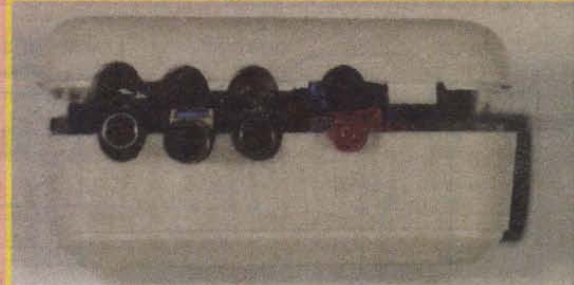
The base of this project is built into, and onto, a handheld, battery powered, test amplifier (often called a "pocket amp" or "mini amp"). These little amplifiers are often used by audio technicians and repairmen in



This laser receiver is remarkably flexible and can be interfaced with a wide range of semiconductors or external apparatus. It is limited only to your imagination.



The digital input and output will provide a binary signal that can be interfaced with computers, oscilloscopes, counters, or a wide variety of other devices such as relays or optocouplers. This receiver is so sensitive, it will produce a high/low pulse code derived from the laser reflection from a piece of paper ... the basics of a bar code reader.



Mounting the jacks and trimmer pot will require half holes to be cut into the front and back halves of the case to allow the ports to extend to the outside.

tracking an audio signal on a circuit board.

Most technicians have built their own from a 741 op-amp, or audio amp IC. But if you look around, you can find a test amplifier, built and ready to go, for less than the time and cost of building it from scratch. While there are dozens to pick from, we selected a Radio Shack Mini Amplifier Speaker (Catalog #277-1008) because it is easy for most people to get their hands on, and it is fairly inexpensive. You can substitute any similar amp in place of this one if you prefer.

A mini amp, all by itself, makes a very good analog laser demodulator if you connect the right components to the input jack. However, many laser tasks are done in a digital, binary, or pulse mode, and a mini amp won't do much good.

To convert a manipulated laser beam into a useful pulsing signal, you'll need to build a separate circuit and add it to the amp. This is very easy to do and you'll only need a few additional components.

You'll need two transistors. The exact part numbers are not critical because you will be using them in a basic "push-pull" switching circuit. You can use almost any generic transistor so long as you stay small (TO-92 case) and it can handle a current of 100 to 300 mA. The transistors used in our prototype were a C1740 (NPN Q1), and an A1015 (PNP Q2), salvaged from the circuit board of a trashed facsimile machine.

If you would rather, you can go to an electronics shop and purchase a matched (complementary) pair of switching transistors, but the price will be notably higher.

You'll need to find a couple of plastic enclosed 3.5mm, two-conductor, panel mount jacks (seen on the schematic as J-1 and J-2). J-2 will need to be NC switched. Most of the time you can find these in blister packs of one or two at almost any electronics supply store. Make sure you get the smallest version you can find.

R1 is a one megohm, multi-turn, linear, PC mount trimmer potentiometer. In this circuit, it functions as a bias adjustment between Q-1 and Q-2, letting you select a trigger and sensitivity point. Its size and shape will fit nicely into this particular pro-

ject. You can get this pot with or without a panel mount adapter. If you do not use an adapter, you will need to adjust the bias with a small screwdriver.

If you do use an adapter, you can then attach to it a small knob that allows you to adjust the bias with your fingers. We used a panel adapter on the one shown in this article, but keep in mind

that a panel adapter for R1 is optional.

In order for this receiver to work, you'll need to get your hands on a special LED. Typically sold under the name "Super Bright LED," you will not use this diode for what it was intended. Instead of putting out a red light, you are going to wire it up backwards and use it to receive red light.

If you are unacquainted with the dynamics of LEDs, it could be news to you that certain LEDs make fantastic laser light receivers.

The material used in this special diode is aluminum gallium arsenide (AlGaAs), the same stuff used in laser diodes. AlGaAs is very responsive to light waves between 620 and 675 nanometers (red), but is nearly blind to all other wavelengths. Further, its water-clear lens offers an incredibly tight and powerful light collection focus, often eliminating the need for additional and expensive lenses and optics.

When hit by a red laser, this diode will respond like a very high-speed solar battery, and it can pump out a voltage of up to 1.4 volts.

Begin the modification by first removing the back cover of the mini amp, and removing the circuit board. To reduce awkwardness, disconnect the speaker wires at the speaker so that you can separate the board from the case.

Find the jumper wire at the top of the PC board as shown in the illustrations. You will need to remove this jumper and replace it on the trace side of the board with an insulated wire to make room for the jacks and resistor that will be mounted on the component side. While you have the board out and open, you should connect 3" to 4" long power tap wires to the circuit.

Pick up a positive tap at the adapter jack common point, and a negative tap at the switched side of the volume control. (The thumb wheel control is also a power switch.)

Run the power tap wires through



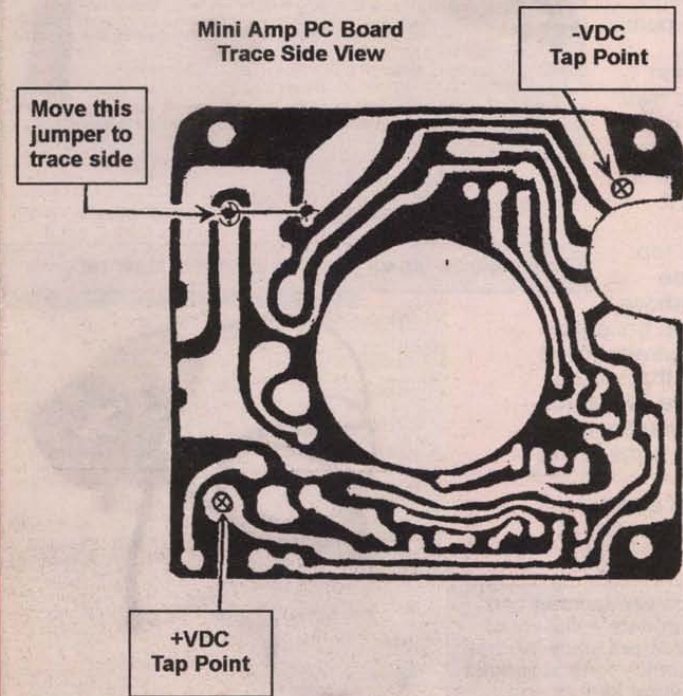
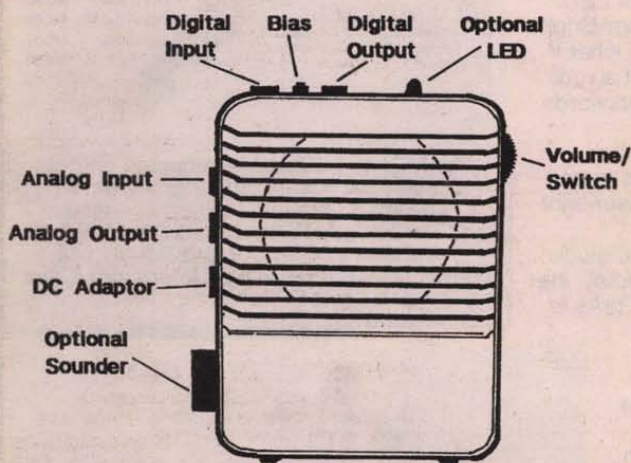
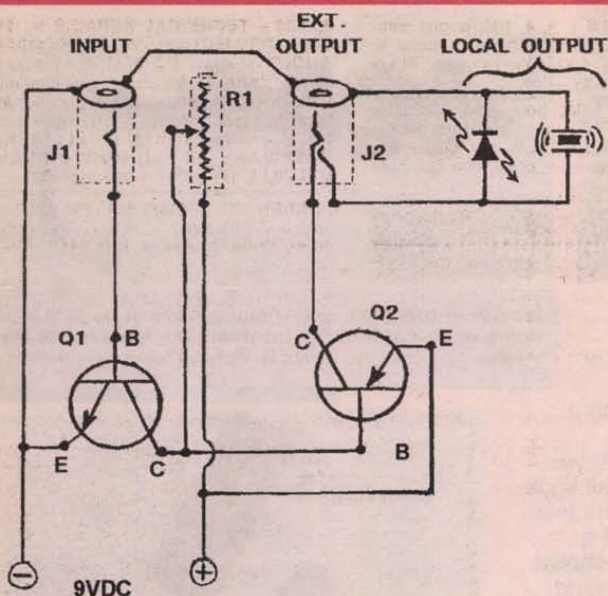
The AlGaAs LED can be mounted entirely inside the 3.5mm plug. The anode is connected to the tip (center) connector, and the cathode to the shield. A small piece of shrink tube over the LED body will restrict unwanted side light interference, and a tighter receiving angle.



The one-size-fits-all (almost) universal laser receiver.



The receiver/decoder can accommodate a variety of photo collectors, allowing free air communications at ranges of several kilometers.



If you are having trouble finding the items used in this article, you can mail order them from Mouser Electronics as listed below, with their warehouse part number. The phone number is 1-800-346-6873 for orders.

PART	DESCRIPTION	MOUSER STOCK NO.
Q1	NPN transistor/TO-92/si	526-NTE85
Q2	PNP transistor/TO-92/si	526-NTE2908
R1	Multi-Turn/1 meg/PC mount pot	594-43P105
PM	Panel mount adapter	594-613
LED	AlGaAs light emitting diode/T13/4	512MV8114
J1	3.5mm plastic enclosed panel jack	16PJ135
J2	Same as J1	Same as J1
P1	3.5mm two-conductor plug/black	17PP095

the speaker hole, and replace the PC board into the case. Screw down the board, and position J-1, J-2, and R1 into the area where they will be mounted.

It becomes quickly obvious that the case will need to be cut to accommodate the parts. What you will need to do is mark the case, and cut half-holes to allow the jack ports to extend through the case, and to drop flatly against the PC board.

There are all sorts of tools that you can use to cut half-holes into plastic, but we do not recommend a chain saw. This work requires a gentle touch and patience. The best cutting tool for this job is a Dremel Moto-Tool with a fine router bit. But, you can get the job done just as well with a sharp-tipped razor blade and a rat-tail file.

If you don't have a rat-tail file, you can make one with a small drill bit by wrapping it with one or two turns of 220 sandpaper. To be safe and to avoid possible damage to the board, remove it from the case prior to cutting or filing. Both the front and back plastic cover will need cutting.

Once the mounting holes are finished, and the parts sit flush with the circuit board, study the schematic to see how to wire this circuit. Set J-1, J-2, and R-1 into place flat against the PC board with the connection pins in an up or outward position for easy soldering tip access. Then hard mount the parts into permanent place with a very small drop of Super Glue™.

Don't get carried away with this stuff. Super Glue, used in excess, will go a very long way and run into places you don't want it, messing up the whole project.

The next step is to install the transistors and power taps as shown in the schematics. Because of the tight area, all connections will be point-to-point work and you'll need a jumper wire to connect the ground points.

You'll get your DC power from the two power tap wires installed earlier. The "local outputs" are optional and can be whatever you want, wherever you want it. A piezo sounder is a good choice of local alert, and it can be attached anywhere on the case with two wires.

The AlGaAs diode shown in this project is specific to red light and especially red laser frequencies. It offers powerful photon collection, and can respond to a direct laser hit several hundred feet away. If you would rather have a receiver that works in the infrared range, you will need to use a different diode, specific to 800 to 900 nanometers.

You can make a clever little collector using a 3.5mm, two-conductor plug and a plastic screw down case. The scheme is shown in the accompanying illustrations. The anode connects to the center pin, and the cathode connects to the shield. A small piece of shrink tube around the diode helps to stop side light interference, and tightens its viewing angle to just a few degrees. It will work very nicely in either the analog or digital input jacks.

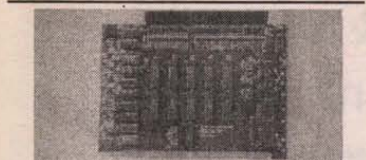
The range of this receiver is directly contingent on how efficiently the collector works. You need to think of laser collectors in the same way you would look at a radio antenna. If you want to pull in a station from a great distance, you will need a good, well-tuned radio antenna. Likewise, if you want to pull in a weak laser signal, you will need a good, well-tuned laser wave collector. It's only a matter of nomenclature. A photon collector IS an antenna. They do the same thing.

Once you have finished this receiver, you will need to take time to work with it and become acquainted with its operation and subtleties. For the beginning laser lover, the casual laser hobbyist, or the high school physics teacher with a red laser pointer pen or helium neon laser tube on their hands, this is a great thing to have around.

Have fun, good luck, and enjoy. **NV**

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L1MW-1 KIT \$49.95

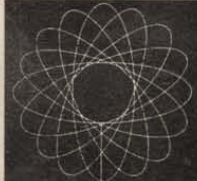
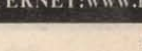
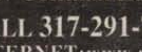
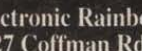
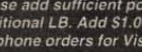
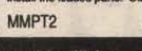
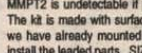
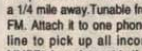
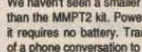
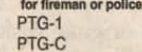
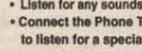
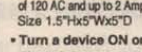
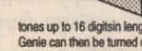
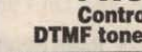
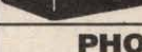
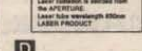
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MM-2 KIT \$34.95

D Deluxe Case

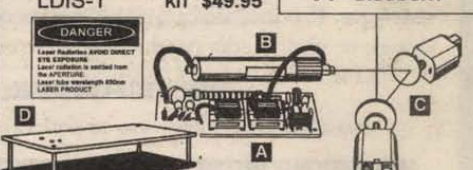
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PTG-C Case \$12.95

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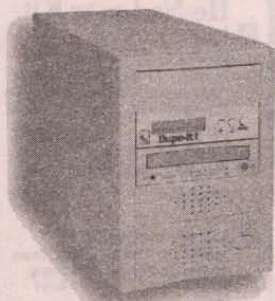
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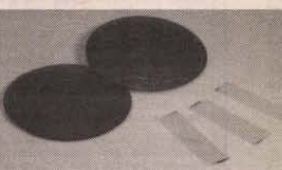
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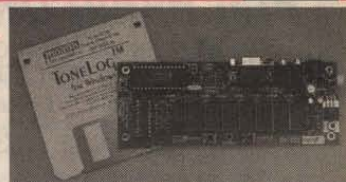
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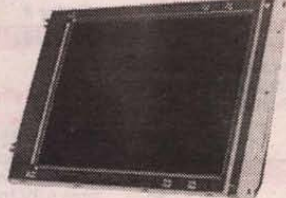
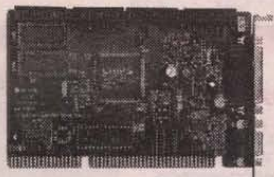
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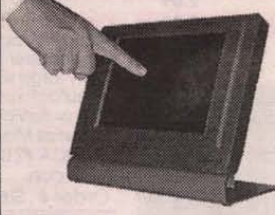
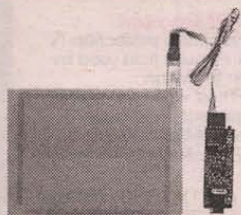
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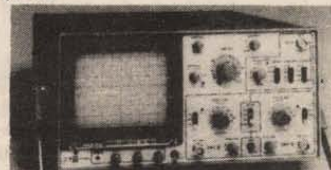
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This article explains the concepts and controversy behind data encryption and provides an encryption program that you can personalize for your own use.

Data Encryption:

Why the Controversy?

by Jeff Stefan

Data encryption has been around in one form or another since mankind started to communicate. When I first think of data encryption, I think of spies decoding secret messages in gray Eastern European alleys, or kids with secret decoder rings deciphering messages on cereal boxes. This outlook, of course, is blatantly naive.

As we evolve toward an information-based economy, more and more of our everyday communications and business affairs are conducted electronically. Millions of financial transactions ranging from Wall Street to the ATM at the corner 7-11 are performed electronically, every day.

This data is exposed to the outside world and needs to be encrypted to preserve privacy and to prevent theft.

The cryptographer's universe was once confined to government intelligence

and many. There is a one-to-one correspondence to the number of letters in a word. Spaces are not hidden, and numbers are not accounted for. The same letter is consistently substituted for the original letter.

In order to attack a cipher like this, start looking for frequently used letters that occur in more than one word. These are usually vowels. The letter d occurs four times, so it probably stands for a vowel.

Look for short words, such as zh and dw. These are usually words like "it," "at," "to," "we," etc. Let's say we pick "dw" to be the word "at" (lucky guess). We assume that d stands for a, and w stands for t. Substituting, the encrypted phrase is now "zh attafn at gazq." This gets us a little closer to the plaintext.

Another way to crack this cipher, after picking "dw" to be the word "at," is to discover that 'd' is three positions

world for financial transactions. It uses 64-bit blocks of data encrypted with 56-bit keys. DES is not an unbreakable code and, with the sufficient computer hardware and brainpower, DES can be broken.

DES is still quite strong enough to keep random hackers and criminals at bay, and should probably be in use for some time to come. Again, the problem with private key encryption is that both parties must have access to the secret encryption key.

The key must be carried to the receiving site by courier or be transmitted over a secure channel. This is the classic private key encryption problem.

How is this problem eliminated? By making the encryption key available to anyone who wants it. That's the driving principle

behind public key encryption.

Public Key Encryption

Public key encryption is brilliant to the core. Instead of using one secret key to encrypt a message, a public key is published that anyone can have access to. If someone wants to send you an encrypted message, they get the public key, encrypt the message, and send it to you. To decrypt the message, you (and only you) have a private key that allows you to extract the original message. This is classified as an asymmetric key algorithm.

It's very difficult, if not impossible, to derive a private key from a public key, and vice versa. Public key encryption was first conceived in 1975 by Whitfield Diffie, a 1960's MIT computer scientist, working with Martin Hellman from

Caesar's Alphabet

1

char CaesarAlphabet [26] =

```
{ 'a','b','c','d','e','f','g','h','i','j','k','l','m','n','o','p','q','r','s','t','u','v','w','x','y','z',
  'd','e','f','g','h','i','j','k','l','m','n','o','p','q','r','s','t','u','v','w','x','y','z','a','b','c' };
```

agencies and the dusty halls of a few university mathematics departments. All of this changed with the invention of two things: the personal computer and public key cryptography. The secret world of data encryption has exploded into the public arena and is now in the hands of the everyday computer user.

Some of the encryption methods are easily cracked, and some are considered impossible to break. The once-exclusive academic/government realm of creating and using unbreakable codes is now within the reach of anyone owning a personal computer. This article shows you how these encryption algorithms work.

Data encryption, like any other scientific or mathematical offshoot, has its own peculiar terminology. See the sidebar Cryptographic Terminology for a definition of some of the terms.

Caesar's Alphabet

One of the earliest and simplest encryption techniques, invented by Julius Caesar, is called Caesar's Alphabet. This is a primitive letter substitution cipher. Caesar's Alphabet substitutes D for the letter A, E for the letter B, and so on. This encoding method is easily expressed in C as a two dimensional array, as shown in Figure 1. We can call this array a key table.

The phrase, "we attack at dawn" encoded using Caesar's Alphabet comes out as "zh dwdfn dw gdzq." The flaws in this encryption method are obvious

away from 'a,' and 'w' is three positions away from 't.' This numerical consistency is a dead giveaway.

The Caesar's Alphabet method of encrypting data is not all bad, though. A more effective approach is to encrypt the entire ASCII character set. Instead of using a fixed substitution offset, a varying offset can be used.

Say that every fourth byte, a new letter will be used to replace the original letter, then every seventh byte, another new letter will be used, and so on. This makes the Caesar's Alphabet method considerably more difficult to crack. This is how the pair of encryption/decryption programs presented in this article work.

The worst problem with this type of encryption technique is that the sending and receiving party must have access to the key table. The key table must be carried to the receiver by hand or transmitted over a secure communications channel. This is called Private Key Encryption, and the key transmission problem is centuries old.

Private Key Encryption

Private Key Encryption is where the sending and receiving parties know the same private key. This is classified as a symmetric key algorithm. One effective and powerful private key algorithm, developed in the 1970s at IBM, is called DES (Data Encryption Standard). DES is so powerful, it was made a standard by the U.S. Government.

DES is used heavily throughout the

Character Encryption Code Fragment

```
// Key table data structure
#define NUM_KEYS 4
int KeyTbl[NUM_KEYS] = { 0x04, 0x02, 0x06, 0x01 };

// Encrypt character using the rotating key formula
c = ( c + Key ) % 0xff;

// Increment the character counter
Count += 1;

// Rotate key depending on count
switch ( Count )
{
    case 0x02 :
        Key = KeyTbl[1]; // Key value is 2
        break;
    case 0x03 :
        Key = KeyTbl[2]; // Key value is 6
        break;
    case 0x05 :
        Key = KeyTbl[3]; // Key value is 1
        break;
    case 0x07 :
        Key = KeyTbl[0]; // Key value is 4
        break;
    default:
        break;
}
```

2

Plaintext

Four score and seven years ago our fathers brought forth on this continent a new nation, conceived in liberty and dedicated to the proposition that all men are created equal.

3

Encrypted Text

Jswx&tdsv&goe\$wg|ko!}icxy!bks"u{sljevnkst\$ftu{hix\$shuxui\$sp&zijw\$"\$□□dprxktkou\$e"tkx!revouo-\$gqtifzif&oo!pmdkxuz\$epj&efhmegzfe\$zq&zif\$□□y

Stanford University.

In 1977, three MIT scientists — Ron Rivest, Adi Shamir, and Leonard Adleman — further refined the Diffie-Hellman concept and came up with a set of working public key algorithms. This set of public key algorithms is called RSA, named after the founders. Although patented, the RSA algorithms are widely published.

Here's how the RSA algorithms work. There are two functions, E and D, that encrypt and decrypt messages. E encrypts a message using a public key pair, and D decrypts a message using a private key pair. The public key pair is (e,n), and the private key pair is (d,n). C is the encrypted message, m is the plaintext message, and n is the product of two prime numbers. The number e is the public key, and d is the private key. The trick is to calculate e and d so they work effectively together.

The E and D functions are expressed as:

$E(m) = m^e \text{ mod } n = C$, where C is the encrypted message.

$D(C) = C^d \text{ mod } n = m$, where m is the original message.

These are the steps required to encrypt and decrypt a message:

Step 1: Pick two prime numbers, p and q. For strong encryption, very large prime numbers must be used.

Step 2: Multiply p and q together to

produce a new non-prime number n.

Step 3: Choose a random integer d that is relatively prime to $(p-1) * (q-1)$. Again, for strong encryption, this number must be very large. This will be the private key. The number d must satisfy $\text{GCD}[d, (p-1) * (q-1)] = 1$. This is the mathematical criteria for relative primes. This just means that d and the number produced by $(p-1) * (q-1)$ can only have 1 as a common factor.

Step 4: Find the number e, the public key. e must satisfy the equation:

$$e * d \text{ mod } (p-1) * (q-1) = 1.$$

The sender can now use $E(m) = m^e \text{ mod } n = C$ to encrypt and send a message, and the receiver uses $D(C) = C^d \text{ mod } n = m$ to decrypt the message.

Here's a concrete example:

Step 1: Pick two primes, p and q. We'll pick p = 5 and q = 7 for our example. In the real world, massive primes are used.

Step 2: Our new non-prime number n is $5 * 7 = 35$.

Step 3: We need to choose a number d that is a relative prime to $(p-1) * (q-1)$.

$$(p-1) * (q-1) = (5-1) * (7-1) = 4 * 6 = 24.$$

A number that is relatively prime to another number means that the only common factor between the two num-

bers is 1.

That's what the expression $\text{GCD}[d, (p-1) * (q-1)] = 1$ is all about. A good candidate is the number 11, so we'll set d = 11.

Step 4: Find the number e, the public key. e must satisfy the equation $e * d \text{ mod } (p-1) * (q-1) = 1$. We can also use 11 for e. If d = 11, and $(p-1) * (q-1) = 24$, then $11 * 11 \text{ mod } 24 = 1$.

Our public key e is 11, and our private key d is also 11. The mod number n is 35. We now have all of the numbers required to encrypt a message using the E and D functions. Let's say that we want to encrypt the number 5. We need to run it through the E function,

$E(5) = 5^{11} \text{ mod } 35 = 10$. To decrypt the message, we need to run it through the D function, $D(10) = 10^{11} \text{ mod } 35 = 5$, which returns the original value. This encryption method is generally believed to be unbreakable.

PGP, which stands for Pretty Good Privacy, is a popular public key encryption program that is used extensively on personal computers. Pretty Good Privacy is based on the RSA algorithms, and is available from many web sites.

Encryption and the Government

The government is understandably worried about the proliferation of public key encryption. Consider the govern-

ment's point of view. Their once exclusive and secret cryptographic domain has almost instantly evaporated.

Sure, they can be relatively sure that encrypted messages can be transmitted and received unmolested, but so can everyone else's messages! Secure telephones can be made truly secure, as well as disk files and E-Mail. The private citizen now has access to nearly the same level of encryption technology that the government has.

The government's initial reaction to this dilemma was the production and promotion of the Clipper Chip.

The Clipper Chip works with secure telephones. The initial government proposal was this: you can encrypt your conversations all you want, as long as you use the Clipper Chip and register the encryption keys with the government.

If a government law enforcement agency feels there is sufficient cause to listen in on a conversation, it gets a court order to use the keys held in "escrow" by the Department of Commerce and the Treasury Department.

Using the two keys, along with the data that the Clipper Chip in the secure telephone provides, a government agency can perform a high-tech wiretap on a secure phone. The Clipper Chip proposal was not well received by industry, let alone the general public. See the sidebar "The Clipper Chip" for a further explanation of Clipper Chip technology.

The Encrypt and Decrypt Programs

The programs encrypt.c and decrypt.c are based on the Caesar's Alphabet method of encrypting data, with the addition of a rotating key. The substitution offset (distance from one letter to another) and the substitution letter is changed on a rotating basis. This is

```

/*-----
* Filename: encrypt.c
* Description: Encrypts a file based on Caesar's Alphabet
using
the formula c = (c + Key) % 0xff. This is the
companion encryption program to decrypt.c.
Very Important Note: The KeyTbl values in this
program MUST match the KeyTbl values in decrypt.c.
(c) 1997 Jeff Stefan
#include <stdio.h>
#include <conio.h>
#include <stdlib.h>
FILE *Infp;
FILE *Outfp;
#define MAX_FILENAME 45
#define NUM_KEYS 4
int KeyTbl[NUM_KEYS] = { 0x04, 0x02, 0x06, 0x01 };
int Key;
void main(void)
{
char InFilename[MAX_FILENAME];
char OutFilename[MAX_FILENAME];
char c;
int i;
long Count=0;
clrscr();
/* Assign first Key value
Key = KeyTbl[0];
*/
}

```

```

* open input file
printf("Enter input filename:");
gets(InFilename);
Infp = fopen(InFilename, "rb");
if(Infp == NULL)
{
printf("Can't open input file.\n");
exit(0);
}
/* Open output file
printf("\nEnter output filename:");
gets(OutFilename);
Outfp = fopen(OutFilename, "wb");
if(Outfp == NULL)
{
printf("Can't open output file.\n");
exit(0);
}
* Encrypt plaintext file
c = fgetc(Infp);
while(!feof(Infp))
{
/* encrypt character using the
rotating key encryption formula.
c = (c + Key) % 0xff;
* Rotate Key depending on value of count.
Count++;
switch(Count)

```

```

{
case 0x02:
Key = KeyTbl[1]; // Key value is 2
break;
case 0x03:
Key = KeyTbl[2]; // Key value is 6
break;
case 0x05:
Key = KeyTbl[3]; // Key value is 1
break;
case 0x07:
Key = KeyTbl[0]; // Key value is 4
Count = 0;
break;
default:
break;
}
/* Print the decrypted character to screen and file
fputc(c, Outfp);
printf("[%2X]", c);
c = fgetc(Infp);
if(!feof(Infp))
fputc(Eof, Outfp);
}
/* Close all files
if(Infp)
fclose(Infp);
if(Outfp)
fclose(Outfp);
}

```



```

/* *****
* Filename: decrypt.c
* Description: decrypts a file based on Caesar's Alphabet
using
* the formula c = (c - Key) % 0xff. This is the
companion decryption program to encrypt.c
*
* Very Important Note: The KeyTbl values in this
program MUST match the KeyTbl values in encrypt.c.
*
* (c) 1997 Jeff Stefan
***** */
#include <stdio.h>
#include <stdlib.h>
#include <conio.h>

FILE *Infp;
FILE *Outfp;

#define MAX_FILENAME 45
#define NUM_KEYS 4

int KeyTbl[NUM_KEYS] = {0x04,0x02,0x06,0x01};
int Key;

void main(void)
{
    char InFilename[MAX_FILENAME];
    char OutFilename[MAX_FILENAME];
    char c;
    char x;
    int i;
    long Count=0;

    clrscr();

    /* *****
    * Assign first Key value
    ***** */
    Key = KeyTbl[0];

```

```

/* *****
* open input file
***** */
printf("Enter input filename: ");
gets(InFilename);
Infp = fopen(InFilename,"rb");
if(Infp == NULL)
{
    printf("Can't open input file.\n");
    exit(0);
}

/* *****
* Open output file
***** */
printf("\nEnter output filename: ");
gets(OutFilename);
Outfp = fopen(OutFilename,"wb");
if(Outfp == NULL)
{
    printf("Can't open output file.\n");
    exit(0);
}

/* *****
* Decrypt encrypted file
***** */
while(!feof(Infp))
{
    c = fgetc(Infp);
    if(!feof(Infp))
        break;

    /* *****
    * Decrypt character using the inverse
    * rotating key encryption formula.
    ***** */
    c = (c - Key) % 0xff;
}

```

```

* Rotate Key depending on value of count.
***** */
Count++;
switch(Count)
{
    case 0x02:
        Key = KeyTbl[1]; // Key value is 2
        break;

    case 0x03:
        Key = KeyTbl[2]; // Key value is 6
        break;

    case 0x05:
        Key = KeyTbl[3]; // Key value is 1
        break;

    case 0x07:
        Key = KeyTbl[0]; // Key value is 4
        Count = 0;
        break;

    default:
        break;
}

/* *****
* Print the decrypted character to screen and file
***** */
printf("[%2X]",c);
fputc(c,Outfp);

/* *****
* Close all files
***** */
if(Infp)
    fclose(Infp);
if(Outfp)
    fclose(Outfp);
}

```

accomplished by key table array called KeyTbl[NUM_KEYS] and a switch statement that examines the value of a variable named Count. The key table array is declared as int KeyTbl[NUM_KEYS] = {0x04,0x02,0x06,0x01}.

These values are added to the incoming file character, c, to encrypt it in encrypt.c. The values are subtracted from the encrypted file character in decrypt.c to return it to the original char-

acter. Only one line of code is required to encrypt the incoming character. This line of code is:

$$c = (c + \text{Key}) \% 0\text{ff}.$$

The value of Key added to the value of c, yields a new character.

What happens when we hit the end of the ASCII character set? We can't go beyond that, so that's where the C mod

operator %, comes in handy. The last character in the extended ASCII PC character set has a value of 256, which is expressed as 0xff in hexadecimal. Using the % operator removes the 256 and leaves the only value of Key.

For example, if the character you want to encrypt has an ASCII value of 251 (the square root symbol), and the value of Key is 11, then the new value of the character will be 6 (the black club symbol from a deck of cards).

Every character that comes in is counted by the long integer variable Count. The Count value is used to assign a new value to Key. This is done inside a switch statement. The code fragment that encrypts a character is given in Figure 2.

To decrypt an encrypted file, all that needs to be done is to subtract the values that were added to the original character. This simple change in the encryption formula is:

$$c = (c - \text{Key}) \% 0\text{ff}.$$

This transforms the encryption formula into a decryption formula. That's the formula that's in decrypt.c.

Figure 3 shows the opening sentence of the Gettysburg Address encrypted with encrypt.c. To return the encrypted text to plaintext, just run the encrypted text through decrypt.c.

Program Customization

You can customize encrypt.c and decrypt.c with your own unique key and count values. You can increase the number of keys in the key table array and use many

more count values in the switch statement to increase the encryption complexity. Remember, you must make the key table and switch statement count values exactly the same in both programs. This is a symmetric key algorithm, so both keys must be exactly the same.

The encryption programs work on binary, as well as ASCII files, so you can encrypt executable programs, word processor documents, and spreadsheets, as well as ASCII text files. I use it to encrypt source code and documents I wish to keep private on my machines.

After you encrypt a file, the original file is still left intact. It's up to you to delete it or save it to disk or on some other off-line storage device, if you so desire. The code, as always, is yours to modify and experiment with. I used Turbo C/C++ to compile the source, but any ANSI C compiler should work.

Encryption and the Near Future

The data encryption controversy is not going to go away. On the contrary, it's only going to heat up. A bill called the Secure Public Networks Act of 1997 is currently gathering congressional steam. This bill will mandate government-sponsored key recovery methods and allow law enforcement agencies to confiscate private keys with a search warrant only.

The patents on the RSA algorithms are due to expire in the year 2000. This is when data encryption will intersect free market capitalism, opening a floodgate of new data encryption start-up companies vying for your crypto dollar.

This will make the privacy versus government eavesdropping debate even more intense, and government may try to introduce even more radically restrictive legislation.

It looks as if a showdown is just beyond the horizon. **NV**

Cryptographic Terminology

Cryptography *The science of concealing the true meaning of a message.*

Plaintext *The original, un-encrypted message.*

Encryption *The process of encoding plaintext to produce ciphertext.*

Decryption *The process of un-encoding a message to produce plaintext.*

Cipher *The encrypted message.*

Key *A special number, symbol, or set of numbers and symbols that allow an encrypted message to be de-crypted.*

Weak Cryptography *An encrypted message that is fairly easily decrypted.*

Strong Cryptography *An encrypted message that is hard or impossible to decrypt.*

The Clipper Chip

The Clipper Chip is a hardware encryption device that utilizes an encryption algorithm called Skipjack. Skipjack was developed by the National Security Agency (NSA).

Every Clipper Chip contains a unique encryption key and serial number.

The encryption key in the Clipper Chip is derived from two separate keys, which are held escrow by the government. One of the keys is held by NIST, which is part of the Department of Commerce, and the other is held at the Automated Systems Division of the Treasury Department.

When two Clipper Chips communicate, a temporary key is first created. The encryption key and the Clipper Chip serial numbers are then encrypted with another key, called the family key. Before the actual data is transferred between Clipper Chips, a Law Enforcement Access Field (LEAF) is exchanged. The data in the LEAF, along with the two keys held in escrow, allow the government to decrypt Clipper Chip messages.



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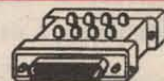
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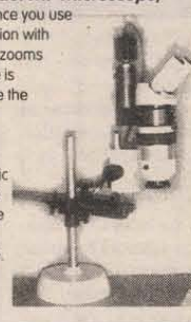
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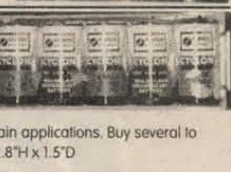
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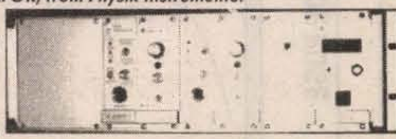
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Nuts & Volts Magazine/September 1997 31

JuJu! Disk-fiksing!

by Alan Johnson

Your floppy disk has crashed, and it has vital data! You've tried everything, every utility, every read-routine, but no-go.

the surface. These two things can occur together, unfortunately. The good news is that, of the two, only the scoring from an abrasive is permanent damage.

If your disk goes down from grease, oil, dust, or some soap-soluble stuff, you

shell; it is made of one piece, folded along the forward edge. The hard-cased 3-1/2" disks require a bit more effort and delicacy. Remember, the casing will be needed to hold the disk after it is re-assembled.

A word here about choices of pocket knives. As disks store data with magnetic impulses, it is safest to make sure your knife is NOT magnetized! A few years ago, it was possible to buy bronze pocket knives imported from Thailand. If you can find one of these, it is the ideal tool.

Bronze gets as sharp as steel, even if it does not retain the edge as long as steel; if it seems a bit soft, lightly hammering the edge will, unlike steel, work-harden the metal. If you cannot find bronze, just make sure your swiss army knife will not pick up paper clips before you begin surgery!

On a 3-1/2" disk, there are four plastic press-rivets that do the main work of holding the halves of the casing together. There is also usually a glue holding the edges of the casing together. The rivets are at the four corners, and the two towards the forward edge are usually vis-

same for the back edge of the disk. Now the only thing holding it together is the rivets.

The knife-point is inserted between the halves, as close to the rivets as possible, without touching the actual disk surface, and then worked, to part the rivets. This must be done delicately, because, as noted before, the halves of the casing will be needed to hold the disk for re-assembly. Be patient and careful; it is easy to warp the plastic.

Start with the rivets toward the back edge. Use different angles to pry the rivet from two sides. The rivet nearest the write-protect notch often seems the toughest; it might be re-inforced, as the notch makes this corner structurally weaker. If, somehow, you blow it at this stage and warp the case, remember it is possible to disassemble a perfectly good blank disk, just to get a usable casing. It all depends on the importance of your lost data!

Once the rivets are parted, the sliding cover is next. Turn the disk bottom side up. On the bottom side of the slide are two pressed-in parts that run in

Last Chance for Lost Data

The floppy disk — that magic thing which holds invisible writing — has failed, and at the worst possible time; just when you were starting to trust it!

Before you throw the disk in the trash and join the foreign legion, there is one last chance. DON'T throw it in the trash! Not yet. Try JuJu! disk fiksing.

Like all magic that might actually work, it's not really magic at all. It simply involves disassembling the disk, washing the surface and re-assembling. Hopefully, you will get at least one last read off the cleaned surface. Of course, there is no guarantee this will work, but if you are desperate, it is well worth one last try.

Floppies usually fail for two main reasons. One is an accumulation of grease and dust on the surface. The other is some kind of microscopic grit or abrasive getting inside the casing and scoring

may recover a fully usable surface! The magnetic patterns of your data are still present, even though the head can't detect them because of stuff adhering to the surface! Only abrasion, or destruction of the magnetic emulsion is death to a disk's surface.

Before beginning, it is useful to define the edges and surfaces of a disk. See Figure 1. The edge inserted foremost into the drive is the front (or forward) edge, the opposite is the back edge. The uppermost side is the top, and the lower — with the hole for the hub — is the bottom.

The first step is to disassemble the disk casing. On 5-1/4" disks, this is easy; just break the little heat-stamped seals on the bottom surface by lifting them up with a small pocket knife. The entire soft casing will simply open up like a clam

ible from the outside. There will be two indentations on the bottom side.

First, the edge adhesive is parted, and then the knife-point is worked between the halves, and the rivets are pried apart.

To part the edge, insert the tip of the blade between the halves, and run it along the seam. This is usually easiest on the side edges of the disk. The back corner, the one which does NOT have the write-protect notch is usually the easiest to start with, but some disks part easier in the center of the side seam. Do not worry about the metal slide for the read/write window; it comes off last.

Hold the disk as in Figure 2, and use your thumb as a fulcrum, rotating the blade to part a single small section at a time. Flip the disk over to get the other edge. Once the sides are parted, do the

grooves in the cover. These are what hold on the slide.

The point of the knife is pushed under the slide, and used to lever the runners out of the grooves, and the slide is forced off. The small spring which retains the slide in a closed position may fly out at this point, or simply be shaken out of the slide. Save the spring; it can be put back in during re-assembly, if desired.

The slide may be sprung apart a bit in this removal procedure, so you may want to bend it back together a bit, if complete re-assembly of the disk is desired (disks can be read from just fine without the slide on).

One half of the case should just lift off, revealing the disk!

You should avoid touching the disk directly; hold it by the hub and maybe the edges, if you have to. Most people can "span" a 3-1/2", pinching the hub between the thumb on one side, and the forefinger on the other; 5-1/4" disks can simply be lifted out once the casing is parted. They can be held by putting the thumb and forefinger together, to make a "point" out of both fingertips, which rests in the center hole.

Now for the fun part — the actual washing of the surface.

Hold the disk by the center in the appropriate method described above, and wet the surface under a medium flow of tap water. Apply soap to your fingers and gently rub the surface of the disk. It's that simple! Use an ordinary soap, like Ivory or Lux; fancy stuff is not necessary.

Avoid powdered soap or powdered detergent, as sometimes abrasives are added. Obviously, lava-pumice, heavy-duty, hand-cleaner type soaps would defeat the purpose of restoring the disk surface!

An alternate method, for the extremely cautious, would be to prepare a "bath" of distilled water and soap in a tray, and actually soak the disk. Distilled water should minimize any potential dam-

Figure 1

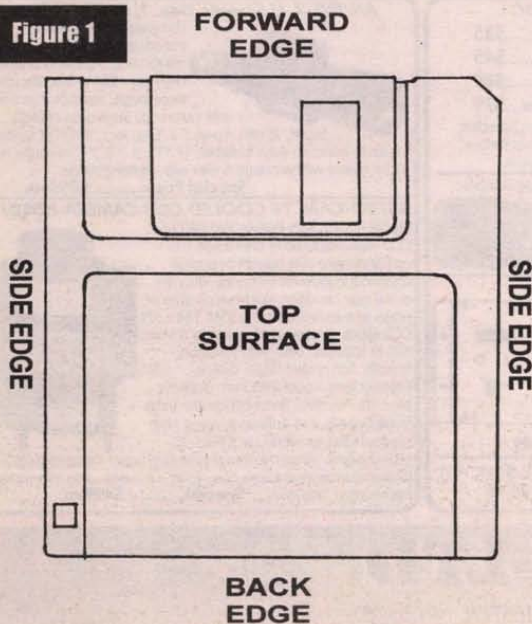
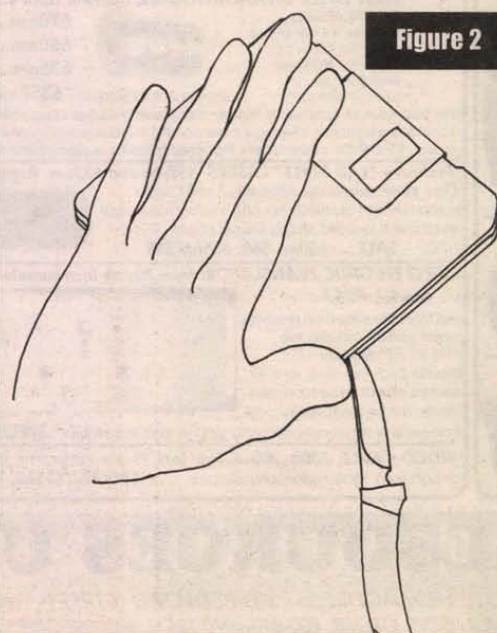


Figure 2



JuJu! Disk-fiksing!

age to the surface. Devise some method of supporting the disk in the center, so any grit which sinks to the bottom will be away from the disk surface. The disk will have to be pushed below the surface tension, and a 5-1/4", lacking a metal hub, may have to be weighted under. So far, simple tap water has been adequate, but if it should fail, it is possible to try again with a distilled-water soak bath.

To rinse the disk, simply hold each surface under the tap, turning the disk to wash away the soap. Allow the disk to air-dry on a clean paper towel. The cheap variety of towel is sufficient; the expensive ones usually just pack in extra loose paper fibers which tend to come off (not good for drive or disk!).

Do not rub the disk surface dry with a paper towel! Paper is actually an abrasive on a near-microscopic scale! Air-drying is best, even though you have to wait! When the "up" side looks dry you can turn the disk over.

To pick the disk up, it is advisable to place one finger on the hub, or the thumb and forefinger into the hub of a 5-1/4", and then slide the opposite hand under the paper towel, to pick the whole thing up, and flip it all over to hold the disk while removing the paper towel. The idea is to avoid touching the surface.

While waiting for the disk to dry, it is possible to take a clean paper towel and lightly brush the soft, white, inner padding of the casing in which the disk spins, just to pick up any particles or grease.

Once the disk is dry, it may be possible to see surface abrasions by catching the reflection off the surface. It is almost normal to see some concentric arcs, due to the spinning, but any radial or semi-radial lines are usually scratches. They are deceptive; sometimes apparently large ones have little effect, and the disk will be usable, and other times small abrasions will cause a cleaned disk to fail after only one or two reads. Perhaps the depth of the scratch is the critical factor(?).

After drying, the casing must be re-assembled. For 5-1/4" disks, it is simplest to cut away the fold-over flaps, so the disk just lays between the two halves, which are still joined along the forward (inward-facing) edge. Re-assembly of a 5-1/4" is that simple. Taping the open edges is actually optional! A 5-1/4" will actually function "loose."

For a 3-1/2", the write-protect button can be placed between the halves of the casing, and can actually still work as intended, once the disk is re-assembled. They only fit one way, with the "lump" side towards the bottom surface.

To re-assemble the halves, use scotch tape on each of the sides. If replacing the read-write cover is desired, first insert the spring into the casing. The spring resides in the upper-left corner of the casing (viewed from the top) and is in the form of a "V," the open part of the "V" facing the front edge of the disk.

To assemble, insert one leg of the "V" into the corner of the casing, and leave the other sticking out. It is possible to compress the spring, and to squeeze the sides of the casing together to hold it in a compressed position. The leg of the "V" which is sticking out of the case must

be placed on a notch in the slide, which is visible on the "fold" (front) edge of the slide; the inside of the bend.

Once this leg is caught on the notch, the slide simply snaps onto the casing, and re-assembly is done! Catching the leg in the notch might take a try or two, but when done, the slide springs over the read-write window good as new.

Once the disk is re-assembled, it is time for the moment of truth: THE READ! One way to do this is to set up a sub-directory on your hard drive (say named: "recover") and use the xcopy command: "xcopy a:.* recover /s." This should get all the stuff on the floppy, however, the problem with this is that xcopy tends to stop the moment it encounters a file which it cannot read.

A possibly more reliable, if tedious, method is to use the old "copy" command: "copy a:.* recover." This will prompt for "abort, retry, ignore or fail" if it encounters a reading problem. I have gotten successful results using the "retry" option. This was after "xcopy" had failed. The drawback to using copy instead of xcopy, is that each sub-directory will have to be copied individually; no "/s" sub-directory switch with the "copy" command.

So far, this relatively simple process has worked for me, using just simple tap water, though I did have to use the "retry" option once, with "copy," as mentioned above. If this fails, there is still one more last possibility! I originally believed that alcohol dissolved the magnetic emulsion on disk surfaces, the way they seem to on audio tape, but upon experimentation I found that isopropyl rubbing alcohol does not leave a residue on a paper towel used to swab the alcohol-soaked surface of a disk!

Remember, paper is usually only dangerous to the surface if rubbed on it dry. If you wish to try alcohol on the disk (I recommend soap and water first!) Q-tips or cotton might be the better choice over paper towels (at last, a use for that stuff in the top of aspirin bottles). The one time I used rubbing alcohol, the results were negative, but the surface of the disk was scored. I had already recovered the data with simple soap and water, and the disk then crashed quickly after; the alcohol was an experiment. I have not dared to try acetone (yet).

If the surface of the disk is not scored, and simply malfunctioned due to grease and dust, you may find that you have recovered not just the data, but a fully usable disk. I have several which are still up and running. The first disk I tried these techniques on was a 5-1/4" which would not format because track 00 was bad. I simply rinsed it in tap water (no soap!), and it formatted with only 5K in bad sectors. As of this writing, it is still functional.

The sequence and procedures described here are hardly carved in tablets of jade; if an alternate method seems expedient, or just seems more likely to work for you, then use it!

Disks are not really magic, and neither is JuJu! disk-fiksing. You're just cleaning the junk off the surface, and hoping it's not too scratched for one last read! A last chance for lost data. Good Luck! NV

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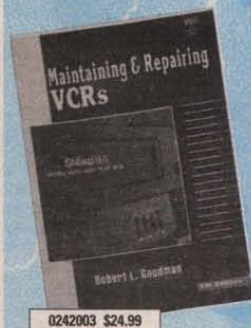
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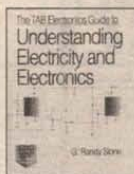
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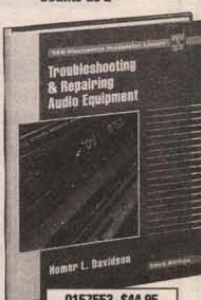
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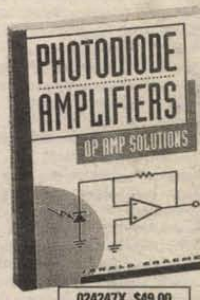
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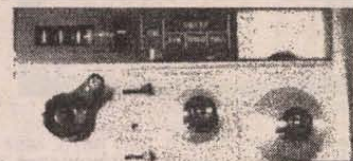
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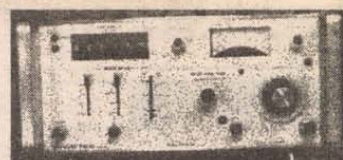
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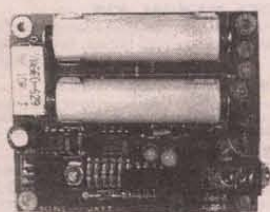
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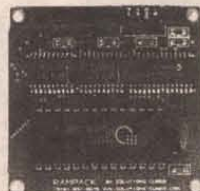
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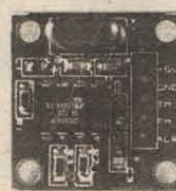
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Stamp Applications!

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

by Jon Williams

When it comes to using character-based LCDs, the truth of the matter is that I'm spoiled. And it's all Scott Edwards' fault! When I need to add an LCD to my Stamp projects, I don't even hesitate; I grab an LCD Serial Backpack, wire up a couple of pins, add a few SEROUT commands to my program, and presto, I've got a nice display.

Demystifying Character-Based LCDs

There is no doubt that Scott's LCD Backpack has saved countless Stamp projects from oblivion and, in the process, has become one of the most popular products in his catalog.

There are times, however, that I do very simple Stamp projects that have adequate code space and I/O resources, so I cannot justify the expense of using an LCD Backpack. Direct control of character-based LCDs is not difficult, yet, it requires some specific steps to succeed. The gory details like initialization code and Register Select control — things that the LCD Backpack hides from us — must be handled by your Stamp code. Like I said, it's not that difficult once you get the hang of it.

How They Work

The operation of character-based LCDs is analogous to your PC's video card and monitor. In your PC, information is sent by the program to the video card via the PC bus. The video card is responsible for the actual task of creating, updating, and refreshing the display. Information in your display is maintained in the video card memory. Our LCDs behave in the same manner: they accept data and commands via a bus, maintain character information in memory, and manage the built-in display. The brains behind the LCD is the Hitachi HD44780. In addition to managing the display (i.e., writing a character, clearing the display, moving the cursor, etc.), it contains three areas of memory: CGROM, DDRAM, and CGRAM.

The CGROM (Character Generator ROM) contains the dot patterns for the characters that can be displayed. This ROM contains most of the US ASCII character set and several Japanese kana characters and symbols.

The DDRAM (Data Display RAM) is the memory where the display contents are stored. The actual content of this memory are the character codes to be displayed. The HD44780 takes care of retrieving the dot patterns from the CGROM and putting them into the display. The DDRAM and its manipulation can be a bit confusing at first, since it usually contains many more characters than can be physically displayed. You can find LCDs as small as 2x8 and as large as 4x20. Keep in mind that the physical display is simply a window into the DDRAM.

In practice, this can be quite useful. You could, for example, write several messages to the LCD as part of the initialization sequence. During program operation, you can then point to a message by setting the display to the correct DDRAM address.

The CGRAM (Character Generator RAM) is memory that we can manipulate to create our own characters. In a pinch, it can also be used as external, general-purpose memory. Use the CGRAM as external memory requires another control line (R/W, LCD pin 5) that we don't normally use in Stamp projects. We will, however, be covering the detailed use of CGRAM to create our own characters next month.

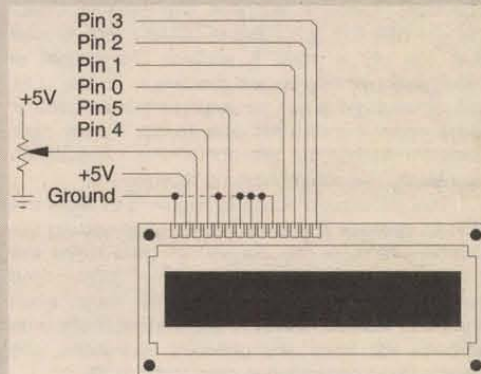
Making the Connection

Connection to the LCD is through a 14-pin interface, physically arranged 1x14 or 2x7. Don't panic, Stamp 1 users. We only need to use six lines to write to the display. And since four of these lines are tri-stated when not in use, they can be shared by other hardware (refer to Parallax Stamp Application Note #1). Table 1 shows the LCD pin connections and how we'll interface them to the Stamp (the connections are the same for the Stamp 1 and Stamp 2).

Notice that the data bus is eight bits wide, but

we're only using four bits. The ability to connect to the LCD through a four-bit interface makes it possible to use the LCD with the Stamp 1. If you're using the Stamp 2, you may elect to use the full eight-bit data bus.

In my projects, I always use the four-bit connection. In my opinion, the four pins this mode saves is worth the few extra lines of code necessary to use the four-bit bus. Another nice aspect of these LCDs is that their power requirement is very low (2 mA max); so much so that you may use a Stamp pin for power control.



Stamp / LCD Connections

Display Basics

Use of the LCD is pretty straightforward. After power-up, wait a half second or so to let the LCD run its own initialization. Since the default mode is eight bits, we'll have to re-initialize it to accept our data via the four-bit bus. When the four-bit initialization is complete, we can send our characters or commands. The difference is determined by the state of the RS (Register Select)

LCD Pin	Symbol	Level	Function	Stamp Pin
1	Vss	0V	Ground	Ground
2	Vdd	+5V	Supply voltage (2 mA max)	+5 or pin X
3	Vo	0 – 5V	Contrast control	
4	RS	L/H	L = Instruction, H = Data	4
5	R/W	L/H	L = Write data, H = Read data	Ground
6	E	H → L	Enable signal	5
7	DB0	L/H	Data bus, bit 0	Ground
8	DB1	L/H	Data bus, bit 1	Ground
9	DB2	L/H	Data bus, bit 2	Ground
10	DB3	L/H	Data bus, bit 3	Ground
11	DB4	L/H	Data bus, bit 4	0
12	DB5	L/H	Data bus, bit 5	1
13	DB6	L/H	Data bus, bit 6	2
14	DB7	L/H	Data bus, bit 7	3

Table 1

Stamp Applications:

1 x 16 Display:

\$00	\$01	\$02	\$03	\$04	\$05	\$06	\$07	\$08	\$09	\$0A	\$0B	\$0C	\$0D	\$0E	\$0F
------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------

2 x 16 Display:

\$00	\$01	\$02	\$03	\$04	\$05	\$06	\$07	\$08	\$09	\$0A	\$0B	\$0C	\$0D	\$0E	\$0F
\$40	\$41	\$42	\$43	\$44	\$45	\$46	\$47	\$48	\$49	\$4A	\$4B	\$4C	\$4D	\$4E	\$4F

Table 2

4 x 16 Display:

\$00	\$01	\$02	\$03	\$04	\$05	\$06	\$07	\$08	\$09	\$0A	\$0B	\$0C	\$0D	\$0E	\$0F
\$40	\$41	\$42	\$43	\$44	\$45	\$46	\$47	\$48	\$49	\$4A	\$4B	\$4C	\$4D	\$4E	\$4F
\$10	\$11	\$12	\$13	\$14	\$15	\$16	\$17	\$18	\$19	\$1A	\$1B	\$1C	\$1D	\$1E	\$1F
\$50	\$51	\$52	\$53	\$54	\$55	\$56	\$57	\$58	\$59	\$5A	\$5B	\$5C	\$5D	\$5E	\$5F

line at the time we write a code. The RS line is set high for characters, low for LCD commands.

Enough chat, let's get to the code. Listings 1 (Stamp 1) and 2 (Stamp 2) demonstrate the basic LCD features. This code is designed for a one-line, 16-character display, which is readily available from surplus suppliers like Timeline and B.G. Micro (see Sources). Timeline supplies the Hitachi driver manual with the purchase of LCDs. I recommend that you get a copy. It explains the details of initialization, writing to and reading from the LCD, and different schemes for display contrast control. Don't worry if you're not able to get a copy right away, the listings are well documented and, with a little study, you should have no trouble.

This initialization code is required to allow the LCD to operate in four-bit mode. After setting the four-bit interface, this section of code turns the display on, turns off the underline cursor, and causes the cursor to increment after each character is written. Just to ensure that there is no garbage left from any previous operations, the Display Clear command is sent to the LCD.

Writing a character or command is done in these steps:

1. Set the RS line (HIGH for character, LOW for command).
2. Place the high nibble of the character/command byte on the bus.
3. Strobe the Enable line (cause a HIGH-to-

LOW transition).

4. Place the low nibble on the bus.

5. Strobe the Enable line one more time.

All the work is done by the sub-routine LCDwr. The entry at label LCDcmd sets the RS line low for LCD commands before writing the code with LCDwr.

Multiple Lines

Multi-line control is an aspect of character-based LCDs that often gives new users trouble. As stated earlier, this has to do with the physical display being a window into the DDRAM. Once the layout of the DDRAM is understood, there is rarely a problem. Be aware that you can obtain 2x8 displays that are physically configured as a 1x16. Honestly, they're a pain to deal with, so I try to avoid them. The DDRAM address range can be extended with the use of additional drivers (HD44100s that are built into the LCD module), and the addresses are not contiguous. Table 2 shows how they're laid out in one-, two-, and four-line displays.

Do you see how the addresses are interleaved? Keep this in mind when shifting multi-line displays. Please refer to the HD44780 manual for additional information. The ability to write beyond the first line requires a small change in the initialization sequence. Once this is done, it is a simple matter of setting the DDRAM address before writing your

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characters. See Listing 3 for details.

Next Time

Next time, we'll cover the use of CGRAM and how to create and display custom characters, including animation techniques. Until then, run the sample code and play with it. If you have any questions, please send a letter or E-Mail. And don't hesitate to pass on any new tricks that you create so we can share them with others.

As a final note, I'd like to publicly thank Scott Edwards for the fantastic work he has done with the Stamp Applications column and for having the faith in me to carry the torch. I'm sure you'll join me in wishing Scott well in his ever-expanding business. And, rest assured, we haven't heard the last of Scott when it comes to Stamps. I'm sure he has something big brewing ... **NV**

Editor's note: Due to space limitations, we could not print all three code listings mentioned in this article. They are available for download from our web site in the Stamp Applications section of the FTP Library under the name septcode.zip Listing 3 is printed on page 111.

' Listing 1
' Nuts & Volts: Stamp Applications, September 1997

' —[Title]———

' File..... LCDDEMO1.BAS

' Purpose... Stamp 1 -> LCD (4-bit interface)

' Author.... Jon Williams

' E-mail.... jonwms@aol.com

' Started... 16 JUL 1994

' Updated... 25 JUL 1997

' —[Program Description]———

' This program demonstrates the various standard features of a 1x16 LCD display that uses the Hitachi HD44780 controller.

' LCD Connections:

' LCD	(Function)	Stamp
' pin 1	Vss	Gnd

' pin 2	Vdd	+5
' pin 3	Vo	Gnd [or wiper of 10K pot]
' pin 4	RS	Pin 4
' pin 5	R/W	Gnd
' pin 6	E	Pin 5
' pin 7	DB0	Gnd
' pin 8	DB1	Gnd
' pin 9	DB2	Gnd
' pin 10	DB3	Gnd
' pin 11	DB4	Pin 0
' pin 12	DB5	Pin 1
' pin 13	DB6	Pin 2
' pin 14	DB7	Pin 4

' —[Revision History]———

' 16 JUL 94 : Version 1.0 - compilation of code from last 3 months
' 08 AUG 96 : Trimmed code to save space - no performance changes!
' 25 JUL 97 : Updated for Nuts & Volts

' —[Constants]———

Stamp Applications:

```
' SYMBOL RS = 4      ' Register Select (1 = char)
' SYMBOL E = 5       ' LCD enable pin (1 = enabled)
```

' LCD control characters

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

' —[Variables]—

```
' SYMBOL char = B1    ' character sent to LCD
' SYMBOL index = B2   ' loop counter
```

' —[EEPROM Data]—

```
EEPROM ("THE BASIC STAMP!") ' preload EEPROM with message
```

' —[Initialization]—

```
' Init: Dirs = %00111111 ' set 0-5 as outputs
'       Pins = %00000000 ' clear the pins
```

' Initialize the LCD (Hitachi HD44780 controller)

```
' LCDini: PAUSE 500 ' let the LCD settle
'           Pins = %0011 ' 8-bit mode
'           PULSOUT E, 1
'           PAUSE 5
'           PULSOUT E, 1
'           PULSOUT E, 1
'           Pins = %0010 ' 4-bit mode
'           PULSOUT E, 1
'           char = %00001100 ' disp on, crsr off, blink off
'           GOSUB LCDcmd
'           char = %00000110 ' inc crsr, no disp shift
'           GOSUB LCDcmd
'           char = ClrLCD
'           GOSUB LCDcmd
```

' —[Main Code]—

```
' Start: FOR index = 0 TO 15
'         READ index, char ' get character from EEPROM
'         GOSUB LCDwr      ' write it
'         PAUSE 50        ' delay between chars
'         NEXT
'         PAUSE 2000      ' wait 2 seconds

'         char = CrsrHm    ' move the cursor home
'         GOSUB LCDcmd

'         char = %00001110 ' turn the cursor on
'         GOSUB LCDcmd
'         PAUSE 500

'         char = CrsrRt
'         FOR index = 1 TO 15 ' move the cursor accross display
'             GOSUB LCDcmd
'             PAUSE 100
'         NEXT

'         FOR index = 14 TO 0 STEP -1 ' go backward by moving to
'             char = DDRam + index ' a specific address
'             GOSUB LCDcmd
'             PAUSE 100
'         NEXT

'         char = %00001101 ' cursor off, blink on
```

```
GOSUB LCDcmd
PAUSE 2000
```

```
char = %00001100 ' blink off
GOSUB LCDcmd
```

```
FOR index = 1 TO 10 ' flash display
char = char ^ %00000100 ' toggle display bit
GOSUB LCDcmd
PAUSE 250
NEXT
PAUSE 1000
```

```
FOR index = 1 TO 16 ' shift display
char = DispRt
GOSUB LCDcmd
PAUSE 100
NEXT
PAUSE 1000
```

```
FOR index = 1 TO 16 ' shift display back
char = DispLf
GOSUB LCDcmd
PAUSE 100
NEXT
PAUSE 1000
```

```
char = ClrLCD ' clear the LCD
GOSUB LCDcmd
PAUSE 500
```

```
GOTO Start ' do it all over
```

' —[Subroutines]—

' Send command to the LCD

' Load char with command value, then call

```
' Clear the LCD ..... $01, %00000001
' Home the cursor ..... $02, %00000010
' Display control ..... (see below)
' Entry mode ..... (see below)
' Cursor left ..... $10, %00010000
' Cursor right ..... $14, %00010100
' Scroll display left ..... $18, %00011000
' Scroll display right ..... $1C, %00011100
' Set CG RAM address .... %01aaaaaa [Character Generator]
' Set DD RAM address .... %1aaaaaaa [Display Data]
```

' Display control byte:

```
' % 0 0 0 0 1 D C B
'       | | |---- blink character under cursor (1=blink)
'       | |---- cursor on/off (1=on)
'       |---- display on/off (1=on)
```

' Entry mode byte:

```
' % 0 0 0 0 0 1 X S
'       | |---- shift display [S=1], left [X=1], right [X=0]
'       |---- cursor move: right [X=1], left [X=0]
```

```
LCDcmd: LOW RS ' enter command mode
'             ' then write the character
```

' Write ASCII char to LCD

```
LCDwr: Pins = Pins & %11010000 ' save 7, 6 and RS; clear bus
'       Pins = char / 16 | Pins ' output high nibble
'       PULSOUT E, 1 ' strobe the Enable line
'       Pins = Pins & %11010000 ' output low nibble
'       Pins = char & $0F | Pins
'       PULSOUT E, 1
'       HIGH RS ' return to character mode
'       RETURN
```


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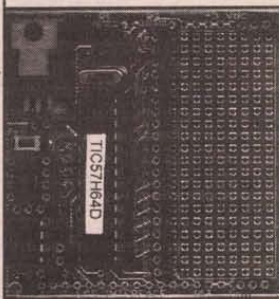
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HP 8901A \$2,600, HP 5345A \$450, Fluke 5100A \$700 (has problem), 1000MHz. Signal generators: Fluke 6080A \$3,900, Fluke 6071A \$2,800, Fluke 6060A \$2,500, Marconi 2022A \$1,800. <http://www.madbbbs.com/amtronix> 716-763-9104, fax 716-763-0371.

TEKTRONIX T202 Scopemeter/DMM w/case & PS, charger, manual & probes, \$600; Wavetek 3000, \$500. SASE for test equipment/manual list, 5175 Westland Dr., New Carlisle, OH 45344. 937-845-0625.

HP 3581C selective voltmeter/wave analyzers, unchecked, power up okay, \$149. Tek AM502s \$149, Fluke 540B thermal transfer standard \$395. Tek 7844 400MHz mainframe \$175. Technologies West 541-267-6064.

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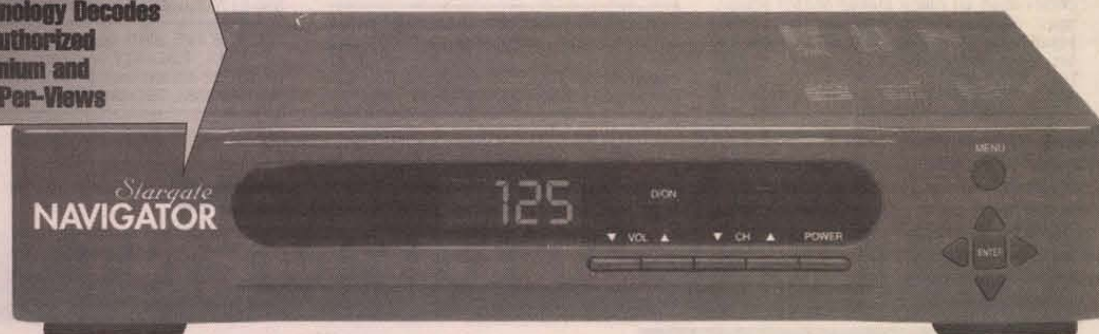
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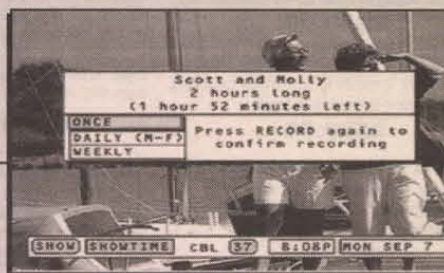
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SHOW Scott and Molly						
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DISC All In A Day's Work	All In A Da					
ESPN Major League Baseball (L)						
FAM Batman						
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DISC Avonlea	Casablanca					
SHOW SHOWTIME CBL 37	8:08P MON SEP 7					

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CHANNEL LABELS	DEFINE
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AC OUTLET POWER	OFF

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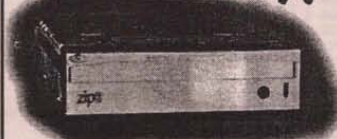
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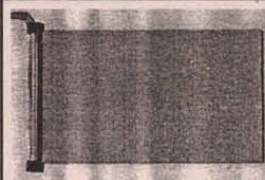
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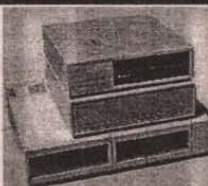
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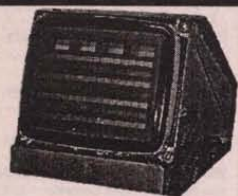


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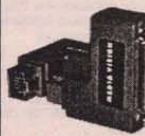
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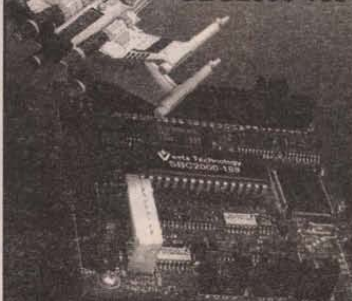
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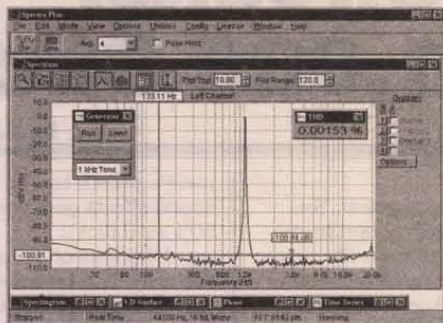
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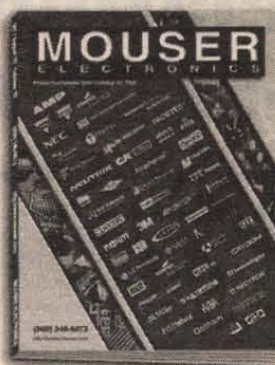
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51

(Part 1) Encyclopedia of Electronic Circuits: The CD-ROM of 1,000 Circuits

by TJ Byers

This unique CD-ROM contains 1,000 circuits that can be knitted together to create virtually any project imaginable. In this three-part series, I show you how to use this CD to go from concept to copper, and build a karaoke amplifier in the process.

Readers often ask me where I get the answers for the "Electronics Q & A" column. Well, some of the answers come from years of experience, and some come from you. But mostly they are the result of searching through countless stacks of trade journals and application notes. To be a good engineer, technician, or Q & A columnist, you don't have to have a good memory, just a good reference library.

One of my sources is the *Encyclopedia*

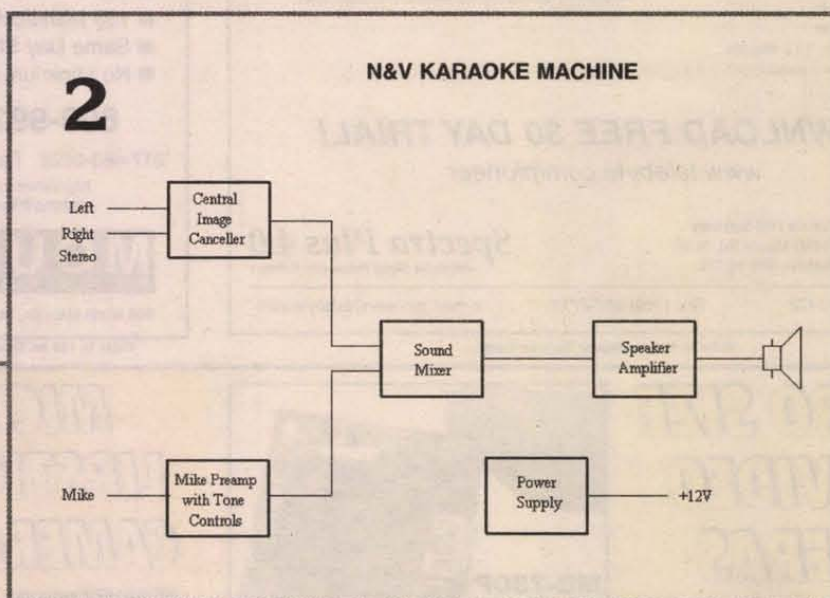
Mental Automation.

By itself, this marriage is no big deal. You don't need a schematic capture program to display schematics on a screen. A simple file viewer will do. What sets this CD-ROM apart from other schematic sources — such as Adobe Acrobat (PDF) files — is that the drawings are in schematic capture format — which means you can load the circuit into SuperCAD and turn it into a printed circuit board using SuperPCB. Moreover, you can modify the schematic right on screen before you commit your design to copper.

there's even a couple of thermins (a sound-effects generator right out of a 50's sci-fi flick).

A handful of the designs, like the two-watt TV transmitter, are quite ambitious and complex. But most of the circuits are simple designs that can be described as one-evening projects.

You know the type, a single IC microphone amp or a light dimmer. The accompanying text is frequently very terse, usually a sentence or two, if at all.




Fortunately, most of the designs are simple enough that they don't need a lengthy explanation in most cases. But, just in case you need more, there's a reference made to the original source of the design.

The cross references are plentiful and well thought out. First, there's a table of contents that catalogs the circuits by function, such as audio circuits or measurement and sensor electronics. There are eight "chapters" in all (Figure 1). Next is an index of topics in alphabetical order. From here you can look up topics like audio oscillators, Geiger counter circuits, or laser-related.

Under each of these choices are anywhere from 1 to 100 circuits on the subject.

Finally, there's the search button. When all else fails, you can usually find what you're looking for by searching the entire contents of the encyclopedia using a keyword.

There are two types of searches: topic and embedded words. When using the topic search, the keyword has to be the first word in the title of the circuit.

-  [Audio Circuits](#)
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-  [Measurement and Sensor Electronics](#)
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- ABC** [Topics in Alphabetical Order](#)

Encyclopedia of Electronic Circuits Selected by Rudolf F. Graf & William Sheets, © 1996 McGraw-Hill & Mental Automation, Inc.

Start Search 32 Microsoft Word - SCAD_N Encyclopedia of Elec 10:30 PM

of *Electronic Circuits* edited by Rudolf Graf & William Sheets and published by McGraw-Hill. This six-volume series contains thousands of circuits gathered from all sorts of professional publications, such as *EDN* and *Electronic Design*. Recently, the first three volumes of this treasure trove were put on a CD-ROM called the *Encyclopedia of Electronic Circuits on CD-ROM* and linked with SuperCAD and SuperPCB, a schematic capture/PCB layout package from

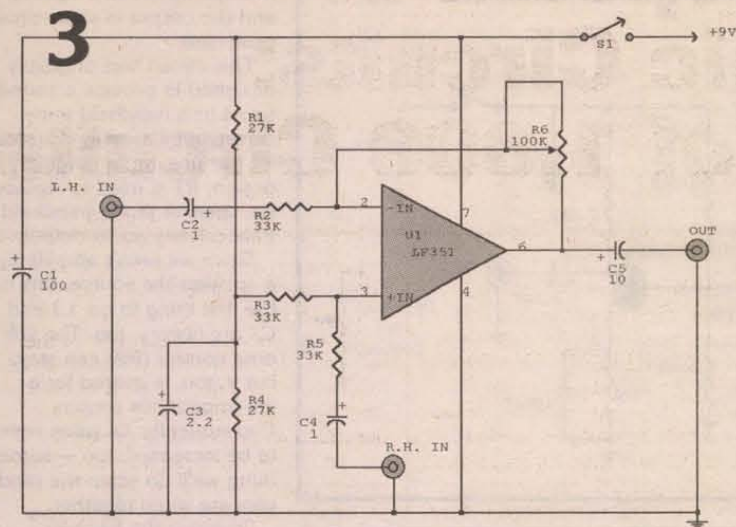
In this article, I'll show you how to convert the circuits on the *Encyclopedia of Electronic Circuits* CD-ROM into a functioning project using the SuperCAD toolkit.

The Encyclopedia

The encyclopedia contains about 1,000 circuits which range in purpose from active antennas to zero-crossing detectors — and a whole lot more. Looking for a Tesla coil? There are two. How about a negative-ion generator? Yep, and

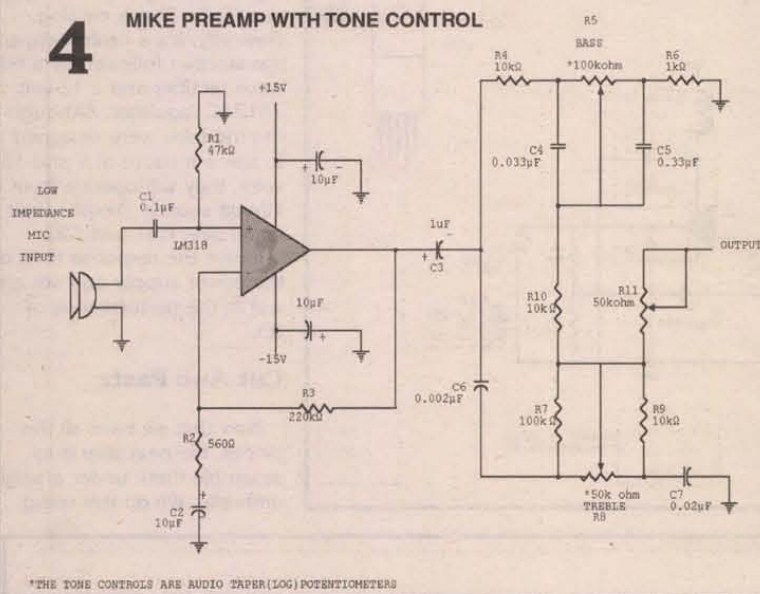
CENTRAL IMAGE CANCELLER

3



4

MIKE PREAMP WITH TONE CONTROL



*THE TONE CONTROLS ARE AUDIO TAPER (LOG) POTENTIOMETERS

Inside The Encyclopedia of Electronic Circuits

The *Encyclopedia of Electronic Circuits* on CD-ROM is a cornucopia of schematics and EDA (Electronic Design Automation) software. The CD-ROM costs just \$99.00, and includes the viewer needed to display the schematics on the screen. To edit the circuits or make a printed circuit board, though, you need the Mental Automation (206-641-2141; <http://www.mental.com>) CAD software, which is also located on the CD-ROM. However, you need to buy a password to unlock them. Fortunately, the programs are modular and you only have to pay for the ones that you want to use. The CD-ROM contains six CAD software products:

SuperCAD Schematic Editor for Windows:
MA8000, \$149.00.

SuperPCB Printed Circuit Board Software – Intermediate level: MA8505, \$149.00.

SuperPCB Printed Circuit Board Software – Intermediate Level with Router: MA8510, \$299.00.

SuperPCB Printed Circuit Board Software – Full Version: MA8500, \$499.00.

SuperSIM Digital Simulator for Windows:
MA8100, \$149.00.

mentalSPICE Analog Simulator for Windows:
MA6600, \$149.00.

There are demo versions of SuperCAD and SuperPCB included on the CD-ROM, too, which cost nothing to use. These demo programs are the same as in the real version, with the exception that you cannot save or print files, and several utilities, such as the netlister and autoplacement, are not included. Also, the number of schematic part symbols and layout packages are limited to those needed for the tutorials and design examples.

To duplicate the features I describe in this article (the first of three), you'll have to spend a total of \$248.00 for the CD-ROM (\$99.00) and SuperCAD (\$149.00). Later, I'll add mentalSPICE (\$149.00) and SuperPCB (\$149.00), which you may or may not opt to use for your projects. All four programs require Windows 3.1 or Windows 95.

because the search function won't click on embedded words. For example, electronic dice can't be found by the keyword dice; electronic is the keyword here.

With the Find function, on the other hand, the same keyword turns up electronic dice plus six other game-related circuits. Unfortunately, the Find feature dredges up every file that contains any permutation of the keyword, so searches using keywords like amplifier or IC generate an overwhelming response that can take time to sort through.

Multiply And Conquer

Sometimes, I use one of these circuits "as-is" to answer your question, but not often. In many cases, the circuit is built around a part that is no longer available or prohibitively expensive, in which case I need to make substitutions. Then there are those questions which are more complicated than a single circuit can solve. The solution is to paste two or more circuits together, a task that the CD-ROM is well suited for.

Let's take a typical design and walk it through from concept to finished project. For this scenario, I'll describe how to turn your stereo or boombox into a karaoke machine.

Karaoke lets you pretend to be Kenny Rogers or Elvis Presley. You take mike in hand, tell the band to hit it, and sing your heart out to an audience (or your parakeet, as the case may be). Generally, the band is a recording of a popular tune, usually a golden oldie such as *Proud Mary*, that has the vocal removed. You sing along with the band and provide the new vocal. What this karaoke machine does is remove the vocal from your records, cassettes, or CDs and leave just the music.

Block By Block

The karaoke machine consists of five modules (Figure 2), four of which I found in the *Encyclopedia of Electronic Circuits*. The fifth I drew myself using the SuperCAD editor.

At the heart of the design is a central image canceller — a circuit that eliminates the vocal portion of an audio signal while leaving the instrumental portion (Figure 3). It does this by mixing the left and right channels 180 degrees

out of phase.

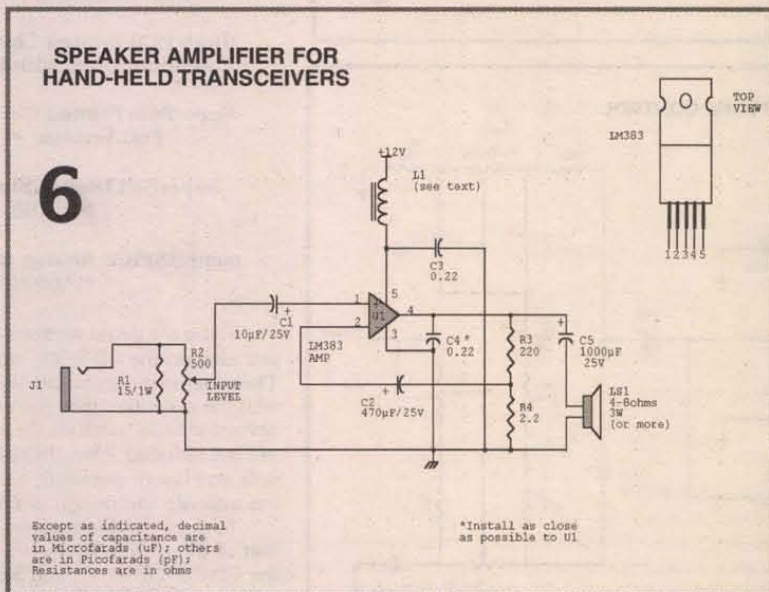
Normally, the voice signals are in phase to create the center channel and the instruments are out of phase to enhance the stereo effect. When mixed by the op amp, the voice will be canceled out, leaving just the instrumental.

Resistor R3 biases the non-inverting input of U1 from an artificial ground created by resistors R1 and R4. Signals applied to the right input are coupled to the non-inverting input of U1 through C4 and attenuating resistor R5. Resistors R3 and R5 make up a 6 dB attenuator so that there is unity voltage gain between the input and the output.

However, the right input signal is not inverted. Therefore, a signal appearing at both inputs is phased out by the circuit and will not appear at the output. Variable resistor R6 is used to adjust for full cancellation should the input voltage of the left and right signals be slightly different.

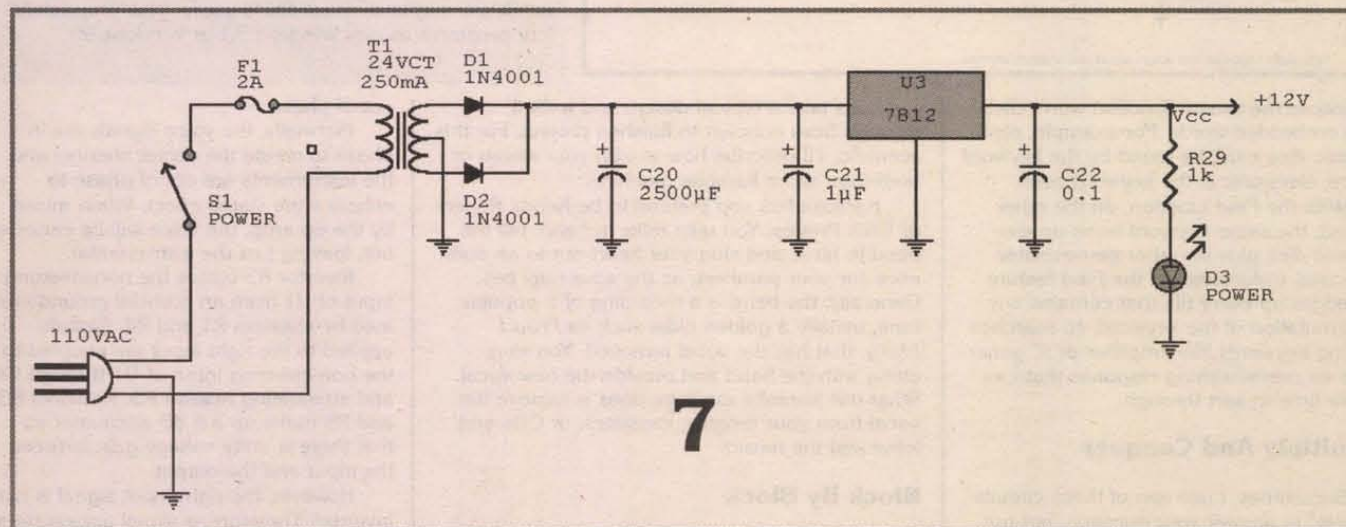
I don't know about you, but I don't sound like Elvis ... or Lou Rawls, for that matter. If I did, this would be a different

Both inputs can be inde-



Powering the karaoke machine is a simple power supply (Figure 7) that I threw together using parts I found in a Radio Shack catalog. Basically, it's a center-tapped transformer followed by a full-wave rectifier and a 12-volt 7812 IC regulator. Although the modules were designed to use a mixture of 9 and 15 volts, they will operate from a 12-volt source. Despite their small size, C21 and C22 improve the response time of the power supply and are critical to the performance of (13.

Now that we have all the pieces, the next step is to assemble them under a single umbrella. We do this using



Let's begin with the central image canceller. We first bring the circuit on screen using the View feature of the

encyclopedia (Figure 8). In the upper left corner, you'll find a reference number, FC59-4. Each circuit in the encyclopedia has its own reference. Write this number down, because we'll need it for the next step.

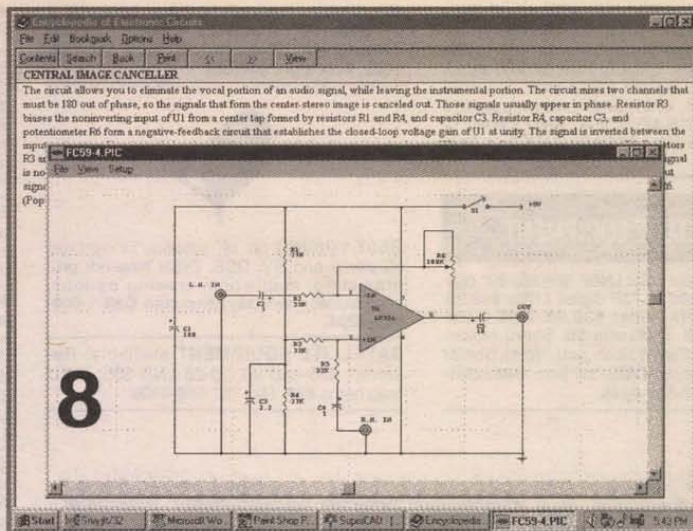
Load the circuit into SuperCAD by clicking on the File/Open menu. The file is located in the Encyclo directory on the CD-ROM. As you see, the text is gone and all that remains is the circuit.

Now draw a box around the circuit and click on Edit/Copy (Figure 9). This copies the circuit to the Windows clipboard, which we'll use to paste the circuit into our karaoke schematic that we'll call KARAOKE.PIC.

This drawing is created by clicking on File/New and pasting the circuit in a size C drawing (Setup/Drawing Size) using the Edit/Paste command. Move it to the upper left corner and save the drawing.

Now we do the same for the remaining four modules.

Each circuit has to be opened then copied to the clipboard one at a time because the clipboard can only hold one module at a time. After copying the circuit to the clipboard, open KARAOKE.PIC, paste the new circuit into place, and save the drawing (Figure 10).

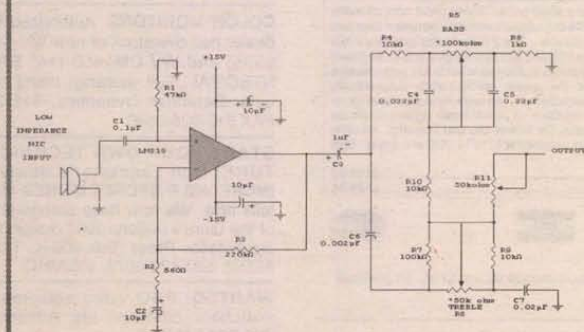
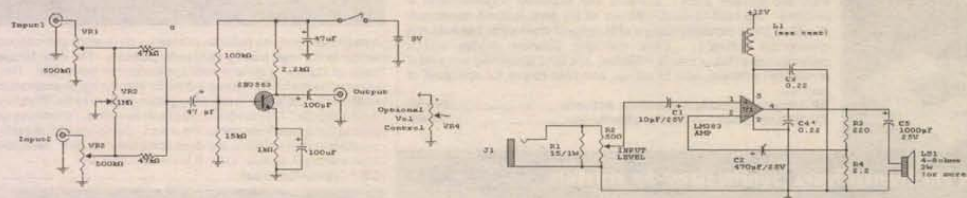
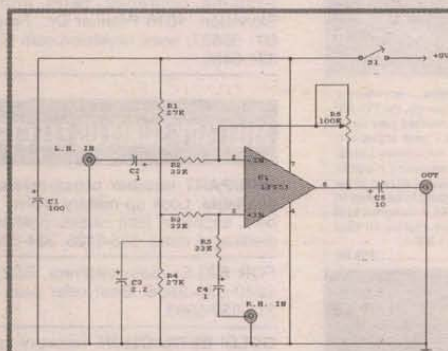
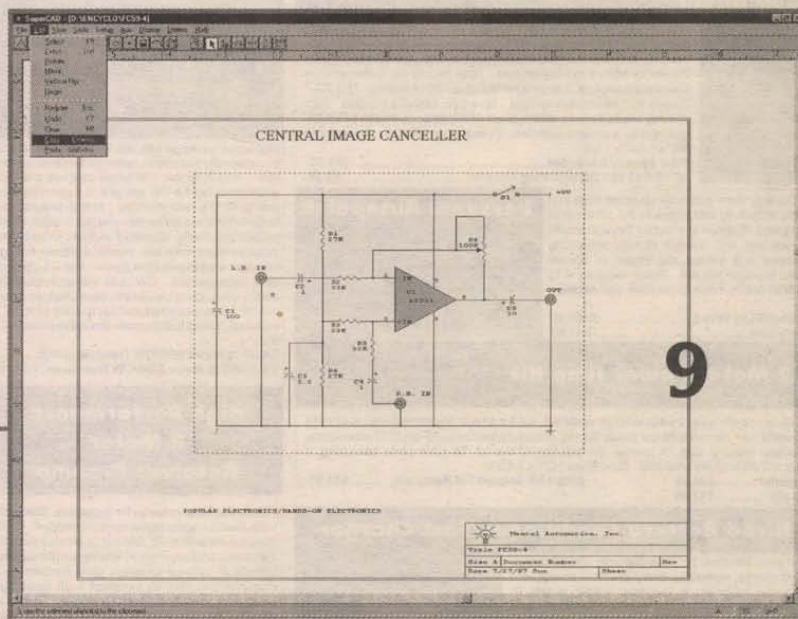


Next Month: Wiring The Modules Together

That's all I have space for this time around. Next month, I'll show you how to wire the modules together and make the necessary part changes to complete the karaoke circuit. The following month, we'll turn the schematic into a printed circuit board.

If you can't wait that long and simply want to build the project, you can download the finished schematic, parts list, and PCB layout from our Web site (<http://www.nutsvolts.com>) under the name KARAOKE.ZIP.

You can also buy an etched and drilled PC board from **Circuit Design**, P.O. Box 5415, Central Point, OR 97502 (541-664-7904; circuit-des@aol.com) for \$24.95. NV



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SDP-600 Personal Autopatch Fully Wired.....\$249.95
SDPA 12 Volt Power Supply Unit.....\$11.95

Personal Autopatch

2 Meter Power Amp Kit

The PA-1 will give you a ten times power gain, 2 watts in for 20 watts out, 4 in for 40 out. Power required is 12 to 14 volts DC at 5 amps with 40 watts out. You provide the power supply, enclosure/heat sink, RF and DC connectors, optional T-R switching, receive preamp and, of course, the building of the kit. To save parts searching, a companion T-R switching kit and preamp are available. Size: 4" x 1 1/2" x 2 1/2".

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PR-10 2 Meter Preamp Kit.....\$17.95

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BP-2 BayPac Portable Packet Plus Software.....\$49.95
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Print-sized package with the DDS synthesizer that runs in 10 Hz steps with exceptionally low phase noise for fantastic weak signal reception. The SX-20 has a built-in iambic CW keyer that has a digital readout of your CW speed, even checking the CW key jack to determine what type of key you're using! A pair of VFO's, with memory, to hop around, dual selectable AGC, plus one button WWV reception lets you get a quick check of reception conditions and calibration. Perky 10 watt RF output can be tuned down for the QRP operation. Includes hand mike with remote up/down tuning buttons and a dirt and water resistant membrane front panel. The SX-20 is compatible with all ICOM style desk microphones. CW buffs will appreciate the optional CW filter with DIP switch selection of bandwidth, from 2400 Hz down to a sharp 100 Hz. Available in both fully assembled and fun to build kit form. Runs on 12 VDC supply, not included, 5 Amp fused power line cable included. Case size 9 5/8" x 3 3/4" x 5 9/8".

SX-20 20 Meter SSB/CW Transceiver Kit.....\$299.95
SX-20WT 20 Meter SSB/CW Transceiver, Fully Wired.....\$369.95

High Performance 2 Meter Receiver Preamp

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PR-100 High Performance 2 Meter Preamp Kit.....\$59.95

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CS-1 Crystal Radio Set.....\$19.95

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80387SX-20	\$17.95	8751H	\$9.95
80387SX-25	\$19.95	8752	\$13.95
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NEC 6X CD-ROM DRIVE FOR VERSA 2400 SERIES

New fast 6X CD-ROM add-on or upgrade for NEC Versa 2400 laptop computer. Slides easily into VersaBay 2400 slot. One year manufacturer's limited warranty.
OP-260-65001 (Versa CD 6X Drive).....\$149.95 Ea.

NEW COLORADO JUMBO 120 INTERNAL TAPE BACKUP DRIVE

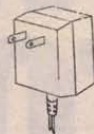
New Colorado Jumbo 120 tape backup system has up to 120MB capacity using data compression. Installs in minutes connecting to most existing floppy controllers. Includes powerful, easy-to-use Colorado backup for DOS software program. Fits into 5-1/4" or 3-1/2" half height drive bays. QIC-40 compatible. Kit includes: drive, cable, mounting screws, and all documentation. Note: Tape not included.
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12Vdc 100Ma	\$1.25 Ea.
12Vdc 200Ma	\$1.50 Ea.
12Vdc 500Ma	\$2.95 Ea.
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Resolution: 25-400 DPI.
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device.
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This board is your basic super VGA video board with 1 meg of DRAM type memory. (ISA BUS TYPE) Core Logic Chip: WD90C31-25-00-02. Resolution/Color: 640x480/256C. 800x600/256C. 1024x768/256C. 1024x1024/16C. Note: Software drivers included with board. Windows 3.1, VESA, Autocad, etc.
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NEW INTEL N80287XLT MATH CO-PROCESSOR

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1 MEGX8-80 30P SIMM (8 chip)	\$7.95 Ea.
1 MEGX8-10 30P SIMM (8 chip)	\$6.95 Ea.

NEW TEAC 1.44 MEG 3.5" FLOPPY DISK DRIVE

New Standard 1.44 Meg 3.5" floppy disk drive. Manufactured by Teac, Model #FD-235HG. Face plate color: Beige. 34 pin interface connector with 4 pin power. FD-235HG Teac 1.44M.....\$32.95 Ea.

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Made by Tandy for Tandy 1000EX Computer. Unit enclosed with cable for hook-up.
Drive inside is a Teac Corp. Model #FD-35 FN-10-U.
Color: White
Tandy Model #25-1061.....\$24.95 Ea.

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Made by Sundisk. (Read/Write 5VDC.) Works with any laptop or PDA with PCMCIA ATA Spec. interface & software drivers. ("Software drivers not included") (Note: 10 meg is uncompressed capacity) Platform compatibility: HP 100X/200X IBM TP 350, 365, 500, 750, 755, and others, contact Sundisk for your specific model. Cards are Plug-Play Windows 95 compatible. Sundisk 408-562-0595 or www.sundisk.com
SDP5-10 SUNDISK.....\$124.95 Ea.

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New Pentium 60/66 heatsink 12VDC fan combo for cooling the older, hotter, CPUs. Low profile type with seven inch wires. Can be used on other CPUs if you have the physical space.
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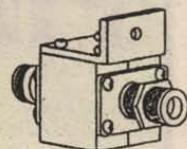
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Digital Voltmeter Capacitance Adaptor

by Fred Blechman

Next to resistors, there are no other more common components in most circuits than capacitors, which come in an amazing number of sizes and shapes, and with an enormous range of values.

The many types of capacitors are generally based on the material used for the dielectric. There are ceramic capacitors, mica capacitors, paper capacitors, synthetic-film capacitors, electrolytic capacitors (polarized and non-polarized), tantalum capacitors, and variable capacitors.

Typical capacitance can range from a few picofarads (one millionth of a microfarad) to thousands of microfarads (one millionth of a farad.) To add to the confusion, capacitor values are identified in different ways, and their actual values are frequently far different from their marked values.

Value markings on capacitors are not nearly as standardized as on resistors. Many, especially those used in some commercial products, have no markings at all! Those that are marked may use simple numbers, coded numbers, color-coded dots, or colored stripes. Some have tolerance codes and temperature limit codes.

All in all, unless a capacitor is clearly marked with its nominal value, or uses a three-digit numerical code that is somewhat similar to the resistor multiplier code, you could have no idea of its capaci-

Capacitors come in many types, sizes, shapes, and an enormous range of typical values — from several picofarads (pF) to thousands of microfarads (uF). This inexpensive capacitance adaptor lets you use a common digital voltmeter (DVM) or digital multimeter (DMM) to measure capacitor values from 20 pF to 2 uF. It can be built from scratch, or from a \$12.95 kit.



ance value or its voltage limitation. If you really need to know the actual capacitance, a proper measuring instrument is needed.

However, measuring the actual value of a capacitor is not anywhere as simple as measuring a resistor value. Digital multimeters apply a constant current through a resistor and measure the voltage across it. Ohms Law: Resistance in ohms is equal to the voltage in volts divided

by the current in amperes. The greater the voltage at a set current, the higher the meter reading. Appropriate meter markings or calibration make this a straightforward task.

But measuring the actual capacitance value of an unknown capacitor takes some form of dynamic testing, since capacitors are initially not charged and their capacity is what must be measured. Capacitors are

inherently AC devices, since they block DC current flow once they are charged, and the amount of AC current they pass is inversely proportional to the AC frequency.

Many methods have been devised to measure the value of capacitors, from various AC bridges with null indicators (such as "magic-eye" cathode ray tubes or zero-center meters) to oscillators that measure the amount of current flowing through a capacitor at a specified frequency.

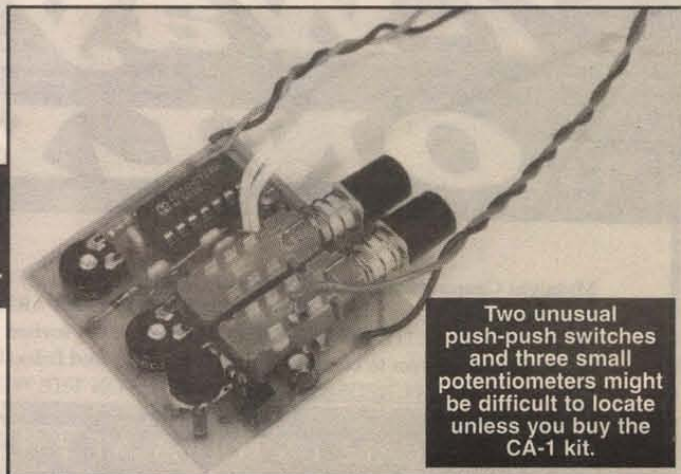
I've owned a Lafayette Condenser Checker Model LC-15 since 1959 (we used to call capacitors condensers in those days) and it still works fine. It uses an AC bridge circuit with a 6E5 magic eye null indicator, and covers a test range from 10 picofarads (pF) to 1000 microfarads (uF) in four overlapping ranges with about 10% accuracy. It also measures the power factor of electrolytic capacitors, and provides five voltage test ranges up to 450 volts. I believe it cost me about \$25.00 back in 1959.

But today you can't find simple instruments like these. Lafayette, Eico, Allied, Heath, and others are either out of business or no longer make simple equipment of this sort, even in kit form. Ah, for the "good old days ..."

Today you can purchase a digital multimeter for \$89.00 that measures capacitance up to 2,000 uF in nine ranges from Bel MERIT, 26242 Dimension Drive, Suite 110, Lake Forest, CA 92630; phone 714-586-



Compactly designed, the CA-1 allows you to measure capacitance from 20 pF to 2 uF using an external digital voltmeter.



Two unusual push-push switches and three small potentiometers might be difficult to locate unless you buy the CA-1 kit.

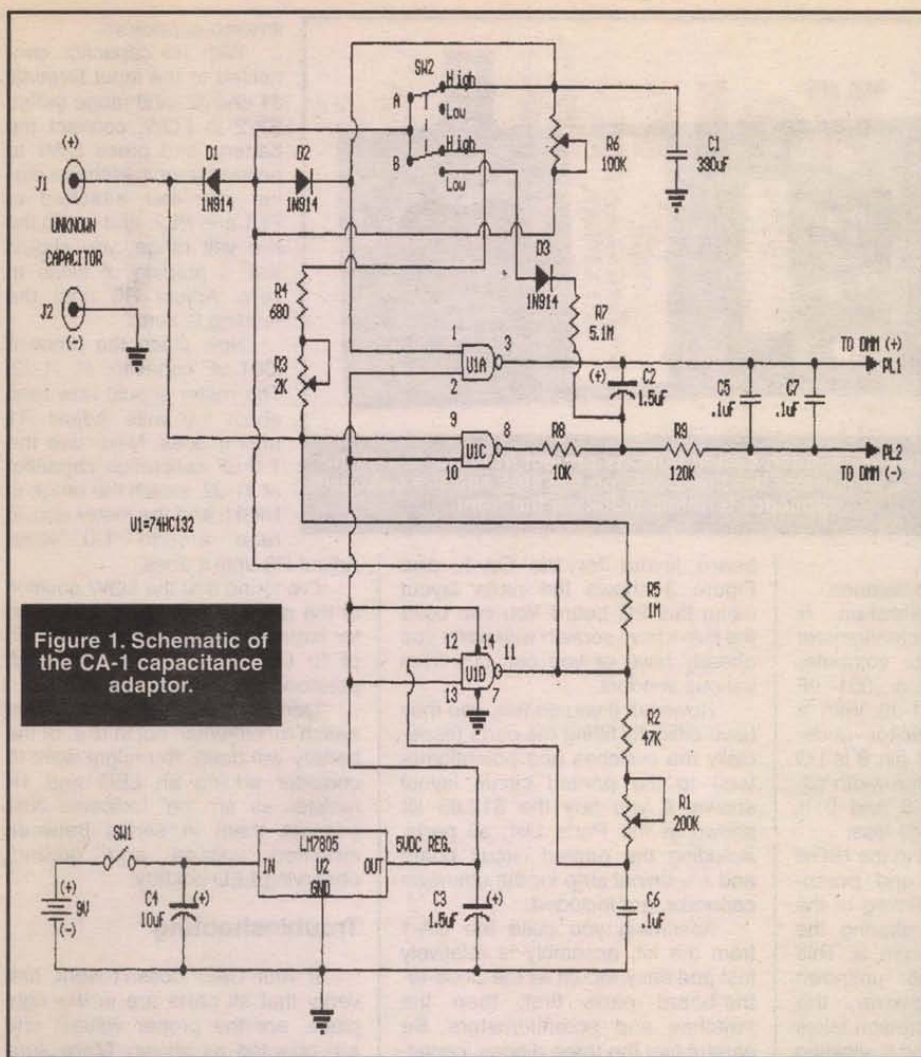


Figure 1. Schematic of the CA-1 capacitance adaptor.

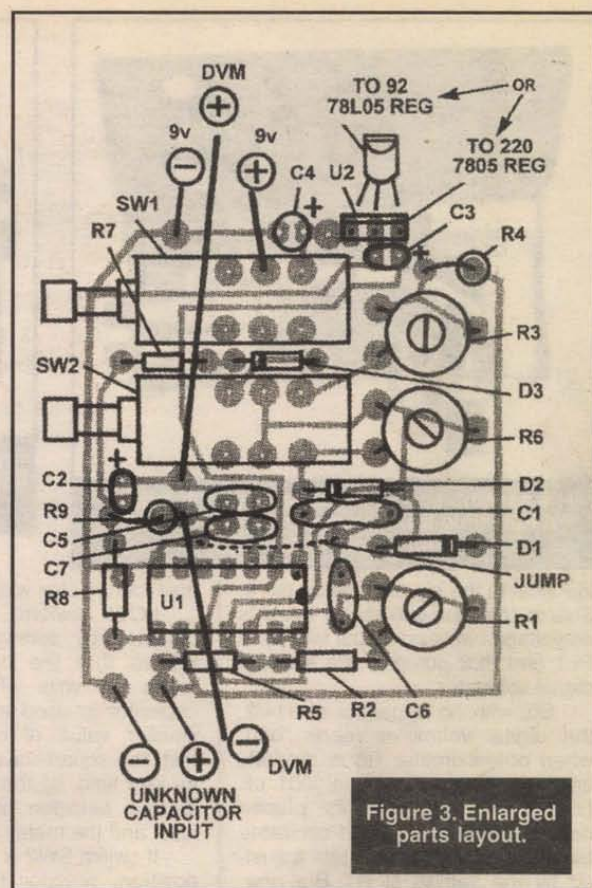
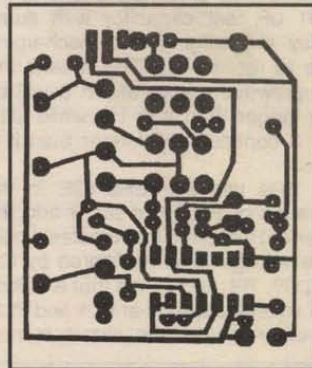


Figure 3. Enlarged parts layout.

Figure 2. Actual size printed circuit board layout.



3700. If you want to measure capacitance only, the Elenco Model CM-1555 Digital Capacitance Meter measures capacitors from .1 pF to 20,000 uF in nine ranges and sells for only \$48.95 (plus \$5.00 shipping) from C&S Sales, 150 W. Carpenter Ave., Wheeling, IL 60090; phone 1-800-292-7711 or 1-800-9445-3201 in Canada.

But, if you're willing to build it from scratch or from a \$12.95 kit, you can measure capacitance from 20 pF to 2 uF with the CA-1 Capacitance Adaptor and a digital voltmeter or digital multimeter you probably already have. Incidentally, the CA-1 will not give proper readings with an ANALOG meter; you need a DIGITAL meter with its typical 10 megohm input impedance.

Features

The CA-1 can measure a range of capacitance from 20 pF to 2 uF in two ranges, using only a standard nine-volt battery and any digital voltmeter that reads up to two volts. It has an on-board voltage regulator and three calibration potentiometers for reasonable accuracy, probably within $\pm 10\%$.

The \$12.95 kit includes everything you need but the battery and solder. Add a simple cabinet and a couple of binding posts and you can carry it around in your shirt pocket or tool box.

However, the CA-1 has certain limitations. It does not reliably measure capacitors higher than 2 uF, so it does not test most electrolytics. It does not perform any voltage tests, or measure the power factor of electrolytics.

Circuit Theory

Figure 1 shows the schematic of the CA-1. The LM7805 voltage regulator (U2), together with capacitors C3 and C4, provides a stable five volts DC even as the nine-volt battery drops in voltage over time. As long as the battery supplies about seven volts, the regulator will provide five volts to the rest of the circuitry. Since the CA-1 current drain is only about five milliamperes, and there is an on/off switch, the battery can last a very long time with its typical occasional use.

Integrated circuit U1 is a 74HC132 Quad NAND Schmitt Trigger, which means it has four fast-

switching NAND gates. Each gate is independent of the others. J1 and J2 are the input points for the unknown capacitor.

Analyzing the operation of this circuit is very tricky. Begin by assuming no capacitance at J1-J2, and the double-pole double-throw range switch — SW2 — is in the LOW position. When power switch SW1 is closed, battery voltage is regulated to five volts by U2 and this five volts (which we'll call HI) is applied to one input of each of the three NAND gates used — pin 2 of U1A, pin 10 of U1C, and pin 13 of U1D. (U1B is not used.)

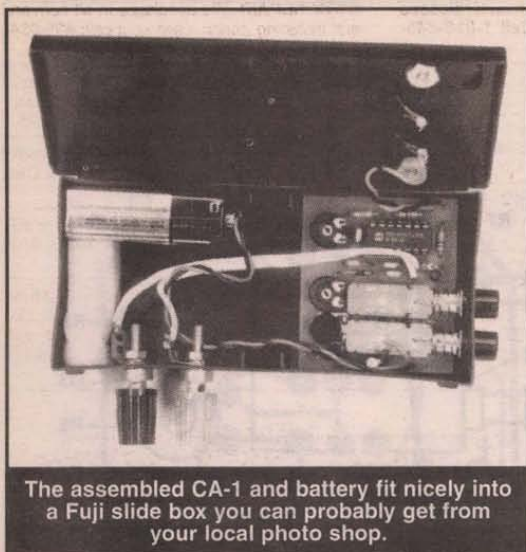
When a NAND gate has any combination but HI on BOTH inputs, the output is HI, so the outputs of all three NAND gates are initially HI. However, look at pin 11 of U1D. The HI here is applied through resistor R2 and potentiometer R1 to capacitor C6, allowing C6 to charge at a rate based on the setting of R1. This is called an RC (resistance-capacitance) circuit, where the capacitor charging time is a function of the resistance and capacitance values; the higher either value, the longer the charging time.

C6 is directly connected to the

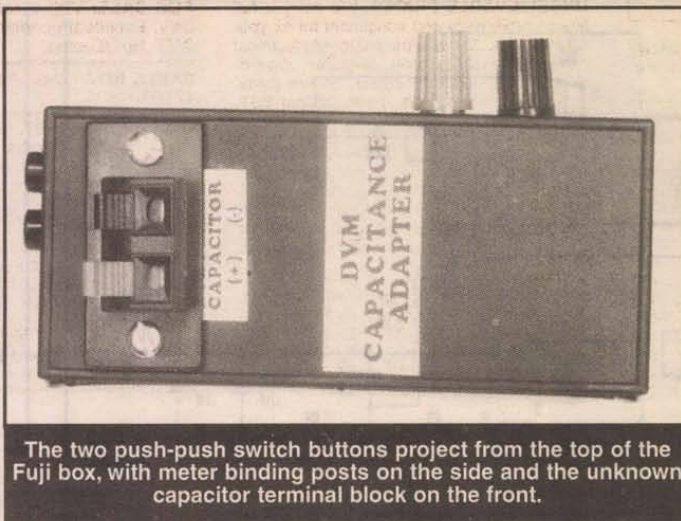
other input, pin 12, of U1D. When C6 reaches the trigger voltage of U1D (about 2.5 volts), U1D sees BOTH inputs as HI, and the output, pin 11, snaps to a LO (ground) voltage. But now C6 can DISCHARGE through R1 and R2 to pin 11, so C6's voltage drops. When it gets down to about 1.5 volts, pin 12 drops LO so pin 11 jumps back to HI, and the cycle repeats. This is an oscillator and, with the values used, it switches about 160 times a second, producing a non-symmetrical five-volt squarewave at pin 11.

Meanwhile, input pin 9 of U1C (through resistor R5) and pin 1 of U1A (through diode D2) follow pin 11, producing squarewave outputs at pins 3 of U1A and 8 of U1C.

Potentiometer R6, together with capacitor C1, steering diode D3, and resistor R7, allow adjustment of the squarewave at pin 3 to be



The assembled CA-1 and battery fit nicely into a Fuji slide box you can probably get from your local photo shop.



The two push-push switch buttons project from the top of the Fuji box, with meter binding posts on the side and the unknown capacitor terminal block on the front.

identical to the squarewave at pin 8. This is the zero-adjust, so there is no voltage between output terminals PL1 and PL2 going to the external digital voltmeter.

So, with no capacitor at J1-J2, the digital voltmeter reads "000" when potentiometer R6 is properly adjusted. Now, assume a .001 uF (1,000 pF) capacitor is placed between J1 and J2. Pin 11 oscillates between HI and LO at a rate adjusted by the setting of R1. But now, when pin 11 is HI, it is charging the .001 uF test capacitor with some delay in charging and discharging due to resistor R5. This means the squarewave output at pin 8 will be LO longer than it is HI, while U1A pin 3 continues HI longer than it is LO.

It is this DIFFERENCE in the duration of the HI at pin 3 and the shorter HI at pin 8 that creates a positive voltage which is filtered by C2, C5, C7, R8, and R9 so that a steady DC voltage appears at PL1 and PL2. In other words, the circuit is now

measuring pulse width difference.

LOW switch calibration is obtained by setting potentiometer R1 so that the digital voltmeter reads 1.0 volts when a .001 uF capacitor is used at J1-J2. With a smaller value of capacitor under test, the squarewave at pin 8 is LO for less time, so the pulse width difference between pins 8 and 3 is less, and the meter reads less.

If switch SW2 is put in the HIGH position, resistor R4 and potentiometer R3 affect the timing of the HI at pin 9 of U1C, altering the squarewave output at pin 3. This compensates for higher unknown capacitor values. However, the same pulse width comparison takes place between pins 3 and 8, yielding a positive voltage value between PL1 and PL2, adjusted by R3 for 1.0 volt DC at PL1-PL2 with a 1.0 uF capacitor at the J1-J2 input.

Assembly

Figure 2 shows a printed circuit

board layout for the CA-1, and Figure 3 shows the parts layout using this PC board. You can build the CA-1 from scratch with parts you already have or you can buy from various vendors.

However, if you do this, you may have difficulty fitting the parts (especially the switches and potentiometers) to the printed circuit layout shown. If you buy the \$12.95 kit shown in the Parts List, all parts, including the printed circuit board and a terminal strip for the unknown capacitor, are included.

Assuming you build the CA-1 from the kit, assembly is relatively fast and easy. Mount all the close-to-the-board parts first, then the switches and potentiometers. Be careful that the three diodes, capacitors C2, C3, and C4, and U2 are properly oriented as shown in Figure 3. Don't forget to add the jumper shown.

Use a socket for U1 (supplied in the kit), and be sure to install pin 1 on the right as shown. Connect the battery snap (supplied), making sure the red wire goes to the (+) shown in Figure 3, and the black to (-).

Use some hook-up wire to connect the unknown (+) capacitor input to the red terminal of the supplied input jack, and (-) to the black jack terminal. Similarly, connect two wires to the (+) and (-) DVM outputs to connect to your digital voltmeter, marking the positive wire.

Testing

The toughest part of the testing is finding the .001 uF and 1.0 uF calibration capacitors. These should really be provided with the kit. Since capacitors vary notoriously from their markings, try to use precision capacitors, or find the actual values using another capacitance tester and adjust your calibration accordingly. I used my Lafayette LC-15 to determine actual values (within 10%) for the .001 uF and 1.0 uF cal-

ibration capacitors.

With no capacitor connected to the input terminal J1 and J2, and range switch SW2 in LOW, connect the battery, and press SW1 to power the unit. With the digital voltmeter attached to PL1 and PL2, and set to the two volt range, you should see a reading of close to zero. Adjust R6 until the reading is zero.

Now place the "known" .001 uF capacitor at J1-J2. The meter should now read about 1.0 volts. Adjust R1 until it does. Next, use the 1.0 uF calibration capacitor at J1-J2, switch the range to HIGH, and the meter should read around 1.0 volts.

Adjust R3 until it does.

I've found that the LOW position of the range switch should be used for capacitor measurement from 20 pF to .001 uF, and the HIGH switch position for .001 uF to 2.0 uF.

Don't forget to turn the power switch to "off" when not in use, or the battery will drain. You might want to consider adding an LED and 1K resistor as an "on" indicator. Just connect them in series between switched voltage and ground, observing LED polarity.

Troubleshooting

If your CA-1 doesn't work, first verify that all parts are in the right place, are the proper values, and are oriented as shown. Make sure the solder joints look good — not gray or grainy.

Next, check the voltages at U1, looking for a steady five volts on pins 2, 10, 13, and 14, and 0 volts at pin 7.

Beyond that, you'll need an oscilloscope. Look for squarewaves on pins 3, 8, and 11 referred to ground, and then check for a squarewave between pins 3 and 8. Also, pin 12 referred to ground should show a 2.5 volt peak-to-peak trianglewave as C6 charges and discharges.

Packaging

I've used a black Fuji Slide Box, shown in the photos, for many of my small projects. This is normally used by film finishers to hold 36 color slides. It is made of soft plastic, easily drilled and cut. See if you can get some from your photo finisher. (Fuji Film charges 25¢ each, but only sells to photo shops.)

The CA-1 printed circuit board and battery fit perfectly in this box. I added two binding posts to allow easy connection to my digital voltmeter leads. The two switch knobs fit through round holes in one end of the box, and the unknown capacitor

- C1** - 390 pF monolithic ceramic or mica capacitor
C2, C3 - 1.5 uF tantalum capacitor
C4 - 10 uF electrolytic capacitor
C5, C6, C7 - .1 uF monolithic ceramic capacitor
D1, D2, D3 - 1N914 or 1N4148 signal diode
J1, J2 - Dual input jack
J3 - Nine-volt battery snap connector
R1 - 200K trim potentiometer
R2 - 47K 1/8-watt 10% carbon resistor
R3 - 2K trim potentiometer
R4 - 680 ohm 1/8-watt 10% carbon resistor
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R8 - 10K 1/8-watt 10% carbon resistor
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SW1, SW2 - DPDT PC-mount push switch
U1 - 74HC132 Quad Schmitt Trigger integrated circuit
U2 - LM7805 or LM78L05 5-volt DC regulator
Misc: 14-pin integrated circuit socket, wire, solder, cabinet, nine-volt battery.

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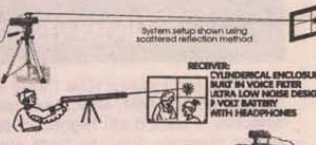
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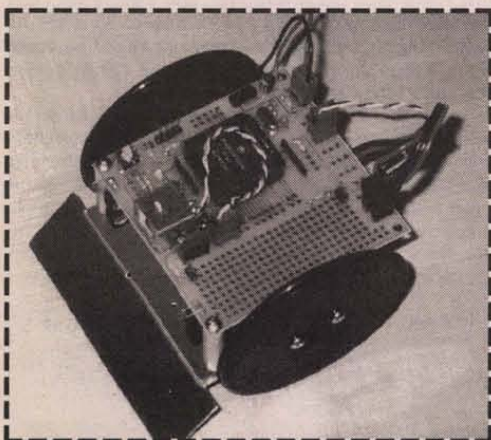
by Karl Lunt

AMATEUR ROBOTICS

I get a lot of E-Mail from readers, and some of it would just break your heart. It's usually from some poor soul stuck out in a robotics hinterland, trying to piece together a robot or a controller board or just anything, but he (and sometimes she) has no one to talk to, no one to bounce ideas off of. Finally, they send off an electron to me asking for help.

I usually get back to them with either a workable solution or a pointer to help them take the next step. But once in a while, a reader will ask the larger question, the solution to which will actually solve all the other, smaller problems: How do I start a robot club like the Seattle Robotics Society?

Tough question, that. Actually, that is two tough questions. The first question really is: How do I start a robotics club? Since I've never actually started a club myself, I can only offer what I think are sensible suggestions. Start by communicating with as many other people of the same persuasion as you can. If you're enrolled in a junior college class on microcontrollers, talk to the others in your class, to your instructor, and to those in similar classes, to see who is interested in robotics. If you're hanging out at the library Internet terminals, leave a card on the bulletin board and see who responds. Post a notice at the local surplus electronics store or computer store. If your city or town has a web page dedicated to local activities, see if you can post a notice to it.



Top view of Marvin's Mini Sumo frame. You get IR object detection, prototyping area, and four servo controllers, in less than a 10 cm by 10 cm square. Not bad!

The point here is to get your interest in robotics across to others similarly inclined. You can almost approach this as if it were a job search. Call all of your friends and ask if they are interested in building robots with you. If they are not (and sadly, many will not be), always ask them for the names of at least two other people that you can contact. The goal isn't to find a lot of people interested in robotics. You are trying to get in touch with as many people as possible, period. In the course of your efforts, you will eventually find the few who want to do 'bots. So when you start calling, be sure to call ALL your friends and relatives, even if you know (or think) they won't do robots.

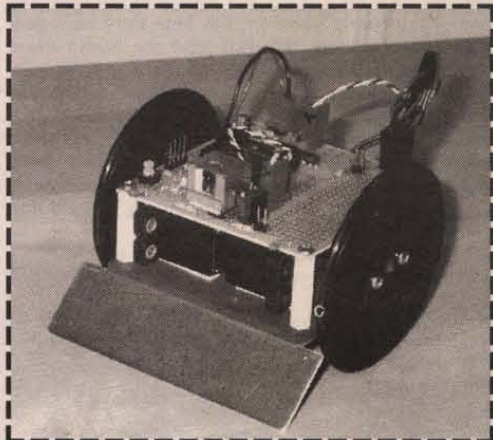
Be sure to contact those you know in hobbies or activities that use similar thinking skills. For instance, if you play Magic or chess, talk to others who play. These hobbies use much the same grey matter as designing robots, and should provide you with a good starting point in your search.

If your area has a local high-tech tourist attraction, hang out with the people who work there.

I did an article some time ago about MBARI, the Monterey Bay Aquarium Research Institute. Talk about a bunch of ready-made robo-nerds! Any two or three of the MBARI staff could have made an excellent core to a robotics club. I'm sure if I had just hung around the aquarium and asked enough questions, I could have connected with some of the engineers.

Then there is the Internet. You can find hundreds (thousands?) of web sites devoted to homebrew robotics, university and government research projects, and robotics designs from private industry. If you visit enough of these and use E-Mail appropriately, I'm sure you can contact others who share your interests. You might even find people close enough to you geographically that you can visit each other.

And remember to investigate Internet sites in related fields. Rather than focus on just robotics, look into geotechnical, astronomy, oceanography, model rocketry, remote control, homebrew electronics, embedded control, model railroading, and ham radio, to name just a few. I'm sure you'll find many people



Front view of the Mini Sumo. This shows the front scoop, the rubber-timed wheels, and the new BotBoard PCB. The silver cube in the center of the PCB's front edge is the IR detector.

with interests in several of these fields, and you can probably interest them in robotics as well. Again, you might find people who live within visiting range.

I mentioned earlier that there were really two questions involved here. The second question is: How do I make a club like the Seattle Robotics Society? The short answer is time, luck, and hard work. The long answer deals with people and synergy.

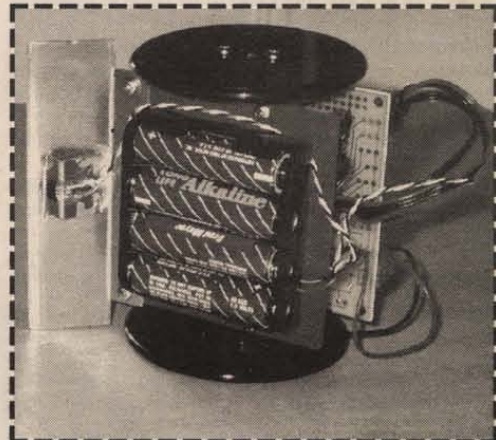
The SRS has been around for a long time. I attended my first meeting in late 1989, so I'm a relative newcomer. The club still has members who recall the very early days of 1981 and 1982, when the SRS first formed. Back then, the club members spent most of their time on mechanics and simple electronics. Microcontrollers in today's form simply didn't exist, and the computers of that day, such as the Apple, were too expensive and too power-hungry to bolt onto a robot frame. This marked the "heavy-metal" phase of the SRS.

Meetings took place each month at a surplus

electronics store in downtown Seattle. The store carried lots of heavy surplus metal and motors, and the SRS members were always a sure sale. The club had a mascot robot, a very large metal frame on very large casters and carrying a very large battery supply. Since almost no one had enough work space in which to tinker with this machine, it usually spent its days in the front of the electronics store, where it served as a nerd-lure and sales gimmick.

By the time I arrived in 1989, regular attendance was on the decline, with the average meeting drawing just 10 or so. Membership continued to drop, and at its lowest ebb, I recall attending a meeting with only about four other people. But the faithful hung in there, the membership slowly rebounded, and today's meetings routinely pull 50 or more attendees.

I think sheer enthusiasm kept the club from dying out altogether. Even when only five of us showed up, we always brought our works in progress, always talked about the robots we would build, and always shared our experiences. To this day, the most important element of each meeting is the time spent describing what we've done and how we did it.



On the underside of the Mini Sumo, you can see the four penlight cells for power. The vertical bar on the left side is the front scoop with its down-looking photodetector for sensing the white line at the ring's rim.

This usually occupies at least an hour of each meeting, and is open to all who wish to talk. To make sure everyone gets a chance to speak, Kevin Ross, the club's president, polls each and every attendee at the beginning of the meeting. If someone wants to talk, Kevin notes the name and topic on the blackboard. After working the room, Kevin goes back to the blackboard and gives each person who signed up their 5 or 10 minutes of speaking time.

I get a chuckle out of the first-timers; they are always shocked that they would be asked if they have an item for the agenda. But that's part of what makes this club work; it doesn't matter if you're a first-timer or a founder, everyone gets a chance to contribute.

And asking questions can be just as important as describing your project. Some of our most interesting discussions have started with someone wanting to know if someone else had solved a certain problem. One such question, regarding a power supply that didn't poop out when the battery dropped

below six volts, spawned a discussion that turned into a design session, ultimately leading to the Junk Box Switcher, the topic of an article a year or so ago.

The years since I arrived have seen a huge change in the type and number of robots in the club. The early "large-iron" designs have given way to small, light machines built of plastic, wood, brass rod, and PCB stock. Where robot builders used to describe batteries in terms of Amp-hours or pounds, they now speak of C-cells or solar cells. And the new machines don't rely on the heavy motors of yesteryear's designs; today's builders go with pager motors and R/C servos.

Since the materials are so light and easy to work, the robots are small and easy to build. The club's periodic nerd-fest, Robothon, will routinely draw 100 attendees or more. Many of the SRS members show up with not just one but several working robots, and the arena is usually thick with little robotic critters.

But the biggest change of all in the time I've been a member concerns the microcontrollers used in the club's robots. In the early days, you could choose from maybe two or three viable microcontrollers, but there weren't a lot of development tools around and few people knew how to write software well enough to get the robot going. Sure, you could build in a 68hc11 board, but that required point-to-point wiring on a perfboard. So making your first microcontroller was a major effort, and building the second one required just as much work. But by then the excitement of getting the first one running had worn off, so making the second one became a chore more than anything else.

Even when you did get a microcontroller built, it was still a major uphill battle to get any software written for it. Everything had to be done in assembly language, assuming you could even find a suitable assembler. If you got stuck on a hard problem, such as setting up interrupt vectors, you had almost no one to talk to about it. And after you got the microcontroller to do anything at all, you then had to write and test the real robot code. The sheer enormity of the struggle stopped a lot of people.

What a difference a few years make! Today, the club sports groups of people with serious design experience on microcontrollers as diverse as the 68hc11, 68hc12, 68332, 80c188, 8051, and others. Anyone in the club who wants to start a design

simply needs to raise a hand and she'll find SRS members who already have etched PCBs, written software tools, and built libraries of working code. Take, for example, the 68hc11. Besides the stock Motorola tools such as asmhc11 and pbug11, SRS members have developed power tools such as Interactive-C and SBasic, with large libraries of tested code. Any member can draw on these resources to help build their own machine, saving a bundle of time and work.

But all of the above doesn't really answer the question of how to make a club like the Seattle Robotics Society. The SRS became an extension of the talents and energy of its members. The club became what it is because so many people wanted so much to spend time with other robot builders, to learn from others, and to help others. In all my years in the SRS, I can't recall hearing a single cross word or seeing a heated argument of any kind. It isn't that we have rules against such, only that they just don't happen.

This is as close as I can get to telling you how to build a club like the SRS; always contribute more than you take.

Mini-Sumo

Some years ago, a robot competition in Japan introduced the world to robot Sumo. Modeled after the traditional Japanese wrestling sport, two small machines square off against each other in a black-surfaced ring. To win, one robot must push the other off the ring. Size and mass restrictions apply to keep the robots within sensible limits.

The Seattle Robotics Society has run Sumo competitions for a few years now, and Bill Harrison, one of the club's stalwarts, has kept the club's gear in primo condition; Bill also runs the Sumo event during the club's periodic Robothons.

But building a Sumo contender can prove difficult. The 20 cm (about 7.87") footprint and 3 kg mass limit translates into a hefty robot packed into a small space. This places a premium on machining skills and tools. To open up the Sumo event to a larger audience, Bill developed the Mini-Sumo contest.

Mini-Sumo robots mass just 500 g and fit into a 10 cm footprint; the contest takes place on a ring half

the size of the larger 'bots, only 77 cm (about 2.5 feet) in diameter. The smaller size and weight limits let you build a Mini robot using lighter materials, which makes the robot easier to build. Of course, you now have the challenge of getting all the electronics, motors, wheels, and batteries to fit in the smaller size and mass limits. But the club has far more Mini robots than full-fledged Sumos, so I think Bill's move to the smaller machines was a good one.

To date, most of the machines are blind pushers. They patrol the Sumo ring in a pattern, hoping their bumper switches will contact something so they can turn and push it off the ring. Think of these designs as first-order solutions, little more than brainless, sightless machines. Naturally, many in the club are pushing for stronger, smarter solutions.

During a recent visit to Seattle, Marvin Green brought along his first version of a Mini robot. Built in a 10 cm square base, it uses hobby R/C servos for motors and has a front skid or scoop for sliding under the opposing machine. Marvin and Bill collaborated on the mechanics, and the result is a clean, simple mechanical solution. Marvin then added a custom-designed BotBoard-style computer to run the robot. He designed a new PCB for this 68hc11 microcontroller, adding features long missing from his original BotBoard product, such as on-board 40 KHz IR object detection and 32K of RAM. The final PCB is smaller than the 10 cm square space restriction for the Mini robot, making it an ideal general-purpose 68hc11 robot controller.

Marvin and I cleared out a working space in my very cluttered robot room, then settled down to some serious hacking. It was the Friday night before the SRS' monthly meeting, Marvin hadn't even built the first robot from his new design, and there wasn't any software for running his new machine. So while he heated up my soldering iron and unpacked his robot parts, I fired up my laptop and began designing the first cut at the Mini Sumo robot code.

Just four hours later, with a short break for sugar and fat, we had a working Mini Sumo robot, complete with IR object detection and tracking software. The fact that we could get so much done in such a short time speaks well for the tool set we used. Marvin's electronics design worked beautifully with no surprises, and my large library of SBasic code let me focus on navigation and strategy without bogging

<pre> minisumo.bas ' Program to control a mini Sumo robot, based on Marvin ' Green's mini-Sumo platform. main: gosub Initialize do gosub GetInput gosub Process gosub Delay, 40 loop ' Look around and return result in Action. ' Note that chasing an object has priority over ' avoiding the ring's perimeter line. GetInput: temp = 0 gosub IRLEDOn, RIGHT_IR gosub Delay, 2 if peekb(porta) and \$80 = 0 temp = 1 endif gosub IRLEDOn, LEFT_IR gosub Delay, 2 if peekb(porta) and \$80 = 0 temp = temp + 2 endif gosub IRLEDOff select temp case 0 Action = IDLE </pre>	<pre> endcase case 1 Action = TURN_RIGHT print "R "; return endcase case 2 Action = TURN_LEFT print "L "; return endcase case 3 Action = FORWARD print "F "; return endcase endselect gosub CheckLine line print peekb(addr4); if peekb(addr4) > LineThreshold Action = REVERSE print "B "; return endif print "I "; return ' Do something, based on value in Action. If ' Action = IDLE, do a little dance while we look ' for a target. Process: if Action = IDLE IdleCount = IdleCount + 1 </pre>	<pre> if IdleCount < 8 return endif if IdleCount < 16 go forward for a while Action = FORWARD endif if IdleCount < 24 Action = TURN_RIGHT endif if IdleCount = 32 IdleCount = 0 Action = TURN_LEFT endif endif select Action case FORWARD poke RTOC, RIGHT_FWD poke LTOC, LEFT_FWD endcase case TURN_RIGHT poke RTOC, RIGHT_REV poke LTOC, LEFT_FWD endcase case TURN_LEFT poke RTOC, RIGHT_FWD poke LTOC, LEFT_REV endcase case REVERSE poke RTOC, RIGHT_REV poke LTOC, LEFT_REV endcase endselect return end </pre>	<pre> ' sit for a while ' leave now ' go forward for a ' turn right for a while ' turn left for a while ' reset counter ' based on Action... ' go forward ' turn right ' turn left ' back up </pre>
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Partial listing of minisumo.bas

down on the low-level problems such as making a motor move. It was quite a thrill that night, watching our little warrior chase a box around on the carpet, knowing that shortly after dinner it had been sitting in various plastic bags in Marvin's luggage.

We strode into the SRS meeting next morning, ready to show off our new creation. Naturally, Murphy was in fine shape and managed to throw a small spanner into our demo. My robot room uses incandescent lighting, which seldom presents a problem with IR object detection systems. The meeting room, however, has fluorescent lighting, which is almost guaranteed to screw up an IR system. Needless to say, we had neglected to add a filter to our IR detector and the little robot saw enemies everywhere. So the demo didn't go as well as we would have liked, but the guys understood what we had done and were appreciative.

By the way, if you've ever run into this lighting problem with IR detectors, just cut a piece of exposed film from the tail end of a roll of color print negatives and glue it over the front of your IR detector. The film is transparent to IR but nearly opaque to regular light, and makes a great filter.

I've included a partial listing of the minisumo.bas file, so you can see how my code translates the IR object detect signals into a plan of action. The code also looks at the floor to make sure the robot isn't sitting on the white line that marks the ring's boundary.

Look at the code in the GetInput routine. It first uses the IR LEDs and IR detector to look for an object. If it finds an object nearby, the code sets a variable to show the desired motor action, then exits immediately, without waiting to look at the floor. This means that the code gives priority to chasing an object over staying away from the edge of the ring. This bit of subsumption gets around a common tactic in Sumo robots, that of deploying a white skirt around a robot so an opponent thinks it's near the edge and breaks off an attack.

Obviously, this code isn't going to compile, as large chunks are missing. But you should get a feel for what is involved in writing software for a simple-minded attacker. Build on this code and you can create a killer Mini of your own. For more details on Sumo in general, see the SRS web page at:

www.seattlerobotics.org — Also, be sure to check out Marvin Green's web site at: www.agora.rdrop.com/users/marvin for the latest on his 68hc11 and 68hc12 projects. To send E-Mail to Bill Harrison about his Sumo efforts, use: sinerobt@halcyon.com

Robot ideas

Linda suggested I add a little section here on how I decide what kind of robot to build next. I'll admit to a blank stare at this concept, since I seldom think about how I think. In response, she pointed out several techniques I use to get over the hurdle and started on the next robot.

For example, she mentioned that I usually stare vacantly out of the window. Well, yes, window staring is important to robot design. In particular, the dark clouds and gray skies of Seattle seem to help spawn robot ideas. There's some aspect of rain clouds scudding across the horizon and sleet pattering on the window that helps me focus on the motor mounts for Tackle-bot or the walking mechanism for my little servo robot. And windows are absolutely the best thing for writing software. I don't know how many times I've turned away from the screen in frustration, only to see the solution in the swaying branches of a fir tree or the manic blossoms on a nearby rhodie.

But windows provide another resource. I've looked outside at spiders in their webs and thought of a rope-climbing robot, then spent much time dreaming up possible mechanisms for scaling a rope or string. Watching ants troop across a window sill helps me get a perspective on walking robots. The rhythm of an ant's legs doesn't translate well into a hobby robot unless you've got a serious junk box, but thinking is free and easy, and you never know where it will lead.

Speaking of junk boxes, Linda points out that I'll spend long hours digging through my tons o' junk, moving parts and pieces around, just playing with how things fit together. Guilty again. I especially like laying out brass rod, battery holders, and BotBoards, then seeing how I can fit them together into a robot design. The brass rod lends itself to designs of kinetic sculpture, and the BotBoards are small enough to fit just about anywhere, so they don't detract from the effect

you're trying to create.

And doing this effectively requires LOTS of junk boxes. I've got cardboard boxes stacked five feet high across one wall of my robot room, and the closet of my robot room, intended to hold clothes and shoes, is packed with books, boxes, half-finished robots, and electronics. I have boxes filled with nothing but motors of various kinds, other boxes crammed full of wheels, and a bin or two packed with batteries. Just as Linda fondles fabric to get ideas for her next quilt design, I juggle junk while searching for that next robot.

But the most important element of designing robots, according to my wife, is laughing. She claims that I'll often get stuck on some part of a robot, so I'll just drop what I'm doing for a while. Instead, I'll pick up a book or watch the squirrels outside our window, and before long I'll be chuckling about something. Shortly thereafter, she'll find me back at the workbench, the problem solved, and I'm on to the next phase.

I'll have to take her word on this one, since I don't pay that much attention to my work habits. But I do laugh a lot, and find humor in just about everything, so she's probably right. I know I've got more Dave Barry books than I do robot books, but that could just be that Dave Barry is more prolific than all the robot authors combined. (Okay, maybe not.)

But it's worth a try. Next time you're stuck on a robot design, grab a little Dave Barry or Jay Leno, tune in the Comedy Channel, or head for the theater. Spend some quality time yukking it up and see what happens. Maybe it'll shake a few ideas loose and get you over the next hump. If not, you can always try my sure-fire cure for robot-block: chocolate eclairs. NV

As always, you can reach me at:

Karl Lunt

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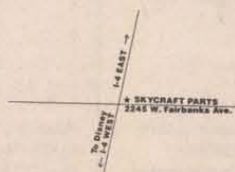
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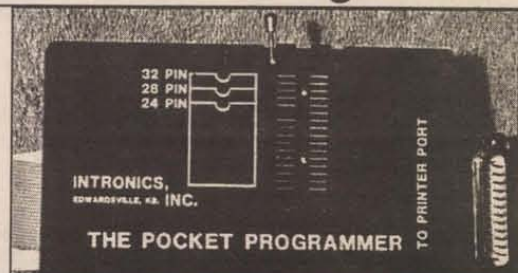
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ELECTRONICS

Q & A

With TJ Byers

In this column, I answer questions about all aspects of electronics, including computer hardware and software. This column doesn't replace the Tech Forum that you've grown to love and support. Instead, it will supplement it, so feel free to participate as always with your questions and answers. You can reach me on America Online at TJBYSERS, on the Internet at TJBYSERS@aol.com, or by snail mail at Nuts & Volts Magazine, 430 Princeland Ct., Corona, CA 91719.

What's Up:

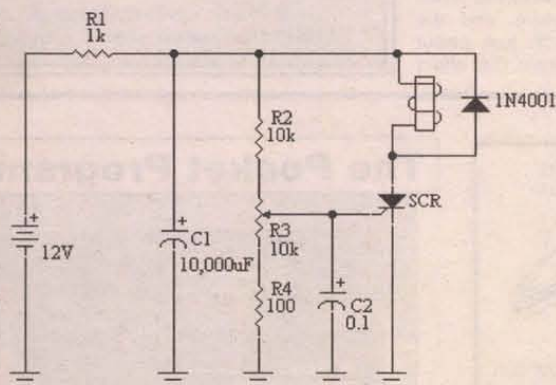
More on power from phone lines, microphone voice compression for AM/SSB, and a SW antenna filter. An LCD meter converter for common-mode operation, a gopher chaser, and ways to repair or silence hard disks.

Electronic Gopher Chaser

Q. This request may be off the wall and I'm not sure if you can answer it, but I'm inundated with gophers. I've tried bait, traps, and smoke bombs, but all to no avail. (Unfortunately, 22-caliber rifles aren't allowed within city limits.) Is there an electronic thing-a-majig that will discourage these vermin from dining on my lawn and garden?

Jim Scardino
Hollister, CA

A. There was a time in my life when gophers drove me crazy, too — which is why I built the "thumper." Basically, it's a stick in the ground that you bang on. The racket gives the critters a headache, after which they pack their bags and leave town (imagine a noisy upstairs neighbor). I've seen wind versions of these rodent chasers, where a little guy is chopping wood or doing some other noisy task, but where I live there isn't always a breeze. So, I replaced the little guy with a solenoid. The other problem I had, though, is that I wanted to protect the south 40 acres, where I don't have utility power. So, I devised this battery-powered circuit.



It runs from a 12-volt car battery that I trickle-charge from a small solar panel. The key components are the 10,000 uF capacitor (C1) and the SCR. As C1 charges through R1, the voltage across the capacitor rises. When C1 is nearly fully charged, the SCR fires and activates the thumper solenoid. The thump rate is adjusted via the 10K pot, R3. The solenoid, you ask? I salvaged mine from a discarded eight-track tape player, but any spring-loaded solenoid seems to work. What you want is the thump, so the heavier the plunger, the better. Feel free to adjust R1 and C1 to suit your needs. Use the formula:

$$t = 4RC$$

where t is in seconds, R is ohms, and C is farads (not uF). Keep in mind, though, that R1 can't be less than 100 ohms, or the SCR might lock up and not release the solenoid.

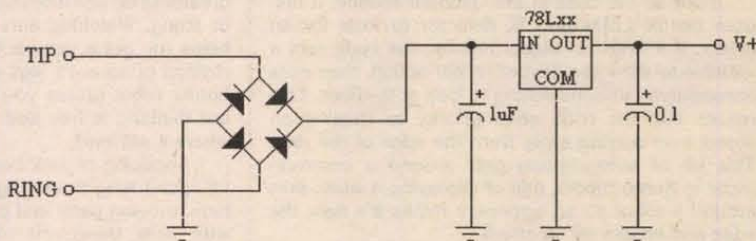
Pa Bell Power: Another Look

Q. Your answer on "Pa Bell Power" (July '97) was a revelation! Our summer home is off the power grid, so we have no electricity — but we do have a telephone. We've often mused about deriving a small amount of dependable power from the phone line to perform simple functions, such as drive a water-level sensor, light an LED, or perhaps trickle-charge a small NiCd. My ques-

tion is the reverse of Mr. Cisneros': With 48 volts at 20 mA to 40 mA to play with, I want to use every drop of power available. How do I most efficiently convert all of those available milliwatts into 12, 9, or 5 volts of useful work? In other words, what power supply design would allow me to operate the largest number of low-current DC Relays, LEDs, and small circuits off the phone line?

Jeff Rothfus
via Internet

A. Have you considered a photovoltaic panel? For \$269.00 you can buy a 42W Unisolar panel from one of our advertisers, Solar Electric (800-842-5678; <http://www.solarelectricinc.com>). This panel is totally indestructible (you can run over it with a truck!) and it delivers 2.5 amps at 16 volts under full sunlight. That's more than enough to charge a 100 Ah battery plus light all the LEDs you could possibly string together. But back to the phone line. First, you have to understand that it's a current source — not a voltage source. The voltage varies from 42.5 volts to 56 volts at a current of 20 mA to 120 mA. On-hook, my voltage measures 52.6 volts with zero current, and 10 volts with 70 mA when it's off-hook. That means I can get about 700 mW of power from Pa Bell. I guess you can call this free power, but I wonder after looking at my phone bill. Nonetheless, if you pay, here's how you can play.



At the front of this circuit is a bridge rectifier, which guarantees that the positive leg will always be positive, no matter what the polarity of the phone line. This is followed by a simple 78xx voltage regulator. The voltage output voltage is that stamped on the IC (e.g., 7805, 7809, etc.) and the current is limited to that available at the moment. The problem is that the more current you draw, the lower the voltage because the phone line has a "carbon pile" (don't ask, look it up) to limit the current and voltage. So, if you pull down the line too far, the voltage may drop below that of the regulator. Anything below about 10 volts, though, is pretty stable. Also be aware that the phone company uses current flow to detect an off-hook condition — picking up the receiver to make a phone call. My phone triggers at 28 mA, at which point I get a dial tone. There comes a lot of beeping and warning messages that follows this condition if you don't dial, but the current remains on. Just remember that once this happens you can't send or receive calls, but you can always unplug the circuit whenever you want and your phone service will be restored. Check out the Mailbox at the end of this column for more information on phone power.

MJE5742, Where Are You?

Q. I eagerly awaited the Aug. '97 issue to see if you answered my question on building a fence charger. The answer was there, but I can't find a supplier for the MJE5742 Darlington, Q1. Who is the manufacturer and where can I buy this critter?

Douglas Cranston
via Internet

A. This transistor is made by Motorola (all MJxxx transistors are Motorola numbers), and is available from Allied Electronics (800-433-5700; <http://www.allied.avnet.com>) for \$2.16. However, few of my circuits have critical components. This transistor, for example, has the following specs.

NPN Darlington
 $I_c = 4A$
 $V_{ce0} = 400$
 $h_{fe} = 200 \text{ min.}$
 $P_d = 80W$

Any transistor coming close to these specs is a suitable substitute — it doesn't even have to be a Darlington or bipolar. A good NTE substitute is the NTE 375 or the ECG 375 (I told you it wasn't critical). When it comes to substituting transistors, the critical factors are breakdown voltage

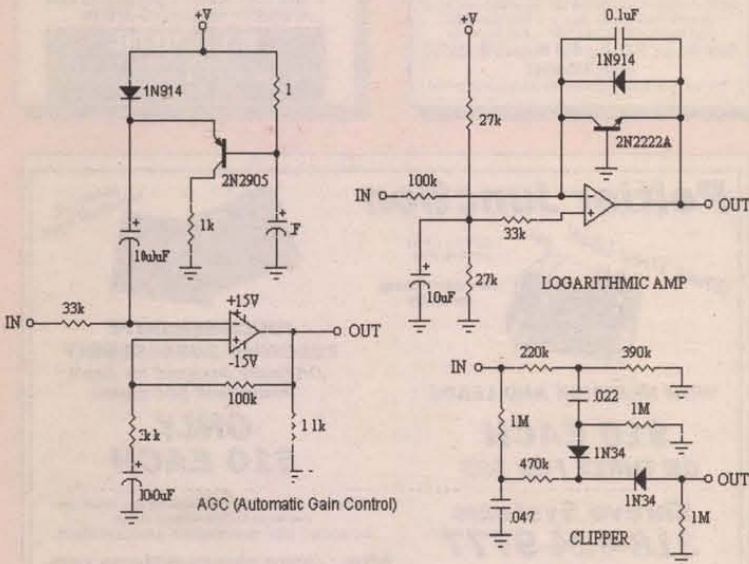
(V_{ce0}), maximum collector current (I_c), and gain (h_{fe}), in that order. Oh yeah, make sure it's the right sex — NPN or PNP. When repairing a stereo or TV, though, exact replacements are a must.

Talk Power

Q. I read and enjoy your column. However, I disagree with your explanation of speech compression being like AVC (or ALC). ALC prevents audio peaks from driving the linear power stages into a non-linear region (for SSBSC) or exceeding 100% with AM modulation. Speech compression (or in its original form, speech limiting) processes the audio non-linearly in such a way that the lower-level audio components are amplified more than are the high-level components, thus increasing the average speech amplitude without increasing the peak amplitude, thus giving more "talk power." Obviously, the greater the amount of compression (and resulting talk power), the greater the audio distortion.

Sid Knox
via Internet

A. You're talking three different things here. AVC, better known as AGC or automatic gain control, simply measures the average volume of the input signal over a relatively long period of time and adjusts the gain of the preamplifier accordingly. In other words, AGC sets the amplification factor decided on the normal signal level, and peaks are still peaks. AGC is used in tape recorders and AM receivers. ALCs (automatic level control) are peak limiters. They work by "chopping" off the top of the waveform, in much the same way a lawnmower cuts grass. Anything taller than a set limit is simply lopped off. Yes, they're full of distortion, an effect used by musicians to create the "fuzz" sound you hear in heavy metal bands. A logarithmic amplifier — like the kind used in mike compression circuits — reacts to instantaneous changes in volume, and attenuates the peaks by reducing amplification as it happens: the louder the volume, the less the amplification. While logarithmic compression isn't hi-fi, it lets you extend your AM and SSB range up to 25%, so I'm told, with good intelligibility. Here's a sampling of the three methods.

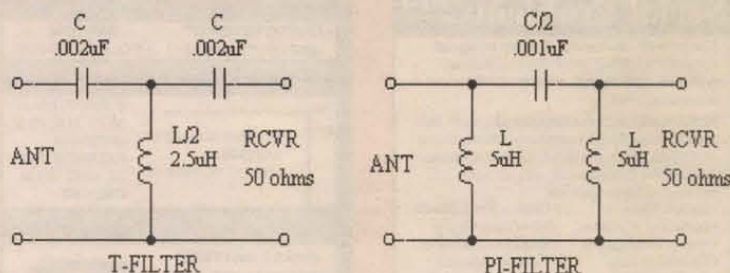


Shortwave AM Filter

Q. I have a tuned radio-frequency, shortwave receiver that's constructed on a solderless breadboard. During daylight hours it picks up a local broadcast station as clear as a bell. Unfortunately, no amount of twisting the dial will let me hear anything but this one station. During nighttime hours, the AM station disappears and shortwave reception is fine. How can the receiver be modified to pick up shortwave stations during the day?

Peter Lehmann
Upper Darby, PA

A. With the exception of clear channel stations, most BCB stations have to reduce their power or sign off at night. This is why you hear the interference only between the hours of dawn and dusk. You can start by placing the receiver in a metal enclosure, and making sure the power leads are bypassed with 0.1 capacitors as close to the IC's power pins as possible. Also place a 1 mH choke in series with the speaker or earphone wires at the point where they enter the metal box — not at the board. If this doesn't reduce or eliminate the problem try using a filter trap on the antenna input, like one of those below.



The first is a T-filter and the second is a pi-filter. One blocks out the unwanted signal, and the other shorts it to ground. Both have a cut-off frequency of 1700 KHz when connected to a 50-ohm antenna source. If your antenna's impedance is different, you can calculate the value of L and C using the following formulas.

$$\omega_0 = 2\pi \times f$$

$$L = \frac{Z}{\omega_0}$$

$$C = \frac{1}{Z\omega_0}$$

555 Cookbook

Q. Do you know of a book on the application of the 555 IC?

Howard Bard, Jr.
Chula Vista, CA

A. Radio Shack sells one called "Timer ICs" written by Forrest M. Mims III. The part number is 62-5010, and it sells for \$1.99. The LM555 datasheet from National Semiconductor (<http://www.national.com>) is another good source of 555 information and applications. Stay tuned for my upcoming feature on the 555 in a couple months.

Continued on page 108

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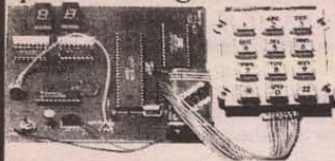
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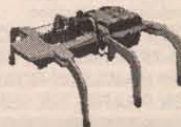
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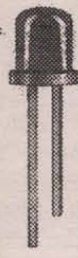
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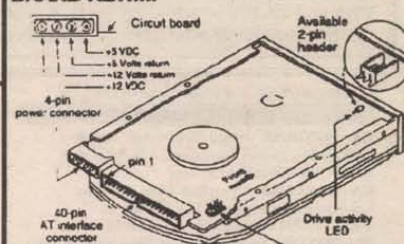
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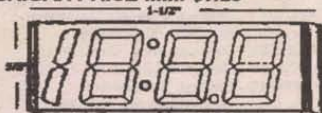
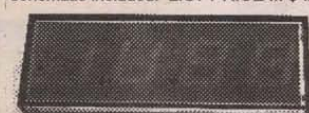


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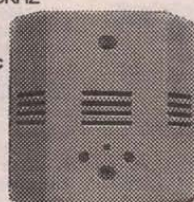
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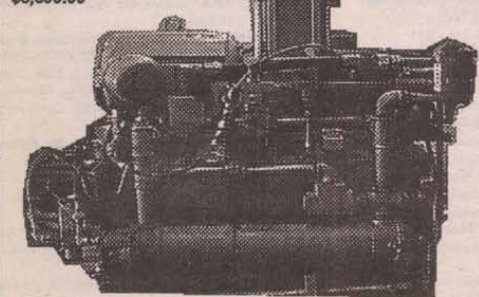
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CALENDAR

SEPTEMBER 1997

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NC - ASHEVILLE - Computer Show. Asheville Civic Center. 9:30am-4pm. MarketPro 201-825-2229
PA - ALLENTOWN - Computer Show. Holiday Inn Conference Center. MarketPro 301-984-0880
VA - MANASSAS - Computer Show. Manassas Fairgrounds. MarketPro 301-984-0880

SEPTEMBER 3-4-5-6

NY - ROCHESTER - Historical Radio Conference. Thruway Marriott. Antique Wireless Association 607-739-5443

SEPTEMBER 5-6

AR - MENA - Hamfest. Charlotte Lee KC5DOR. 870-642-7656

SEPTEMBER 5-6-7

WI - MADISON - Super Computer Sale. Dane Co. Expo Center. Blue Star Productions 612-788-1901

SEPTEMBER 6

AL - PELL CITY - Hamfest. Johnny Thompson N4MLP. 205-884-4613 or 205-884-1585
CANADA - ONTARIO - LINDSAY - Hamfest. Ann Jones VE3KWI. 705-324-0638
CA - DALY CITY - Computer Show. Cow Palace. Gate #5. Geneva & Santos. Robert Austin Corp. 1-800-243-7041. <http://www.robertaustin.com>
CA - SANTEE - ARC of El Cajon Ham. Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
IL - ROLLING MEADOWS - W9DXCC Convention & Banquet. Holiday Inn. Phil Camera KB9CRY. 708-343-1696 E-Mail: iphil@megsnet.net
IN - SPENCER - Hamfest. Kathryn Smith KB9INU. 812-829-2140
LA - PRAIRIEVILLE - Hamfest. Gourmet Catering, Inc. 13417 Hwy. 73. AARC 504-673-8396
MA - HARWICH - Computer Show. Cape Cod Tech. Northern Computer Shows 508-744-8440
MI - LIVONIA - Super Computer Sales. Elks Lodge Hall. 31117 Plymouth Rd. 10am-3pm. Computers & You 313-283-1754
MO - COLUMBIA - Hamfest & Computer Fair. Good Time Country. HY 63S. 8am-2pm. Perry Ogletree N0NMC pogletree@mail.com, missouri.edu
PA - ERIE - Hamfest. Franklin Twp. Firehall. 8am-2pm. Chris Robson KB3A. 814-474-1211
VA - RICHMOND - Computer Show. The Showplace. 9:30am-4pm. MarketPro 301-984-0880

SEPTEMBER 6-7

CANADA - MANITOBA - AUSTIN - Hamfest. Manitoba Agricultural Museum. Dave Snyder VE4XN. 204-728-2463
DE - NEWARK - Computer Show. University of DE. 9:30am-4pm. MarketPro 301-984-0880
FL - JACKSONVILLE - Computer Show. Morocco Shrine Auditorium. 9:30am-4pm. MarketPro 301-984-0880
KY - LOUISVILLE - Hamfest, Computer Show, & ARRL State Convention. KY Fair & Exposition Center Pavilion. Greater Louisville Hamfest Assn., POB 34444, Louisville, KY 40232
MA - WILMINGTON - Computer Show. Shriner's Auditorium. 9:30am-4pm. MarketPro 201-825-2229
MD - TIMONUM - Computer Show. Timonium Fairgrounds. 9:30am-4pm. MarketPro 301-984-0880
NY - WHITE PLAINS - Computer Show. Westchester Co. Center. 9:30am-4pm. MarketPro 201-825-2229
PA - MONROEVILLE - Computer Show. Pittsburgh Expo Mart. 9:30am-4pm. MarketPro 301-984-0880
TN - KNOXVILLE - Computer Show. Knoxville Civic Auditorium. 9:30am-4pm. MarketPro 301-984-0880

SEPTEMBER 7

CA - LIVERMORE - Swapmeet. Las Positas College. Noel Anklam 510-447-3857
IL - JOLIET - Hamfest/Electronics/Computer. Inwood Recreation Center. 3000 W. Jefferson St. (Rte. 52). BARS Hotline 630-759-7005
MD - GAITHERSBURG - F.A.R.fest. Montgomery Co. Agricultural Center Fairgrounds. Mary Morris N4TCI. 703-971-3905, N4TCI@erols.com
MI - GRAND RAPIDS - Super Computer Sales. Crowne Plaza. 5700 28th St. SE. 10am-4pm. Computers & You 313-283-1754
NH - DURHAM - Computer Show. Whittemore Arena @ UNH. Northern Computer Shows 508-744-8440
OH - FINDLAY - Hamfest. Hancock Co. Fairgrounds. FRC. Box 587. Findlay, OH 45839
PA - BUTLER - Hamfest & Computer Show. Farm Show Gnds. Cliff Frescura K3LL. 412-538-9491
VA - HAMPTON - Computer Show. Hampton Coliseum. 9:30am-4pm. MarketPro 301-984-0880

SEPTEMBER 12-13-14

CA - RIVERSIDE - ARRL Southwestern Division Convention. Riverside Convention Center. Joe Magaditsch. 909-685-7441
WI - MILWAUKEE - Super Computer Sale. State

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.

Fairgrounds. Blue Star Productions 612-788-1901

SEPTEMBER 13

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves
CA - OAKLAND - Computer Show. Oakland Convention Center, Broadway @ 10th St. 1-800-243-7041 <http://www.robertaustin.com>
MI - TAYLOR - Super Computer Sales. Democratic Club Hall, 23400 Wick Rd. 10am-3pm. Computers & You 313-283-1754
NY - BALLSTON SPA - Hamfest. Saratoga Co. Fairgrounds. Darlene Lake N2XQG. 518-587-2385
OH - TALLMADGE - Computer Show. Summit Co. Fairgrounds. 9:30am-4pm. MarketPro 301-984-0880
OR - GRESHAM - Metropolitan Amateurs' Picnic. Red Sunset Park. 11am-3pm. Gene Buell KA7KBH. 503-614-0563
PA - LEBANON - Computer Show. Lebanon Valley Expo Center. 9:30am-4pm. MarketPro 301-984-0880
SC - GREENVILLE - Computer Show. Palmetto Exposition Center. 9:30am-4pm. MarketPro 201-825-2229

SEPTEMBER 13-14

FL - ORLANDO - Computer Show. Central Florida Fairgrounds. 9:30am-4pm. MarketPro 301-984-0880
GA - KENNESAW - Computer Show. Outlet Mall, I-75 @ Exit 117. Georgia Mountain Productions 706-838-4827
IN - FORT WAYNE - Computer Show. Memorial Coliseum. 9:30am-4pm. MarketPro 301-984-0880
MD - GAITHERSBURG - Computer Show. Montgomery Co. Fairgrounds. 9:30am-4pm. MarketPro 301-984-0880
NY - STONY BROOK - Computer Show. SUNY Stony Brook. 9:30am-4pm. MarketPro 201-825-2229

SEPTEMBER 14

MA - SWANSEA - Computer Show. Venus DeMilo. Northern Computer Shows 508-744-8440
MI - FLINT - Computer Show. Holiday Inn, Gateway Centre, US 23 @ Hill Rd. Exit. Five Star Productions 810-890-0988
MI - LANSING - Super Computer Sales. Holiday Inn South Convention Center, 6620 S. Cedar St. 10am-4pm. Computers & You 313-283-1754
MI - MT. CLEMENS - ARC Swap & Shop. L'Anse Creuse High School. 8am-2pm. Richard Dzick 810-268-4671
MO - MONETT - Hamfest & Picnic. City Park. Joe KB0RVB. 417-235-8359
NC - ASHEVILLE - Computer Show. Asheville Civic Center. 9:30am-4pm. MarketPro 201-825-2229
NC - MONROE - Hamfest & Computer Fair. National Guard Monrovia. Zachary Davies KF4FDE. 704-536-1952 E-Mail: KF4FDE@JUNO.COM
NJ - TRENTON - Hamfest. Tall Cedars of Lebanon picnic grove. 609-882-2240
NJ - PARSIPPANY - Computer Show. Parsippány Hilton. 9:30am-4pm. MarketPro 201-825-2229
NY - YONKERS - Hamfest. Yonkers Raceway, Central Ave. & Yonkers Ave. 8am-2pm. WECA 914-741-6606
OH - STRONGSVILLE - Computer Show. Holiday Inn Select. 9:30am-4pm. MarketPro 301-984-0880
PA - LANCASTER - Computer Show. Holiday Inn Lancaster Hotel. 9:30am-4pm. MarketPro 301-984-0880

SEPTEMBER 19-20-21

MI - TAYLOR - Computer & Technology Show. Gibraltar Trade Center, 15525 Racho Rd. 313-287-2000
WI - WAUSAU - Super Computer Sale. Marathon Park. Blue Star Productions 612-788-1901

SEPTEMBER 20

CA - SANTEE - ARC of El Cajon Ham, Computer &

Electronic Swapmeet. Santee Drive-in. 619-561-0052
CA - SEBASTOPOL - SCRA Swapmeet/Auction. Holy Ghost Hall. Rick Reiner K6ZWB 707-575-4455
GA - GAINESVILLE - Hamfest. Fairgrounds. LARC 770-532-4118
IN - INDIANAPOLIS - AGI Computer Fair. Indianapolis Events Center. 3655 E. Raymond St. 10am-4pm. 317-299-8827
KS - CHANUTE - Hamfest. Central Park. 9am-1pm. Charlie WDOAKJ. 316-431-6402
KY - CAVE CITY - Hamfest. Cave City Convention Center. Larry Brumett KN4IV. 502-651-2363
ME - AUGUSTA - Computer Show. Civic Center. Northern Computer Shows 508-744-8440
MN - WARROAD - Hamfest. Warroad Area Community Center, 222 Virginia Ave. NE. David Landby 218-386-1092
NY - Poughkeepsie - Computer Show. Mid-Hudson Civic Center. 9:30am-4pm. MarketPro 201-825-2229
OR - PORTLAND - Ham Fair & Computer Swap Meet. Collectors' Market, 8900 N. Vancouver. 9am-5pm. Ed 503-257-4822 or www.hamfair.com
PA - GREENSBURG - Computer Show. Greengate Mall Expo Center. 9:30am-4pm. MarketPro 301-984-0880
SC - CHARLESTON - Computer Show. King Street Palace. 9:30am-4pm. MarketPro 201-825-2229

SEPTEMBER 20-21

AK - ANCHORAGE - Hamfest. Kincaid Park Rec Center. Lillian Marvin NL7DL 907-277-6741
FL - FORT MEYERS - Computer Show. Harborside Convention Complex. 9:30am-4pm. MarketPro 301-984-0880
FL - TAMPA - Computer Show. State Fairgrounds. 9:30am-4pm. MarketPro 301-984-0880
IL - PEORIA - Hamfest & Computer Show. Exposition Gardens, Northmoor & University Streets. 309-692-FEST
MA - WORCESTER - Computer Show. Worcester Centrum. 9:30am-4pm. MarketPro 201-825-2229
MI - DEARBORN - Super Computer Sales. Dearborn Civic Center, 15801 Michigan Ave. 10am-4pm. Computers & You 313-283-1754
OH - COLUMBUS - Computer Show. Ohio Expo Center. 9:30am-4pm. MarketPro 301-984-0880
PA - KING OF PRUSSIA - Computer Show. Valley Forge Convention Center. 9:30am-4pm. MarketPro 301-984-0880
VA - CHANTILLY - Computer Show. Capital Expo Center. 9:30am-4pm. MarketPro 301-984-0880
VA - NORFOLK - Computer Show. Norfolk Scope. 9:30am-4pm. MarketPro 301-984-0880
VA - VIRGINIA BEACH - Hamfest & State Convention. Virginia Beach Pavilion. Manny Steiner K4DOR. 757-HAM-FEST

SEPTEMBER 21

CT - NEWTOWN - Hamfest. Edmond Town Hall. 9am-2pm. Bill Schaeffer N1PJG. 203-798-2831
FL - NEW PORT RICHEY - Hamfest & Computer Show. New Port Richey Recreational Center, 6630 Van Buren. Mimmie KO4FB. 813-937-7455
IN - NOBLESVILLE - AGI Computer Fair. Hamilton Co. Fairgrounds. 10am-3pm. 317-299-8827
MA - CAMBRIDGE - Flea Market. Kendall Square area. 9am-2pm. MIT. Nick Altemurnd 617-253-3776
MI - ADRIAN - Hamfest & Computer Show. Lenawee Co. Fairgrounds. 8am-2pm. Brian J. Sarkisian KG8CO. 517-265-1537 kg8co@juno.com
MI - ANN ARBOR - Computer Sale. Washtenaw Community College, Morris Lawrence Bldg. 9:30am-4pm. 313-971-0990
NH - PORTSMOUTH - Computer Show. Yoken's. Northern Computer Shows 508-744-8440
NY - ALBANY - Computer Show. Empire State Plaza. 9:30am-4pm. MarketPro 201-825-2229
OH - CINCINNATI - Communications Expo '97.

All listing information should be sent to:

Nuts & Volts Magazine Events Calendar

430 Princland Court
Corona, CA 91719

Phone 909-371-8497

Fax 909-371-3052

E-mail events@nutsvolts.com

SEPTEMBER 26-27-28

MO - KANSAS CITY - Super Computer Sale. Kansas City Market Center. Blue Star Productions 612-788-1901

SEPTEMBER 27

CA - DALY CITY - Computer Show. Cow Palace. Gate #5. Geneva & Santos. Robert Austin Corp. 1-800-243-7041. <http://www.robertaustin.com>
FL - DAYTONA BEACH - Hamfest & Computer Show. DBARA E-Mail: k4bv@juno.com
IN - TERRE HAUTE - Computer Fair. Vigo Co. Fairgrounds. 10am-4pm. David Martin 812-442-0110
ME - LINCOLN - Hamfest. Ella Burr School. Max Soucia 207-732-3263
ME - PORTLAND - Computer Show. Portland Expo Center. Northern Computer Shows 508-744-8440
NJ - WESTFIELD - Computer Show. Westfield Armory. 9:30am-4pm. MarketPro 201-825-2229
NY - HORSEHEADS - Hamfest/Computerfest. Chemung Co. Fairgrounds. 6am-3pm. Dave Lewis 607-589-7495

PA - CARLISLE - Computer Show. Carlisle Fairgrounds. 9:30am-4pm. MarketPro 301-984-0880
SC - ANDERSON - Hamfest & Computer Fair. Civic Center. 9am-4pm EDT. C. H. Merrell 864-225-0028

SEPTEMBER 27-28

FL - FORT LAUDERDALE - Computer Show. War Memorial Auditorium. 9:30am-4pm. MarketPro 301-984-0880
IL - GRAYS LAKE - Radio Expo '97. Lake Co. Fairgrounds. Sat: 8am-4pm, Sun: 8am-3pm. Mike Brost 708-457-0966
KY - LOUISVILLE - Computer Show. Commonwealth Convention Center. 9:30am-4pm. MarketPro 301-984-0880
MD - NEW CARROLLTON - Computer Show. Ramada Conference & Exhibition Center. 9:30am-4pm. MarketPro 301-984-0880
OH - DAYTON - Computer Show. Montgomery Co. Fairgrounds. 9:30am-4pm. MarketPro 301-984-0880
TN - EAST RIDGE - Computer Show. Camp Jordan Arena. 9:30am-4pm. MarketPro 301-984-0880
VA - ANNANDALE - Computer Show. Northern VA Community College. 9:30am-4pm. MarketPro 301-984-0880
WA - WALLA WALLA - Hamfest. National Guard Armory, 113 S. Colville. W7DP, POB 321, Walla Walla, WA 99382

SEPTEMBER 28

CA - SANTA ANA - Swapmeet. ACP parking lot. Mary Russo 714-558-8813
CO - LONGMONT - Radio/Computer Swap. Boulder Co. Fairgrounds. 8am-2pm. BARC 303-673-0289
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
KY - LOUISVILLE - Computer Fair South. Executive West Hotel. 9:30am-3pm. Sammy L. Hastings 812-333-9300
MA - TAUNTON - Computer Show. Holiday Inn. Northern Computer Shows 508-744-8440
MI - MADISON HEIGHTS - Super Computer Sales. UFFCW Hall, 876 Horace Brown Dr. 10am-4pm. Computers & You 313-283-1754
MO - ST. PETERS - SPARC SwapFest. St. Charles Co. Community College. 7am-1pm. Allen Underdown N0GOM. 314-939-9444
NY - OLD WESTBURY - Computer Show. SUNY Old

Events CALENDAR

Westbury. 9:30am-4pm. MarketPro 201-825-2229
NY - YONKERS - Electronic Flea Market. Lincoln High School. 9am-3pm. Otto Supliski WB2SLQ, 914-969-1053
OH - BEEA - Hamfest & Computer Show. Cuyahoga Co. Fairgrounds. 8am-2pm. Hamfest Assn. of Cleveland 1-800-CLEFEST info@hac.org
PA - YORK - Computer Show. Holiday Inn Holiday & Conference Center. 9:30am-4pm. MarketPro 301-984-0880

OCTOBER 1997

OCTOBER 3-4-5

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

OCTOBER 4

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-In. 619-561-0052
PA - WARMINSTER - Mid-Atlantic States VHF Conference. Benjamin Wilson Senior Center, on Delmont Ave. 9am-9pm. John Sortor KB3XG, 610-878-5674
TX - BELTON - Ham Expo. Bell Co. Expo Center. Mike LeFan WA5EQQ, 254-773-3590

OCTOBER 4-5

NC - GREENSBORO - Computer Show. Greensboro Coliseum Complex. 9:30am-4pm. MarketPro 201-825-2229
NJ - EDISON - Computer Oktoberfest. Middlesex Co. College. Sat: 9am-6pm, Sun: 9am-4pm. Lee Le'Mon 717-786-2260
NJ - SOMERSET - Computer Show. Garden State Exhibit Center. 9:30am-4pm. MarketPro 201-825-2229

OCTOBER 5

CA - LIVERMORE - Swapmeet. Las Positas College. Noel Anklem 510-447-3857
IL - OAKBROOK TERRACE - Hamfest. Oakbrook Terrace enclosed parking lot. 8am-3pm. George 773-545-3622
IN - BEDFORD - Hamfest. Lawrence Co. 4-H Fairgrounds. Sat: 10am-11pm, Sun: 5am-7pm Dewey Sowders WD9DKO, 812-279-5546
NH - NASHUA - Computer Show. Sheraton Tara Hotel. Northern Computer Shows 508-744-8440
NY - QUEENS - Hamfest. New York Hall of Science parking lot, Flushing Meadow Park, 47-01 111th St. 9am-3pm. Arnie Schiffman WB2YXK, 718-343-0172
PA - WARRINGTON - Hamfest. Bucks Co. Drive In. Brian Taylor 215-257-6303

OCTOBER 10-11-12

MD - BALTIMORE - Digital Communications Conference. Holiday Inn BWI Airport, 890 Elkridge Landing Rd., Linthicum, MD. Tucson Amateur Packet Radio, 817-383-0000, FAX 817-566-2544, Internet: tapr@tapr.org, Web: www.tapr.org
MI - TAYLOR - Computer & Technology Show. Gibraltar Trade Center, 15525 Racho Rd. 313-287-2000
MN - MINNEAPOLIS - Super Computer Sale. State Fairgrounds. Blue Star Productions 612-788-1901

OCTOBER 11

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138
FL - TAMPA - Hamfest. Unit Building, 4050 Dana Shores Dr. J. F. Strom K9BSL, 813-822-9107
GA - AUGUSTA - Hamfest & Computer Show. Evans Middle School, Washington & Belair Rd. 9am-4pm. Frank KS4OC, 706-560-9600
MA - WESTPORT - Computer Show. White's Hospitality Center. Northern Computer Shows 508-744-8440
NY - BUFFALO - Computer Show. Hamburg Fairgrounds. 9:30am-4pm. MarketPro 201-825-2229
WA - BREMERTON - Hamfest & Electronics Swapmeet. Kitsap Co. Fairgrounds. Susan Johnson 360-697-4469

OCTOBER 11-12

GA - KENNESAW - Computer Show. Outlet Mall, I-75 @ Exit 117. Georgia Mountain Productions 706-838-4827
MA - WILMINGTON - Computer Show. Shriners Auditorium. 9:30am-4pm. MarketPro 201-825-2229
NY - WHITE PLAINS - Computer Show. Westchester Co. Center. 9:30am-4pm. MarketPro 201-825-2229
TN - MEMPHIS - Hamfest & Computer Show. Big One Expo Center, 2585 North Hollywood at I-240. Sat: 8:30am-4pm, Sun: 8:30am-2pm. John Lovett KD4EJH 901-388-8745

OCTOBER 12

MI - MASON - Ham Fair. Ingham Co. Fairgrounds. 8am-1pm. Chuck McNease N8CM, 517-694-2757
NH - MANCHESTER - Computer Show. Center of NH Expo Complex. Northern Computer Shows

508-744-8440

NJ - LINCROFT - Hamfest. Brookdale Community College. Al Jackson NK2O, 908-922-8121
NY - ROCHESTER - Computer Show. The Dome Center. 9:30am-4pm. MarketPro 201-825-2229
OH - ASHLAND - Hamfest. County Fairgrounds, Claremont Ave. 8am-2pm. David Fike N8UCA, 419-289-1082 days

OCTOBER 13

MA - BRAintree - Computer Show. Sheraton Tara. Northern Computer Shows 508-744-8440

OCTOBER 17-18

FL - STARKE - Hamfest & Computer Show. Bradford Co. Fairgrounds on US 301 N. of Starke. Fri: 1pm-8pm, Sat: 8am-3pm. Dan Phillips K4RVD, 352-475-2695

OCTOBER 17-18-19

IL - PEORIA - Super Computer Sale. Peoria Civic Center. Blue Star Productions 612-788-1901

OCTOBER 18

CA - OAKLAND - Computer Show. Oakland Convention Center, Broadway @ 10th St. 1-800-243-7041 http://www.robertaustin.com
CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-In. 619-561-0052
IN - INDIANAPOLIS - AGI Computer Fair. Indianapolis Events Center. 3655 E. Raymond St. 10am-4pm. 317-299-8827

MA - HYANNIS - Computer Show. Tara-Hyannis. Northern Computer Shows 508-744-8440

MA - WEST SPRINGFIELD - Computer Show. Eastern States Exposition. 9:30am-4pm. MarketPro 201-825-2229

TN - GRAY - Hamfest. Appalachian Fairgrounds, Tri-Cities Hamfest, POB 3682 R3, Johnson City, TN 37602

OCTOBER 18-19

NJ - SECAUCUS - Computer Show. The Meadowlands Expo. Center. 9:30am-4pm. MarketPro 201-825-2229

OCTOBER 19

IL - SALEM - Hamfest. Salem Community Activity Center. Daisy King, 618-532-6606
IN - KOKOMO - AGI Computer Fair. Ramada Inn. 10am-3pm. 317-299-8827
KY - LOUISVILLE - Computer Fair South. Executive West Hotel. 9:30am-3pm. Sammy L. Hastings 812-333-9300
MA - CAMBRIDGE - Flea Market. Kendall Square area. 9am-2pm. MIT. Nick Altemurnd 617-253-3776
MI - FLINT - Computer Show. Holiday Inn, Gateway Centre, US 23 @ Hill Rd. Exit. Five Star Productions 810-890-0988
MI - KALAMAZOO - Hamfest. Kalamazoo Co. Fairgrounds. Hazel Grey Bldg. 616-657-4482
NH - SALEM - Computer Show. Rockingham Park Race Track. Northern Computer Shows 508-744-8440
NY - TROY - Computer Show. Troy Armory. 9:30am-4pm. MarketPro 201-825-2229
PA - GREENSBURG - Hamfest. Greensburg Hose Co. No. 1. 8am-2pm. Al Compton N3LQX, 412-523-3727

PA - NEWTOWN - Tradefest '97. Bucks Co. Community College, Swamp Rd. Steve 215-752-1202

OCTOBER 25

IL - BRADLEY - Computer Show & Sale. Ramada Inn. 9am-3pm. Gary 815-935-1605
MA - WORCESTER - Computer Show. Worcester Convention Centre. Northern Computer Shows 508-744-8440
MN - ST. PAUL - Hamfest & Computer Expo. Civic Center, Kellogg & 7th St. 8am-4pm. Hot line: 612-535-0637
NY - LAKE GROVE - Computer Show. Sports Plus. 9:30am-4pm. MarketPro 201-825-2229
NY - POMPEY HILLS - Hamfest. Pompey Hills Fire Dept. 8am-2pm. 315-469-0590
OR - RICKREALL - Swap-toberfest, ARES/RACES Convention. Polk Co. Fairgrounds. 9am-3:30pm. Gary Zinn KC7BSX, 503-838-2008
SC - SUMTER - Hamfest, Computer Fair, & ARRL State Convention. Sumter Co. Exhibition Center, 700 W. Liberty St. 8am-4pm. Steve Bregger KD4HTS, 803-983-4251

OCTOBER 25-26

FL - MIAMI - Computer Show & Hamswap. Dade Co. Fair & Expo Center, SW 112th Ave. & SW 24th St. 9:30am-4pm. Evelyn 305-642-4139
NC - CHARLOTTE - Computer Show. The Charlotte Merchandise Mart. 9:30am-4pm. MarketPro 201-825-2229

OCTOBER 26

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 - WESTMINSTER - Computer & Hamfest. Carroll Co. Ag Center. George Johns N3JKY 717-633-6641, E-Mail: gjohns@sun-link.com
ME - PORTLAND - Computer Show. Verrillo's Convention Center. Northern Computer Shows 508-744-8440
NJ - PARSIPPANY - Computer Show. Parsippary Hilton. 9:30am-4pm. MarketPro 201-825-2229
OH - MARION - Hamfest & Computer Show. Marion Co. Fairgrounds Coliseum. 8am-3pm. Karen Eckard N8KE, 614-499-3565
PA - SELLERSVILLE - Hamfest. Sellersville Fire House Bethlehem Pike. 7am-2pm. Linda Erdman KA3TJZ, 215-679-5764

OCTOBER 27-28-29

VA - TYSONS CORNER - Surveillance Expo '97. Sheraton Premiere Hotel. Marilyn Roseberry 703-450-2200, Fax 703-450-2204

NOVEMBER 1997

NOVEMBER 1

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-In. 619-561-0052
NH - SEABROOK - Computer Show. Greyhound Park. Northern Computer Shows 508-744-8440
OK - ENID - Hamfest. Garfield Co. Fairgrounds, Hoover Bldg. 8am-5pm. Tom Worth N5LWT, 405-233-8473

NOVEMBER 1-2

TX - ODESSA - Hamfest. Ector Co. Coliseum, Exhibit Bldg. C, 42nd & Andrews Hwy. Sat: 8am-5pm, Sun: 9am-2pm. Robert Jordan N5RKN, 915-335-7980

NOVEMBER 2

CA - LIVERMORE - Swapmeet. Las Positas College. Noel Anklem 510-447-3857
OH - CANTON - ARRL Auctionfest '97. Stark Co. Fairgrounds. Jack Cale N8FEB, 330-477-8261

NOVEMBER 7-8-9

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

NOVEMBER 8

AL - MONTGOMERY - ARRL State Convention, Hamfest & Computer Show. Garrett Coliseum, South AL State Fairgrounds. 8am-5pm. Phil 334-272-7980 after 5pm

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138
CA - OAKLAND - Computer Show. Oakland Convention Center, Broadway @ 10th St. 1-800-243-7041 http://www.robertaustin.com

IN - INDIANAPOLIS - AGI Computer Fair. Indianapolis Events Center. 3655 E. Raymond St. 10am-4pm. 317-299-8827
LA - WEST MONROE - Hamfest. West Monroe Convention Center, corner North 7th & Ridge Ave. 8am-3:30pm. 318-323-6621
NH - SALEM - Computer Show. Rockingham Park Race Track. Northern Computer Shows 508-744-8440

SC - MYRTLE BEACH - Radio and Computer Show. Myrtle Beach High School, 38th Avenue North. Robert Battle 803-236-2887

NOVEMBER 8-9

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

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

NOVEMBER 9

IN - ANDERSON - AGI Computer Fair. Ramada Inn, 5901 Scatterfield Rd. 10am-3pm. 317-299-8827
KY - LOUISVILLE - Computer Fair South. Executive West Hotel. 9:30am-3pm. Sammy L. Hastings 812-333-9300

MA - SWANSEA - Computer Show. Venus DeMilo. Northern Computer Shows 508-744-8440

NOVEMBER 14-15-16

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

NOVEMBER 15

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

Continued on page 109

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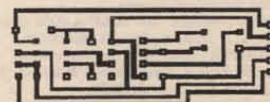
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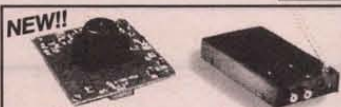
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COOB37S	37 Pin Socket	.89	.85	.77
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FLOAT YOUR PORTABLE

Most portable electronic equipment will quickly self-destruct when any kind of water gets inside on the circuit board or delicate mechanisms. Saltwater immersion is the greatest threat — saltwater quickly attacks the copper traces on the circuit board, and within a few days, the traces break down and the result is an open connection.

Freshwater may have enough minerals and

proof. Wrong! The US Coast Guard rating is based on spray and splashes, not water pressure when your equipment takes a tumble into a shallow creek or sandy ocean bottom.

The few marine electronic exceptions to this would be the ICOM M-15 submersible VHF handheld transceiver (ICOM America, 206-454-8155), the Navico Axis submersible VHF handheld marine transceivers (Navico, 813-524-1555), and the Magellan 5000 series of "big body" GPS



The Newmar bag had the most secure closure to seal out water.

attached to the equipment by a little rubber tag to keep you from losing them.

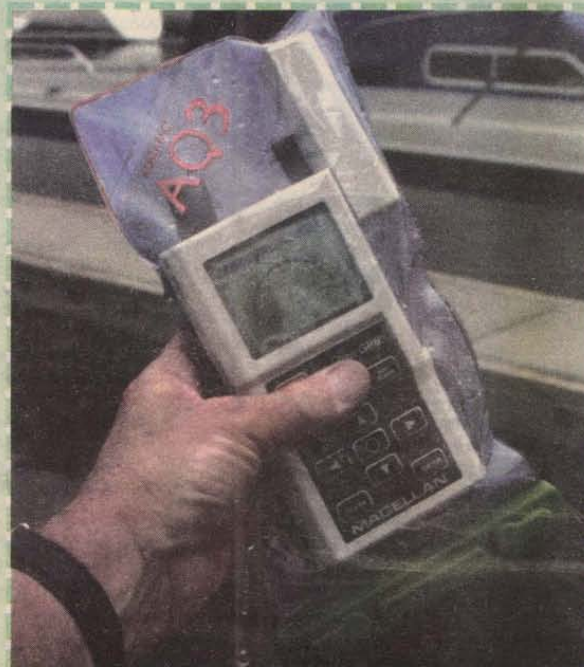
But after about one year of operation, the little rubber stoppers somehow work free of the equipment, and you probably didn't realize their importance until you got into a wet environment. Now you know! If any type of spray seeps into those openings, your radio equipment may quickly fail.



Once the bag is sealed, this GPS receiver can now go down to 30 feet under water!



For personal watercraft, here is the perfect solution to protect and float your safety two-way radio.



You can still push buttons through the waterproof bag.

impurities in it to create a high resistance short across the portable battery system, and failure may occur within a few days, too.

Total submersion — when the portable goes into a lake, river, or ocean — usually inputs water behind the keypad membrane, quickly closing contacts that would normally be open when the equipment is dry.

Portable equipment like marine VHF radios and marine GPS receivers are sometimes advertised as waterproof, meeting the United States Coast Guard CFR 46 Standards. Many boaters mistake this waterproof rating as submersion-

receivers (Magellan, 909-394-5000).

Unless you own one of these specific submersible radio and GPS receivers, a little water on the inside will quickly spell disaster.

Stop Those Stoppers

If you are using a handheld transceiver where there is blowing spray or blowing dust and sand, it is extremely important to close up the microphone, speaker, and power port jack-openings with the provided rubber stopper protectors. These little rubber stoppers should already be in place when you purchase your equipment; and when you unplug them to charge your batteries or run an external speaker microphone, they stay

Many personal stereos have wide-open jacks for water intrusion. They don't come with stoppers. You will need to develop your own little rubber plugs in order to keep those stereo sounds thumping when you are out there in wet weather on your bike or hiking trail. Even a little bit of perspiration getting into your personal stereo earphone jack can lead to circuit board failure.

And when you take your equipment to the beach, blowing sand can really do a number on the mechanics of your CD player or tape cassette drive. Sand and saltwater are number one enemies of your portable electronics down at the seashore.

The Bag

Vinyl submersible bags have been around for

over 40 years. I remember my first bag that had a glass window for an inside Kodak viewfinder camera to take underwater snapshots. Getting the camera in the bag required unscrewing the hose clamp around the glass window, putting the camera inside, then replacing the round glass window and securing the hose clamp back on, nice and tight.

The test was to hold the equipment under water and see whether or not there were any bubbles. If you saw bubbles, your underwater equipment was in deep trouble!

New Bags

For the last 10 years, submersible portable electronic bag containers have been readily available in the marine stores for a variety of equipment that could go on the inside:

- Two-way radios
- Beepers
- Cellular phones
- GPS receivers
- Personal stereo safekeeping
- Portable AM/FM radios
- Cameras
- Fluxgate compasses
- Handguns
- Electronic chart devices
- Binoculars
- Jewelry
- Night scopes

As you can see by this list, the possibilities of what you want to protect inside the submersible vinyl bag are almost endless! But keep in mind that the bag is designed for a total seal, so running your personal CD player on a set of headphones is going to be tricky when trying to figure out how to make a tight exit with the headset wires. It can be done, and we'll tell you more about how these bags get sealed for positive water rejection.

The equipment within the bag can still be operated. When you turn the volume up, you get about 95% volume out of the bag with the vinyl not cutting down on any fidelity. The clear vinyl lets you readily see all of the buttons and readouts, and provides an acoustic transducer for the inside speaker.

The vinyl is flexible enough that you can push buttons, turn small volume and squelch controls, and manipulate any little switch that may be on your portable electronic gear. For cameras, these little bags allow you to easily adjust focus, aperture, speed, and give you an easy view through the viewfinder.

About the only time that these bags get cumbersome is when you are trying to use them in extremely cold weather. The vinyl firms up on the ski slope, and you may need to warm up the vinyl in order to get a good grasp on the volume control.

When you put your equipment

inside the bag, you need to make sure that rubber antennas, flip-up GPS patch antennas, and flip-up flash strobes have enough space. Most manufacturers and marine sellers of these bags have at least five different styles to accommodate big or small electronics on the inside.

If you just want to keep your beeper dry, get the small bag. If you're planning on running a big GPS map unit inside the bag, better get the big style. If your VHF aircraft or marine radio has a real tall antenna, be sure to get the bag with the longer vinyl antenna tube. And most of these bags come with a convenient thumb flap that lets you easily stick your thumb into the bag and make your equipment adjustments without ever having to take anything out of the bag.

The Test

We brought in waterproof bags for river and ocean testing from the following organizations:

West Marine

1-800-538-0775

"Aquasafe" bags, eight different styles, three with neoprene additional float power to handle heavy metals.

Boat/US

1-800-937-2628

Large and small waterproof PVC pouches.

Consumer Marine Electronics

1-800-332-2628

"Aquaman" pouches, 15 different sizes and styles!

Defender

Standard and miniature pouches.

Newmar Corporation

714-751-0488

"Aquapak" ultra-deep submersible pouches, seven different styles.

There are probably many other manufacturers and sellers of pouches, but these are the ones that I have personally taken out on the water and put to the plunge and underwater pressure tests.

We found it very important to know the size of our equipment before dialing the 800 number to order these 20 \$25.00 underwater bags. Measure the height of your equipment, including any extended antenna, the width and depth of the equipment, and you might even see how much it weighs.

Most pouches will easily float a piece of marine electronics with just the natural air buoyancy on the inside. However, if you have an old Russian night scope, or are packing a small caliber handgun, you better go with a pouch with extra flotation, such as the neoprene models from West Marine.

Most of these pouches also

come with a lanyard. This keeps your equipment from floating away in case you take a nosedive off of your personal watercraft, or if you accidentally slip into the river and let go of everything.

During one of our recent river tests of handheld pouches, some downstream fishermen indicated that on a busy weekend, they would occasionally see one of these pouches go floating by with probably all sorts of neat things on the inside. I can just see the ultimate pouch collector down at the bottom of the river turning up everything from lost handheld radios to the very best in Walkmans. Best secure your pouch, via the lanyard, to your canoe, life raft, or maybe on your wrist.

All of the pouches could go down to at least six feet deep and survive the water pressure without water intrusion. The Aquapak pouches from Newmar can go down to 30 feet. Why the difference? The more simple the pouch opening system for putting electronics in and out, the less depth that can be achieved under water before pressure overcomes the seal. The more elaborate (i.e., more complicated and frustrating) the sealing method, the better chance that your equipment will stay dry down to the sea floor or lake bed bottom.

During our tests, all of the pouches made a quick plunge to 30 feet without water entry. The Newmar Aquapak pouches went down to 60 feet without a water droplet on the inside. This double-depth is a function of its elaborate plastic securing system. Although we found this system a little frustrating to close out on a rocking boat, once we understood how it all went together, we began to appreciate how well it double-seals out any water. The Newmar is best for going very deep.

The other locking systems were simply closing up the PVC or vinyl opening, clamping a little bar over the seal, and then squeezing the bar closed with two little levers. This one you could figure out without reading the instructions. But on the Newmar unit, keep the instructions handy!

We judged the ease of operating the equipment within the bag as reasonable, but slightly cumbersome. What do you expect when you're trying to turn a volume and squelch knob through a cold vinyl bag? Leave the bag out in the warmth of the sun, and adjustments get immediately easier. But try to work this out on the ski slopes, stand by for the thaw to get a real grip on things.

The most important feature of these bags is personal safety. On a personal water craft five miles out from shore, your VHF handheld transceiver may be the only way to



New waterproof and submersible Icom VHF marine handheld set.

call for help. And if you get spilled out of the PWC, and this is attached to your wetsuit, you are still on the air even though you are treading water.

Same thing for windsurfers, hang gliders, and other types of sports that may put you into the drink — even though your electronics go under water, the waterproof pouch keeps them bone dry.

So what is your favorite piece of portable electronics? Take some measurements, then call up for a waterproof pouch that will completely seal out the water elements. Yes, we did manage a reasonable seal on our CD player with the headphone cord exiting the sealed up opening.

While it's not recommended, it kept water out down to a foot under, and this was fine for us as we splashed our way down the river, completely soaking and wiping out our headset, but keeping the inside electronics absolutely dry in our waterproof pouch. **NV**

Renewing Your Most Renewable Resource Education and Training Resources for Busy People

It's the "back-to-school" time of the year, so let's talk a little bit about school, training, and related topics. You can get a tremendous electronics or computer education without leaving home. In this month's column, we will take a look at some of the options.

Knowledge, skills, and abilities are most people's only, or most valuable, renewable resource. You can update present knowledge or gain new knowledge. Whether it is for your hobby or your work, constantly adding new knowledge is the way to improve and keep on going to newer heights. In fact, given the modern economy, you had better be constantly updating old and gaining new knowledge if you want to remain in the game. The economy changes rapidly, and opportunities come to the well prepared.

I talked to a friend of mine recently, and it was a bit sad. He was a computer programmer all of his life, but had remained stagnant in older systems and languages. He had clearly not kept up. Now, at the age of 50+, he was too expensive for too little return, so was laid off. He was desperately trying to come up-to-date by taking courses in the local college ... but that takes time (he recently got a little boost because he was rehired for the "Year 2000" problem ... but that will soon expire).

Another friend of mine teaches college in Ireland. For several years, he has used a distance learning course of study to pursue a second bachelors degree (information systems major) to guard against personal obsolescence as he grows older.

First, before starting, let me tell you a little bit about my own history so that you understand why I am so passionate about this topic. My high school diploma was one of the "industrial arts" variety because I learned to be a Radio-TV repair technician. After high school, I took a couple of correspondence courses (Motorola Training Institute in two-way radio repair, and Capitol Radio Engineering Institute in computers). I also spent two years of night school getting the extra high school courses needed to get into college. I spent only one year in full-time college, and the rest of the time in night school. It took me 11 years to complete a bachelor of science degree, and another two for a master of science in electrical engineering.

Because of the vagaries of my own checkered background, I am a firm believer in distance education, computer-based training (CBT), and Internet-based education. Let's take a look at some options.

Options

There are a number of ways to acquire new knowledge, but the most effective way is to take appropriate courses (you could, of course, buy my books!). Traditional courses require the students and the instructors to be together in the same place at the same time. Unfortunately, this form of learning, while quite valuable, is often not suited to people who are at a distance from the teaching site; the course venue might just be

too far away from your home. I've known people who made 100-mile commutes to classes, but they are a hearty and lucky few.

The time constraint may also be a problem. If courses are only given during your work day — when you are interacting with customers, colleagues, the boss, or otherwise tending to business — then either your business or your education will suffer. Guess which one it is?

For many people, the most effective way to acquire new knowledge is through distance learning. Although the distance learning phenomenon is booming right now, it actually has a much longer history. The University of London offered distance learning since the mid-19th century. In the United Kingdom, the Open University is training many thousands of students. Many US soldiers and sailors in the 1960s earned college credits through the University of Maryland Extension Service. Some U.Md courses were taught aboard Navy ships or on Army and Air Force bases worldwide.

Correspondence courses, although the butt of some very funny jokes about brain surgery, have provided good training in many fields for a long, long time. In electronics, we are particularly

lucky because the correspondence course method goes a long way back, and it's been largely high quality stuff. I've seen 1930s vintage radio magazines that advertised National Radio Institute (NRI) in Washington, DC. You could learn to be an electronics technician, Radio-TV repairer or other types of job by mail. NRI was founded by James Smith in 1914, so was a well-established institution by the late 1930s.

Also in Washington, DC was the Capital Radio Engineering Institute (CREI). They had both correspondence and residence courses. The residence course of CREI was originally taught in a building on Sixteenth Street NW, in Washington. It formed the basis of a four-year degree granting electronics technology school called Capitol College located in DC's Maryland suburbs.

Both the NRI and CREI correspondence courses were bought out by NRI/McGraw-Hill, who still offer courses by mail from an office near Washington, DC (web site at <http://www.mhcec.com/mk/nricrse.html>).

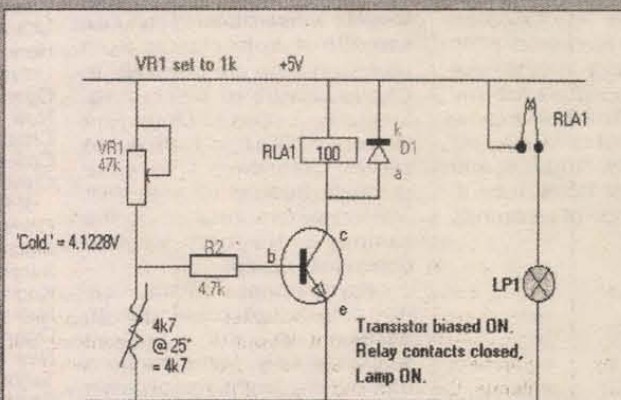
Open Channel

by Joseph J. Carr
K4IPV

Electronics Principles 3.0.

DC AC Power Semi-Conduct Diodes Number Logic Measure Help

Thermistor Controlled Switch.



$$\text{Junction Voltage} = \frac{\text{Supply Volts}}{\text{VR1 setting} + \text{Thermistor value}} \times \text{Thermistor value}$$

Calculations

Topic Theory

Copy & Paste

Hot

Active Circuits

- ☐ Light Depend P1
- ☐ Thermistor
- ☐ Light Switch
- ☐ LDR Relay
- ☒ Thermistor

Figure 1.

Electronics Principles 3.0



Start VISIO Technical

Electronics Principles 3.0

Microsoft PowerPoint - [P]

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One of the most promising developments in the distance learning field is information technology. Computers, multimedia CD-ROMs, and the Internet offer opportunities for distance learning that were unheard of only a short time in the past. "Virtual universities" are springing up that offer entire college degree programs via the Internet.

Because of the nature of the Internet, it is no longer necessary for you to be in the same city, time zone, or even country as the distance learning provider. Although most accredited colleges require you to travel to some site or another for examination and interaction once to several times per year, others provide local examination sites.

Nova Southeastern University (www.nova.edu) requires information technology students to travel to Florida several times a year. Otherwise, instruction and interaction between students, and with the faculty, are carried out on-line.

Scotland's Heriot-Watt University (website: www.ebs.hw.ac.uk, or E-Mail to enquiries@ebs.hw.ac.uk), on the other hand, provides examination venues world wide for their Master of Business Administration (MBA) program. Although some students must travel for the twice yearly exams, others find that local venues are available.

Remember Heathkit? And who in electronics doesn't? Many of us spent a large part of our early years building Heathkit products. Most of my early ham radio and electronics test equipment was from Heathkit. The stories of their demise are a bit overstated. True, Heathkit doesn't make those neat kits anymore, but Heathkit Educational Systems (455 Riverview Drive, POB 1288, Benton Harbor, MI 49023-1288; 1-800-253-0570 (voice), 1-616-925-2898 (FAX); E-Mail heathkit@iserv.net; web site: <http://www.heathkit.com>) is still in business. Remember those AC and DC electronics fundamentals courses? They still have them available, plus many more courses as well.

Some other old standbys are also found on the web. Cleveland Institute of Electronics (CIE), Grantham College of Engineering, International Correspondence Schools, and others are still around. When researching this article I came across the fact that ICS operates in a lot of countries, including the United Kingdom and Zimbabwe, as well as the United States. The CIE web page demonstrates the range of electronics training that is available:

- Broadcast Engineering
- Electronics Communication
- Industrial Electronics
- Electronics Engineering
- Automotive Electronics
- Electronics Technology and Advanced Troubleshooting
- Electronics Technology with Digital & Microprocessor Laboratories.

Self-Motivated Study?

If you are interested in gaining knowledge, but not necessarily obtaining formal credentials, then there is always the old fashioned book route. My own private library runs 14 80-inch high, 30" to 36" wide bookcases jammed to the limit. Indeed, I also have several tables and a desk piled high with books (my wife, I am sure, rolls her eyes when she sees me coming home from a

bookstore!). If you know the topic you need to learn, then try any good bookstore. Sometimes, Borders and Barnes & Noble stores have technical titles (especially in computer topics). You can also search on-line for technical topics from Amazon.com books (<http://www.amazon.com>).

It takes a lot of self-discipline to learn this way, but it fits a lot of schedules that other methods do not. But if you are something of an autodidact (self-learner), then it might have advantages. Acquiring knowledge in this manner may be a bit fractured and disorganized, but it is also possible to be extremely tightly focussed. After all, you don't need a curriculum in information systems technology if all you want to do is learn how to use the Microsoft Access database program.

Synchronous and Asynchronous Distance Learning Courses

In distance learning there is no "one-size fits all" solution to the problem of delivering instruction. Diversity of student populations and course requirements means that different solutions are optimal for different situations. Distance learning experts recognize two forms of delivery: synchronous and asynchronous courses.

Synchronous communication between faculty and students occurs in real-time, with both parties being present simultaneously. Traditional face-to-face in-class instruction and one-on-one mentoring are examples of synchronous communication. Also included are technological solutions such as telephone or conference call hook-ups, satellite or cable TV delivery, or via the Internet through chat rooms and real-time audio. Clearly, "simultaneously" does not necessarily mean "in the same room."

In Virginia, the University of Virginia (U.Va) and Virginia Polytechnic Institute and State University (VPI & SU), fierce rivals elsewhere, jointly operate a center in Northern Virginia where students can take satellite remote classes from professors who are physically in Charlottesville or Blacksburg. Similarly, Old Dominion University (ODU) in Norfolk, VA serves Northern Virginia graduate students through their TeleNet system installed on the campus of Northern Virginia Community College.

Asynchronous communications does not require both parties to be present simultaneously. Some media is used for the exchange between instructor and student. Examples of courseware for asynchronous instruction include printed materials, voice mail, E-Mail, video tapes, electronic files, computer software (multimedia and text), and computer bulletin boards.

The World Wide Web offers opportunities for decentralizing instruction that were undreamed of only a short time ago. A number of companies are now offering authoring software that permits courseware to be installed on a web site for

downloading to the student. Updates to the course content can be posted on the web site at the instructor's convenience. In addition, students can upload their work for review by the instructor rather than sending it in by mail.

External Degrees

Some years ago the New York State Board of Regents, which governs education in New York, formed a group that was called the Regents Credit Bank. They would allow recording of credits earned at numerous universities, and provide a common transcript for all. They evolved into the Regents External Degree Program, and are now called Regents College (7 Columbia Circle, Albany, NY 12203-5159).

Regents College can offer a large number of degrees (including both Associates and Bachelors in electronics technology), and are fully accredited. You take the courses elsewhere, and then have official transcripts sent to Regents once a year or so. They also have other ways of earning credit including examination, evaluation of non-academic training, and special assessment. The latter is a way for people with objectively testable knowledge to receive credit even if they have not taken a formal course. This is not one of those "life's learning" deals, but must represent knowledge in a recognized academic field (e.g., electronics technology), and must be objectively testable in some way.

Virtual College Degrees in the Future?

There are currently a large number of distance learning opportunities, both on the Internet and via other means. I can see a day when a program, conceived perhaps much like Regents, will exist to offer accredited degrees based on courses taken via distance learning

Some On-line Distance Learning Sites

Weber State College (Utah)	www.weber.edu
Western Governor's University	www.westgov.org
UCLA (Home Education Network)	www.then.com
Heriot-Watt University	www.ebs.hw.ac.uk
University of CA-Berkeley	www.cmil.unex.berkeley.edu
Open University (Florida)	www.openu.com
New School Social Research	www.diainsa.edu
Chattanooga State TCC	http://cstcc.Chattanooga.net
College of Dupage	www.dupage.edu
Cleveland Institute of Electronics	http://www.cie-wc.edu
Commonwealth of Learning	www.col.org
Indiana School of Education	www.indiana.edu
Internet University	www.capecod.net
Knowledge On-Line	www.jec.edu
National Technological Univ.	www.ntu.edu
Open College (UK)	www.opencollege.co.uk
New York Inst. of Photography	www.nvip.com
Tennessee State (Project DIANE)	www.diane.tnstate.edu
George Washington University	www.gwu.edu
Graduate School of America	www.tgsa.com
Stanford Distance Learning	http://minas.stanford.edu
Thomas Edison State College	www.tesc.edu
University of Berkeley	www.uofb.com
University of Georgia	www.coe.uga.edu
University of Louisville	www.louisville.edu
University of Maryland	www.umuc.edu
University of Washington	www.washington.edu
Western Michigan University	www.wmich.edu
University of Phoenix	www.uophx.edu
McGraw-Hill Continuing Edu.	www.mhcec.com
Nova Southeastern University	www.nova.edu
James Cook University (Aus.)	Sue.McGinty.jcu.edu.au
University of Canberra	www.canberra.edu.au
Heathkit Educational Systems	http://www.heathkit.com

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from dozens of institutions. A student would be able to custom tailor a program with the guidance and approval of the college. Perhaps they will hold graduation in an Internet "chat room" with real audio and video to monitor the proceedings (I'm not kidding!).

There is no real reason why all students need be at a physical college (although some will). The main complaints that I've heard seem to be from faculty that appear to be afraid of losing jobs. At least one study demonstrated that even more faculty is needed to do distance learning properly, although the infrastructure is greatly reduced.

Self-Standing CBT Courses

An increasing number of vendors are offering reasonably priced CBT instructional programs. I've seen several in electronics technology. I recently obtained a copy of Electronics Principles 3.0 by EPT Educational Software (Pump House, Lockram Lane, Witham, Essex, UK, CM8 2BJ; phone 011-44-01376-514008; E-Mail sales@eptsoft.demon.co.uk; web site: <http://www.octagon.co.uk/ext/ept/software.htm>).

The price was £49.95 (about \$80.00 in US funds). EPT accepts Visa and MasterCard. If you order via mail, and use the credit card, then the pounds sterling price will be converted to US or Canadian dollars by the credit card company. Alternatively, you can obtain a pounds sterling money order or cashiers check (or is that

"cheque") ... but beware of the fee (some banks charge \$25.00 for this service!).

Figure 1 shows the screen for Electronics Principles 3.0. The menu bar along the top allows selections of AC, DC, Power, Semi-Cond, Op-Amps, Number, Logic, Measure, and a Help topic.

When a topic is selected, a window opens with a circuit and certain controls. In the example shown, the circuit is a transistor driver for an electromechanical relay. Option buttons on the right side of the panel allow different types of input sensor. In the case shown, a thermistor is used for the sensor. When the temperature reaches a certain point, the voltage across the thermistor rises enough to turn on the NPN transistor which, in turn, activates the relay coil.

Several command buttons along the base of the window allow Calculations, Topic Theory, and Copy & Paste. In this particular screen, there is also a Hot/Cold button that shows what happens under the two conditions. The Calculations button opens a window or panel that shows the arithmetic used to calculate the circuit. The Topic Theory opens a textbox that describes how this circuit works. The Copy & Paste button puts the active window on the Clipboard, so that it can be pasted into other applications. I successfully pasted the images into Visio Technical 4.1 and Microsoft PowerPoint 97.

Other titles in the EPT series include Electronics Principles 4.0 (£99.95), Electronics Toolbox 3.0 (£19.95), and Mathematics Principles 3.0 (£49.95).

Congratulations Are In Order

Congratulations are in order for *Nuts & Volts* columnist Harry Helms. Our software guru, and my predecessor in this column, recently passed the test for the Federal Communications Commission Radiotelegraph license. That's right, radiotelegraph. You know the stuff: CW, merchant marine operators ("Sparks"), Morse code, etc. ... He reports that the test still had vacuum tube stuff ... so apparently hasn't been updated in decades. I'm not sure why Harry wanted the Radiotelegraph License ... he is, after all, one of the leading lights in electronics publishing, and is a pioneer in computer and Net-based training. Congrats, Harry! I think. **NV**

Connections ...

I would like to hear from people who have had experience with distance learning, either good or bad. I can be reached at P.O. Box 1099, Falls Church, VA 22041. Or via E-Mail at carrij@aol.com

One student's perspective on distance education is below. Formerly in New York City, she now lives in New Hampshire: "If you have a telephone, a computer with a MODEM, a VCR, cassette tape deck, a FAX machine, and an address Fed-Ex can find, who the hell needs Manhattan!"

MISC. ELECTRONICS FOR SALE cont.

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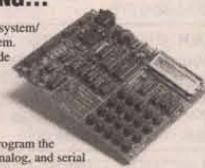
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- simply add antenna, data, power
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- SAW controlled - stability

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SILRX-4XX-F..... \$41.92



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- 19200 baud with ASCII
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- 5v operation
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- Auto TX/RX changeover

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TXR-464-DTR100 \$313.50



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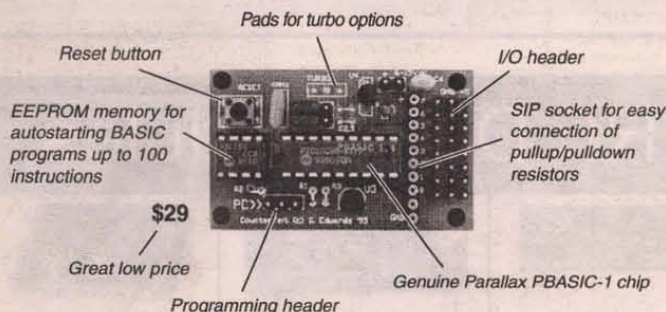
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LED backlit

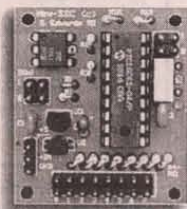


Counterfeit Kits

Designed by the author of the *Stamp Applications* column, the Counterfeit is no fake! It's the **genuinely** easy, **truly** inexpensive kit equivalent to the BASIC Stamp I microcontroller. Get started with microcontrollers today with a \$69 Counterfeit Development System, or add a Counterfeit to your Stamp collection for \$29.



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\$29 kit
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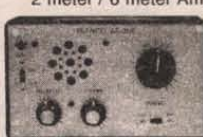
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- rooster crow, buzzer, cuckoo
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TECH FORUM

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 would like to see a schematic and parts values for a de-modulation probe for use with an audio signal tracer.

9971 C. Mills

I want to add the current date and time to a video feed from a tiny surveillance camera, which I will then record on a VCR. I need a schematic, or at least what chip(s) to use to do this.

9972 Chris Estabrook
Glendale, CA

I have a Texas Instruments Model 3000 Travelmate laptop that has a broken LCD display. Is this a color display, and what key sequence is used to activate the external monitor connector?

9973 Bill Brinkerhoff
Savannah, GA

Does anyone have information on restoring the missing parts of the 800 band in the Bearcat Tracker 7 scanner? I know that you can reprogram the EPROM. I would like to know if there is any other way that it can be done. I bought two BCT-7s from Grove Electronics.

9974 Raymond A. Moreno
Somers, CT

I need information on hardware that would provide J1850 and SCI interface via an RS232 port.

9975 Simo Meskouri
Ann Arbor, MI

I need a proximity detector for backing up my vehicle like on new Expeditions. I need something without a separate receiver. How can I use an old Motorola three-watt bag phone as an intrusion monitor without using phone lines? Could it be locked on a little-used frequency and monitored by a scanner or another cell receiver on that frequency?

9976 Grant Maxwell
Nanaimo, BC, Canada

I have a hardware/software communications need. Currently, I have the computer modem connected to a single telephone line. However, when I am working on the computer doing Internet searches, the incoming personal phone call gets a busy signal, but I have no indication that someone is trying to call me.

I wish I could install an interface (hardware or software) which would visually indicate that there is an incoming call in progress. This would allow me to interrupt my work at a good stopping point and switch over to the voice telephone to answer the call.

I look forward to your help in recommending a solution where I am limited financially in using only a single telephone line for both computer [data] and voice calls.

9977 John J. Janda
Mayaguez, PR

I'm trying to do a "freeze-frame" on NTSC composite video; capture one frame and continually play it back — similar to the "pause" button on VCRs and the freeze button found on some VGA to NTSC scan converters. Can anyone suggest a circuit/chip/chipset to do just that?

9978 via Internet

I have two walkie talkies and a base unit on the 483.000 band. I was wondering, is there any way I can connect my scanner to my base unit to listen to my local police department base channel? I would like to have my scanner key up my base station when it receives a transmission. How would I go about doing this? Do I need some kind of VOX system?

9979 Vincente Sanchez
Los Angeles, CA

I have a RELM VHF FM high band programmable transceiver model #LM V2548B that I would like to use on the two meter ham band. I need to know how to program the unit (front panel keypad or PC) and if any re-tuning would be required. The factory service manual has been on back-order for approximately four months now, and the RELM technician I spoke with would not answer my questions regarding programming of the unit. Any help would be appreciated.

99710 B. Piller

I need a circuit to provide a pulsating voltage, 0 to peak around 50Hz, but it is not critical. The coil it will power will be about 100 ohms, again not critical. The supply voltage will be 12 VDC. I would prefer to use the 555 timer due to the cost for, if successful, I will be making a number of the devices. I don't know if the 555 can carry the current for prolonged periods of time. Again, the output does not have to be alter-

nating, only unidirectional pulsating DC.
99711 Charles Forman
San Diego, CA

I am looking for a way/circuit to add to an DAC output, to increase the output specs. The circuit should provide up to 300 mA from the 2.5 mA of the DAC, while maintaining a constant 3.5 volts.

99712 K. Hollis
kman007@ab-io.com

I am designing a game that requires multiple players to wirelessly signal a central unit whether their 'buzz in with the answer' button is pushed from as much as 50'-100'.

I tried using commercial TV infrared controllers and receivers but, if two players buzz in nearly simultaneously, the signals interfere and the receiver gets confused. Any suggestions?

99713 Jeffrey J. Schwartz
via Internet

Does anyone know how to reset problem codes and the Service Required light for a '91 Jeep Cherokee onboard computer? Also, I would like to find information describing the serial protocol used by Chrysler, GM, and Ford so that I could build a interface between a laptop PC and the auto's computer box. With this protocol information I could write PC software to troubleshoot the auto's fuel system.

99714 Winstan J. Hattala
Vail, AZ

I have a harder time waking up in the winter than in the summer. Do you know of a product or kit that will, at a pre-determined time, slowly turn on a Halogen light?

I want to use the Halogen light because of it's brightness and close resemblance to sunlight. I figure if the circuit can handle a Halogen, it should be able to easily handle incandescent lighting.

99715 Glen Devers
via Internet

ANSWERS

ANSWER TO #7974 - JULY 1997

As a preface, the biggest problem in measuring signals in many circuits is the measurement technique. Small signal levels and high frequencies can cause things to appear differently than

ANSWER INFO

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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

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- Questions may be subject to editing.

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- Include your Name, Address and Phone Number. Only your name will be published with the question, but we may need to contact you.

they really are.

Part 1: regarding the voltage drop seen across five, 600 mH inductors in series and connected to a 555 [squarewave] running at 470 KHz. Ideally, the drop across each inductor is the same. What's changing is more likely a result of the measurement technique.

Since reader Moran hasn't said exactly how he's making these measurements, let's assume his scope is grounded to the 555 common, and he's measuring the voltages at each

TECH FORUM

connection between a pair of inductors and comparing the difference between each reading. With this measurement technique, the voltages will steadily decline.

Consider that a typical scope has an input impedance of 1 megohm. Calculate the reactance of the 600 mH inductor at 470 KHz and you'll find that it's 1.77 megohms.

So, if you draw the circuit being measured, you have a string of five 1.77 megohm reactances to ground. With each measurement, you're paralleling the reactances below the test point with the 1 megohm scope impedance.

What you actually have is a voltage divider. The upper leg being the number of inductors above the measurement point, the lower leg being the rest of the inductors, paralleled by the scope's 1 megohm.

Each node between inductors will have a different division ratio. The closer to ground, the higher the loss. The harmonics likely result from capacitive coupling between the inductors.

The other condition present, equal capacitors and a switching diode, contains similar problems with measurement. Here, however, remember that 470 KHz is really RF.

Besides capacitance, the leads and components also have inductance associated with them. And inductors and capacitors together will have resonances.

The situation posed is interesting, but of questionable value other than to point out that measurement technique and a reasonable understanding of the circuit being measured is important. Seeing something on a scope doesn't always prove something's really there.

Richard Nelson
Newport News, VA
rickn2432@aol.com

ANSWER TO #89711 - AUGUST 1997

The DB15 female port is for an external transceiver to an ethernet network. You can use your NCR PC as a Unix (or some other OS) and your terminal to create a host/terminal environment. But, I would recommend you get a cheap PC and make a small ethernet network. You should be able to get a small 386 for under \$100.00 and it will be more functional than a VT220.

Don Burkey
via Internet

ANSWER TO #8971 - AUGUST 1997

Do not, under any circumstance, splice a video tape. The fact that the tape is stretched against a 3600 RPM cylinder head assembly will eventually unsplice any fix.

The glue or adhesive that will be released and possibly attached to the cylinder will result in required cleaning will negate any gain for the splice.

The best one can do is choose the reel with the most remaining, and salvage that by throwing away the shorter

piece and fastening the end of the longer to the spool just emptied.

If the video is so important on the broken tape, then one could make two cassettes of the two ends at the expense of pitching a worthless tape from another cassette. Use the two empty spools and make two with the two ends of broken tape. Dub the result ASAP onto a new tape.

The only loss will be that video that won't scan as it is too close to the end near the spool.

Travis Brackeen
Fayetteville, GA

ANSWER TO #8973 - AUGUST 1997

A 16-bit ISA slot is also an eight-bit slot; the difference is a 16-bit slot has an extra extension for 16-bit cards to plug into for faster communications to the computer processor at twice the speed of an eight-bit slot.

You can use all five slots as eight-bit slots. Just plug your card into the slot in the longer portion as this is the eight-bit portion. You can tell this by comparing it to the single eight-bit slot you mention the motherboard has.

I suggest you check your local library or bookstore where you can obtain a book by Que called *Upgrading and Repairing PCs*. It's a very good source for learning about the internal function of computers and the components they use.

Wesley K. Miller
Camp Hill, PA

ANSWER TO #89717 - AUGUST 1997

Reader Larry L. Williams in Union, MO, is asking about a serial port switch. I don't know his exact needs, but there are AUTOMATIC serial switches that might serve his purpose.

In the latest *All Electronics* catalog, the following ad appears:

Four-way automatic switch for

computers and peripherals (serial RS-232 connectors)

Ora Electronics # PSB-41S automatic switch allows two, three, or four computers to share one serial device without changing cables or pushing buttons. Time-out between operations can be adjusted to fit software requirements. Selectable auto form feed will automatically instruct a printer to advance to a new page after each print job is completed. Requires "straight-through" cables with DB-25 male ends.

6 1/8" X 3 3/8" X 7/8"
CAT# PSB-41S \$8.00 each

He can contact **All Electronics** at 1-800-826-5432.

This might serve his purpose, and I just don't think one could be hacked together for less than the \$8.00 (plus shipping)!

John M. Hoyt
Fayetteville, AR
amicon@specnet.com

ANSWER TO #89718 - AUGUST 1997

There should be a jumper block labeled CNH1 just to the right of the SCSI terminating resistor near the lower left side. The Table looks like this:

J1-2	J3-4	J5-6	SCSI ID
Open	Open	Open	0
Short	Open	Open	1
Open	Short	Open	2
Short	Short	Open	3
Open	Open	Short	4
Short	Open	Short	5
Open	Short	Short	6
Short	Short	Short	7

Fujitsu is available at 1-800-626-4684, 408-432-6333, fax is 408-894-1709.

Don Burkey
via Internet

ANSWER TO #8977 - AUGUST 1997

There are two simple ways to measure temperature with a PC. The first is

the traditional analog method.

The sensor could be a National LM335. This provides a fixed output voltage change per degree.

The analog output voltage is converted with an analog-to-digital converter.

A company called **Electronic Energy Control (1-800-842-7714)** makes eight-bit and 10-bit A/D converters with RS-232 serial output (easy to connect to the serial port of your PC) for \$100.00 and \$125.00, respectively.

The 10-bit resolution gives you 1024 steps of temperature, while eight-bits only gives you 256 steps. These A/D boards accept up to eight analog inputs. Or you could make your own.

The other method is all digital.

Dallas Semiconductor makes the DS1621 [http://www.dalsemi.com/DocControl/PDFs/1621.pdf] direct digital temperature sensor. It could be interfaced to a PC parallel port with a few parts and a little software support. The DS1621 would require four wires between the sensor and the computer, though.

Tim Godfrey
tgodfrey@unicom.net

ANSWER TO #8976 - AUGUST 1997

There are quite a few things to consider when designing a switch mode transformer and selecting a core. Frequency of operation, power, switcher topology, and core operating temperature (not ambient temperature) are probably the most important.

Cores are frequency sensitive, and looking at the curve of Q versus frequency will show that quite dramatically. Each material has a maximum frequency, beyond which permeability drops rapidly. Selection of frequency will determine the type of rectifier

Continued on page 109

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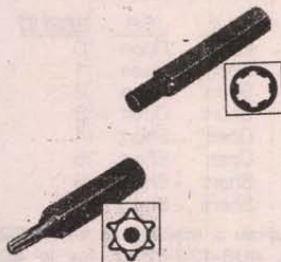
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USER'S GUIDE TO AUDIO POWER AMPLIFIER ICs

Part 2

by Ray Marston

Last month's opening installment of this five-part series explained audio power amplifier basics and showed how they are applied in many modern audio power amplifier ICs.

This month's installment takes an in-depth look at nine popular current-production audio power amplifier ICs that have maximum output power ratings in the range 325 mW to 5.5W, and shows how they can be used in practical applications.

PRACTICAL ICs

A large range of audio power amplifier ICs are readily available. Some of these ICs house a single (mono) amplifier, while others house a pair (a dual) of amplifiers. Figure 1 lists the basic characteristics of nine popular audio power amplifier ICs with maximum output power ratings in the approximate

that is housed in an eight-pin DIL package and uses power supplies in the 4V to 15V range. It consumes about 4 mA of quiescent current and is ideal for use in battery-powered applications.

The IC's voltage gain is variable from $\times 20$ to $\times 200$ via external connections, its output automatically centers on a quiescent half-supply voltage value, and it can feed several hundred milliwatts into an 8 Ω load when operated from a 12V supply. Its differential input terminals are both ground-referenced, and have typical input impedances of 50K.

Figure 2 shows the LM386's internal circuit. Here, Q1 to Q6 form a differential amplifier in which both inputs are tied to ground via 50K resistors (R1 and R2) and the output (from Q3) is direct-coupled to the input of common emitter amplifier Q7.

The Q7 collector signal is direct-coupled to the IC's output terminal via class-AB unity-gain power

Ray Marston looks at nine popular audio power amplifier ICs with maximum output power ratings in the range 325 mW to 5.5W in this second part of this five-part series.

the emitters of Q1 and Q3 ($= R5 + R6$). Thus, the IC can be used as a minimum parts amplifier with an overall voltage gain of $\times 20$ ($= 2 \times 15K/1.5K$) by using the simple connections shown in Figure 3, where the load is AC-coupled to the IC output via C2, and the input signal is fed to the non-inverting terminal via RV1.

Note that C1 is used to RF-decouple the +VE supply pin (pin 6), and R1-C3 is an optional Zobel network that ensures HF (high frequency) stability when feeding an inductive speaker load.

Device number	Amplifier type	Maximum output power	Supply voltage range	Distortion, into 8 Ω	Z_{in}	A_v	Bandwidth	Quiescent current
LM386	Mono	325mW into 8 Ω	4 to 15V	0.2%, $V_s = 6V$, $P_o = 125mW$	50k	26dB	300kHz	4mA
LM831	Dual	220mW per channel, into 4 Ω	1.8 to 6V	0.25%, $V_s = 3V$, $P_o = 50mW$	25k	48dB	20Hz - 20kHz	6mA
TDA7052	Mono	1.2W into 8 Ω	3 to 15V	0.2%, $V_s = 6V$, $P_o = 100mW$	100k	40dB	20Hz - 20kHz	4mA
LM388	Mono	1.5W into 8 Ω	4 to 12V	0.1%, $V_s = 12V$, $P_o = 0.5W$	50k	26dB	300kHz	16mA
TDA2822	Dual	1.0W per channel, into 8 Ω	1.8 to 15V	0.3%, $V_s = 9V$, $P_o = 0.5W$	100k	40dB	120kHz	6mA
TBA820M	Mono	2.0W into 8 Ω	3 to 16V	0.4%, $V_s = 9V$, $P_o = 0.5W$	5M Ω	34dB	20Hz - 20kHz	4mA
LM1877	Protected-output Dual	2.0W per channel, into 8 Ω	6 to 26V	0.04%, $V_s = 20V$, $P_o = 2W/channel$	4M Ω	34dB	65kHz	25mA
LM380	Protected-output Mono	3.0W into 4 Ω	8 to 22V	0.2%, $V_s = 18V$, $P_o = 2W$	150k	34dB	100kHz	7mA
LM384	Protected-output Mono	5.5W into 8 Ω	12 to 26V	0.25%, $V_s = 22V$, $P_o = 4W$	150k	34dB	450kHz	8.5mA

Figure 1. Basic details of the nine ICs described in this chapter.

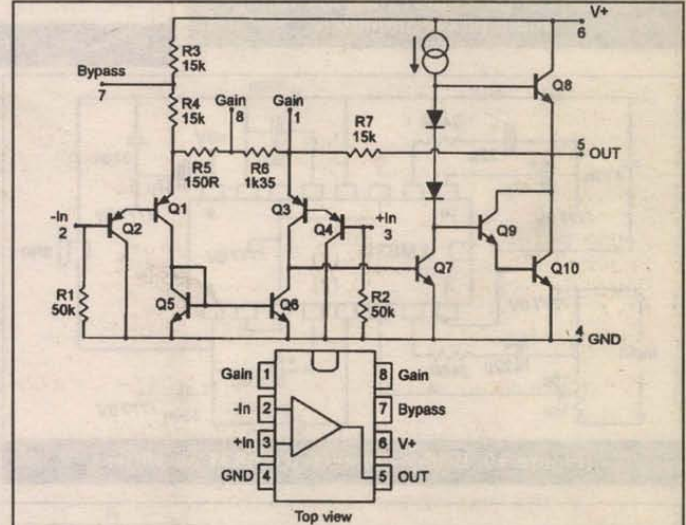


Figure 2. Internal circuit and pin connections of the LM386 low-voltage audio power amplifier.

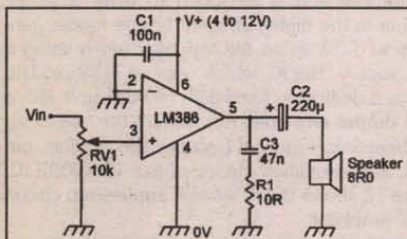


Figure 3. Minimum-parts LM386 amplifier with $A_v = 20$.

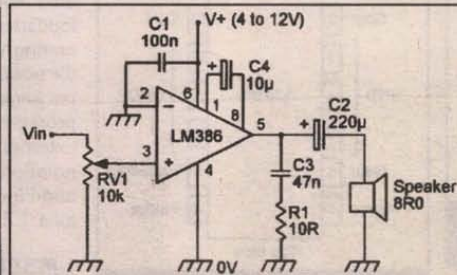


Figure 4. LM386 amplifier with $A_v = 200$.

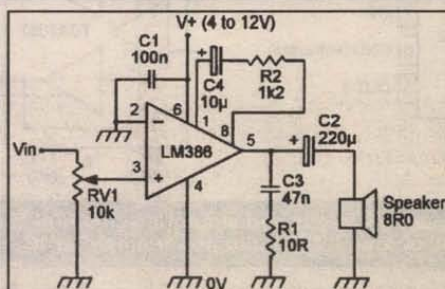


Figure 5. LM386 amplifier with $A_v = 50$.

Figure 4 shows the above circuit modified to give an overall voltage gain of $\times 200$ by using C4 (between pins 1 and 8) to effectively short-circuit the internal 1K35 resistor of the IC. Alternatively, Figure 5 shows how the gain can be set at $\times 50$ by wiring a 1K2

range 325 mW to 5.5W; note that the LM831, TDA2822, and LM1877 are dual types, and that the LM1877, LM380, and LM384 have fully protected (short-circuit proof) output stages. The rest of this article is devoted to detailed descriptions of each of the above nine IC types.

LM386 BASICS

The LM386 is a very popular audio power amplifier IC (manufactured by National Semiconductor)

amplifier stage Q8-Q9-Q10 which, to minimize internal volt-drops and maximize the available output power, is not provided with overload protection circuitry.

LM386 APPLICATIONS

The LM386 is very easy to use. Its voltage gain equals double the pin 1 to pin 5 impedance value (15K in Figure 2) divided by the impedance between

resistor (R2) in series with C4.

The voltage gain of the LM386 can also be varied by shunting the internal 15K pin 5 to pin 1 feedback resistor. Figure 6 shows how to shunt this resistor with C4-R2, to give 6 dB of bass boost at 85 Hz, to compensate for the poor bass response of a cheap loudspeaker.

Finally, Figure 7 shows how the LM386 amplifier can be modified for use as a built-in amplifier in an AM radio. Here, the detected AM signal is fed to the

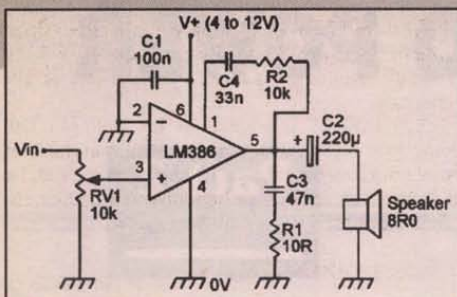


Figure 6. LM386 amplifier with 6 dB of bass-boost at 85 Hz.

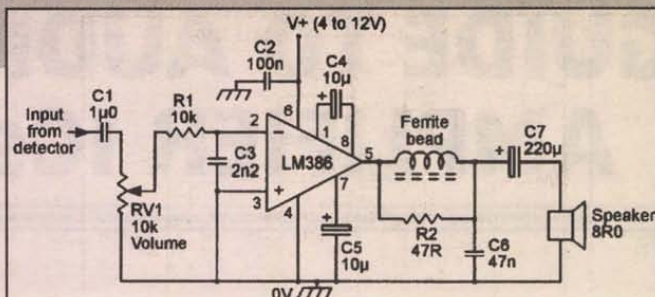


Figure 7. AM-radio power amplifier.

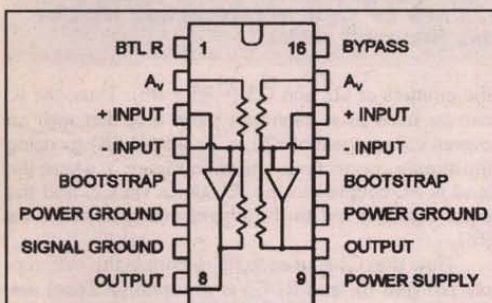


Figure 8. Outline, basic circuit, and pin notations of the LM831 dual low-voltage audio power amplifier.

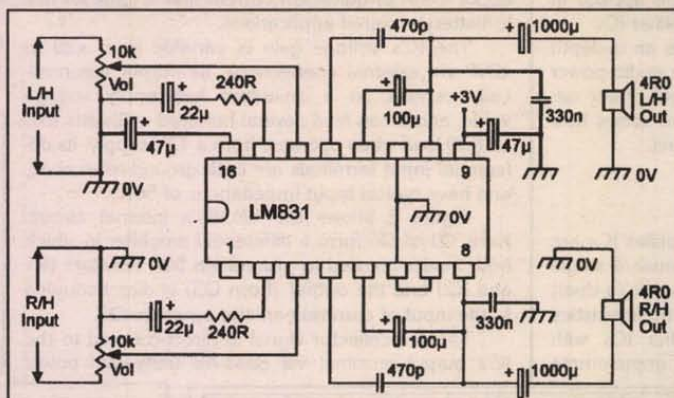


Figure 9. LM831 stereo amplifier.

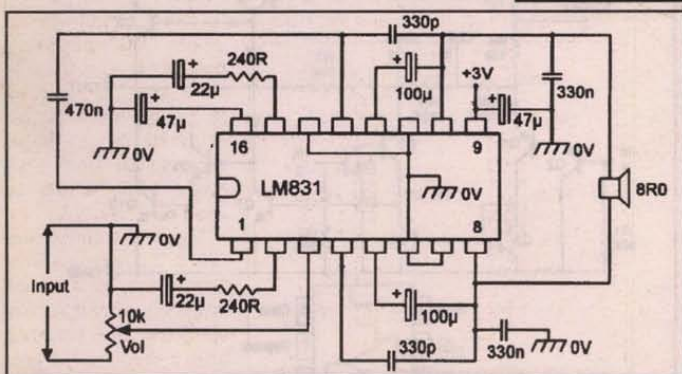


Figure 10. Bridge-connected LM831 amplifier.

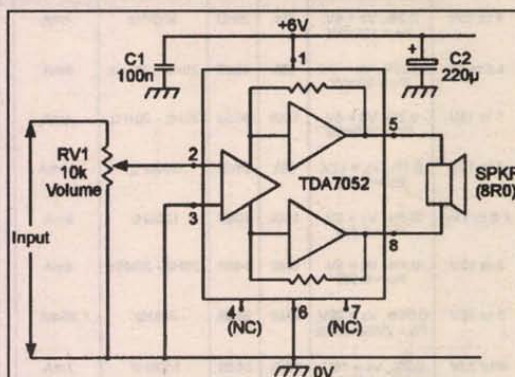


Figure 12. Super-simple TDA7052 application circuit as 1.2W amplifier.

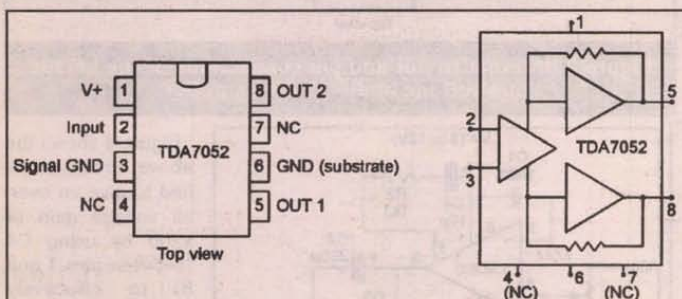


Figure 11. Outline, pin notations and simplified circuit of the TDA7052 bridged-output 1.2W audio power amplifier IC.

non-inverting input of the IC via volume control RV1, and is RF-decoupled via R1-C3; any residual RF signals are blocked from the load via a ferrite bead. C4 sets the IC's voltage gain at x200.

Note that this circuit is provided with additional power-supply ripple rejection by wiring C5 between pin 7 and ground; this ripple-rejection capacitor can also be used with the Figure 3 to 6 circuits if required.

Before leaving the LM386, note that this IC is a member of a long-established family of audio power amplifier ICs designed around the basic Figure 2 chip circuit, and that two of these ICs — the LM389 and the LM390 — have recently been withdrawn from production through lack of demand.

The LM389 contained an array of three independently accessible wide-band NPN transistors on the same substrate as the basic amplifier, and used an 18-pin DIL package. The LM390 had a modified

LM386 output stage and used a 14-pin DIL package that enabled it to feed 1W into a 4R0 load when operating from a 6V supply.

One other member of the family, the LM388, which can feed 1.5W into an 8R0 load when using a 12V supply, is still available and is described in greater detail later in this article.

LM831 CIRCUITS

The LM831 is a dual power-amplifier IC designed specifically for very low-voltage operation; it can use supplies in the 1.8V to 6V range. Its two independent amplifiers give good low-noise and low-distortion performances, and generate minimal RF radiation, thus enabling the IC to be used in close proximity to an AM receiver. The IC is housed in a 16-pin DIL package, using the pin notations shown in Figure 8.

The two amplifiers of the LM831 can either be used independently to make a low-voltage stereo amplifier, or can be interconnected in the bridge mode to make a boosted-output mono amplifier. Figures 9 and 10 show the circuit connections of these two options.

When these circuits are powered from a 3V supply derived from two 1.5V cells, each channel of the stereo amplifier can deliver 220 mW into a 4R0 speaker load (and gives a 3 dB signal bandwidth of 50 Hz to 20K Hz), and the bridge amplifier can deliver 440 mW into an 8R0 load (and gives a 20 Hz to 20 KHz bandwidth).

When constructing these two circuits note that, in the interest of adequate circuit stability, the PCB must be laid out with large earth planes, and the pin 9 decoupling capacitor must be as close to the IC as possible and must have a minimum value of 47 µF; the two 330nF decoupling capacitors must also be as close as possible to the IC.

TDA7052 CIRCUITS

The TDA7052 is intended for use in battery-powered equipment and is designed to drive a single loudspeaker in the highly-efficient bridge mode, generating up to 1.2W in an 8R0 speaker when using a 6V power supply. The IC, which uses an eight-pin DIL package, is a dedicated fixed-gain (40 dB) unit with a protected output and does not require the use of an external heatsink. Figure 11 shows the outline, pin notations, and simplified circuit of the TDA7052 IC, and Figure 12 shows the IC's basic application circuit as a 1.2W amplifier.

LM388 CIRCUITS

The LM388 is a slightly modified version of the LM386 and uses a 14-pin DIL package with internal heatsink (see Figure 13) and can feed 1.5W into an 8R0 speaker when powered from a 12V supply. The most significant internal difference between this IC and the LM386 relates to C7 (see Figure 2), which uses an internal constant-current collector load in the LM386, but which uses an external load in the LM388. This external load feature greatly increases the versatility of the IC.

Figure 14 shows one way of using the LM388. R1 and R2 are wired in series between the positive supply

Next month's installment of this series looks at eight popular audio power amplifier ICs with maximum power ratings in the range 6W to 12W.

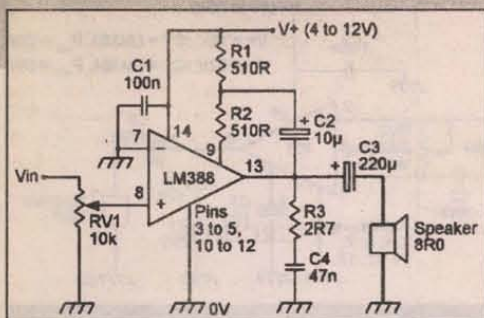


Figure 14. LM388 with a gain of x20 and load returned to ground.

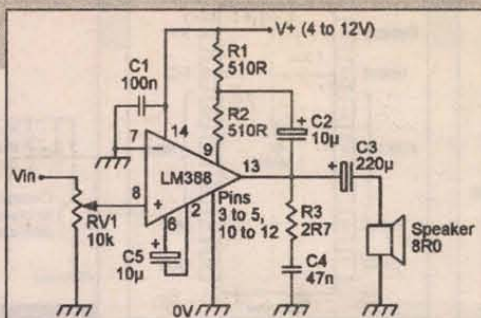


Figure 15. LM388 with a gain of x200 and load returned to ground.

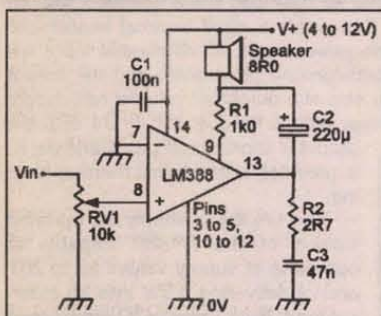


Figure 16. LM388 with a gain of x20 and load returned to +VE supply.

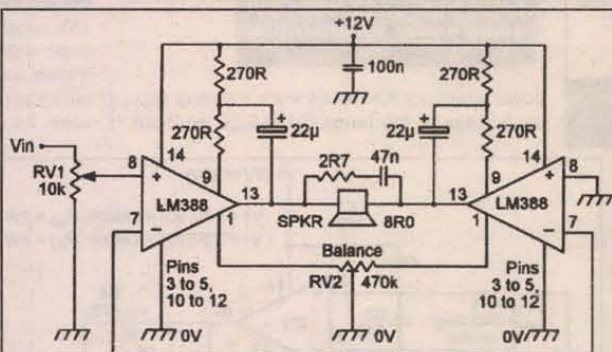


Figure 17. LM388 bridge amplifier delivering 4W to an 8R0 load.

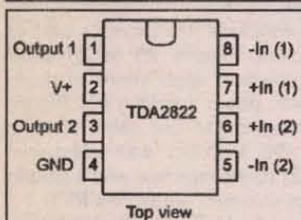


Figure 18. Outline and pin notations of the TDA2822 dual amplifier IC.

line and pin 9 of the IC, to provide collector current to the internal Q7, and the R1-R2 junction is bootstrapped from the IC's output via C2, to raise the AC-impedance of R2 (and thus the voltage gain of Q7) to a value far greater than its DC value. The LM388's overall voltage gain is determined in the same way as in the LM386, and equals x20 in Figure 14. Figure 15 shows how the gain can be increased to x200, by wiring C5 between pins 2 and 6.

Figure 16 shows another way of using the LM388. Here, DC current is fed to pin 9 via the speaker and R1, and the low end of the speaker is AC-driven by the amplifier's output, thus bootstrapping R1 and giving it a high AC impedance value. This circuit thus gives a performance similar to that of Figure 14, but does so with a saving of two components.

Finally, Figure 17 shows how to connect a pair of LM388 ICs in the bridge configuration, to provide 4W of drive to a direct-coupled 8R0 speaker load when using a 12V power supply. Pre-set pot RV2 is used here to set the quiescent output of the two ICs at identical values, to minimize the circuit's quiescent current consumption.

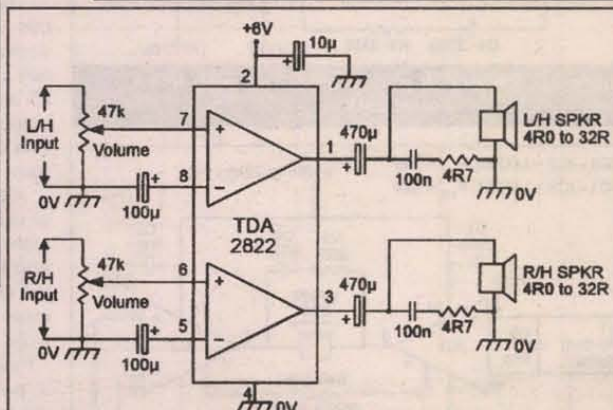


Figure 19. TDA2822 stereo amplifier circuit.

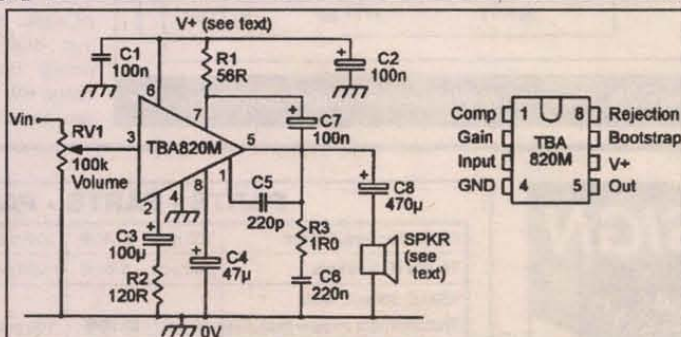


Figure 20. TBA820M low-power audio amplifier circuit.

Before leaving the LM388, note that this IC has a fairly poor supply line ripple rejection performance, and if any problems are met in this respect they can be overcome by wiring a 10 μ F (or larger) capacitor between pin 1 and ground.

TDA2822 CIRCUITS

The TDA2822 is a versatile dual amplifier that can use any DC supply in the 1.8V to 15V range; it

can be powered from a 3V supply and used to drive headphones at 20 mW per 32-ohm channel, or from a 9V supply and used to drive 8R0 speakers at 1W per channel.

The TDA2822 is housed in an eight-pin DIL package (see Figure 18), and uses the minimum of external components. Figure 19 shows how it can be used as a stereo speaker or headphone amplifier circuit that is powered from a 6V supply.

TBA820M CIRCUITS

The manufacturers describe this device as a low-power amplifier that is capable of generating a few hundred milliwatts in a 4R0 to 16R speaker load, although it can, in fact, generate as much as 2W in an 8R0 load. The IC uses an eight-pin DIL package, can operate from supplies as low as 3V, and features low quiescent current, good ripple rejection, and low cross-over distortion.

Figure 20 shows the outline and pin notations of the TBA820M IC, plus a practical application circuit for the device. Here, R2 determines the voltage gain of the IC, and R3-C6 form a Zobel network across the loud-speaker. This circuit can use a maximum supply voltage of 16V with a 16R speaker, 12V with an 8R0 speaker, or 9V with a 4R0 speaker.

LM1877 CIRCUITS

The LM1877 is a protected-output dual amplifier that can feed up to 2W into each output channel when using a pair of 8R0 speakers. Figure 21 shows the outline and pin notations of the IC, which uses a

14-pin DIL package; note that — in use — GND pins 3 to 5 and 10 to 12 are meant to be soldered to a large ground plane on the circuit's PCB, which is used as a heatsink.

Figure 22 shows the LM1877's basic application circuit, as a stereo amplifier driving 8R0 speakers and powered from a single-ended supply. The voltage gain of each amplifier is set at x200 by its 100K/510R negative feedback resistance network, and each

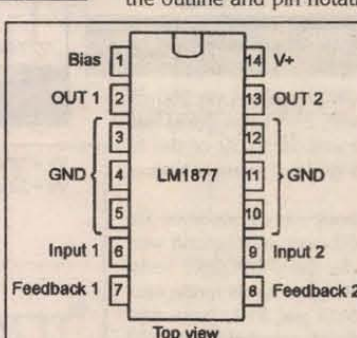


Figure 21. Outline and pin notations of the LM1877 dual 2W amplifier IC.

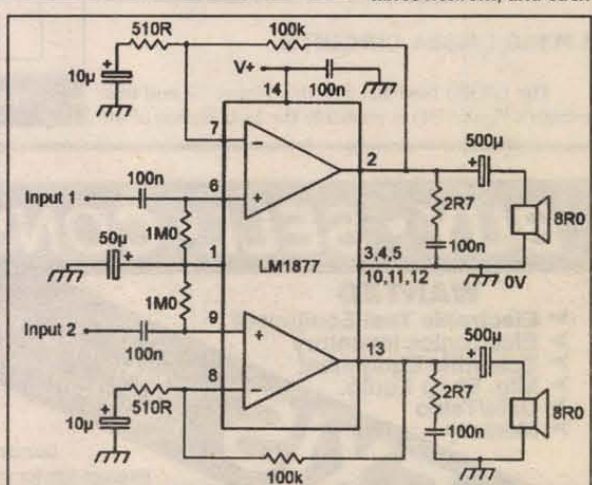


Figure 22. LM1877 stereo amplifier using a single-ended power supply.

amplifier's input signal is applied to its non-inverting terminal, which is wired to the IC's decoupled pin 1 bias terminal via a 1M0 isolating resistor.

Other points to note are that the amplifier out-

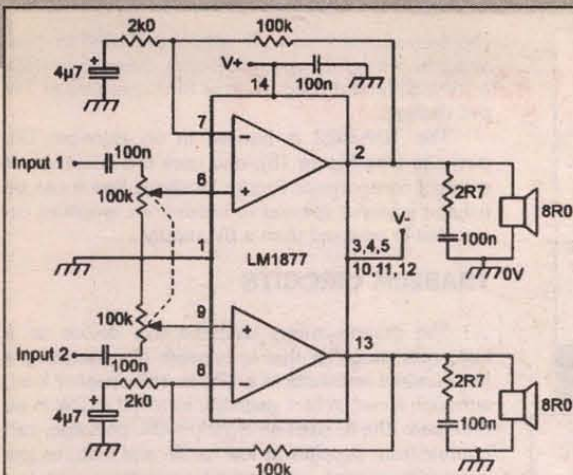


Figure 23. LM1877 stereo amplifier using a split (dual) power supply.

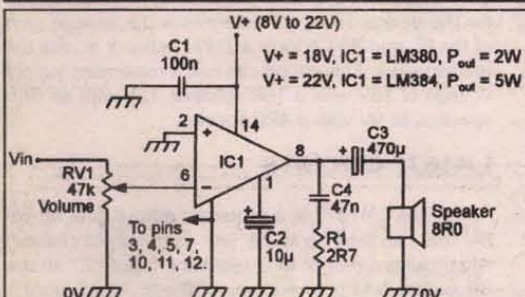


Figure 25. 2W or 5W amplifier with simple volume control and ripple rejection.

puts are AC coupled to the 8Ω speakers via 500 μF electrolytics and are fitted with 2R7-100nF Zobel networks, and that pins 3 to 5 and 10 to 12 of the IC must be wired to the PCB's ground plane, which is used as a heatsink.

Figure 23 shows the above circuit modified for operation from a split (dual) power supply, and with its voltage gain set at x50 by the 100K/2K0 resistance ratios and with its input signal levels made variable via stereo volume control pot RV1. Note that each amplifier's output is direct coupled to its 8Ω speaker, that the IC's pin 1 bias terminal is connected directly to the power supply 0V (common) line, and that pins 3 to 5 and 10 to 12 of the IC must be wired to the PCB's negative supply rail (which must be of substantial size), which is used as a heatsink.

LM380/LM384 CIRCUITS

The LM380 (see last month's Figure 17 and this month's Figure 24) is probably the best known of all

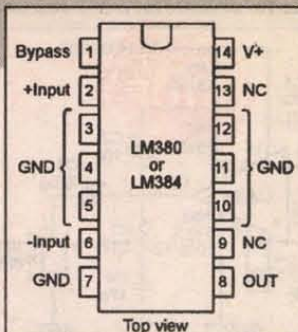


Figure 24. Outline and pin notations common to the LM380 2W and LM384 5W audio power amplifier ICs.

power amplifier ICs. It can work with any supply voltage in the range 8V to 22V, and can

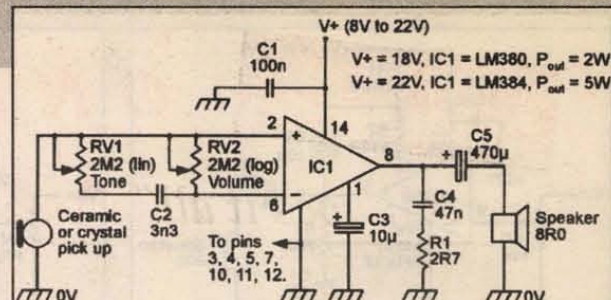


Figure 27. 2W or 5W phono amp with common mode volume and tone controls.

deliver 2W into an 8Ω load when operated with an 18V supply (but needs a good external heatsink to cope with this power level). Its differential input terminals are both ground referenced, and the output automatically sets at a quiescent value of half-supply volts. Its voltage gain is fixed at x50 (= 34 dB), the output is short-circuit proof, and the IC is provided with internal thermal limiting.

The LM384 is simply an up-rated version of the LM380, capable of operating at supply values up to 26V and of delivering 5.5W into an external load. Both types of IC are housed in 14-pin DIP packages, in which pins 3 to 5 and 10 to 12 are intended to be thermally coupled to an external heatsink.

To conclude this month's part of this series, Figures 25 to 28 show some practical applications of these two audio power amplifier ICs. Figure 25 shows how to use either IC as a basic x50 amplifier with enhanced (via C2) ripple rejection and a simple form of volume control (via RV1).

Alternatively, Figure 26 shows how to use either IC as a phono amplifier with RIAA equalization (via R1-C4), and Figure 27 shows how to modify the circuit for use with so-called common mode volume and tone controls.

Finally, Figure 28 shows how to use a pair of these ICs in the bridge mode, to give a maximum output of either 4W or 10W.

A further selection of applications of audio power amplifier ICs (including dual types), with maximum power ratings in the approximate range 6W to 68W, is given in the next two parts of this series. NV

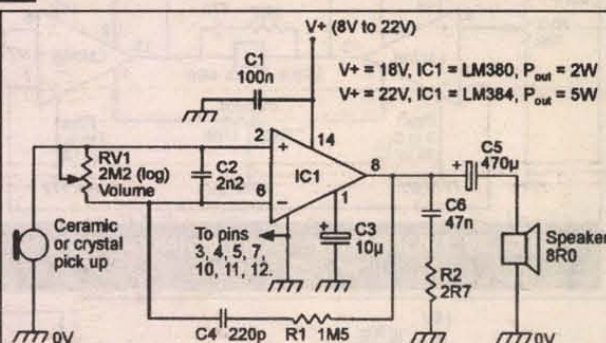


Figure 26. 2W or 5W phono amplifier with RIAA equalization.

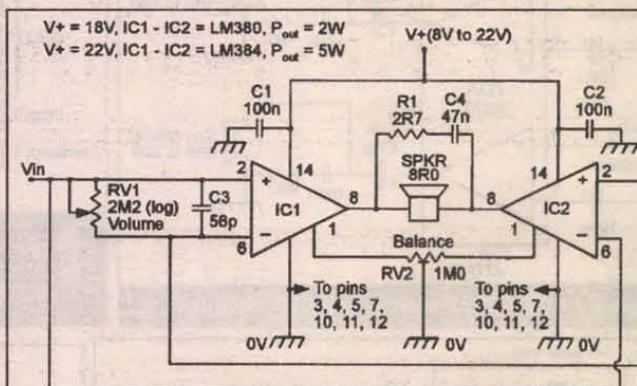


Figure 28. 4W or 10W bridge-configured amplifier.

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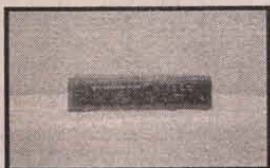
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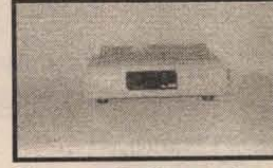
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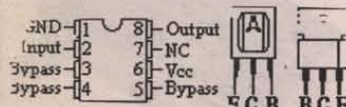
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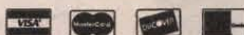


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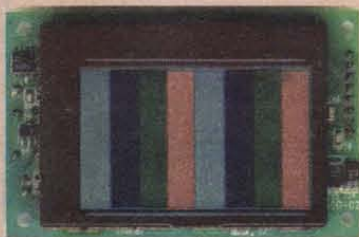
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NEW PRODUCT EDITOR
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News

HS-961 TRICOLOR LCD MODULE



Shoreline Electronics introduces the Tricolor Smart LCD Module, HS-961.

The HS-961 is a complete tricolor display system and incorporates all of the necessary components required to display graphics and text.

Display ideas can be created on a PC and transferred to the HS-961 via the PC COM port. The HS-961 removes all of the tedious work and time required to use a LCD display. The Flash memory used in the HS-961 will save the display program indefinitely or can be reprogrammed for product upgrades or design changes. Graphics, text, and animation can be displayed simultaneously.

For more information, contact:

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408-987-7733
E-MAIL: ShoreElec@aol.com

PHONE LINE SIMULATOR



Phone line simulators act like a phone company central office. They can give you flexibility and lower your costs when you are demonstrating or testing any type phone product. Fax, modem, voice, or video conferencing recognize simulators as real phone lines, making them ideal for trade shows, customer sites, or the lab.

The ILS-1000 from Teltone® gives you two ISDN basic rate interface lines for one end-to-end simulation. Configuration software is included, making the unit extremely flexible. Use it to demonstrate the

unique features of your products in trade shows, sales training, to customers, or for test and development in your lab.

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PC TO CONTROLLER AREA NETWORK ADAPTER



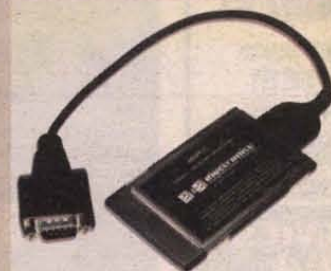
Embedded Micro Software announces the CANPORT, PC Parallel Port to Controller Area Network (CAN) adapter.

The CANPORT is used to connect a PC to a CAN. Included in the package are dynamic link libraries (DLLs) for Windows, DOS libraries, and a stand-alone application for sending and receiving messages. Custom application software is also available.

Single quantity price is \$109.00.
For more information, contact:

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RS422/485 SERIAL PORT



Slip the new #485PCC PCMCIA card from B&B Electronics into

your laptop and gain an RS422/485 serial port. This single card can be configured for either RS422 or RS485 and high-speed or normal communications.

The Type II (5 mm) PCMCIA card features automatic send data control which handles RS485 driver enable and disable functions transparently, allowing easy use with Win 95 and software without RTS support. This is ideal for field service reps who work on numerous different configurations.

Users can also set the 485PCC to 4X clock mode which allows baud rates up to 460.8 Kbaud. A high-speed 16550 UART allows high-speed communications with reduced CPU overhead.

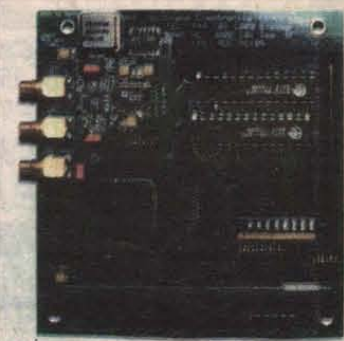
The 485PCC pinouts match the SMPTE video standard for controlling devices. A simple configuration program is shipped with the 485PCC. Configuration options are stored in non-volatile memory. A 12-inch cable has a DB9 male connector.

No. 485PCC PCMCIA Serial Port Card is \$159.95.

For more information, contact:

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PC/104 A/D BOARD



Designed specifically for the analysis of fast transient signals such as ultrasonic transducer waveforms, the FADC-50 is a unique, economical 50 MHz dual-channel sampling A/D card in the PC/104 form factor. Supporting both AC and DC coupled inputs with 32 Kbytes of onboard fast RAM for each channel,

real-time high-speed data acquisition is possible for applications where the capture of short high-frequency signals is required.

Applications include ultrasonic inspection systems, wave acquisition and processing, transient signal analysis, and optical and laser signal analysis.

A TTL trigger input can be used for synchronization with external events to acquire voltage spikes or flash signals, but internal triggering is also provided. An adapter is available to make this board useable in ISA-bus computers too.

Featuring the dual input eight-bit AD9059 A/D converter, FADC-50 comes complete with DOS/Win3.1/Win95 application software and source code for data acquisition and direct-to-screen display of captured waveforms.

FADC-50 is available at \$1,845.00 from stock.

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F-2800 & F-2850 FREQUENCY COUNTERS

Elenco Electronics introduces two new handheld frequency counters, Models F-2800 and F-2850.

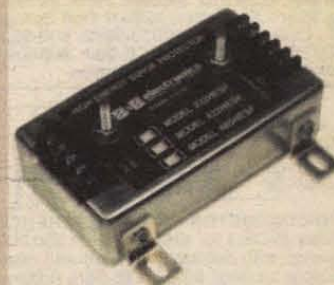
Both counters offer wide input ranges. The F-2800 displays frequencies from 1 MHz to 2.8 GHz and the F-2850 range is 10 MHz to 2.8 GHz.

Each unit has a 250 MHz direct count range for high resolution. The F-2850 also reads period and has auto triggering. Both units have data hold and 16-segment signal strength bargraph. Many other features included.

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HIGH-ENERGY SURGE PROTECTORS



A new line of heavy duty surge protectors from B&B Electronics is designed to help protect data and communication lines against lightning strikes, power surges, and

New Product News

other types of voltage disturbances. Up to five signal lines are protected.

The new models offer three stages of protection: a gas discharge tube, a series resistor, and a transient voltage suppressor. The heavy metal case offers two terminal posts and two metal mounting brackets to provide a good solid ground connection, which is important for the units' proper operation.

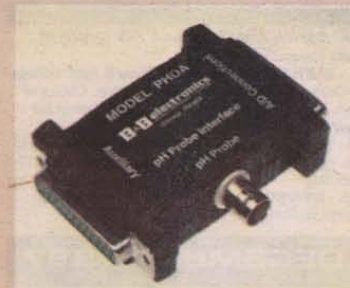
The units have been tested to meet IEC 1000-4-5 and IEEE C62.41 specifications. They also meet CE regulations. Standard connectors are five-position terminal blocks. An RS232 model with M/F DB-25 connectors is also available. Size is 4-1/2"L x 3-1/4"W x 1-3/4"H and weight is seven ounces.

The new high-energy surge protectors range from \$74.95 to \$124.95.

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LOW-COST SIGNAL AMPS



Temperatures, pH levels, and the output of full bridge sensors can be linked to a PC using these new sensor interfaces from B&B Electronics. The modules amplify and condition sensor signals and are normally used with B&B data acquisition modules which convert the signal to RS232 or RS485 so that it can be monitored and recorded on a computer.

Measure temperatures between -50°C and 200° with #TCDA thermocouple interface and a data acquisition module. Factory modification can change the temperature range. The #TCDA costs \$99.95 and the data acquisition modules commonly used with it are \$89.95-\$109.95. Accessories include a 36" bead-tip thermocouple at \$13.95 and a 12-volt power supply for \$14.95.

The pH measurement unit can be plugged to a thermocouple interface to correct for the temperature dependence of pH readings and the combined signal sent to a single data acquisition module. This also uses only one com port on the PC. #PHDA pH Electrode Interface is \$64.95.

The #FBDA module has

adjustable gain settings to suit a wide variety of signals from full-bridge transducer sensors. The module also has the adjustable excitation voltage required by transducer sensors. This module is often used to monitor the voltages produced by strain gauges, load cells, pressure sensors, and other full-bridge transducer sensors. #FBDA is \$64.95.

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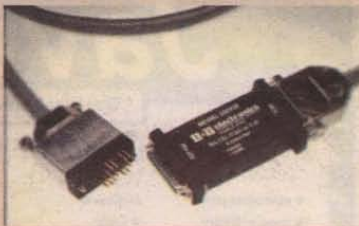


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INTERFACE ADAPTER



The new #232V35 interface adapter from B&B Electronics allows you to connect a PC's RS232 (V.24) serial port to the V.35 port on a mainframe computer. It utilizes a complete V.35 integrated circuit to provide full compliance with both the RS232 and V.35 communications standards. The RS232 connection is a DB-25 female connector and the V.35 interface is a male 34-pin connector complying with ISO/IEC 2593.

The 232V35 is configured at the

factory to connect a RS232 DTE device (synchronous terminal or server) to a device with a V.35 DCE interface (synchronous modem, CSU/DSU or multiplexer). The unit can easily be reconfigured by the installer to reverse the transmit and comm connections. The #232V35 is powered by 12 VDC (a power supply is optional).

The #232V35 supports these signals: TD, RD, TC, RC, Ext TC, RTS, CTS, DTR, DSR, DCD. The maximum data rate is 64 Kbps and the unit is protocol independent (the synchronous protocol is provided by the interconnected devices). This cable-end adapter plugs into the PC serial port, requiring no internal board installation. A six-foot cable is included.

No. 232V35 interface converter is \$139.95.

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PIC16C66/67 OTP MCUs



Microchip Technology, Inc. introduces PIC16C66 and PIC16C67 OTP MCUs. These devices combine extensive communications capability and industry-leading performance of 5.0 MIPS CPU with cost-effective OTP technology to provide a new price/performance point in the eight-bit microcontroller market.

The EPROM-based PIC16C66/67 features a Universal Synchronous/Asynchronous Receiver Transmitter (USART) operating up to 5.0 million bits per second for high-speed communications capability. With large 8K x 14 bits works of program memory and 368 bytes of data RAM, these devices are ideal for computationally intensive applications.

The PIC16C66/67 offer 200-nsec microcycle times; 35 powerful single-cycle instructions, each 14 bits wide; and small footprint 28-pin and 40-pin packages. Both devices provide an ideal embedded control solution for applications — such as air bag controllers, motor control, central office line cards, set top boxes, and network switches — which require high-processing speed and extensive communications with other processors or resources.

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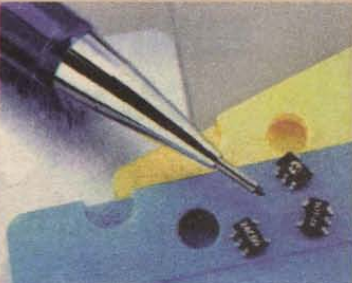


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WORLD'S SMALLEST SERIAL EEPROM



Microchip Technology, Inc. introduces the world's smallest serial EEPROM. The first member of the 24XX00 family, the 24C00, is a 16-byte, 128-bit 1st™ serial EEPROM in a substantially smaller five-lead SOT-23 package (measuring 0.110"L x 0.059"W x 0.035"H).

The 24C00 provides a 10X reduction in board area requirement over a traditional eight-lead PDIP package and a 3X reduction over a

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Events CALENDAR

Continued from page 79

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NOVEMBER 16
NH - LEBANON - Computer Show. Lebanon High School. Northern Computer Shows 508-744-8440

NOVEMBER 21-22
MS - OCEAN SPRINGS - Hamfest/Swapfest. Latimer Community Center. Fri: 4:30pm-9pm, Sat: 8am-3pm. Harry McLemore KD4AK, 601-872-0732

NOVEMBER 21-22-23
MI - TAYLOR - Computer & Technology Show. Gibraltar Trade Center, 15525 Racho Rd. 313-287-2000

NOVEMBER 22
CA - DALY CITY - Computer Show. Cow Palace, Gate #5, Geneva & Santos. Robert Austin Corp. 1-800-243-7041, <http://www.robertaustin.com>
ME - AUGUSTA - Computer Show. Augusta Civic Center. Northern Computer Shows 508-744-8440

NOVEMBER 23-23
FL - TAMPA - Radio & Computer Convention. State Fairgrounds, Expo Hall. Jean 813-525-5178

NOVEMBER 23
IL - WHEATON - Radio Fest Electronics Flea Market. DuPage Co. Fairgrounds. GMRS 815-756-3933
NH - PORTSMOUTH - Computer Show. Yoken's Conference Center. Northern Computer Shows 508-744-8440

NOVEMBER 26
NH - NASHUA - Computer Show. Sheraton Tara.

Northern Computer Shows 508-744-8440

NOVEMBER 29
CA - OAKLAND - Computer Show. Oakland Convention Center, Broadway @ 10th St. 1-800-243-7041 <http://www.robertaustin.com>
IN - COLUMBUS - AGI Computer Fair. Holiday Inn. 10am-3pm. 317-299-8827
MA - FALL RIVER - Computer Show. Whites of Westport. Northern Computer Shows 508-744-8440

NOVEMBER 29-30
MI - FLINT - Computer Show. Holiday Inn, Gateway Centre, US 23 @ Hill Rd. Exit. Five Star Productions 810-890-0988

NOVEMBER 30
CA - SANTA ANA - Swapmeet. ACP parking lot. Mary Russo 714-558-8813
IL - GLEN ELLYN - Computer Show & Sale. College of DuPage. Main Arena of Phys Ed Bldg. Corner of Park Blvd. & College Rd. 9:30am-3pm. Computer Central Shows 847-940-7547
IN - NOBLESVILLE - AGI Computer Fair. Hamilton Co. Fairgrounds, 2003 E. Pleasant. 10am-3pm. 317-299-8827
MA - HYANNIS - Computer Show. Tara Hyannis. Northern Computer Shows 508-744-8440

DECEMBER 1997

DECEMBER 6
CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

DECEMBER 7
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DECEMBER 12-13-14

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

DECEMBER 13

CA - DALY CITY - Computer Show. Cow Palace, Gate #5, Geneva & Santos. Robert Austin Corp. 1-800-243-7041, <http://www.robertaustin.com>

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

IN - INDIANAPOLIS - AGI Computer Fair. Indianapolis Events Center. 3655 E. Raymond St. 10am-4pm. 317-299-8827

DECEMBER 14

IN - KOKOMO - AGI Computer Fair. Ramada Inn, 1709 E. Lincoln. 10am-3pm. 317-299-8827

DECEMBER 20

CA - OAKLAND - Computer Show. Oakland Convention Center, Broadway @ 10th St. 1-800-243-7041 <http://www.robertaustin.com>
CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

DECEMBER 20-21

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

DECEMBER 21

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

DECEMBER 26-27-28

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

JANUARY 1998

JANUARY 23-4

MN - ROCHESTER - Super Computer Sale. Mayo Civic Center. Blue Star Productions 612-788-1901

JANUARY 9-10-11

WI - LA CROSSE - Super Computer Sale. La Crosse Civic Center. Blue Star Productions 612-788-1901

FEBRUARY 1998

FEBRUARY 7-8

FL - MIAMI - Hamboree. Dade Co. Fair & Expo Center, SW 112th Ave. & Coral Way. Evelyn 305-642-4139, Home Page: WWW.HAMBOREE.COM

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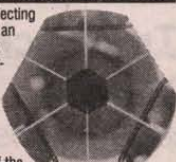
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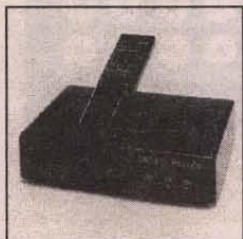
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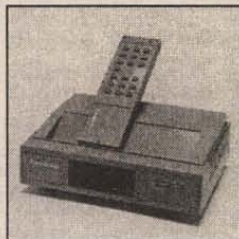
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Don Lancaster's

RESOURCE BIN

number sixty eight

Terribly tricky terrific toner techniques

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

I'm now in the process of setting up my new *Guru's Lair* web site you will find at (where else?) www.tinaja.com — This is the place you go for instant tech answers. Among the many files in our library, you will find complete reprint sets for all of the *Resource Bin* and other columns. Plus a brand new *Synergetics Consultant's Network*.

Terrific Toner Tricks

The toner that's used in most laser printers is a mixture of black stuff and hot glue. That black stuff (or carbon) part obviously could get used to dirty up otherwise clean sheets of paper. But that hot glue (or polyethylene) part is frequently ignored. Giving you all sorts of very unusual new toner-based opportunities.

Let's review a few of the emerging possibilities ...

Printed Circuits

The polyethylene toner component makes an excellent etch resist for use in printed circuit processing. After a number of false starts, we now have simple and effective ways of getting the toner out of the printer and onto the printed circuit board stock.

The *Toner Transfer System* by *Dyna Art Designs* is one good product. An alternative is sold by *Techniks*.

In either case, a 1:1 printed circuit positive is laser toner printed onto a magical transfer medium. Heat and pressure then get used to transfer the toner onto your super clean printed circuit board material. Etching then proceeds as usual.

You'll get the best results when you use a real heat press to do the actual transfer. On older laser print-

ers with a fusion wiper pad (such as a *Canon CX* or *SX*), it also pays to use a "dry" pad (rather than one providing a thin film of fusion oil) when you are using these materials.

Note that the *Dyna Art* address and phone number has newly changed.

Decals

The word "decal" can have different meanings to lots of different users. A traditional *water slide decal* was some artwork that you soaked in water till its glue softened. The artwork image then got slid off onto

NEXT MONTH: Don shows us how to use PostScript for PIC flutterwumpers.

a suitable final home. Railroad and aircraft models have long used this type of decal.

These days, though, a decal could mean "any old stick-on." With fancier artwork backed by a more permanent adhesive and a release sheet.

You can easily make your own personal custom decals. Note that a single dot in a 600 dpi printer at an HO model railroad scale of 87:1 is around *one sixth of an inch*. Lettering as small as a scale one inch high could, in theory, be accommodated.

Do note that waterslide decals are currently restricted to toner or micro dry ink methods. Inkjets tend to use inks that are not waterproof.

Several useful decal resources are sold by *Dyna Art Designs*.

There's also a new kid on the block by the name of *Larry Boulet's Labco*. Labco has a nice little booklet called *Making Decals on your Computer and Printer*, along with reasonably priced materials and techniques. Larry has explored all sorts of different printers and color processes, and has come up with some real winners.

Contact him for further details.

One source for these decal stocks in larger quantities is

Andrews Decal.

Transfer Papers

Special heat transfer toners are sold for most laser printers. The suppliers advertise in *Recharger* magazine.

A product called *Color Laser Copier Transfer Paper* can let you move any copier or toner images onto T-shirts, mousepads, caps, or whatever. Usual quantity cost is 30¢ a sheet.

One brand is *Photo Trans* available from *Pro Distributors*. There's also a *Photo Trans Opaque* which helps you apply transfers to dark colors or black T-Shirts. Basically, your opaque goes down first and creates a white surface the size and shape of your image or artwork. The regular *PhotoTrans* then overprints the image.

The final image transfer takes place with an iron or a suitable heat press. As before, a real heat press gives you more consistent results.

Usually, your images are printed backwards or *horizontally reversed*. So they end up *between* your fabric and the actual heat transfer material. Thus "locking them in" and giving you fair protection against normal wear and machine washings.

To backwards print in PostScript, use *-1 1 scale*. Lots more on this is stashed on the PostScript library shelf of www.tinaja.com

Special papers are optimized for heat transfer, inkjet, thermal wax, dye sub, or for color copier systems. Two other sources for these materials are *Conde* and *Alsina*.

Their web sites are www.conde.com and www.alsina-inc.com

Specialty Products

Carefully selecting what you print on or transfer your toner to can lead to all sorts of oddball and interesting product ventures.

For instance, one source for mugs which accept slide-in inserts is *Neil Enterprises*. Two suppliers of badges and buttons are *Badge-a-Minit* and the *Super Button and Badge* folks.

All of the direct mail paper outfits now offer all kinds of color matched business cards, letterheads, or unique announcement stocks. Typical sources include *Technique*, *Great Papers*, *Paper Access*, *Paper Direct*, or *Premier Papers*. There is also the national *Paper Plus* retail chain that I've personally found to be highly useful.

For really strange printing stocks that include prismatics, holographics, and related wild effects, try *Coburn*. Puzzle blanks are newly

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resold by *Pro Distributors*. Sandblasting photoresists are available from *Cooper Graphics* and *National Sandblast*.

Resources for a wild assortment of precuts are *Die-O-Perf*, *Ticket Express*, and *Blanks USA*. Such as tickets, door hangers, and table tents.

Specialized single color toners, mag stripe or "banknote" toners, and heat transfer toners are often advertised in *Recharger* magazine.

Your leading certificate supplier is *Goes Lithography*. It is usually better to get their products through *Paper Plus* or a direct mail outfit.

Your own rubber stamps are easily done these days. Thanks to those new photopolymer systems. Two sources of kits and supplies are *Grantham* and *Justrite*, while bulk materials are sold by *Merigraph*.

Special carriers that let you directly inkjet print onto fabrics are available from *Micro Format* as their *Imaging Gallery* product line.

Flock? The older "cabbage duster" style is available from *Don Jer*, while newer *hot split plastisols* are available from *Gerber* or *Stahls*.

Stahls has pretty near everything you need for school or sports lettering materials and supplies.

Those hot split plastisols are really neat. You'll print them like ordinary silkscreen ink. Then, you violently rip them apart *while still wet*.

Your final result from this sudden shearing is a warm and fuzzy "felt" effect. With none of the time, labor, or mess of loose cut fibers.

Great for gimmie caps and such.

Cross Linking

Uh, I am not allowed to say too much about this, because it is still in development. But the polyethylene in toner is a *polymer*. One that can get *chemically modified* for any desired degree of adhesion or stick-ticity.

Thus, you could toner print onto a suitable transfer sheet, spray on the special glop to convert your toner into *real* self-stick adhesive, and then stick the toner to your final product.

Stay tuned for details on this one.

Laser Buddy

One example of a *temporary* cross linking is that *Laser Buddy* spray. This makes toner way glossier and much blacker. At \$9.00 per can, it is particularly useful for improvement of camera-ready art or certificates.

A solvent dissolves a portion of the toner and adds some extra plastic to it. When your solvent evaporates, the toner gets blacker, shinier, and more durable. More gooder.

But note that a little of this goes a long way. Too much and you'll lose resolution. Halftones and greys do not usually improve and may end up blotchy and a lot worse. Use this only in a well-ventilated area. And note that *Laser Buddy* is *not* suitable for printed circuits since it deposits both on the printed and unprinted portions of the final page.

Great stuff otherwise, though.

When the Pressure is On

As with nearly anything else, there are two ways to melt toner: heat and pressure. You can apply lots of heat and little pressure. Or you can get the same effect with little heat and lots of pressure. The older *ColorBus* system is rather pricey, since this one is mainly intended for printshops and specialty advertisers. What it does is take any black and white or color copier or a toner print and literally force it into the surface of a hard substrate. Such as a wooden plaque or whatever.

Only modest temperatures (of 200° or so) are combined with very high pressures. This is far below the standard toner melting point of 375° Fahrenheit.

You could probably do the same thing yourself by working out some suitable tensioning scheme and some sort of pressure roller. No reason that your machine should cost more than \$99.00. Note that it is much easier to get high pressure along a line contact, instead of over an entire surface.

There's also a new mystery super secret *Brooker DIT* toner process. I do suspect this is just a variation on the long available *ColorBus* system. Or perhaps at a different point along the temperature-pressure continuum. I did find their poorly done \$10.00 video demo to be singularly uninformative, since it just shows you a bunch of wooden blocks with toner on them. I'd also guess their high profile patent is totally useless as well.

More on how trivial it is to bust do-it-yourself patents can be found in *BUSTPAT.PDF* on www.tinaja.com

Wood Micro Veneers

There's another approach you can easily explore to put toner onto wood items. Simply and cheaply.

An outfit called *Cards of Wood* has created what they call *micro veneers*. Which are ultra thin sheets of wood glued together in one or two layers. In several dozen assorted flavors.

Yes, some of these are thin enough to run through certain laser printers. Be sure to pick a printer that is heavy stock rated and has a fairly straight paper path option.

The ancient *Canon CX* might be a good choice. If you don't want to risk this, you can use one of the transfer sheet methods instead.

As their company name suggests, all these micro veneers are quite well suited to unusual business cards. But note they can also be glued or double stuck onto any other piece of wood, a trophy base, a letter opener handle, or whatever. Curved, even.

Several thicknesses and ply options are stocked. They also can do custom and specialty work.

Although made from interesting species of genuine wood, their grain patterns somehow do not seem quite as dramatic as I'd expect. Probably owing to how a veneer is made. The cards are surprisingly sturdy, because of the "plywood" construction.

Prices are as low as a dollar per page sized sheet. A sampler of all the different woods is also offered.

Lots of possibilities here.

Some Magazines

Your single most important toner magazine is *Recharger*. Here you'll find tutorials and ads for all sorts of refill toners, specialty products, and assorted bits and pieces.

Several little known magazines outside of their specialty fields also offer lots of new opportunities and ideas here. *POP* and *Sign Design* is an example from the point-of-purchase display industry. Or check out *Awards and Engraving*. People who are newly discovering the power of powder.

As with just about any industry, the commercial T-shirt folks have their own trade journals. Two biggies here are *Impressions* and *PrintWear*.

Your foremost silkscreen mag is apparently *Screen Printing*. There is also that *Screen Printing and Graphics Imaging Association*. You'll find them online at www.sgia.org

RESOURCE BIN

A favorite sign magazine of mine is *SignCraft*. *Sign Business* is also useful. The printshop pubs are *Quick Printing* with its great *Helene's Hotline* finder service; and *Instant Printer*.

For books, videos, and training info on laser printer service and repair, your best source is *Don Thompson*.

One good way to pick up new mags and the insider pubs in just about any field is with the new and free online *Oxbridge Media Finder* you'll find at www.mediafinder.com

Foil Effects

This old opportunity has kind of just been stumbling along. It somehow just missed ever hitting the big time. Probably because it never ended up quite reliable enough and that most supplies and machines were always horrendously overpriced.

The "hot glue" part of toner can be used to grab hot stamp foils. Giving you brilliant colors, gold and silver metallics, and other special effects.

Early pioneers in this area were *Omnichrom* and *Kroy Color*. Neither firm still remains in the toner-to-foil business. But just about any of those specialty paper houses do offer small stick-on foil kits that can get used to add hot stamp effects to a letterhead or business card.

A two-step process gets involved, where you will run a foil carrier back through your laser printer or through a special heat fusion machine. Usually you'll tape a small piece of foil over only what you want to emphasize.

A supplier for roll fed production machines is *Banner American*. Selling a *Fuser 1200*. A second competing firm seems to be *Foilmax*.

One of many bulk foil sources is *Transfer Print Foils*. Hot stamping foil magazines do include *Inside Finishing* and the aptly named *Foiled Again*.

But I've just found an exciting new replacement for these foil effects that seems much better and much cheaper for most users. And far more reliable.

This involves new ...

Micro Dry Inks

The smartest toner trick of all might be to not use toner at all. I've been playing with the *Alps MD2010* printer and am quite impressed with its color capabilities. This \$370.00 street machine uses special ribbons of *micro dry inks*.

Their color is stunning.

You'll find a four ribbon series of black, magenta, cyan, and yellow. A second group of ribbons directly

print foils as metallic silver, metallic gold, magenta foil, and cyan foil. And the third group of costlier *photo-realistic* ribbons is for newer machines in the series. Which can give you results that are in every way comparable to "real" color photo processing.

Even to a glossy overprint.

Thanks to Adobe Acrobat, the *Alps MD2010* is fully compatible with real PostScript. Its powerful print drivers automatically make color separations and even do retouching for you.

Specialized T-shirt transfer iron-on papers and photorealistic media are available.

Yeah, the print speed is somewhat less than glacial and your per-page costs are far higher than toner. But I am finding this beast especially useful for BOD book covers, shipping and disk labels, foil letterheads, fancy business cards, and specialty ads.

These Alps printers also perform extremely well with the Labco decal materials. Their foils are truly opaque and thus can look good on any color background. Even black.

More on BOD in my *Book-on-demand Publishing Kit* and on the BOD library shelf of www.tinaja.com — Per my nearby *Synergetics* ad.

This Month's Contest

For our contest this month, just tell me about any unusual new ploy for toner. Or some related product or a substitute technology that I may have missed out on.

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

Send all your written entries to me here at *Synergetics*, rather than to *Nuts & Volts* editorial.

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

Microcomputer pioneer and guru Don Lancaster is the author of 33 books and countless tech articles. Don maintains his no-charge US tech helpline found at (520) 428-4073, besides offering all of his own books, reprints, and consulting services. Don also offers a free catalog full of his unique products and resource secrets. The best calling times are 8-5 on weekdays, Mountain Standard Time.

Don is in the process of setting up his *Guru's Lair* at <http://www.tinaja.com>

Full reprints and preprints of all Don's columns and ongoing tech support appear here. You can reach Don at *Synergetics*, Box 809, Thatcher, AZ 85552. Or send any messages to his US Internet address of don@tinaja.com

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Tom G. - FL Excellent Service, fast and quick. The only bad thing about this company is they don't sell Cable Boxes. We hope someday they will.....

David P. - CA We called around for help on filters and nobody had any answers except one, call the "THE FILTER COMPANY" we did and had an answer in a matter of seconds.....

John B. - IL Our company buys in the 100 quantities and needs a large selection of different channels. "The Filter Company" was the only one who was able to supply.....

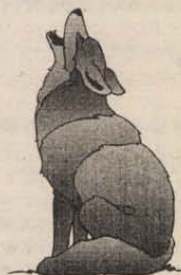
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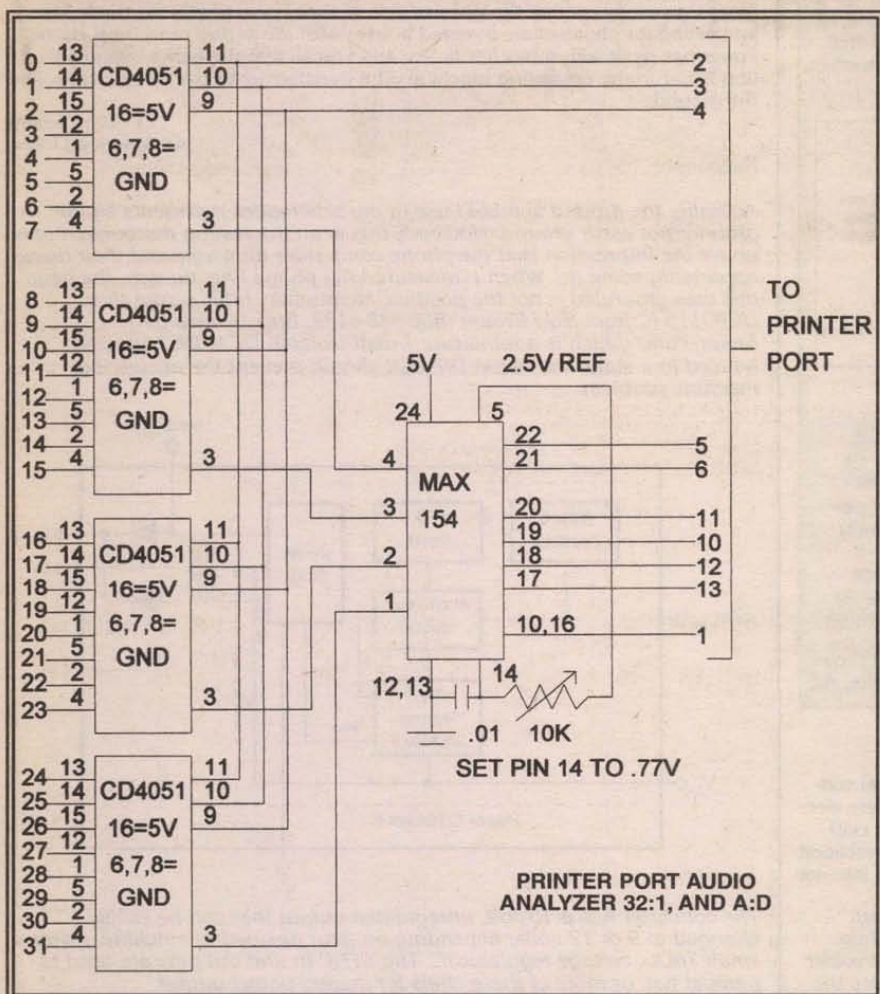
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The fullwave rectifiers response time is controlled by the resistor feeding the 1 uF capacitor. For a 486 computer, 10K works fine, but

The computer printer port has eight data out bits. They are used to select the channel to check on. There are four input bits, normally used to obtain the status of the printer, but now are used to read four bits of the selected analog



```

* 32 CHANNEL PRINTER PORT AUDIO ANALYZER 4/23/96
* BY BOB DAVIS 640 X 200 CGA RESOLUTION
CLS : LOCATE 8, 20: PRINT "PRINTER PORT AUDIO ANALYZER"
LOCATE 11, 20: PRINT "COPYRIGHT 1995 BY ROBERT J. DAVIS"
LOCATE 14, 20: INPUT "USE PRINTER PORT NUMBER: ", LPT
DOUB = &H378: COUT = &H37A: CIN = &H379
IF LPT = 1 THEN DOUB = &H3BC: COUT = &H3BE: CIN = &H3BD
IF LPT = 3 THEN DOUB = &H278: COUT = &H27A: CIN = &H279
CLS : SCREEN 1: COLOR 0, 0
FOR A = 10 TO 170 STEP 10
    LINE (1, A)-(400, A)
NEXT A
LOCATE 23, 2: PRINT "1—CHANNELS—1625—FREQUENCY—16";
LOCATE 24, 8: PRINT "PRINTER PORT AUDIO ANALYZER";
START:
FOR B = 10 TO 310 STEP 10
    OUT DOUB, (B - 10) / 10
    OUT COUT, 0: OUT COUT, 255
    LEVEL = (INP(CIN) XOR &H70) \ 8
    LINE (B - 2, 10)-(B + 2, 165), 0, BF"BLANK OLD LINE
    LINE (B - 2, (LEVEL) * 5 + 10)-(B + 2, 172), 2, BF
NEXT B
IF INKEY$ = "Q" THEN END
GOTO START
  
```

inputs to the converter can be used if the cable length causes errors. The sensitivity adjustment can be set for .77 volts for most mixers, but it is a relative setting corresponding to the top of the VU meters.

To connect to older Tandy computers, an adapter to a 25-pin connector is needed. My pin numbers are for IBM standard 25-pin printer ports. Another solution is to add a second printer port card. Configure it to LPT3 and select port 3

when you run the software.

The software listing is for quick BASIC, but the compiled version has more features, such as creating its own numbers so they can be correctly positioned under each VU meter.

As you can tell, the software is quite simple. A filled box is drawn on the screen for each channel of a size proportional to the level input for that channel. BASIC comes with DOS and should be found in your DOS directory.

For a true VU meter, a formula would have to be added to the software to convert the linear result from the analog-to-digital converter to a logarithmic value. NV

value. There are also four bits normally used to send commands to the printer, but now are used to tell the analog-to-digital converter to start conversion. Since it has a four-bit flash converter, the upper four bits are available almost immediately, so there is no need to check the ready line.

The spectrum analyzer option can be built by using the design of Richard Schroeder that appeared in the Jan. '94 *Nuts & Volts*. His "professional-type audio spectrum analyzer" gave the design and values for a 28-channel analyzer. Add 25 Hz by using a 620K resistor and 20 KHz with a 680-ohm resistor to expand his design to 30 channels.

You can use every other frequency, starting with 25 Hz, for 15 channels. He used 1K and 10 uF as the RC values for reading peak levels. Where that signal feeds the FETs (Qa, Qb, Qc, and Qd) is where it would instead feed the 4051 IC for my design.

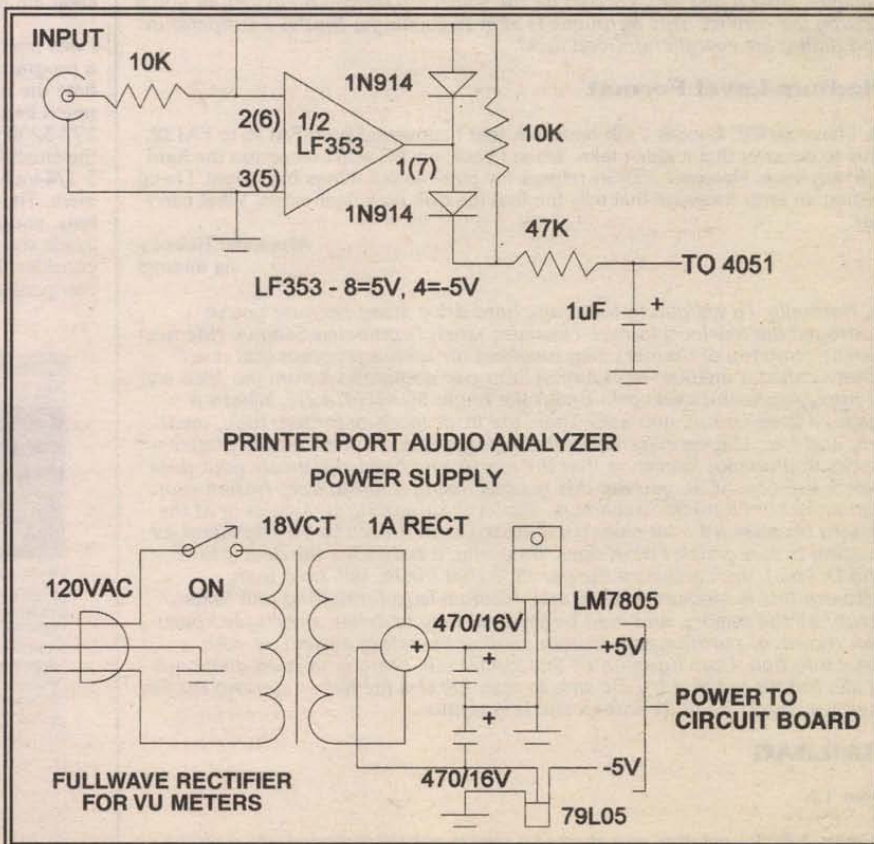
The project can be built in a small box, about 6" by 8" by 3", or larger if you plan on adding the spectrum analyzer or more channels. The biggest space is needed for the 16 RCA jacks for the 16 inputs. Use a plug-in circuit board for ease of design modification.

Plugging and unplugging all 16 inputs is not easy.

For more than 16 channels, a 44-pin edge connector will come up short. A solution is to mount the printer port connector on the board or have a header that goes to a ribbon cable to the connector.

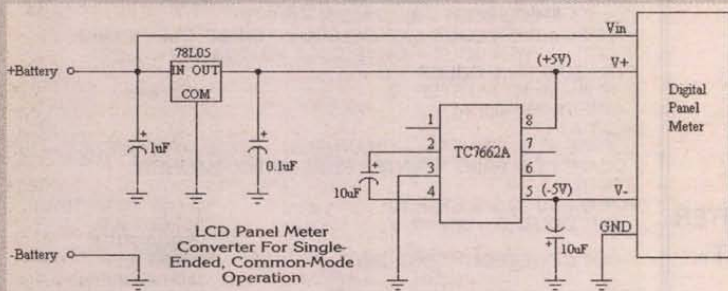
To connect to the mixer, use 16 shielded cables about 4' to 6' in length. Put RCA connectors on one end and 1/4" audio connectors on the other end. For mixers with an "insert" output jack, the 1/4" connector needs to be a stereo version. Tip and ring then are connected together and to the wire to the converter. The shield of the wire always goes to the sleeve of the 1/4" connector.

The cable from the audio analyzer to the computer should be kept short — about 5' is ideal. Pull up resistors of about 470 or 1K on the



Reader's Tip

In the July '97 issue, you published a circuit that would let me monitor a 12-volt battery using my digital panel meter. However, this modification didn't work with my cheap DPM, so I experimented with some DC-to-DC converter chips and came up with this design that does the trick.



The secret of this circuit is a TC7662A charge pump (sometimes called switched-capacitor) voltage converter, which generates -5 volts from a +5-volt source. What I did was place the V+ and V- connections of the DPM across the +5- and -5-volt lines, for a total of 10 volts to the meter (my particular meter can operate over a range of 9 to 12 volts, some DMPs can't). Then, I grounded pin 3 of the TC7662A to split the source, and place -5 volts below ground. The meter likes this solution. However, the reference divider voltage changed a little, so I had to lower the 1K scaling resistor to 476 ohms (by paralleling a 910-ohm resistor across it) to bring the meter's linearity back in line.

Ronald Stowe
Snowflake, AZ

Naked Solar Cells

Q. I recently purchased a solar cell that doesn't have any leads for electrical connections. The solar cell is deposited on glass with a thin metal backing where electrical connection must be made. How do I attach wires to this type of solar cell?

Charles Cheatwood
via Internet

A. Ever so carefully! Too much heat, and bang your contacts are history (vaporized). I suggest a 15-watt soldering iron with a brand-new chisel tip. Let it heat up to full heat and apply a liberal coating of fresh rosin-core solder. The wire should be #22 or #24 stranded wire that has been tinned. Place the tinned wire on your solar cell contact and touch the hot iron to the back of the wire. Hold it just long enough for the solders to meld — no longer, or you'll destroy the contact. This technique is akin to cooking a soufflé — temperature and timing are everything. Good luck!

Medium-Level Format

Q. I have an IDE Conner 1 GB hard disk that I converted from FAT16 to FAT32, only to discover that it didn't take. When I boot, my PC won't recognize the hard disk anymore. Moreover, FDISK refuses my pleas to put things back right. I keep getting an error message that tells me that the disk no longer exists. What can I do?

Alexander Belenky
via Internet

A. Normally, I'd tell you to throw the hard drive away because you've destroyed the low-level format. However, when I contacted Seagate (the new parent company of Conner) they provided me with a program that does what's called a medium-level format. You can download it from our Web site at <http://www.nutsvolts.com> under the name SGATFMT4.ZIP. What's a medium-level format, you ask? There are three levels of format: high, medium, and low. Low-level format is the laying down of tracks on the platter — tracks that remain forever so that the read/write head can locate your data. Before IDE and SCSI, you did this yourself using a utility from Norton (now Symantec) or Ontrack. Nowadays, low-level formatting is done only at the factory because it's a lot more complicated than it used to be. High-level formatting is that which FDISK does. Basically, it partitions the disk into C: and D: (etc.), then activates the partition that the PC will boot from. Between this is medium-level format. Medium-level formatting will "data-scrub" all the sectors, and may be the only way to delete a corrupted partition record, or partition record from another operating system, or even a virus infection. I can't guarantee this format will bring your hard disk back to life, but it's worth a try. Be sure to read the text file before starting the format; it's chuck full of directions and information.

MAILBAG

Dear TJ:

In your July '97 column, you showed a way to get DC voltage from a phone

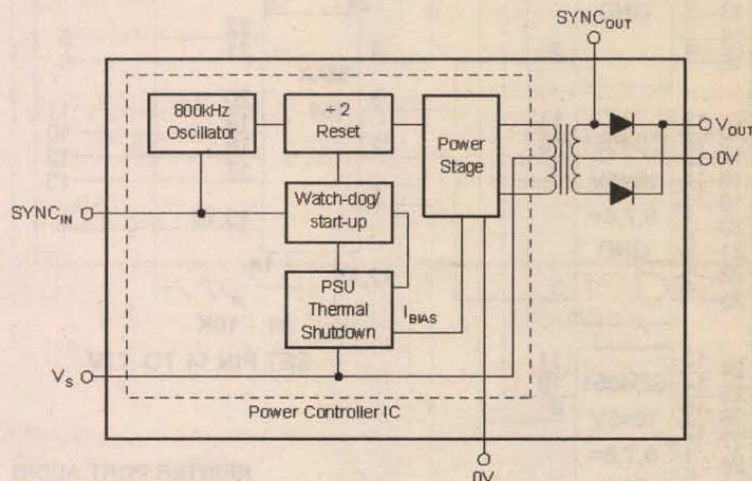
108 September 1997/Nuts & Volts Magazine

line, with the outputs labeled positive and ground. I've heard that phone companies generally ground the positive side of their lines, which has made life interesting for photovoltaic-powered houses with answering machines! Home Power has dealt with this a few times, and I recall that the best-working solution is to run the answering machine off a transformer-based inverter to isolate the grounds.

Jim Tolson
via America Online

Response:

Actually, the ground symbol I use in my schematics represents signal ground, not earth ground. However, this is an interesting discovery. I was under the impression that the phone companies didn't ground their lines; apparently some do. When I measured my phone line, though, the negative was grounded — not the positive. Meanwhile, I ran across this DCP0115 IC from Burr-Brown (800-548-6132; <http://www.burr-brown.com>) which is a miniature 1-watt isolated DC-to-DC converter housed in a standard 14-pin DIP that should prevent the answering machine problem.



The converter has a 15-volt, unregulated output that can be easily changed to 9 or 12 volts, depending on your answering machine, using a small 78Lxx voltage regulator IC. The SYNC in and out pins are used to parallel two or more of these chips for greater power output.

Dear Mr. Byers:

I was interested to read in your Jul. '97 column about Decibel Instruments. As a programmer, I spend a good part of my life close to a computer and I really hate the noise they make — especially the hard disk. There is, however, a much better solution for silencing computer noise from Silent Systems (617-273-3200; <http://www.silentsystems.com/2index.htm>). This DIY kit, dubbed the HushKit, includes a sleeve that fits any internal 3.5-inch drive (housed in a 5 1/4-inch bay), and serves as both an acoustical baffle and a heatsink for the drive. The replacement power supply reduces fan noise using state-of-the-art fans, coupled with an internal component layout that minimizes air resistance inside the power supply. The HushKit goes for \$149.00 — not bad when you consider that it includes a new power supply! I'm grateful that there are finally companies addressing this problem.

Steve Freeman
via Internet



Mr. Byers:

I have been reading *Nuts & Volts Magazine* for quite some time, and I just wanted to comment on the "Electronics Q & A" column. I think it is a great idea, and I get a lot of useful information out of it. However, it seems to be gravitating more and more towards questions related to computers, which usually have nothing to do with electronics unless the problem is an actual hardware problem, such as a bad printer switch. Now, I know there is some amount of overlap between electronics and computers, and that it can sometimes be difficult to tell the difference between the two, but I would hate to see the magazine (or the column) go "computer-happy" like some other electronics publications have done. I have nothing against computers. In fact, I love computers more than I do electronics, but *N&V* is an electronics hobbyist magazine, not a computer magazine. If you must print computer questions, perhaps you could start another column called "Computer Q & A." While it's not the ideal solution, it would be better than having to weed through the computer questions to find the actual electronics questions. Just my opinion.

Paul Veres
via Internet

Response:

Thanks for the kind remarks and suggestion. However, I simply answer the questions as they arrive. Some months have more computer questions than others. I wish I had an answer to this dilemma, because we don't have space for a separate computer Q & A column. Perhaps if the computer questions were bunched at the end?

TJ Byers
Q & A Editor

reader FeedBack

Continued from page 5

The SGC tuners have some other features. Most of their switches have one side connected to ground, and the pi configuration minimizes the voltages the input side switches. The T network makes both sides see high voltages.

The design would be simpler and more rugged if a switched inductor were used instead of the substitute roller inductor.

Gerald Roylance
Mountain View, CA

Response:

Mr. Roylance is correct. Higher voltages can be present while transmitting with improper loads connected to any antenna tuner. As I stated in the arti-

cle, the PC boards began to heat up at 300 watts. To operate at this level would eventually damage the unit. 150 watts — or half the rating — would be the recommended level, and I assumed users would not purposely damage the tuner. My fault for not stating it in the text.

In tests with the tuner I built, readers can be assured that I operated it with very many improper loads while experimenting with it. No component failure was, or is, evident. I would like to thank Mr. Roylance for his feedback and that he found the article interesting.

Carl can be reached at:
615-847-9704
Internet: The2x4@aol.com
Page at: <http://members.aol.com/the2x4/efj.htm>

Carl Motsinger

TECH FORUM

Continued from page 91

required and obviously the specifics of the filter network, but frequency may also be a consideration that's dependent on the application for the power supply.

As an example, a switcher operating at 2 KHz might cause objectionable audible coupling into an audio circuit, whereas 1 MHz could require special high-frequency diodes and careful filter layout. Selection of a frequency >50 KHz puts ripple outside the audible range, but still requires an appropriate high-speed rectifier. You won't be able to use a garden variety 1N4007.

Cores are made of a number of different materials, and are supplied in different styles: toroids, pot cores, E cores, as examples. Toroids and pot cores will have lower leakage, if leakage (RF) is a concern. Toroids are the trickiest to wind, whereas pot cores, E

cores and others have bobbins on which the wire is wound, and then placed on the core and assembled.

Back in the 80s, Ferroxcube (Saugerties, NY) had a whole design package with nomographs and data sheets to make the design process easier.

If we assume an 80% efficiency (achievable with a good design) and the desired 400V @ 0.5A (200 watts) plus 100V @ 20 mA (2 watts), then picking a core rated for at least 250 watts should handle it.

An E-core of 3C8 material from Ferroxcube, model EC52, is about a 2" E-core, and shows 250 watts at 20 KHz, increasing to 400 watts capacity at 50 KHz on the Ferroxcube nomogram.

A companion standard bobbin is P/N 52PTB, and the mounting parts P/N 52U and 52 PLATE.

Calculating the turns, wire sizes, final operating frequency, and power capability also requires the primary voltage, which Hemken didn't specify in his letter.

Richard Nelson
Newport News, VA
nelson@jlab.org

ANSWER TO #89714 - AUGUST 1997

Optoelectronics has a new pager-sized DTMF decoder that will do what you want. It's the first entry in their TechToyz line and costs \$89.00. Call them at 1-800-327-5912 and order one — it looks like a neat little unit!

Phil Combs
Dayton, OH

ANSWER TO #89710 - AUGUST 1997

For good UHF reception, you need a UHF preamp mounted at the antenna. Also make sure you have a good antenna. This will give you more signal and less noise. There are several good models available from Winegard, Channelmaster, or Radio Shack.

The FCC's present plan for HDTV calls for TV stations to simulcast an HDTV signal on a second channel (mostly UHF) for several years until people start to buy digital sets or converters. After that period, the old analog channels will be turned off and only the digital will be left. The timetable has been very flexible and will probably change as the project unfolds.

There are already converter systems on the market for off-air TV, but you won't need one for several years. The cost is high now, but should drop later. Satellite equipment may not need replacing since the small dishes use digital now.

Commercial, or "free TV," will probably always be with us!

Dennis Daugherty
Russellville, KY

ANSWER TO #89719 - AUGUST 1997

There is no practical cost-effective way to convert your generator to those specifications.

In the March '96 issue of *Nuts & Volts*, I wrote an in-depth answer that should cover all of the questions and answers that you might have.

The issue here is "cost-effective," and it is cheaper to replace the unit with one that meets your requirements than it is to try and convert it.

Chris
Bieber, CA

ANSWER TO #89715 - AUGUST 1997

The hard drive you have is a 20 meg. Select Type 2 on the CMOS set-up.

Michael Young
Newville, AL

ANSWER #89713 - AUGUST 1997

The answer here is simple. Since nothing is attached to the Adaptec card, it is not being used and you don't need it. So, remove it and store it in an anti-static bag. Try loading Windows 95 again. In general, it is best to add components one at a time in a working Windows 95 system and allow the soft-

ware to autodetect any new hardware. In this case, though, just forget about the Adaptec card.

Michael Young
Newville, AL

ANSWER TO #89722 - AUGUST 1997

These tiny SOT devices with three to six legs have been proliferating like rabbits in the last few years. We have been keeping index cards on all those we've run across in our work and have several thousand to date. There are several problems involved in figuring them out.

1. What are they? Multiple devices are housed in these packages. Transistors, both conventional and digital. Transistor arrays, single or dual diodes, TTL or CMOS gates, RF or operational amps, etc.

2. If the device is known, how is it based? A transistor or diode or dual diode in a three-pin package can be configured in several ways.

3. Who is the manufacturer? Many companies make these packages and they all seem to have their own stamping or marking codes. In some, the first letter is a company abbreviation, such as R for ROHM. In others, the last letter is this, such as a small P for Philips. Therefore, in a three-digit number, only two of them may be significant as a part number.

To really get a handle on these things, one almost has to have a schematic of the device they are in, along with a knowledge of the manufacturer.

In the case of the first one, R1A, or possibly RIA, if we go for a ROHM transistor, we get ST3904. If we go for the 1A, by Motorola, Toshiba, or Zetex, we come up with MMBT3904, YTS3904, or CMPT3904. If we try for the R1, by Motorola or Temic (formerly Telefunken), we get an RF NPN transistor BRF93.

It is our guess that, assuming this is a transistor, it is either a 2N3904 or BRF93. As for the R1P or RIP, if all the letters are large case, the Rohm version is ST2222A. If the last P is small case, BFR93. A 1P is basically back to the 2222A type, MMBT2222A for Motorola and FMPT2222A for Zetex, or YTS2222A for Toshiba. Our guess is BRF93 for an RF NPN, or 2N2222 for general-purpose NPN.

C3L is more difficult. We have no listing for C3L at all. Under 3L, we have both a PNP type for Motorola, Central, or Zetex called BC858C, or an NPN type by NEC called 2SC1623R. Under C3, we have seven different items, four of them dual diodes, one N-ch JFET, and a PNP transistor.

If it is a PNP transistor, it may be a Motorola MMBT4126. Our guess would be the Central version of the 2N4126. If these are in a transmitter with coils, etc. they may have to be removed to be properly tested. I don't see how they could all go bad, unless severely staticed-out or excessive voltage was applied.

Bomarc Services
Casper, WY
ROLLO@TRIB.COM

New Product News

tiny eight-lead SOIC 150-mil package. The SOT-23 package has an extremely low height, making it ideal for applications requiring a low profile. The smaller package size requires less board space, reducing size and cost of the printed circuit board.

For more information, contact:

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WEB: www.microchip.com

DB-25 PORT REVERSER



The #232DTE is a DCE/DTE port reverser. It is a valuable tool for technicians when two PCs need to be temporarily connected for testing. Within the connector, the data lines and available handshake lines are crossed instead of being looped back. Pin 1 passes straight through, while pins 2 and 3 cross, 4 and 5 cross, and pin 20 crosses to 6 and 8. No other pins pass through. The unit comes configured with one DB-25 male connector and one DB-25 female connector.

No. 232DTE DCE/DTE Port Reverser is \$15.95.

For more information, contact:

B&B ELECTRONICS
MANUFACTURING CO.
707 DAYTON RD., DEPT. NV
OTTAWA, IL 61350
815-433-5100 FAX: 815-434-7094
<http://www.bb-elec.com>

SERIAL-TO-DIGITAL INTERFACE



ICS Electronics announces a new serial-to-digital interface that combines a parallel digital interface and monitoring capabilities in one module. Uses include controlling digital devices from a serial COM port and for monitoring remote signals.

The 2363 serial->parallel interface provides 48 programmable I/O lines that are user configurable as inputs or outputs in groups of eight

lines. The I/O lines use Texas Instruments new BCT drivers with high sink/source capacity for driving digital signals, LEDs, relays, or other loads up to 48 mA. Internal pullups are provided for inputting TTL/CMOS signals or contact closures. Data transfer can be by commands to a specific byte(s) or by combining multiple bytes into data strings.

For more information, contact:

ICS ELECTRONICS
473 LOS COCHES ST., DEPT. NV
MILPITAS, CA 95035-5422
408-263-5500

MOTOROLA ANTENNA ADAPTER



Nemal Electronics International introduces a coaxial adapter for use with Motorola P110 and GP300 handheld radios. The adapter, part number NE9395, accepts a BNC plug and adapts to the Motorola miniature 3.5 mm type antenna connector. The adapter features a gold-plated center contact and teflon insulation for optimum performance throughout the VHF and UHF spectrum, and a knurled body for ease of connection. Part number NE9395 is a direct replacement for Motorola part number HLN9756A.

Pricing for 100-piece quantity is \$4.95.

For more information, contact:

NEMAL ELECTRONICS
12240 N.E. 14TH AVE., DEPT. NV
NORTH MIAMI, FL 33161
305-899-0900 FAX: 305-895-8178
E-MAIL: info@nemal.com

DATA ACQUISITION MODULES



These new data acquisition modules from B&B Electronics can receive signals from up to eight external sensors, control various devices, and output analog voltages. The compact modules plug easily into DB-25 serial ports. Applications include monitoring sen-

sors and controlling process and test equipment, and monitoring and controlling ON/OFF states.

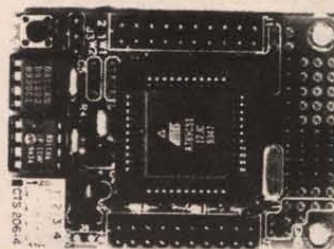
RS232 and RS485 modules have the ability to interface seven A/D channels, two digital input channels, one digital output channel, and four channels of eight-bit D/A outputs. Only four commands are needed to control the modules. For applications where long wire runs are required or a lot of line noise may be encountered, there are two current loop models which output a 4-20 mA current.

The four data acquisition modules in the series range from \$89.95 to \$109.95. Each module comes complete with a demo program and API programs.

For more information, contact:

B&B ELECTRONICS
MANUFACTURING CO.
707 DAYTON RD., DEPT. NV
OTTAWA, IL 61350
815-433-5100 FAX: 815-434-7094
<http://www.bb-elec.com>

TIGER BYTE-51 SINGLE BOARD COMPUTER



Allen Systems announces the release of their new TIGER BYTE-51 single board computer. This board is small in size, but big on performance. It measures just 1.650 by 2.50 inches and is based on the 89S8252, which is 80C51 compatible.

The 89S8252 is a powerful CPU with clock speeds of up to 24 MHz. A major feature, however, is its 8K bytes of flash for program storage. This allows for "in-system" programming when software is installed or updated. That is, the flash can be programmed without removing the CPU from its target hardware. In addition, programming can take place without special programming equipment. A simple PC equipped with a parallel printer port is all that is required.

The quantity one price is \$59.00 for the 12 or 24 MHz version. A developer's kit is also available for \$79.00 and includes the board, cable, and PC-based programming software.

For more information, contact:

ALLEN SYSTEMS
2346 BRANDON RD., DEPT. NV
COLUMBUS, OH 43221
614-488-7122

NEW IEEE1394 BUS ANALYZER FE

Products Intl., Inc. introduces the Model #LA-1394FE, IEEE1394 bus analyzer FE from Kenwood.

The #LA-1394FE was designed to support interface development of equipment incorporating the IEEE1394 bus, inspection tools for IEEE1394 chips in measuring fields, and monitoring of incident and resolution tools during development of equipment incorporating the IEEE1394 bus.

The IEEE1394 standard is a high-speed interface for the next generation interconnection of computers, Digital Video Cameras, DVD, and printers. The bit rate for this bus is capable of 100 Mbps and 200 Mbps now. Measuring instruments specialized for bus timing and data analysis are indispensable because of high bus speed. The #LA-1394FE would need a logic analyzer and a personal computer for use as a bus analyzer system.

For more information, contact:

PRODUCTS INTERNATIONAL
8931 BROOKVILLE RD.
DEPARTMENT NV
SILVER SPRING, MD 20910
301-587-7824 FAX: 301-585-5402
1-800-638-2020

ISDN TESTER



The aurora^{plus} is a powerful and flexible basic rate ISDN tester. It tests most ISDN call and connection types at their U interface and on the S bus, including point-to-point and point-to-multi-point operation. It uses the national ISDN protocol, as well as custom protocols for AT&T and Nortel switches. Displays dialed number, calling party number, and cause codes, along with control and status information, and can verify dual B-channel packet test.

For more information, contact:

JENSEN TOOLS
7815 S. 46TH ST., DEPT. NV
PHOENIX, AZ 85044
1-800-426-1194 FAX: 602-438-1690
<http://www.jensentools.com>

Stamp Applications: *Continued from page 43*

' Listing 3
' Nuts & Volts: Stamp Applications, September 1997

' [Title] _____

' File..... LCDDEMO2.BAS
' Purpose... Stamp 1 -> Multi-line LCD [4-bit interface]
' Author.... Jon Williams
' E-mail.... jonwms@aol.com
' Started... 16 JUL 1994
' Updated... 25 JUL 1997

' [Program Description] _____

' This program demonstrates the various standard features of a 1x16 LCD display that uses the Hitachi HD44780 controller.

' LCD Connections:

LCD	(Function)	Stamp
pin 1	Vss	Gnd
pin 2	Vdd	+5
pin 3	Vo	Gnd (or wiper of 10K pot)
pin 4	RS	Pin 4
pin 5	R/W	Gnd
pin 6	E	Pin 5
pin 7	DB0	Gnd
pin 8	DB1	Gnd
pin 9	DB2	Gnd
pin 10	DB3	Gnd
pin 11	DB4	Pin 0
pin 12	DB5	Pin 1
pin 13	DB6	Pin 2
pin 14	DB7	Pin 4

' [Revision History] _____

' 16 JUL 94 : Version 1.0 - compilation of code from last 3 months
' 08 AUG 96 : Trimmed code to save space - no performance changes!
' 25 JUL 97 : Updated for Nuts & Volts

' [Constants] _____

SYMBOL RS = 4 ' Register Select [1 = char]
SYMBOL E = 5 ' LCD enable pin [1 = enabled]

' LCD control characters

SYMBOL ClrLCD = \$01 ' clear the LCD
SYMBOL CrsrHm = \$02 ' move cursor to home position
SYMBOL CrsrLf = \$10 ' move cursor left
SYMBOL CrsrRt = \$14 ' move cursor right
SYMBOL DispLf = \$18 ' shift displayed chars left
SYMBOL DispRt = \$1C ' shift displayed chars right
SYMBOL DDRam = \$80 ' Display Data RAM control
SYMBOL Line1 = \$00 ' starting address of line 1
SYMBOL Line2 = \$40 ' starting address of line 2

' [Variables] _____

SYMBOL char = B1 ' character sent to LCD
SYMBOL index = B2 ' loop counter

' [EEPROM Data] _____

EEPROM ("This is Line 1") ' preload EEPROM with messages
EEPROM ("This is Line 2")

' [Initialization] _____

Init: Dirs = %00111111 ' set 0-5 as outputs
Pins = %00000000 ' clear the pins

' Initialize the LCD (Hitachi HD44780 controller)

LCDini: PAUSE 500 ' let the LCD settle
Pins = %0011 ' 8-bit mode

PULSOUT E, 1
PAUSE 5
PULSOUT E, 1
PULSOUT E, 1
Pins = %0010 ' 4-bit mode
PULSOUT E, 1
char = %00101000 ' 2-line mode
GOSUB LCDcmd
char = %00001100 ' disp on, crsr off, blink off
GOSUB LCDcmd
char = %00000110 ' inc crsr, no disp shift
GOSUB LCDcmd

' [Main Code] _____

Start: char = ClrLCD ' clear LCD, home cursor
GOSUB LCDcmd
PAUSE 1000

L1: FOR index = 0 TO 13
READ index, char ' get character from EEPROM
GOSUB LCDwr ' write it
PAUSE 50 ' delay between chars
NEXT
PAUSE 2000 ' wait 2 seconds

char = DDRam + Line2 ' move to line 2
GOSUB LCDcmd

L2: FOR index = 14 TO 27
READ index, char
GOSUB LCDwr
PAUSE 50
NEXT
PAUSE 2000

GOTO Start

' [Subroutines] _____

' Send command to the LCD

' Load char with command value, then call

' Clear the LCD \$01, %00000001
' Home the cursor \$02, %00000010
' Display control (see below)
' Entry mode (see below)
' Cursor left \$10, %00010000
' Cursor right \$14, %00010100
' Scroll display left \$18, %00011000
' Scroll display right \$1C, %00011100
' Set CG RAM address %01aaaaaa (Character Generator)
' Set DD RAM address %1aaaaaaa (Display Data)

' Display control byte:

% 0 0 0 0 1 D C B
| | +- blink character under cursor [1=blink]
| +- cursor on/off [1=on]
+- display on/off [1=on]

' Entry mode byte:

% 0 0 0 0 0 1 X S
| +- shift display [S=1], left [X=1], right [X=0]
+- cursor move: right [X=1], left [X=0]

LCDcmd: LOW RS

' enter command mode
' then write the character

' Write ASCII char to LCD

LCDwr: Pins = Pins & %11010000 ' save 7, 6 and RS; clear bus
Pins = char / 16 | Pins ' output high nibble
PULSOUT E, 1 ' strobe the Enable line
Pins = Pins & %11010000
Pins = char & \$0F | Pins ' output low nibble
PULSOUT E, 1
HIGH RS
RETURN ' return to character mode

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24DOT7, Inc.49	Cunard Associates.....25	MCM Electronics23	Scott Edwards Electronics88
A1 Cable102	Cyber-Test97	Mega Electronics75	Seabird Technical75
Abacom Technologies87	Danbar Sales Company45	Metric Equipment Sales, Inc.30	Shreve Systems74
ABC Electronics100	Davilyn Corp.7	M.F.M. Communications92	Sinaco Electronics74
Ace Computers37	Decade Engineering75	microEngineering Labs51	Skycraft Parts & Surplus, Inc.71
ACP Super Store82	Detection Dynamics75	Midwest Electronics6	Software Clearance Outlet81
Advanced Educational Systems87	Dexis75, 96	Micromint, Inc.2	Solarbotics Ltd.81
Alfa Electronics38	Direct Cable Supply100	Modern Communications15	Solutions Cubed40
All Electronics Corporation65	DYNAMIC Technologies46	Modern Electronics97	Spectrum Research82
Allison Technology Corporation.33, 74	Earth Computer Technologies24	Mo-Tech Distributors49, 101	Spy Outlet75
Alltech Electronics Co.48	E.H. Yost & Co.73	Motron57	Square 1 Electronics6
Alltronics29	Electro Tool, Inc.25	Mouser Electronics51	Street Smart Security36
American Innovations, Inc.33	Electronic Rainbow Ind., Inc.21	Mr. NiCd73	Surplus Sales of Nebraska22
Andromeda Research.....5	Electronic Service and Supplies82	MWK Industries92	Surplus Traders74
Antique Radio Classified75	Electronics Book Club®35	National Cable Services47	Synergetics103
Ar2 Communications Products6	EMAC, Inc.14	National Control Devices7	Techniks, Inc.74
Autotime11	EPS75	Netcom5	Technological Arts74
Basic Electrical Supply	Foss Warehouse Distributors74	New Company101	Televue Distributors58
& Warehousing Corporation30	Gateway Electronics, Inc.60	Novaplex50	Test Equipment Sales14
Battery-Tech, Inc.76	General Device Instruments74	Optoelectronics.....115	The Filter Company, Inc.105
Baylin Publications.....11	Global Connections15	One Stop Supplier97	The RF Connection.....40
BCD Electro74	Greenleaf Electronics59	Parallax, Inc.Back Cover	Timeless Products102
Bell Electronics22	Halted Specialties Co.3	PARAMAX, INC.67	TNR Technical, Inc.66
Bilocon Corp.75	H.T. Orr Computer Supplies44	Phelps Instruments36	Turner Electronics75
Bisme Computer, Inc.14	I.E.S.79	Pioneer Hill Software51	Uncorn Electronics81
Brigar Electronics77	Images Company74	Plazac Sales, Inc.88	USI Corp.14
C & S Sales, Inc.8, 89	Index Publishing Group, Inc.7	Polaris Industries51	UTS Wholesaler49
C and H Sales Company102	Information Unlimited68	Prairie Digital, Inc.75	V&V Mach. & Equipment, Inc.75
Capital Electronics, Inc.66, 96	Intronics, Inc.71	Prime Electronic	VersaTech Electronics44
Cellular Technology Group61	J & M Microtek, Inc.40	Components, Inc.57	Vesta Technology, Inc.49
CFX Technologies75	Jade Products, Inc.74	Progressive Solutions75	Video Media75
Chenesko Products, Inc.24	Javanco100	Quality Electronics91	Viking International30
Circuit Etching Technics6	Jectech74	R & S Surplus47	Visitect, Inc.36
Circuit Specialists, Inc.114	Kable Works, Inc.44	RA Enterprises15	Visual Communications, Inc.76
Communications Electronics, Inc.17	KDE Electronics Corp.81	Ramsey Electronics, Inc.56	Weeder Technologies24
Consumertronics39	Kimtronix82	Resources Un-Ltd.31	Western Test Systems12-13
Converters, LTD.67	Koll-Dove47	R.E. Smith74	White-Star Electronics92
Corporate Systems Center22	La Paz Electronics Int'l.24	Roger's Systems Specialist16	Wholesale Cable66
Cruising Equipment25	M2L Electronics88	S & N Cellular40	Xandi Electronics, Inc.80

AMATEUR RADIO & TV

Abacom Technologies	87
Alltronics	29
Communications Electronics, Inc.	17
Decade Engineering	75
Index Publishing Group, Inc.	7
Jade Products, Inc.	74
Ramsey Electronics, Inc.	56
USI Corp.	14

BATTERIES/CHARGERS

Battery-Tech, Inc.	76
Cruising Equipment	25
Cunard Associates	25
E.H. Yost & Co.	73
Jade Products, Inc.	74
Mr. NiCd	73
Solutions Cubed	40
TNR Technical, Inc.	66

BUSINESS OPPORTUNITIES

24DOT7, Inc.	49
Cheneko Products, Inc.	24

BUYING ELECTRONIC SURPLUS

ABC Electronics	100
Alltech Electronics Co.	48
Bell Electronics	22
C and H Sales Company	102
Dexis	75, 96
Earth Computer Technologies	24
Kable Works, Inc.	44
Metric Equipment Sales, Inc.	30
MWK Industries	92
RA Enterprises	15
Roger's Systems Specialist	16
Skycraft Parts & Surplus, Inc.	71

CABLE TV

A1 Cable	102
Basic Electrical Supply & Warehousing Corporation	30
Converters, LTD.	67
Direct Cable Supply	100
DYNAMIC Technologies	46
Foss Warehouse Distributors	74
Greenleaf Electronics	59
I.E.S.	79
Kable Works, Inc.	44
KDE Electronics Corp.	81
Kimtronix	82
Mega Electronics	75
Modern Communications	15
Modern Electronics	97
Mo-Tech Distributors	49, 101
National Cable Services	47
New Company	101
Novaplex	50
One Stop Supplier	97
Plazac Sales, Inc.	88
Quality Electronics	91
Television Distributors	58
The Filter Company, Inc.	105
Timeless Products	102
UTS Wholesaler	49
Video Media	75
Visual Communications, Inc.	76
White-Star Electronics	92
Wholesale Cable	66

CB/SCANNERS

Communications Electronics, Inc.	17
Index Publishing Group, Inc.	7
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American Innovations, Inc.	33
Decade Engineering	75
Detection Dynamics	75
Images Company	74
Polaris Industries	51
Ramsey Electronics, Inc.	56

Resources Un-Ltd.	31
Seabird Technical	75
Spy Outlet	75

COMPONENTS

BCD Electro	74
Capital Electronics, Inc.	66, 96
Circuit Etching Technics	6
Images Company	74
Javanco	100
Kable Works, Inc.	44
Skycraft Parts & Surplus, Inc.	71
Surplus Sales of Nebraska	22
Unicorn Electronics	81

COMPUTER

Hardware

Ace Computers	37
ACP Super Store	82
Allison Technology Corp.	33, 74
Alltech Electronics Co.	48
Autotime	11
Bisme Computer, Inc.	14
Consumertronics	39
Corporate Systems Center	22
Earth Computer Technologies	24
EPS	75
General Device Instruments	74
Halted Specialties Co.	3
La Paz Electronics Int'l.	24
Midwest Electronics	6
Prime Electronic Components, Inc.	57
Roger's Systems Specialist	16
Shreve Systems	74
Techniks, Inc.	74

Software

Bisme Computer, Inc.	14
Pioneer Hill Software	51
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Abacom Technologies	87
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Bisme Computer, Inc.	14
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Scott Edwards Electronics	88
Solutions Cubed	40
Square 1 Electronics	6
Technological Arts	74
VersaTech Electronics	44
Vesta Technology, Inc.	49

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Capital Electronics, Inc.	66, 96
J & M Microtek, Inc.	40
Spectrum Research	82
Turner Electronics	75
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EDUCATION

Advanced Educational Systems	87
EMAC, Inc.	14

EVENTS/SHOWS

ACP Super Store	82
Koll-Dove	47

KITS

Alltronics	29
C & S Sales, Inc.	8, 89
Earth Computer Technologies	24
Electronic Rainbow Ind., Inc.	21
EMAC, Inc.	14
Gateway Electronics, Inc.	60
Information Unlimited	68

Jade Products, Inc.	74
Ramsey Electronics, Inc.	56
Scott Edwards Electronics	88
Weeder Technologies	24
Xandi Electronics, Inc.	80

LASERS

Information Unlimited	68
MWK Industries	92
Resources Un-Ltd.	31
Unicorn Electronics	81

MISC./SURPLUS

All Electronics Corporation	65
Alltech Electronics Co.	48
Brigar Electronics	77
C and H Sales Company	102
CFX Technologies	75
Circuit Specialists, Inc.	114
Consumertronics	39
Cyber-Test	97
Electronic Rainbow Ind., Inc.	21
Gateway Electronics, Inc.	60
Halted Specialties Co.	3
Javanco	100
MCM Electronics	23
Prime Electronic Components, Inc.	57
RA Enterprises	15
Resources Un-Ltd.	31
Shreve Systems	74
Skycraft Parts & Surplus, Inc.	71
Surplus Traders	74
Unicorn Electronics	81
Viking International	30
Visitec, Inc.	36
Weeder Technologies	24

PROGRAMMERS

Andromeda Research	5
General Device Instruments	74
Intronics, Inc.	71
J & M Microtek, Inc.	40
M2L Electronics	88
microEngineering Labs	51
Progressive Solutions	75
Sinaco Electronics	74

PUBLICATIONS

Antique Radio Classified	75
Consumertronics	39
Electronics Book Club®	35
Mouser Electronics	51
Netcom	5
Square 1 Electronics	6
Surplus Sales of Nebraska	22
Synergetics	103

ROBOTICS

Abacom Technologies	87
Images Company	74
PARAMAX, INC.	67
RA Enterprises	15
Solarbotics	81
Solutions Cubed	40

SATELLITE

Baylin Publications	11
---------------------	----

SECURITY

American Innovations, Inc.	33
Ar2 Communications Products	6
Information Unlimited	68
Polaris Industries	51
Spy Outlet	75
Street Smart Security	36
Visitec, Inc.	36

SOLAR EQUIPMENT

Cruising Equipment	25
Solarbotics	81

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OR
CATEGORY

STEPPER MOTORS

Alltronics	29
PARAMAX, INC.	67

TELEPHONE/CELLULAR

American Innovations, Inc.	33
Ar2 Communications Products	6
Bilcocon Corp.	75
Cellular Technology Group	61
Communications Electronics, Inc.	17
Electronic Service and Supplies	82
Index Publishing Group, Inc.	7
Jectech	74
M.F.M. Communications	92
S & N Cellular	40
Weeder Technologies	24

TEST EQUIPMENT

ABC Electronics	100
Alfa Electronics	38
Allison Technology Corp.	33, 74
Autotime	11
Bell Electronics	22
C & S Sales, Inc.	8, 89
C and H Sales Company	102
Cruising Equipment	25
Danbar Sales Company	45
Davilyn Corp.	7
Dexis	75, 96
Electro Tool, Inc.	25
Intronics, Inc.	71
MCM Electronics	23
Metric Equipment Sales, Inc.	30
Optoelectronics	115
Phelps Instruments	36
Pioneer Hill Software	51
R & S Surplus	47
Seabird Technical	75
Test Equipment Sales	14
Western Test Systems	12-13

TOOLS

Electro Tool, Inc.	25
Intronics, Inc.	71
MCM Electronics	23
Unicorn Electronics	81
White-Star Electronics	92

WIRE/CABLE & CONNECTORS

Global Connections	15
Javanco	100
Roger's Systems Specialist	16
The RF Connection	40

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Fantastic DMM Offer!!!

Don't let the price fool you. This meter is a digital multimeter designed for engineers and hobbyists. Equipped with 5 functions and 19 ranges. Each test position is quickly and easily selected with a simple turn of the FUNCTION/RANGE selector rotary switch.

General
Display: 3-1/2 Digit LCD, 21mm Figure Height with Automatic Polarity
Overrange Indication: 3 Least Significant Digits Blank
Temperature for Guaranteed Accuracy: 23°C±5°C RH<75%
Temperature Ranges:
Operating: 0°C to 40°C (32°F to 104°F)
Storage: -10°C to 50°C (14°F to 122°F)

Power: 9V Alkaline or Carbon-Zinc Battery (NEDA1604)
Low Battery Indication: BAT on Left of LCD Display
Dimensions: 188mm long x 87mm wide x 33mm thick
Net Weight: 400g

DC Voltage (DCV)
Range: Resolution: Accuracy:
200mV 100µV
2000mV 1mV
20V 10mV ±(1%rdg+2dgt)
200V 100mV
1000V 1V
Maximum Allowable Input: 1000V DC or Peak AC

DC Current (DCA)
Range: Resolution: Accuracy:
200µA 100nA
2000µA 1µA
20mA 10µA ±(1.2%rdg+2dgt)
200mA 100µA
10A 10mA ±(1.2%rdg+2dgt)
Overload Protection: mA Input. 2A/250V fuse.

AC Voltage (ACV)
Range: Resolution: Accuracy:
200V 100mV ±(1.2%rdg+10dgt)
750V 1V

CAT NO **DESCRIPTION** **PRICE**
9300G Rugged High Quality DMM with Rubber Boot **\$19.00**



Our Best Offer Ever on a High Quality Full Sized DMM

Rubber Boot Included

\$19.00 any qty

Resistance (Ω)
Range: Resolution: Accuracy:
200Ω 100mΩ
2000Ω 1Ω
20KΩ 10Ω ±(1.2%rdg+2dgt)
200KΩ 100Ω
20MΩ 10KΩ ±(2%rdg+10dgt)
Maximum Open Circuit Voltage: 2.8V

Diode Test
Measures forward voltage drop of a semiconductor junction in mV test current of 1.5mA Max.
ohmTest
Measures transistor hFE.
Frequency Range: 45Hz-450Hz
Maximum Allowable Input: 750V rms
Response: Average Responding. Calibrated in rms of a Sine Wave.

Switchable Scope Probe Sets

(Selectable X1/Ref/X10)

These high quality scope probe sets are for oscilloscopes up to 60MHz (model HP 9060) or 150MHz (model HP9150). Both sets include a handy storage pouch and include an IC test-hook adapter for the probe. The BNC connector rotates to avoid cable tangle or kink. Cable length is 1.4 meters.

CAT NO **DESCRIPTION** **PRICE EACH**
HP-9060 Scope Probe Set DC-60MHz \$16.49 \$14.49 \$11.58
HP-9150 Scope Probe Set DC-150MHz 24.95 21.95 18.62



CCD Camera - IR Responsive

This black and white monochrome CCD Camera is totally contained on a PCB (70mm x 46mm). The lens is the tallest component on the board (27mm high from the back of the PCB) and it works with light as low as 0.1 lux. It is IR Responsive for use in total darkness. It comes with six IR LED's on board. It connects to any standard monitor, AUX or video input on a VCR or through a video modulator to a TV. Works with a REGULATED 12V power supply (11V-13V). Hooks up by connecting three wires: red to 12V, black to ground (power & video) and brown to video signal output.

Power Supply Regulating Kit for CA-H34 This simple kit is designed to fit onto the back of the CA-H34 CCD camera. It resolves the problem of hooking up the camera to an UNREGULATED supply (which damages the camera) by providing safe regulated power from any 12V-14V DC supply. It also provides regulated 12V DC from a 12V AC source.

CAT NO **DESCRIPTION** **PRICE EACH**
CA-H34A PCB Mounted IRCCD Camera \$99.00 \$85.00
A34 Power Supply Regulating Kit \$6.95

PM-128: 3-1/2D LCD Digital Panel Meter **PM-129: 3-1/2D LED Digital Panel Meter**

Features
• 200mV Full Scale Input Sensitivity
• PM-128 - Single 9VDC Operation
• PM-129 - Single 9VDC Operation
• Decimal Point Selectable
• PM-128 - 13mm Figure Height
• Automatic Polarity Indication
• Guaranteed Zero Reading for 0 Volt Input
• High Input Impedance (>100Mohm)
Specifications - PM-128/PM-129
Maximum Input : 199.9mV DC
Maximum Display : 1999 counts (3-1/2 Digits)
w/Automatic Polarity Indication
Indication Method : PM-128 - LCD Display
PM-129 - LED Display
Measuring Method : Dual-Slope Integration
A/D Converter System (cont.)
(cont.)
Overrange Indication : "1" Shown in the Display
Reading Rate Time : 2-3 Readings per sec.
Input Impedance : >100 Mohm
Accuracy : ±0.5% (23-5°C, <80% RH)
Power Dissipation : PM-128 - 1mA DC
PM-129 - 60mA DC
Decimal Point : Selectable w/Wire Jumper
Supply Voltage : PM-128 - 9V DC
PM-129 - 9V DC
Size : 67mm x 44mm
Applications Include:
• Voltmeter
• Thermometer
• pH Meter
• dB Meter
• Watt Meter
• Current Meter
• Capacitance Meter
• LUX Meter
• LCR Meter
• Other Industrial & Domestic Uses

Positive Photo Resist Pre-Sensitized Printed Circuit Boards

These pre-sensitized printed circuit boards are ideal for small production runs. They provide high resolution and excellent line width control. High sensitive positive resist coated on 1oz. copper foil allows you to go direct from your computer plot or art work layout. No need to reverse art.

Single-Sided, 1oz. Copper Foil on Paper Phenolic Substrate

CAT NO **DESCRIPTION** **PRICE EACH**
PP101 100mm x 150mm/3.91" x 5.91" \$2.55 \$1.90 \$1.70
PP114 114mm x 165mm/4.6" x 6.6" 2.98 2.45 1.98
PP152 150mm x 250mm/5.91" x 9.84" 5.40 3.98 3.60
PP153 150mm x 300mm/5.91" x 11.81" 6.15 4.48 4.10
PP1212 305mm x 305mm/12" x 12" 12.78 10.65 8.52

Single-Sided, 1oz. Copper Foil on Fiberglass Substrate

CAT NO **DESCRIPTION** **PRICE EACH**
GS101 100mm x 150mm/3.91" x 5.91" \$ 3.90 \$2.98 \$2.60
GS114 114mm x 165mm/4.6" x 6.6" 4.80 3.49 3.20
GS152 150mm x 250mm/5.91" x 9.84" 8.69 5.98 5.78
GS153 150mm x 300mm/5.91" x 11.81" 10.20 7.20 6.80
GS1212 305mm x 305mm/12" x 12" 18.88 15.73 12.59

Double-Sided, 1oz. Copper Foil on Fiberglass Substrate

CAT NO **DESCRIPTION** **PRICE EACH**
GD101 100mm x 150mm/3.91" x 5.91" \$ 5.07 \$3.68 \$3.38
GD114 114mm x 165mm/4.6" x 6.6" 5.95 4.29 3.99
GD152 150mm x 250mm/5.91" x 9.84" 10.47 7.39 6.98
GD153 150mm x 300mm/5.91" x 11.81" 11.95 8.69 8.30
GD1212 305mm x 305mm/12" x 12" 22.09 18.35 14.68

Developer This product is used as the developer on our positive photo-resist printed circuit boards. Includes instructions. 50 gram package, mixes with water, makes 1 quart.

CAT NO **DESCRIPTION** **PRICE EACH**
POSDEV Positive Developer \$.95 \$.80 \$.50

Etching Tank This handy etching system will handle PC boards up to 8" x 9", two at a time. Ideal for etching your PCB's! System includes an air pump for etchant agitation, a thermostatically controlled heater for keeping etchant at optimum temperature and a tank that holds 1.35 gallons of etchant. A tight fitting lid is also supplied to prevent evaporation when system is not being used. Typical etching time is reduced to 4 minutes on 1oz. copper board!

CAT NO **DESCRIPTION** **PRICE** **REDUCES ETCHING TIME!**
12-700 Etch Tank System \$37.95

Etching Chemicals/Ferric Chloride
A dry concentrate that mixes with water to make 1 pint of etchant, enough to etch 400 sq. inches of 1oz board.

CAT NO **DESCRIPTION** **PRICE EACH**
ER-3 Makes 1 pint \$3.50 \$2.75

Digital Panel Meters (LCD & LED) 3-1/2 Digit LCD 3-1/2 Digit LED 4-1/2 Digit LCD
PM-328: 4-1/2D LCD Digital Panel Meter

Don't let the prices fool you. These digital panel meters are not surplus, so even if you design them into an ongoing manufactured product, you can be assured of continued availability. These high quality digital panel meters are decimal point selectable with guaranteed zero reading at zero volts input.

Specifications - PM-328
Maximum Input : 199.9mV DC
Maximum Display : 1999 counts (4-1/2 Digits)
w/Automatic Polarity Indication
Indication Method : LCD Display
Overrange Indication : "1" Shown in the Display
Input Impedance : >100 Mohm
Accuracy : ±0.05% (23-5°C, <80% RH)
Power Dissipation : 1mA DC
Decimal Point : Selectable w/Wire Jumper
Supply Voltage : 9V DC
Size : 67mm x 44mm
Features:
• 200.0mV Full Scale Input Sensitivity
• Single 9V DC Operation
• Decimal Point Selectable
• 11mm LCD Figure Height
• Automatic Polarity Indication
• Low Battery Detection and Indication
• High Input Impedance (>100 Mohm)
CAT NO **DESCRIPTION** **PRICE EACH**
PM-128 3-1/2 Digit LCD Panel Meter \$ 9.90 \$ 7.09 \$ 6.40 \$ 5.86 \$ 5.25
PM-129 3-1/2 Digit LED Panel Meter 11.49 9.54 8.67 7.95 6.95
PM-328 4-1/2 Digit LCD Panel Meter 19.88 16.40 14.90 13.66 11.93

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For Commercial and Mobile Radio testing, the **Optoelectronics Xplorer** stands alone. Let the Xplorer perform all your quick radio checks, instantly determining the radio's frequency, **CTCSS**, **DCS**, **DTMF**, deviation or signal strength. The Xplorer automatically locks on to any nearfield signal from **30MHz - 2GHz** in less than a second.

There is **no setup necessary**-Whether you're in the field or in the shop, the Xplorer is the portable, compact and **economical solution** for any two-way communications business.



Patent No. 5,471,408

FEATURES

- Nearfield receiver, sweeps **30MHz-2GHz** in <1 second (Cellular blocked on all U.S. units)
- Decodes **CTCSS**, **DCS**, and **DTMF**. Manually record tones into memory
- Lockout up to 1000 frequencies
- Store **500 frequencies** in **memory** with time & date stamp, as well as number of hits per frequency
- NMEA-0183 **GPS interface** for recording Latitude & Longitude coordinates (GPS Required)
- **VFO mode** for tuning to specific frequencies
- PC interface for **downloading** data from **memory**
- FM demodulation / **Built-in speaker**
- **Auto** or manual frequency **hold**
- **Maximum nearfield** reception / Up to **1/4 mile** away

\$899

Summer Special Includes:
Spectrum CD & CC30 Case

Xplorer includes: TA100S antenna, NiCads, Charger, PC Download cable and software

SPECIFICATIONS

Freq. Range	30MHz - 2GHz
Modulation	FM Deviation
Freq. Response	50 - 3000Hz
Auto Sweep Time	<1 second
Input 50 Ohm	-59dBm @100MHz -25dBm @1GHz
Display	2 line LCD
Power	Internal NiCad



CTCSS Decode



DCS Decode



DTMF Decode

CTCSS, DCS, and DTMF Decoding

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BASIC Stamp® computers

Tiny computers run PBASIC programs

BASIC Stamps answer the request for small, low-cost, easily programmable computers. BASIC Stamps are programmed in Parallax BASIC (PBASIC), a simple language with powerful I/O instructions. BASIC Stamps have their own PBASIC interpreter, non-volatile EEPROM, and 5-volt regulator. Because of their reliability and ease of programming, BASIC Stamps are the microcontroller of choice for hobby projects and industrial control.



Mechanical insect controlled by BASIC Stamp

Parallax's United Kingdom distributor Milford Instruments (www.milinst.demon.co.uk) uses the BASIC Stamp I to control servos, LEDs and antennae switches in their BASIC Stamp Bug kit. The BASIC Stamp Bug was a popular guest in our booth at the June COMDEX show in Atlanta, Georgia, and now finds its way into our regular product line. Call for pricing and availability of this little beast.



Plastic extrusion machine industrial application

Fisher Automation of Whitestone, New York uses BASIC Stamps in their plastic extrusion machines to sense the appropriate time to start a cut cycle and sequence several pneumatic valves. Fisher Automation reports that "the BASIC Stamp has proven extremely reliable in our applications, running 24 hours per day, seven days a week, and performing up to 70 cuts per minute."

BASIC Stamp® modules

BS1-IC Module

8 I/O lines
80 PBASIC instructions max.
2000 instructions/sec.
2400 baud serial I/O
14-pin SIP module

Familiar PBASIC language with I/O instructions including BUTTON, HIGH, INPUT, LOW, OUTPUT, POT, PULSIN, PULSOUT, DEBUG, PWM, REVERSE, SERIN, SEROUT, SOUND, and TOGGLE.



\$34

BS2-IC Module

16 I/O lines
500 PBASIC instructions max.
4000 instructions/sec.
50k baud serial I/O
24-pin DIP module

Similar language as BS1-IC, plus DTMFPUT, FREQOUT, SHIFTIN and SHIFTOUT, XOUT (X-10 powerline control), etc. I/O functions common to both modules have a higher resolution on the BS2-IC, due to its faster clock speed. Larger EEPROM, high speed, and diversity of instructions make the BS2-IC our most popular product.



\$49

BASIC Stamp® Starter Kits

BASIC Stamp I Starter Kit (part #27205) \$99

BASIC Stamp II Starter Kit (part #27203) \$149

BASIC Stamp Starter Kits include the BS1-IC or BS2-IC modules shown above, carrier board with prototype area and 9-volt battery clip, manual, application notes, and software. Free technical support is also included.



BASIC Stamp I Starter Kit shown with BS2-IC module on carrier board

Serial LCD Displays

2-line x 16 character LCD display (part #27910)

\$54

4-line x 20 character (part #27919)

\$109

Serial LCD modules from Scott Edwards Electronics take one BASIC Stamp I/O line and ground, and are controlled with simple SEROUT instructions.



BASIC Stamp AppKits

MAX7219 8-digit LED display driver (part #27914)

\$26

LTC1298 12-bit A/D converter (part #27916)

\$26

DS1620 digital thermometer / thermostat (part #27917)

\$26

CM8880 DTMF Transceiver (part #27915)

\$26

Xicor X25640 8k serial EEPROM (part #27918)

\$26

AppKits include all the materials you need to learn about interfacing electronic parts to the BASIC Stamp. Each AppKit contains a sample device and supporting components, easy to read documentation, and source code.

Visit Parallax at fall trade shows!

September 29 to October 2, 1997
San Jose Convention Center
Booths #2019 and #2021



November 4 to 6, 1997
Santa Clara Convention Center
Booths #5405 and #5407



November 17 to 21, 1997

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Watch our web site for booth information.



Yes, there will be new products released at these trade shows. Watch our web site for free guest passes, too.

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