

Real PostScript for PIC robotics  
"Six clicks" to display PostScript  
Shattering the homopolar myths  
Motor & generator fundamentals  
Melody IC's and sound modules

There sure seems to be a lot of web interest these days in *homopolar generators*. For these really old and poorly understood electrical machines have newly gotten blamed for everything from "over unity" perpetual motion ripoffs to cures for warts to three foot high killer chickens.

In reality, a homopolar generator can lead to a winning student paper or project. But otherwise can end up almost totally useless. Owing to its extremely low output voltage and its woefully poor efficiency.

A few of the more intellectually challenged webizens seem to confuse homopolar machines with *magnetic monopoles*, and "near monopoles".

The latter is the current *Scam De Jour* of the pseudoscience crowd.

Well, I hate to mention this, but magnetic monopoles flat out do not exist. Your alternate name for "near monopoles" (magnets with one pole appearing much stronger than the other) is *bad labwork*. Labwork so mesmerizingly awful that it flat out is *not even wrong*.

### Some Electrical Laws

Most of the fundamental electrical developments that lie behind motors and generators took place hundreds of years ago. This ground has been pretty thoroughly plowed. Over and over again. It's safe to bet that the fundamentals have been pretty well proven. Far beyond even the remotest shadow of doubt.

Let's look at a few basics...

**Conservation of energy**—This tells us that there is no non-nuclear process known by which energy can either be created or destroyed. Connect a hand cranked generator to any lamp via a switch. Closing the switch makes the cranking a lot harder.

Every time.

In the real world, there is always friction. Friction *always* ends up as useless low grade heat. Even though you cannot create or destroy energy, *there is no way you can ever so much*

*as hope to break even*. Worse yet, if a heat engine or a temp differential is in any manner involved, *most* of your input energy usually gets once again converted into uselessly low quality heat. Which is the *Carnot* efficiency limitation from that *Second Law of Thermodynamics*.

More on this in [HACK64.PDF](#) on [www.tinaja.com](http://www.tinaja.com) And in those hard copy *Hardware Hacker* reprints.

**Electric currents**—An *electric charge* is simply some place where there is some excess or a lack of electrons. Excess for negative; lack (or excess *holes*) for positive. The point electric charges can and do exist.

No static over that.

An electric current results when a conductive path gets placed between points having positive and negative charge accumulations. *Ohm's Law* tells us the strength of the current, based upon the charge differences,

the conductivity of the path, its area, and its active length.

The current continues only until the charges fully equalize.

A conventional current is defined as *positive to negative* in a load and *negative to positive* in a source. The conventional current is the same as the hole current, but is the *opposite* of the electron current.

*Always* use conventional current!

**Magnetic flux**—Nobody, but nobody has *ever* observed a point magnetic charge. Otherwise referred to as a *magnetic monopole*. While certain controversial theories do suggest that magnetic monopoles just *might* be possible, nobody has yet grabbed one for the cover of *Science*.

One of Maxwell's equations tells us *the total magnetic flux through any closed surface is zero*. This tells us that magnetic poles *always* have to be paired and *always* have to be of

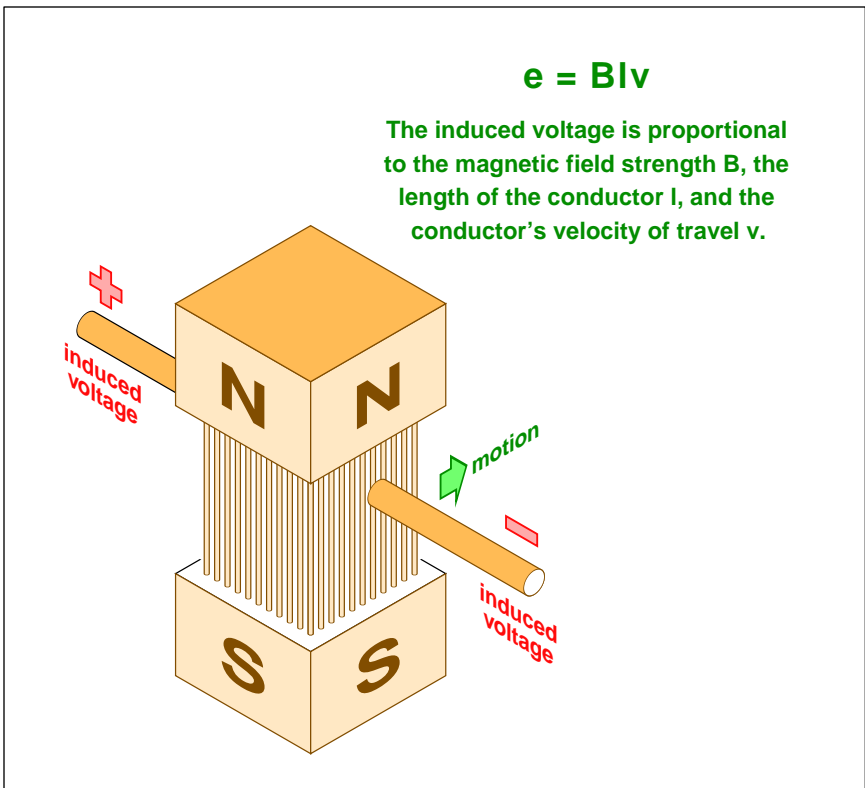


Fig. 1 – The "BLV" VOLTAGE RULE for motors and generators.

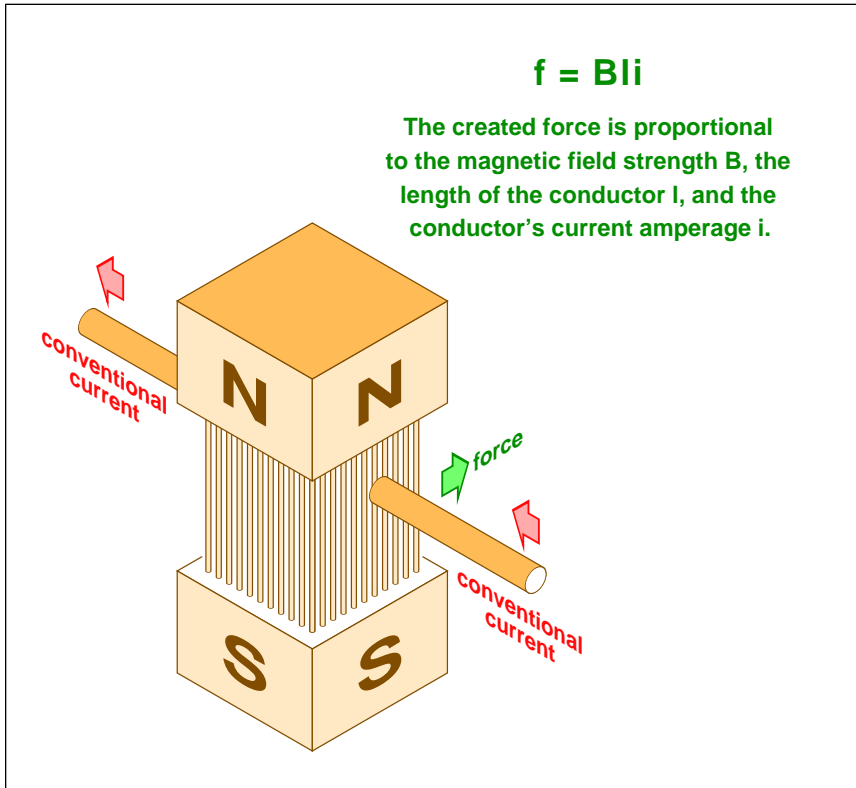


Fig. 2 – THE "BLI" FORCE RULE for motors and generators.

equal strength. What goes out north simply has to come in south.

Motors or generators that involve magnetism will *always* need magnets

that provide two poles of equal and precisely opposite strengths.

You can easily get from electricity to magnetism by running a current

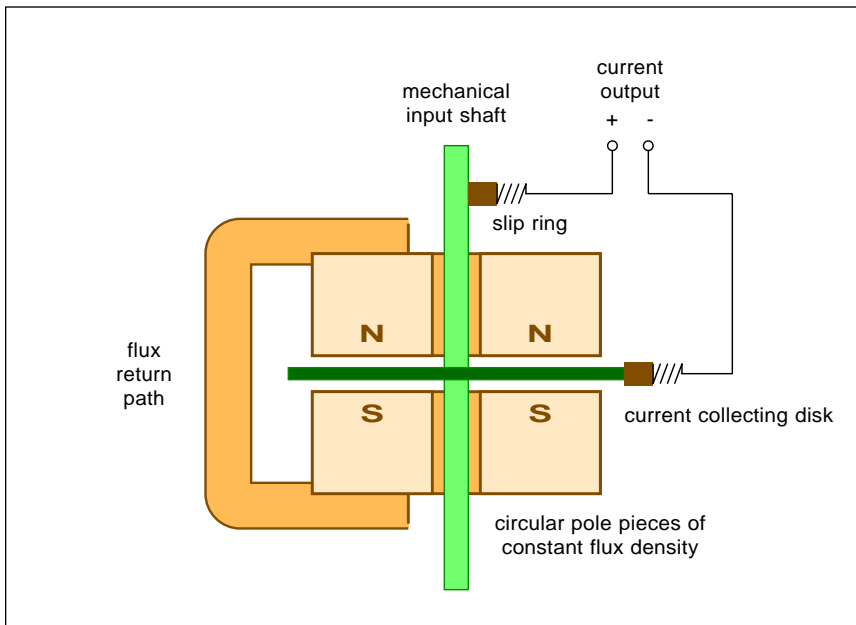


Fig. 3 – THE HOMOPOLAR GENERATOR offers a true dc output, quite low voltage, and extremely high output currents. Typical applications are largely restricted to "Uh, compared to what?" uses where tens of thousands or even millions of amperes of current might be required.

through a wire. Closed circular *lines of magnetic flux* will form around the wire per a *right hand rule*.

The strength of the magnetic field is proportional to the current and is inversely proportional to the square of the distance from the conductor.

**The law of induction**—To get from magnetism to electricity, we apply *Faraday's Law* of figure one.

Mathematically, we have...

$$e = Blv$$

Which tells us that "the voltage induced in a wire depends upon how long the wire is, the strength of the magnetic field your wire is moving through, and the wire's velocity.

Your usual demo here is to take a hollow coil of wire and connect it to a center zero microammeter. As you move the magnet through your coil, you get a current. Resulting from the induced voltage going through the meter's resistance as per Ohm's law. But you get a current *only* when the magnet is *moving*.

Entry swings positive and exit will go negative. Reverse your poles and you reverse the polarity. The faster you go, the higher the peak induced voltage and the higher the current.

**The law of winding force**—Otherwise known as *Fleming's Rule* and shown here in figure two.

Again mathematically...

$$f = Bli$$

Or "Whenever a current carrying conductor interacts with an external magnetic field, a force results at right angles to both the conductor and the field." This force is proportional to the strength of the magnetic field, the length of your conductor, and that current through your conductor. Per another *right hand rule*. Motion will result when this force is not opposed. This process is reversible. You can input a force to create a current or input a current to create a force.

Note that work is done *only* when a force moves through a distance.

When your conductor is allowed to move, an *opposing voltage* is also produced by our previous  $e = Blv$  rule. This is known as the *back emf* or as the *counter emf*.

In the absence of any mechanical motor load, your back emf will very

<b>Chips from SEIKO EPSON—</b>	
SVM7910	16 pin dip, 64 notes, tone or chime
SVM7922	4 pin sop, 64 notes, external amplifier
SVM7931	14-pin dip, 64 notes, speaker output
SVM7943	16-pin dip, 512 notes, piezo or buzzer
SVM7954	16-pin dip, 64 notes, piezo or buzzer
SVM7962	24-pin sop, 127 notes, speaker output
SVM7973	18-pin dip, 640 notes, high quality
SVM7992	16-pin dip, 512 notes, speaker output
SVM7903	8-pin dip, 60 notes, speaker or piezo
<b>Recordable speech chips from ISD—</b>	
ISD1000	16 to 20 seconds, dip or soic
ISD1100	10 to 12 seconds, dip
ISD1200	10 to 12 seconds, dip or soic
ISD1400	16 to 20 seconds, dip or soic
ISD2500	32 to 120 seconds, dip, soic, or tsop
ISD33000	1 min to 4 min, dip, soic, or tsop
<b>Kits from DIY ELECTRONICS—</b>	
SG1M	– Four train sounds
SG2M	– Cellular phone sounds
SG3	– Sixteen door chimes
SG4	– Three sirens and machine gun
SG5	– Ding dong door chime
SG6	– Melody IC in TO92 package
SG7	– "Love Story" melody card
SG8	– Sixteen second voice recorder
SG9	– Ten second ISD voice recorder
SG10	– Hen, cat, cow, dog animals
SG11	– Siren sound generator
SG12	– Gun and bomb sounds
SG13	– "Happy Birthday" melody card
SG14	– Three Christmas carols card

Fig. 4 – SEVERAL MELODY IC chips and kits.

nearly cancel out your input voltage, resulting in very little current at low loading. As any mechanical loading increases, your back emf magically drops, increasing the current exactly as needed for energy conservation.

Your major difference between a motor and a generator is that you'll input the rotary motion and extract current with a generator. You input current and extract a rotary motion with any motor. Indeed, because of back emf, a motor generates and a generator "motorates".

To build a motor or a generator, you arrange some coil-like windings, magnetic fields from permanent magnets or electromagnetic coils, the forces, voltages, and some means of coupling your currents off a moving conductor. Then let them interact.

### The Homopolar Generator

Figure three shows us an ancient and unusual piece of machinery that is called a *homopolar generator*.

Or sometimes an *acyclic* generator. There is only *one* air gap involved. *One* oddball shaped magnet can be used, having *one* north pole and *one* south pole. In the setup shown, the poles are circular but have a small shaft access hole in their centers.

Curiouser and curiouser.

A disk shaped conducting rotor is placed in the air gap. As the disk is spun, a *radial* dc current is produced. The strength of this current depends upon the disk speed and the strength of the magnetic field. This current is collected by one or more *slip rings* on the outer edge of the disk.

The homopolar generator has some very unusual properties. *It is the only known electromechanical generator that is able to produce a true direct current output.* More popular 2-pole generators will have to *commutate*, or selectively switch into sequential ac winding peaks to get an *apparent* dc output at the terminals.

The homopolar generator always produces very low voltages and very high currents. A mid-sized machine might output eight volts at a current of 20,000 amperes.

Er, about that 20,000 amperes. A slip ring with a 0.001 Ohm resistance will drop 20 volts and must be able to dissipate 400,000 watts!

*Three times* what your generator can produce. And remember that you need *two* sets of slip rings.

Thus, the enormous currents lead to monumental wiring and slip ring losses. So much so that *any practical homopolar generator almost always ends up extremely inefficient.*

Your high currents must get used "nearby", or the buss bar "wires" will gobble up nearly all of the remaining energy that the slip rings may have decided to leave you with.

In comparison, much less copper and less iron is required in simpler structures for any traditional higher voltage and lower current multipole generator. And a dc output is no big deal with today's cheap rectifiers and synchronous rectification.

A homopolar generator is simply a machine that applies conventional laws of physics. By applying them to inefficiently generate low dc voltages at high currents. Done in complex and physically larger devices at much higher costs.

There have been other variations upon homopolar generators, some of which used spinning magnets. As far as I know, this version I've shown here is one of the scant few to ever see any commercial use.

I strongly suspect the main reason that homopolar generators find favor with the free energy crowd is because of the utterly simplistic ease with which errors of measurement and/or interpretation can be made.

High currents are *extremely* tricky to measure; a rather special *Kelvin* connection is required. Their strong magnetic fields also tend to *directly*

MELODY IC AND SOUND MODULE RESOURCES

**Asian Sources**

1020 Church St  
Evanston IL 60201  
(847) 475-1900

**Clegg**

19220 S Normandie Ave  
Torrance CA 90502  
(310) 542-1600

**Honsitak Enterprises**

5F 494 S3 Chung Shan Rd  
Shinchung City, Taipei  
(8862) 9010513

**Ozen Sound Devices**

6 Grace Ave Ste 201  
Great Neck NY 11021  
(516) 482-4825

**Am Voice I/O Society**

PO Box 20817  
San Jose CA 95160  
(408) 323-1783

**Eletech**

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Industry CA 91744  
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(310) 517-7770

interact with some meter movements. Nonlinearities, temperature effects, and phase shifts are all guaranteed to cause you problems.

As are big time misinterpretations of what is really coming down.

Still, there are a few remaining legit manufacturers of homopolar generators. Mostly for exotic "Uh, compared to what?" applications that require enormous but brief currents. Stuff such as rail gun research, super magnet studies, specialized welders, or electrochemistry aps. One source for custom homopolar generators is *Parker Kinetic Designs*. Currents as high as five million amperes can be found in their product line.

**"Six Click" Display PostScript!**

I've long been a fan of the superb PostScript computing language. A general purpose language that has suddenly gotten a lot easier to use.

The holy grail here has been a pair windows on a PC. You change your source code in one window, and your graphical or other output instantly responds on the other.

Well, we are not quite there yet. Purty nigh but not plumb.

But close enough that PostScript is now fast and fun to use. The key two secrets: Adobe's *Acrobat Distiller* is an outstanding PostScript computer. And that Adobe's *Acrobat Exchange* quickly gives you a full on-screen PC visual display.

Magnifiable and anti-aliased, even.

You are within six clicks of having access to your very own PC based display PostScript. Here are the six secret steps involved...

- 1 - Save source mods to disk
- 2 - Exit Exchange
- 3 - Select work folder
- 4 - Drag source into Distiller
- 5 - Exit Distiller
- 6 - Drag PDF file into Exchange

More details on using PostScript as language are in [DISTLANG.HTML](#) and the [POSTFLUT.PDF](#) found on my [www.tinaja.com](#). More on the six mouse clicks themselves in, of all places, [SIXCLICK.HTML](#).

You don't quite have all the more obscure commands of a true Display PostScript. And we are not quite real time. But typical turnaround is less than ten seconds. Since errors only give you a stack dump, you might want to substitute free (but otherwise not as good) *GhostScript* instead. If a view-plot-till-the-mistake capability is absolutely needed.

Among its amazing other powers, PostScript can easily get taught to read any disk in any file format in any language. You can also write to nearly any file format. Such tasks as font conversions or web site log file

analysis are trivial. Better yet, real PostScript is now available for low end PIC robotics. Royalty free.

Scads more PostScript-as-language examples are on my website.

**Melody IC's & Speech Modules**

I guess that old punch line went something like "the thong has ended but the malady lingers on."

At any rate, a lot of you have been asking for more info on melody and voice integrated circuits. I've shown a few places to go for these as this month's research sidebar.

There's two basic types of chips here: The first are tiny pre-recorded *Chip-on-board* devices you can use in everything from greeting cards to model railroads. The second are the larger one time use or re-recordable modules. Often based on *Information Storage Device* chips.

Most of the melody IC modules are sourced in China, with *Honsitak Enterprises* being a typical supplier. Both *Seiko Epson* and *LSI/CSI* also offer these. In several experimenter friendly packages. I've summarized a few of the more interesting Seiko parts in figure four.

And, of course, *Hallmark* is one big retailer of the final products.

Your leading source for low cost experimenter kits is an foreign firm called *DIY Electronics*. *Marlin Jones* and *Circuit Specialists* are two US distributors. I've also shown some of these kits in figure four. A typical kit costs \$6 or so. I particularly like the one that sounds like a cellular phone ringing. It sure is fun to turn this one loose in a large Yuppie crowd.

**NEED HELP?**

Phone or write all your US Tech Musings questions to:

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Synergetics  
Box 809-EN  
Thatcher, AZ, 85552  
(520) 428-4073

US email: [don@tinaja.com](mailto:don@tinaja.com)  
Web page: [www.tinaja.com](http://www.tinaja.com)



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Mountain View CA 94039  
(800) 833-6687

**Adventures Unlimited**  
PO Box 74  
Kempton IL 60946  
(815) 253-6390

**American Jnl of Physics**  
5112 Berwyn Rd  
College Park MD 20740  
(301) 345-4200

**Amp Kynar Piezo**  
950 Forge Ave Bldg B  
Norristown PA 19403  
(610) 650-1505

**Ghostscript/Aladdin**  
Box 60264  
Palo Alto CA 94306  
(415) 322-0103

**Industrial Computing**  
67 Alexander Dr  
Research Triangle Park NC 27709  
(919) 549-8411

**Lindsay Publications**  
PO Box 538  
Bradley IL 60915  
(815) 935-5353

**NC Shop Owner**  
1100 Superior Ave  
Cleveland OH 44114  
(216) 696-7000

**Newnes**  
313 Washington Street  
Newton MA 02158  
(617) 928-2500

**Parker Kenetic Designs**  
5806 Mesa Drive Ste 335  
Austin TX 78731  
(512) 302-4500

**PC Portables**  
8484 Wilshire Blvd Ste 900  
Beverly Hills CA 90211  
(213) 651-5400

**Qualcomm Inc**  
6455 Lusk Blvd  
San Diego CA 92121  
(619) 587-1121

**Rowmark**  
15 Massirio Drive  
Kensington CT 06037  
(860) 828-8282

**Science/AAAS**  
1333 H St NW  
Washington DC 20005  
(202) 326-6400

**Synergetics**  
Box 809  
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(520) 428-4073

**Texas Instruments**  
PO Box 809066  
Dallas TX 75380  
(800) 336-5236

If you find one that sounds like my fire pager, let me know. I sure could use it to cope with certain helpline callers. Especially sales reps.

All you need for a circuit is a coin cell or two, a simple switch that is often a finger of card stock between two contacts, and a piezo buzzer or a small speaker. You get the best sound quality with chips optimized for real speakers. Certain chips offer inputs that let you select which of any group of sounds gets output.

One useful source of custom cards and modules is *Clegg Industries*.

For recordable sound modules, try *Eletech*. They do call themselves the point-of-purchase ad experts. They have an IR model for permanent ad displays, an EP series that's built into a small picture frame and that LC "disposable" low cost series. Some of these are one time recordable, while

others are reusable as needed.

Activation can be by pushbutton or by full motion sensing.

Competitors include *Sentinel* and *Ozen Sound Devices*. *Radio Shack* has the ISD chips that these modules are often based on.

One industry association is *AVIOS*. Otherwise known as that *American Voice Input/Output Society*.

One very good far east industry directory is available as *Electronics* magazine from *Asian Sources*. They also have a free product locator CD available. One trade journal where lots of ads for recordables appear is *POP & Sign Design*.

Tellyawhat. Let's make a contest out of all this. An *Incredible Secret Money Machine II* for the dozen or so best new uses for these chips. And an all expense paid (FOB Thatcher, AZ) *tinaja quest* for the best of all.

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### New Tech Lit

An utterly amazing C. A. Ordez paper is in the *American Journal of Physics*, #64v4 April 1996 p479-481. In which a *nitrogen* powered car is shown to give you the same energy density as the very best of today's EV batteries. At potentially less than *four percent* of the total system cost!

Yes, nitrogen.

From *Texas Instruments*, a new *Logic Selection Guide and Databook* CD. From *Qualcomm*, a *Synthesizer Products Data Book*. This one does have a good review of direct digital frequency synth fundamentals.

*Lindsay Publications* has recently re-released a 1937 *Sylvania* vacuum tube *Technical Manual*. While this clearly says twenty-five cents on the cover, I suspect he really expects \$10.95 for it. From *Newnes*, a Jon

Hagen introductory text on *Radio Frequency Electronics*. And a thick Colin Bayless power engineering text on *Transmission and Distribution in Electrical Engineering*.

Shelf upon shelf of fascinatingly fictitious pseudoscience titles are now stocked in depth by *Adventures Unlimited*. Antigravity, mind control, pyramid energy, black helicopters, vortex electrogravitics. It seems the whole sordid gang is here. Lots more on pseudoscience can now be found at [www.tinaja.com/pseudo01.html](http://www.tinaja.com/pseudo01.html)

New trade journals for this month include *NC Shop Owner*, *Industrial Computing*, and *PC Portables*.

Free piezo film sensor samples from *Amp Piezo*. These make dandy microphones. Free laser compatible engraving plastics samples from the *Rowmark* folks.

For most individuals and smaller

scale startups most of the time, any involvement with patents is virtually certain to end up as a net loss of your time, energy, money, and sanity.

Find out why in my *Case Against Patents* package. Also shown are my tested and proven alternatives.

Per my nearby *Synergetics* ad.

I have also just posted the secrets of busting a \$650 patent as a new file [BUSTPAT.PDF](#). In that *Guru's Lair* website at [www.tinaja.com](http://www.tinaja.com). Also new are the secrets of bringing PostScript to PIC's. As [POSTFLUT.PDF](#). Plus my new *Infopack* service that quickly gets you cost effective research.

As usual, most of the mentioned items should appear in the *Names & Numbers* or the *Melody IC Resources* sidebars. Always check here before you call our US technical helpline shown in the *Need Help?* box.

Let's hear from you. ♦