Don Lancaster's

Tech Musings

March, 1999

Military surplus update
A SETI search invitation
CD and web USGS maps
Magnetic recording books
AC and DC lamp dimmers

The web sure makes electronic design quite a bit simpler and far easier than before. In case you haven't met them yet, be sure to check out *www.questlink.com* Who now provide instantly available data sheets and ap notes on just about everything from everybody.

Of the many newsgroups, I have found these to be handy…

sci.electronics.design
sci.electronics.equipment
sci.electronics.misc
sci.electronics.repair

I have recently added several more key electrical engineering links to my *www.tinaja.com/eeweb01.html*

Lamp Dimming Fundamentals

Say you have some lamps that you want to cheaply control with a PC, a PIC, or another microprocessor. How would you go about it?

We've seen in MUSE129.PDF how theaters and concerts use the fancy DMX512 communications standard. And saw in RESBN76.PDF how home automation often makes use of their X-10 dimmer controllers.

Any incandescent lamp might be brightened or dimmed by changing the dc or rms voltage sent to it.

The obvious method of putting a variable resistor in series with your light has big time inefficiency and heat problems. When you control a 100 watt bulb, as much as 25 watts of heat would have to get burned up in the series controller.

One ancient alternative was to use a *Variac*, or variable ac transformer. In which a knob twisted a contact to select a changing turns ratio. Early theater lighting controls used ganged banks of motor driven variacs.

Incandesacent lamps can be better brightened or dimmed by changing a *duty cycle*. Or the percentage of time voltage is applied. Duty cycling can be very efficient, since the controller is always either on or off. The ratio of on time to off time helps set the brightness. The switching frequency is usually 120 Hertz or higher. The thermal inertia from the light bulb's filament and the human persistence of vision will *integrate* or "average out" the on and off times so as to reduce or eliminate flicker.

Your approaches to lamp dimming will differ between ac and dc power systems. The dc routes of figure one might be used in automobiles, for caving helmets, or in flashlights. In 1-A, a power semiconductor such as a MOS field effect transistor is placed between lamp and ground. The lamp turns on by making the gate positive by five volts or so. It will turn off by leaving the gate voltage near ground. Very little gate current is needed, so the MOS device acts as a powerful "amplifier". Linear *or* switched.

One source of white LED caving

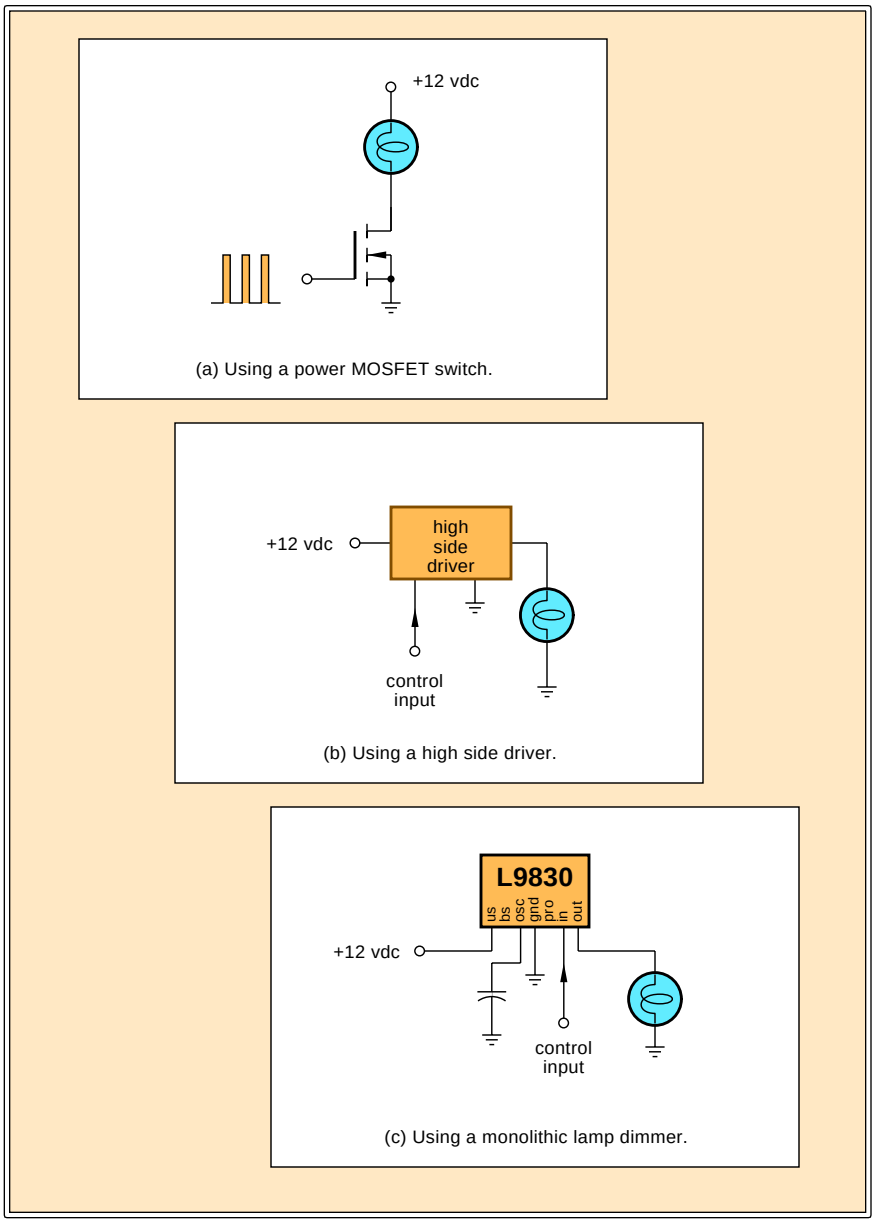

Fig. 1 – SOME DIRECT CURRENT lamp dimming circuits.

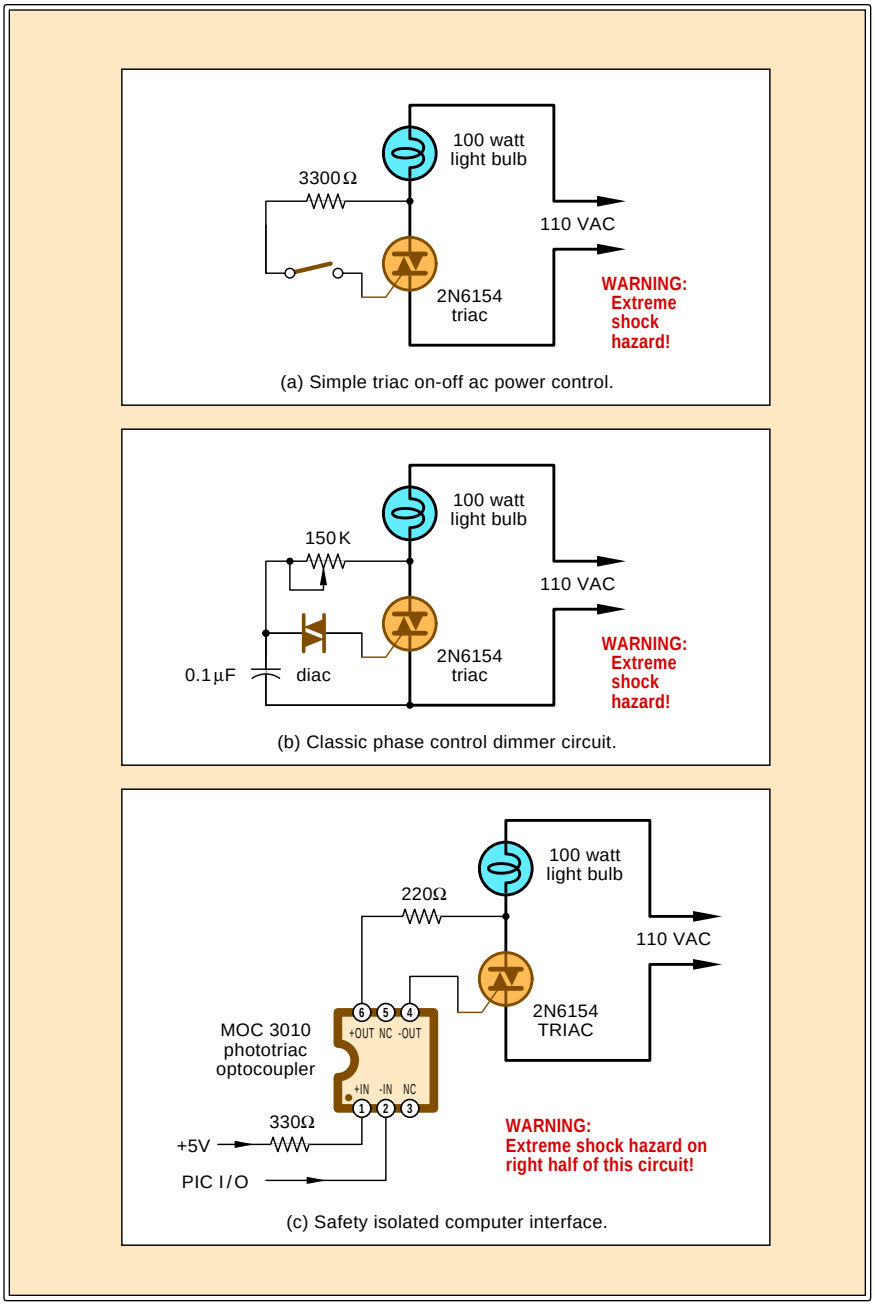

Fig. 2 – LINE OPERATED lamp dimming circuits.

lights which use these techniques can be found at *www.hdssystems.com*

In 1-B, a newer style of integrated circuit known as a *high side driver* is used. A high side driver is basically a series power MOSFET having some additional control circuitry. The high side driving eliminates the need for more than one wire going to the lamp. The return path can end up via the vehicle frame or chassis. High side driver circuits also sense open bulbs, detect other faults, and shut down on short circuit currents.

One-piece chips are available that can combine dimming and high side driving. Figure 41-C shows us how to use the new *SGS-Thomson* L9830. Its intended use is dimming dashboard lights in an instrument cluster.

The ac dimmers of figure two all provide a way to switch line voltage *bipolar* currents that can be positive or negative. This leaves most power semiconductors out. Except for the very popular switching device that is known as a *triac*.

A triac has three terminals, called *gate*, *T1*, and *T2*. There is no current between T1 and T2 until a brief and small gate current pulse is delivered. At that time, your triac turns on and heavily conducts between T1 and 2. Above the rather small load *holding* current, the triac will *latch* and *stay* on. The triac will stay on until such time as the main current returns to zero. Turnoff will usually occur at the next current zero crossing of the line ac sinewave.

The simple triac on-off switching circuit appears in figure 2-A. Closing the switch turns the triac on; opening the switch will turn the triac back off just after the next zero crossing. The sensitivity of a triac's gate changes a little with the changing line and gate polarity. But proper gate drive can switch either polarity load with either polarity gate pulse.

Your classic triac wall dimmer is shown in figure *2-B*. The *diac* shown is a bilateral switching diode. A diac turns on whenever its lead voltage exceeds a set amount. Often 30 volts or so. Each ac half cycle, your pot starts charging the capacitor. When the capacitor reaches the threshold voltage, the diac will turn on, in turn tripping the main triac.

The *lower* the pot resistance, the *earlier* in the half cycle that turnon occurs, and the *brighter* your lamp. The *higher* the resistance, the *later* in the cycle that turnon occurs, and the *dimmer* the lamp. Such a circuit is called a *proportional phase control*. A second resistor and capacitor (not shown here) will often be added to eliminate any "jumping" problems at very low light levels.

We saw waveforms on this back in MUSE108.PDF

One big gotcha with triacs is that they are connected to one side of the ac power line. Which creates serious "hot chassis" shock safety issues.

Figure 2-C shows us the standard and safe way of interfacing a triac to a PIC or a personal computer port. A small and low cost beastie called a *phototriac isolator* is used. Which is just a light emitting diode that shines onto a phototriac. Pulse the LED with suitably limited current (typically 10 mils) and both the little triac and the big main one turn on.

There are three possible ways to use this circuit: You can simply use it for on-off control. Or, for heaters or such, you can sense power line *zero crossings* somehow and then provide turnon *only* just after a zero crossing. Such a *zero voltage switch* eliminates annoying clicks and radio noise and is gentler on both the power line and your load. But note that zero crossing switching is not usable for dimming because the frequency is too low.

Flicker would be unacceptable.

Instead, you do have the option of carefully pulsing your LED on at an exact *position* inside of each ac half cycle. Thus creating a proportional phase control. This gives you a wide flicker-free brightness range.

Combined triacs and optoisolators are called *ac solid state relays*. These are offered in a wide variety, but tend to be more expensive.

Your PIC or PC port can also get programmed to do fancy tricks. Such as slow dimming, stepped brightness, random "somebody is home" security lights, or get used for theater lighting scene sequences.

The brightness versus duty cycle is not linear. Why? Because there is more energy at a half sinewave peak than at the "corners". Table lookup software can easily adjust for linear voltage versus current, linear power versus current, log compression for input audio, or even create flickering "flame" effects.

We've looked at these concepts in EMERGOP5.PDF and MUSE109.PDF.

Do observe the "backwards" LED connection. Because many computer ports and interface drivers are a lot better at sinking current than they are at sourcing, an *active low* scheme is normally used that turns the LED and your triac *on* with a *low* input and off with a *high* input.

Watch this detail.

A triac that switches in mid cycle could generate severe radio noise and other interference. Series LC filters and suitable shielding is often needed to reach acceptable levels.

The leading triac and optoisolators manufactureres do include *Motorola*, *Teccor*, and *Texas Instruments*.

A *color organ* is an older name for *psychedelic lighting* or audio control of lamps. Design tips and ideas can be found in MUSE108.PDF

Crydom A0241	Solid State AC Relay SIP
Holtek HT7620	PIR Controller with Dimmer
Holtek HT7700	Key and Touch Linear Dimmer
Holtek HT7703	Touch Linear Dimmer
Holtek HT7704	Touch Dimmer
Holtek HT7712	Minimum Component Touch Dimmer
LSI/CSI 7234	Touch Control Continuous Dimmer
LSI/CSI 7237	Touch Control Stepped Dimmer
LSI/CSI 7338	Touch Control with Timed ON
LSI/CSI 7314	Multi-level Touch Control Dimmer
LSI/CSI 7534	Up-Down Touch Control Dimmer
Microchip 12C08	Low Cost Baby Programmable PIC
Microchip 16C70	Extra I/O Programmable PIC
Philips TCA785	Phase Control
Philips TDA1023	Proportional Triac Trigger Circuit
SGS L9830	Monolithic DC Lamp Dimmer
Siemens SLB0587	Dimmer IC for Halogen Lamps
Unitrode UC3871	Fluorescent Dimmer Ballast Chip

Fig. 3 – A SAMPLER OF some commercial dimmer integrated circuits.

A Selection of Dimmer Chips

You have a choice of building up a dimmer from bits and pieces; by use of a PIC or other microcontroller; or by going to new specialized dimmer chips. A surprising variety of custom chips are available and summarized in figure three.

Two obscure companies who seem to be in the dimmer forefront here are *Holtek* and *LSI/CSI*.

The *Basic Stamp* from *Parallax* or the PIC or baby PIC from *Microchip Technology* are often superb chioces. Control can be by way of an *up* and a *down* pair of input pins; by a resistor going to an A/D converter; parallel "set level" inputs; serial data; or an analog voltage.

A number of useful PIC dimmer ap notes are downloadable directly from *Microchip Technology*. To download, use the *Questlink* listings or the links at *www.tinaja.com/picwb01.html*

One *very* interesting combination for multiple control of lots of lamps would be to drive a slew of up-down PIC's with several of the new *Dallas* DS2407 dual addressible switches.

From their *MicroLAN* series.

Which would let you cheaply and independently control dozens or even hundreds of lamps using a one wire simple networking system.

Each PIC would test every so often to decide if the brightness needed changed. With 64 brightness levels, the slew rate from full off to full on would be just over half a second with half cycle sampling. *If* the elaborate *MicroLAN* comm scheme could be made fast enough. Each addressed *up* or *down* command would be carefully synchronized and adjusted to last for a precise line cycle interval. Levels would be synchronized either with a master reset or simply by supplying enough *down* commands in a row to guarantee everything is off.

A possible block diagram appears in figure four. Should the best data rates of a *MicroLAN* end up too slow, a second baby PIC might get applied instead at higher baud rates.

Even simpler might be a "one long serial word" setup. Your first six bits go to lamp number one. The second six bits go to lamp number two, and so on. Sort of a "mini" DMX512.

Yes, your PIC can directly drive a triac gate. This would eliminate the cost of your phototriac optoisolator. But the extreme shock hazard would have to be addressed at other points in your circuit or system.

Zero crossing detection could get simplified by sensing only positive zero going transitions and deriving turn on pulses for *both* half cycles by use of a half cycle delay. Or else by sensing both positive and negative ac line transitions.

For further consulting and design info, see *www.tinaja.com/info01.html*

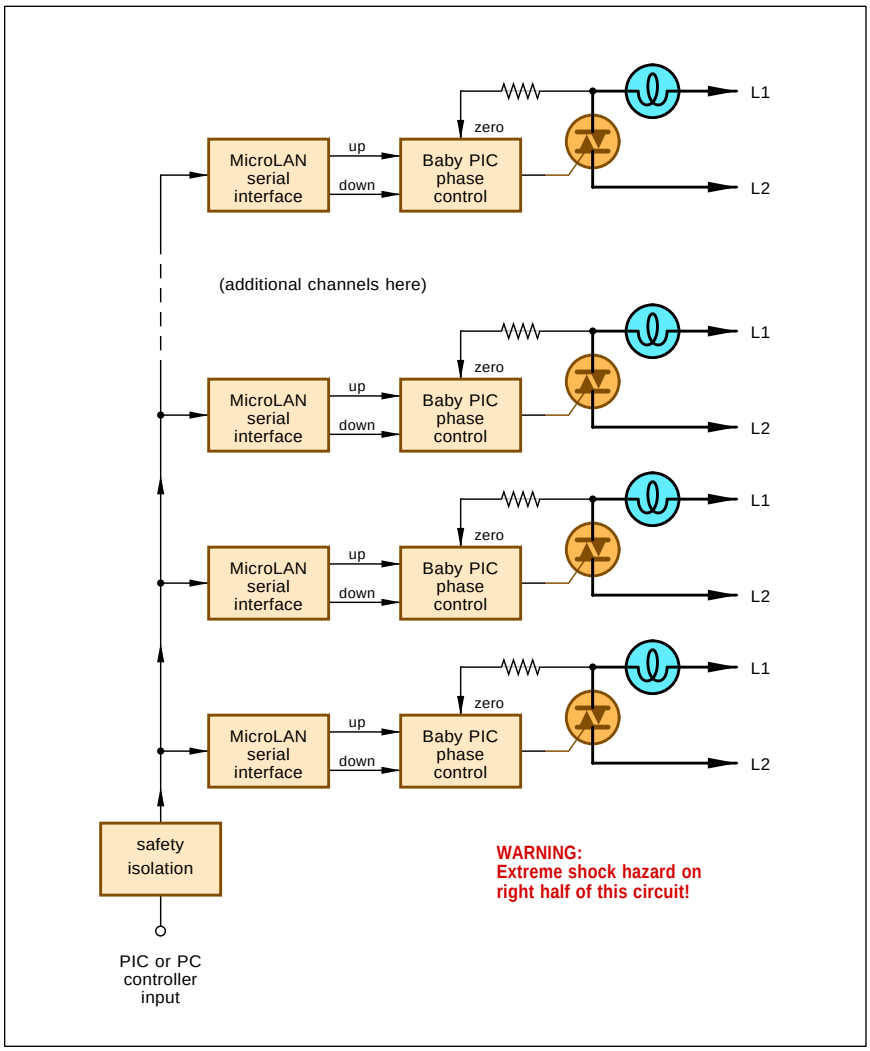

Fig. 4 – ONE POSSIBLE SCHEME to remotely dim many lamps using only a single interconnecting wire.

What About Fluorescents?

Fluorescent lamp dimming needs special circuits. *Ordinary dimmers must definitely not ever be used with fluorescents!* But new concepts let you dim from full brightness down to as low as four percent.

One source of suitable ballasts is *Advance Transformer*, while useful chips and ap notes can be found at *Unitrode*. Small laptop fluorescents and suitable dimming technique info is offered by *JKL Industries*.

We just might look at fluorescent dimming further in a future column. Meanwhile, *do not try it!* Unless you really know what you are doing.

Magnetic Recording Books

A list of magnetic recording books shows up for this month's resource sidebar. More info on any of these at *www.tinaja.com/amlink01.html*

A useful new trade journal here is *Data Storage*.

Custom research into any technical field is available at surprisingly low cost at *www.tinaja.com/info01.html*. This is especially useful in gathering essential broad-based primary and backgound material on any emerging or unfamiliar tech topic you might want to get into big time.

NEED HELP?

Phone or write all your US Tech Musings questions to:

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Web page: *www.tinaja.com*

Surplus Update

At present, the admin expenses of selling military surplus electronics do seem to be running something like $1.60 for each dollar in public sales. Thus, your tax dollars are being used to pay people to haul away surplus bargains. Your best defense here is to recycle your tax dollars by grabbing some of these for yourself.

To improve their bottom line, the feds appear to be experimenting with DRMO office closures; "term" sales in which you agree to accept a full year's worth of stuff; other new types of sales; and privatization.

An asset management outfit by the name of *Levy-Latham* is now doing a few of the fed's surplus sales. Mostly big ticket items like machinery and boats. So far. Supposedly a lot more of this will be done in the future. For more details on getting involved, you can visit *www.levylatham.com*

Although seldom advertised, most DRMO sites do stock lists of people and firms who will photograph, bid, pack, and ship items for you. These lists are usually available on request. The type and quality of their services offered seems to vary with the base and who happens to live nearby. The major problem here is triage. Where you literally will want to lighten up a lot before you ship.

A pair of tutorials on mil surplus bidding insider secrets can be found at *www.tinaja.com/resbn01.html*. Hot buttons on my home page take you directly to the various DRMS access pages. Examples of the actual surplus bargains available these days are up at *www.tinaja.com/barg01.html*

New Tech Lit

You are invited to participate in a new SETI extraterrestrial intelligence search. An ongoing quest that needs zillions of net-linked computers. For info, see *setiathome.ssl.berkeley.edu*. Or pick up the summary invitation in *Science* for October 30, 1998.

Meanwhile, you also might follow the separate *Planetary Society* billion

NAMES AND NUMBERS

Advance Transformer
10275 W Higgins Rd
Rosemont IL 60018
(708) 390-5000

Argonne Natl Laboratory
9700 S Cass Ave
Argonne IL 60439
(800) 627-2596

Ark-Plas Products
Hwy 178 N
Flippin AR 72634
(870) 453-2343

Dallas Semiconductor
4401 Beltwood Pkwy S
Dallas TX 75244
(972) 450-0400

Data Storage
10 Tara Blvd, 5th Fl
Nashua NH 03062
(603) 891-0123

Galco
26010 Pinehurst Dr
Madison Heights MI 48071
(800) 575-5549

Holtek Technology
1342 Ridder Park Dr
San Jose CA 95131
(408) 573-8050

Horizon MapInfo
3990 Ruffin Road
San Diego CA 92123
(800) 828-2808

Jameco Electronics
1355 Shoreway Rd
Belmont CA 94002
(800) 536-4316

JKL Components
13343 Paxton St
Pacomia CA 91331
(800) 421-7244

Levy Latham
6263 N Scottsdale Rd Ste 371
Scottsdale AZ 85250
(602) 367-1100

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

LSI/CSI Systems
1235 Walt Whitman Road
Melville NY 11747
(516) 271-0400

Map One
PO Box 999
Dewey AZ 86327
(520) 632-8774

Microchip Technology
2355 W Chandler Blvd
Chandler AZ 85224
(602) 786-7200

Parallax
3805 Atherton Rd #102
Rocklin CA 95765
(916) 624-8333

Planetary Society
65 N Catalina Ave
Pasadena CA 91106
(818) 793-5100

SGS-Thomson
1000 E Bell Rd
Phoenix AZ 85022
(602) 867-6259

Siemens Components
2191 Laurelwood Rd
Santa Clara CA 95054
(408) 980-4500

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

Teccor Electronics
1801 Hurd Dr
Irving TX 75038
(214) 580-1515

Unitrode
7 Continental Blvd
Merrimack NH 03054
(603) 424-8610

channel extraterrestrial assay in real time at *seti.planetary.org*

Volume 9, #4 of the *Tech Transfer Highlights* by the *Argonne National Lab* describes some magic new *ionic conductor* filters. One can be used to extract oxygen from air. Another can separate hydrogen from gas streams.

USGS topo maps are at long last finding their way onto the web and CD-ROM. Continuous, even, without page breaks. Although not yet in full res, full quality, or in the zoomable and compact *Adobe Acrobat* format. One low cost CD-ROM source in my neighborhood is *Map One* you'll find at *www.bslnet.com/map1*

Included will be 64 seven minute quads to TIFF quality, three reference maps and a viewer for $16!

MapInfo, a division of *Horizons Technology* has a much more pricey new web and CD-ROM based service. Check their web site you will find at

SOME MAGNETIC RECORDING BOOKS

Magnetic Measurements Handbook (J.M. Janicke)
Complete Handbook of Magnetic Recording (Finn Jorgensen)
Ferromagnetic Materials: Structure aned Properties (R. A. McCurie)
Ferromagnetism (Richard Bozorth)
The Foundation of Magnetic Recording (John Mallinson)
Handbook of Electromagnetic Materials (Perambur Neelakanta)
Magnetic Disk Drive Technology: Heads... (Kanu Ashar)
Magnetic Storage Handbook (Eric Daniel)
Magneto-Resistive Heads: Fundamentals... (John Mallinson)
Modern Recording Techniques (D. M. Huber)
The Physics of Magnetic Recording (C.D. Mee)
Practical Recording Techniques (Bruce Bartlett)
Theory of Magnetic Recording (Neal Bertram)
Theory of Magnetism (Kei Yosida)
Troubleshooting and Repairing Audio & Video.... (Homer Davidson)

For more details, see ***www.tinaja.com/amlink01.html***

www.horizons.com/suremaps These two are obviously the first two early tricklings of a deluge. I'd predict free viewing of USGS topo maps routinely provided on hundreds of web sites within a year or so. And snap-in GPS receiver modules within two.

From *Jameco*, the latest electronic components catalog 984. Get this one free by clicking on their banner on my website. From *Galco*, their latest industrial electronics catalog. Galco specializes in high power electronics.

Nomadics, human-scale transport, and energy efficiency are all nicely covered by Steve Roberts through his *Microship* site at *www.microship.com* Grab his free newsletter ezine.

Free samples this month include a TLC5615 ten bit serial D/A converter from *Texas Instruments*; along with plastic fittings, tubing, and such from the folks at *Ark-Plas Products*.

The latest of "new-old" books by *Lindsay Publications* now include the *Harper's Aircraft Book, Manufacture of Wireless Components*, along with *Electrical Designs*. All of these are unique turn-of-the-century reprints.

The *Ultimate Modem Handbook* is a Cass Lewart book from *Prentice Hall*. More details on all these titles at *www.tinaja.com/amlink01.html*

For most individuals and smaller scale startups most of the time, any involvement with patents is virtually certain to result in a net loss of your time, energy, money, and sanity.

Find out why, along with proven and tested real-world alternatives in my *Case Against Patents* package.

Per my nearby *Synergetics* ad.

The latest website additions at my *www.tinaja.com* include an expanded PIC libary, lots more classic *Blatant Opportunist* uploads, plus improved layout and nav. The newest surplus bargains which you should now find at *www.tinaja.com/bargte01.html* include mystery cyrogenics, mil tube testers, distortion analyzers, superb luminance probes, and radiosondes.

As usual, most of the mentioned resources show up in the *Names & Numbers* or the *Magnetic Recording* sidebars. Always check here before using our US technical helpline that is shown in the nearby box.

Let's hear from you. ✦