Don Lancaster's

Tech Musings

August, 1997

PIC chips now on CD ROM
Hydrogen car fact and fancy
A brand new TV Typewriter!
Fuel cells and related resources
Decade's BOB-5L design contest

Somebody on the net has just invented a water powered car. They were loudly bemoaning the fact that nobody noticed. Repeated contacts to universities and talk shows were totally ignored, as were newspaper letters and magazine inquiries. Why, even Detroit wasn't showering them with megabucks.

Golly gee Mister Science.

I was left with the feeling that they simply had not done their homework. There are lots of very good and very bad things about hydrogen powered cars. And in fact, there has been a new hydrogen storage discovery that could end up rather interesting. So, it might be a good time for my…

Thoughts on Hydrogen Power

Hydrogen powered vehicles have some rather obvious advantages. The energy density *by weight* of hydrogen is three times better than gasoline. Hydrogen can power a fuel cell and thus might "beat" the thermodynamic *Carnot* efficiency limitations on heat engines. Possibly by a factor of two or more. And the usual main product from hydrogen energy conversion is plain old water. For potential (but by no means at all guaranteed) localized pollution *reduction*.

Hydrogen can be made anywhere, totally trashing geopolitics. Lastly, those low voltages and high currents used in hydrogen production are very much solar compatible.

But here is the downside…

Hydrogen is not a fuel–I'll define a fuel as any substance that is able to produce *net* BTU's of energy at an economically reasonable cost.

Ferinstance, assume you fill your tractor with ten gallons of gasoline, plant some corn, and distill the corn into six gallons of grain alcohol. You could think of this process as a giant funnel. You'll pour gasoline into the top, and alcohol dribbles out of the bottom. The alcohol is *not* a fuel; it is simply an *energy transfer medium* for gasoline in disguise.

You'll produce a fuel *only* when you have net deliverable BTU gains in the process. Your fuel might be competitive only if and when those gains are quite large.

Whenever you allow for "gasoline equivalents" for such things as labor, *true* costs, and interest, *I know of no proven process for making alcohol that comes even remotely close to an energy breakeven*.

Let alone ending up economically competitive.

Similarly, hydrogen usually comes from the *electrolysis* of water. Using that highly energy intensive process shown in figure one.

You first make the water conduct. Perhaps by adding a weak acid. Then put the water into a "U" shaped tube and apply a dc current. Your current *dissociates* the H_2O water by way of *electrolysis*, liberating oxygen gas at the positive or *anode* side and twice as much hydrogen at the negative, or *cathode* side.

Your gases can then be collected and compressed for further use.

The reaction is…

$$2H_20 \leftrightarrow 2H_2 + O_2$$

This is a nearly *reversible* reaction. Tremendous amounts of energy are *consumed* in going from left to right. Tremendous amounts of energy are *liberated* in going from right to left.

Because of cell heating and related side reactions, more electrical energy input to your cell is *always* required compared to the energy returned.

You might have seen that recent expose and criminal prosecution of a major pseudoscience hydrogen scam. As usual, the culprit started off with plain old bad labwork that was not even wrong. Combined with wishful thinking plus "too good to be true" results that got out of hand.

Other hydrogen production ploys apply steam to existing hydrocarbons or use water to oxidize sodium. Since

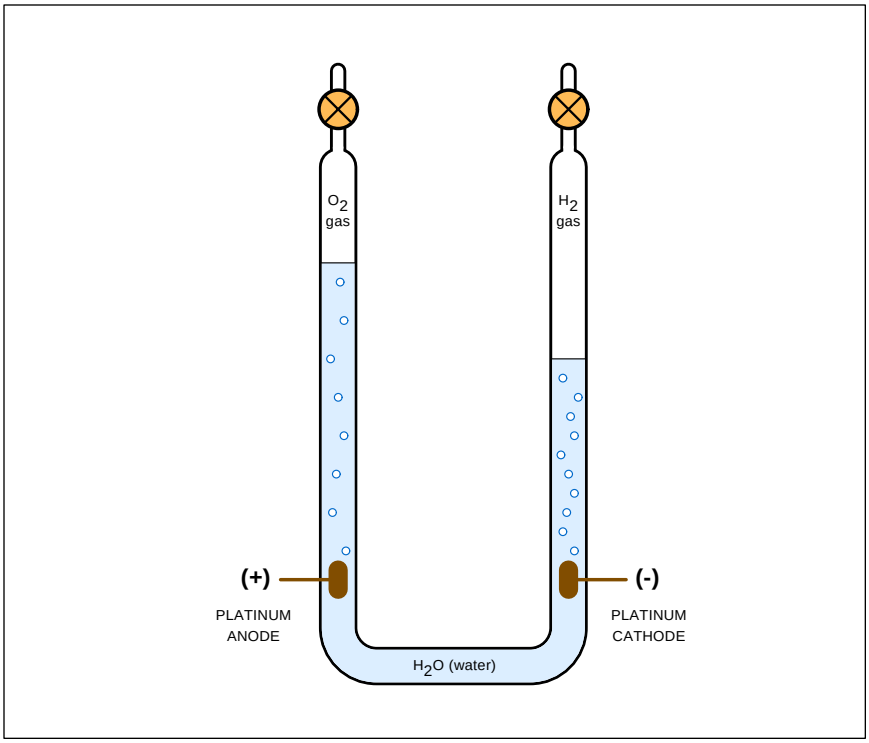

Fig. 1 – HYDROGEN IS NORMALLY PRODUCED by the electrolysis of water. There is no known non-nuclear process for hydrogen generation that creates more energy than it consumes. Thus, hydrogen is definitely ~not~ a fuel.

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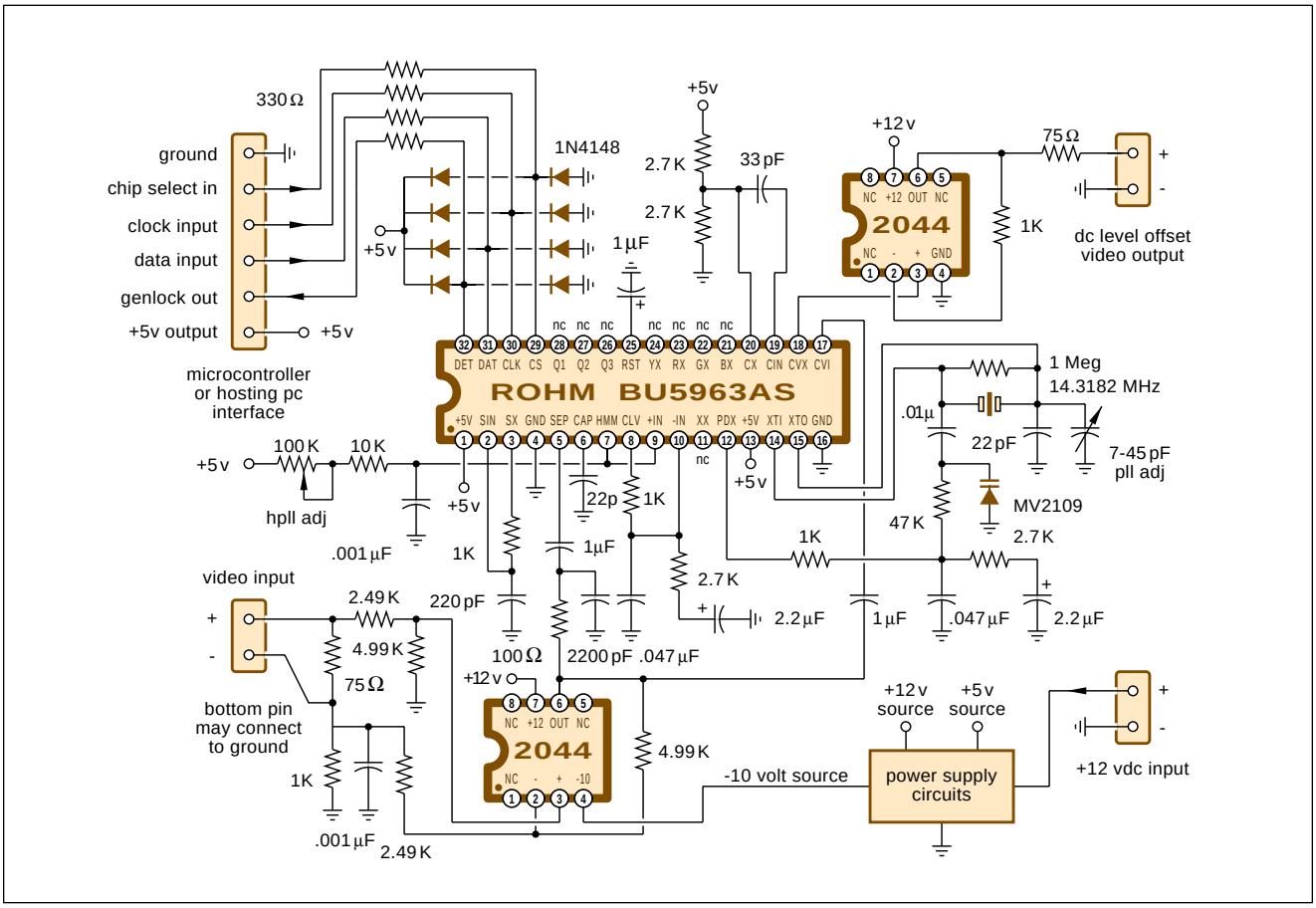

Fig. 2 – THE SCHEMATIC FOR THE BOB-5L TV TYPEWRITER. 10 row x 24 character color display generates its own NTSC baseband video or overlays an external input. Uses include PIC data displays, teleprompters, low end titlers, large print aides, time of day, or budget point-of-purchase systems. There's an amazing variety of options.

these gobble up your input products, such processes are even more energy consumptive than electrolysis.

No non-nuclear means is currently known to generate hydrogen that can deliver more in energy BTU's than it consumes! Thus, at its best, hydrogen can only *move* pollution. It can never eliminate it. And can only *raise* your cost of energy.

When you talk about a hydrogen economy, the total production costs must *always* be included. Total costs that are direct and indirect, obvious and hidden.

We saw more on electrochemisty last month in MUSE114.PDF and in the *Tech Musings* reprints.

Hydrogen is quite hard to store–The energy density of hydrogen gas is an outstanding 38,000 watt hours per kilogram. Compare this to gasoline at 13,500 wh/kg or lead acid at its 25 wh/kg. But a kilogram of hydrogen at standard temperature and pressure takes up 11,126 liters. For an utterly laughable energy density by volume of 3.4 watt hours per liter.

Compared to gasoline at its 9600 wh/l or lead acid at 40 wh/l.

One way to reduce the volume of a gas is to compress it. The pressures involved quickly get horrendous, and safety becomes a rather serious issue. Instead, processes are sought out to *chemically bind* hydrogen to another substance, creating a *hydride*.

The best storing hydride in nature is methane or CH_4. Methane can store 25 percent hydrogen by weight. And, until recently, the most promising of man-made carbon hydrides were way on down at 4 percent or so.

A new graphite nanofiber storage material was recently announced by a Nelly Rodriguez and her research team at Northeastern University. In which some recyclable hydrides got created that store up to 75 percent of their weight as hydrogen.

If verified and proven, this could give a 20:1 density improvement. As much as *thirty* liters of hydrogen can be stored *per gram* of nanofibers! A recyclable cartridge the size and the weight of a tank of gasoline could run a car for 5000 miles.

An announcement on this ongoing development is in *New Scientist* for December 27, 1996. Based on a fall 1996 Boston paper at the *Materials Research Society* conference. Their full paper should show up in *Science* magazine "real soon now".

A useful summary appears in the *Hydrogen and Fuel Cell Letter* for February of 1997.

While this new storage scheme is very exciting, we are merely talking highly preliminary lab work for now. Off-the-shelf products and systems to deliver them might be something else entirely. Especially solutions that are safe and economically competitive.

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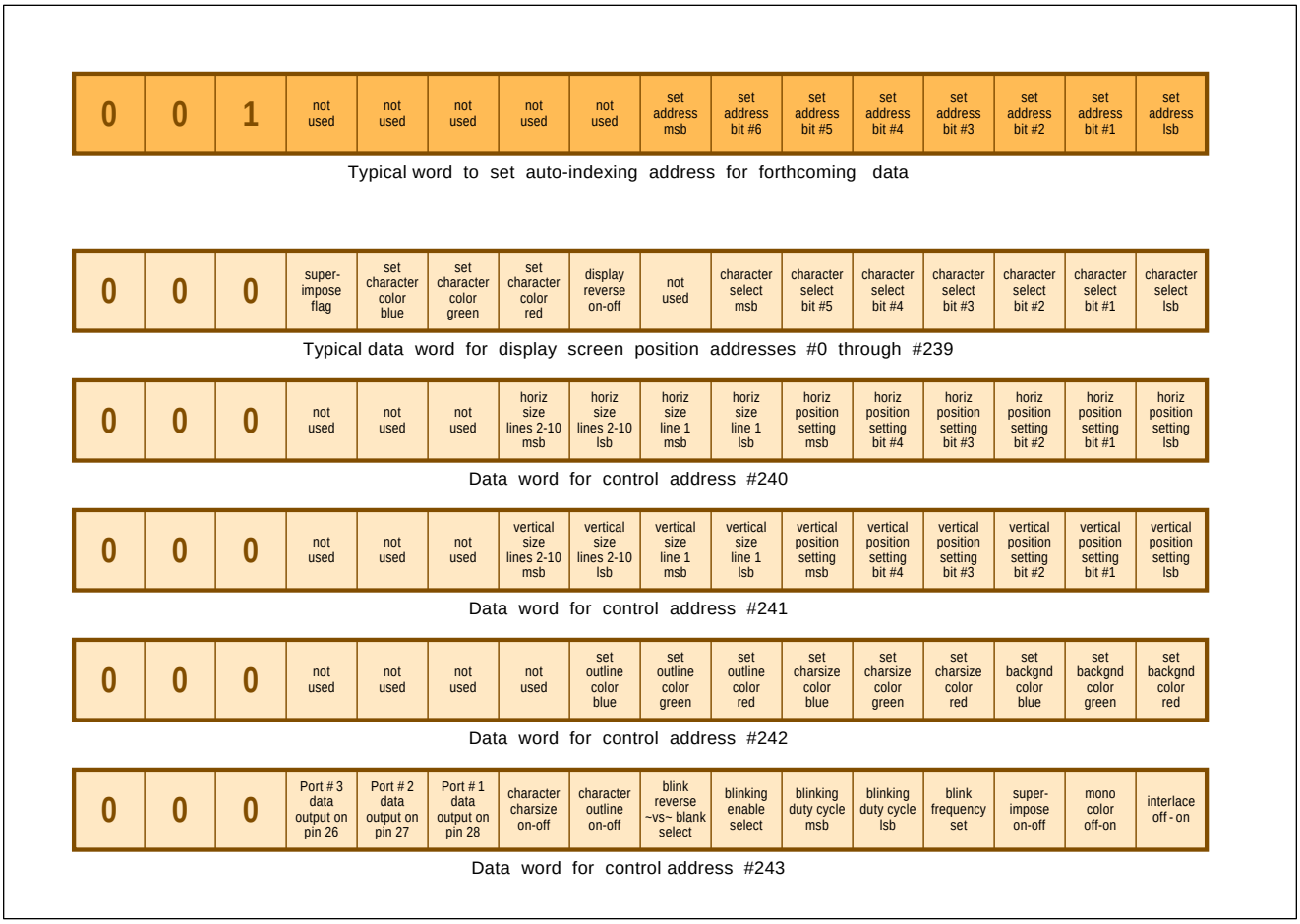

0	0	1	not used	not used	not used	not used	not used	set address msb	set address bit #6	set address bit #5	set address bit #4	set address bit #3	set address bit #2	set address bit #1	set address lsb

Typical word to set auto-indexing address for forthcoming data

0	0	0	super-impose flag	set character color blue	set character color green	set character color red	display reverse on-off	not used	character select msb	character select bit #5	character select bit #4	character select bit #3	character select bit #2	character select bit #1	character select lsb

Typical data word for display screen position addresses #0 through #239

0	0	0	not used	not used	not used	horiz size lines 2-10 msb	horiz size lines 2-10 lsb	horiz size line 1 msb	horiz size line 1 lsb	horiz position setting msb	horiz position setting bit #4	horiz position setting bit #3	horiz position setting bit #2	horiz position setting bit #1	horiz position setting lsb

Data word for control address #240

0	0	0	not used	not used	not used	vertical size lines 2-10 msb	vertical size lines 2-10 lsb	vertical size line 1 msb	vertical size line 1 lsb	vertical position setting msb	vertical position setting bit #4	vertical position setting bit #3	vertical position setting bit #2	vertical position setting bit #1	vertical position setting lsb

Data word for control address #241

0	0	0	not used	not used	not used	not used	set outline color blue	set outline color green	set outline color red	set charsize color blue	set charsize color green	set charsize color red	set backgnd color blue	set backgnd color green	set backgnd color red

Data word for control address #242

0	0	0	Port # 3 data output on pin 26	Port # 2 data output on pin 27	Port # 1 data output on pin 28	character charsize on-off	character outline on-off	blink reverse ~vs~ blank select	blinking enable select	blinking duty cycle msb	blinking duty cycle lsb	blink frequency set	super-impose on-off	mono color off-on	interlace off - on

Data word for control address #243

Fig. 3 – ADDRESS MAP FOR BOB-5L. The low 240 locations hold on-screen display characters and their individual attributes. The high 4 locations hold global formatting information. If incoming bit B13 is a one, the 16-bit word sets an autoindexing address. If B13 is a zero, data gets placed into the previously set address.

Hydrogen rots metal–That hydrogen molecule is the smallest one known. It thus easily *diffuses* through many common materials. Waltzes right on by. Worse yet, hydrogen reacts with metals and causes *embrittlement*. A metal in contact with hydrogen for a long time tends to lose most of its strength. Ultimately stress cracking or shattering to failure.

This leads to severe safety, testing, and lifetime considerations when you are talking about a hydrogen powered anything.

Hydrogen is dangerous–Even after you get on past the *Hindenberg* and *Three Mile Island*, this is still nasty stuff. Uh, the flammability range of hydrogen in air is one of the broadest known, ranging from 4 to 74 percent. Inside most of this range, hydrogen is violently explosive.

Hydrogen can burn with a nearly *invisible* flame. A stunt that us fire department haz mat teams use is to tie a rag onto our pike pole and then attempt to "joust" with the hard to see flame front.

Do not try this at home.

Hydrogen storage systems should be designed such that any total and catastrophic release of all contained energy is extremely unlikely. Sort of like a flywheel that could expend its failure energy by tearing itself apart rather than violently ejecting pieces. Hydrides would seem better at slow release than a pressure tank hydrogen gas system would be.

Fuel cells are expensive–Just like the Volkswagen van heaters, "significant improvements" in the fuel cells have been claimed every year for the past three decades. And in fact have been demonstrated.

But my feet are still cold.

The appeal of fuel cells is obvious. Beat Carnot at his own game. Flush thermodynamics and approach 100% efficiency. Route air and hydrogen to an electrochemical cell that directly generates electricity. Output (mostly) water as a byproduct.

Sadly, we flat out ain't there yet. Expensive catalysts are involved. The cells remain large, costly, and offer limited life. Output voltages are very low. Many cells have to run at higher temperatures. They sometimes can be slow to start or change power levels. Claimed efficiencies are often fudged by assuming you can use your waste heat for something else.

But sharply increased funding for next year's grant will magically cure all of this. Just ask any researcher.

For this month's resource sidebar, I've gathered together a few places to go to get more hydrogen info.

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HYDROGEN ENERGY RESOURCES

Alternate Energy
901 N Columbus Street
Alexandria VA 22314
(800) 469-2519

Am Assn for Fuel Cells
50 Mile Street
Greenfield MA 01301
(413) 774-6051

American Hydrogen Assn
216 S Clark Dr Ste 103
Tempe AZ 85281
(602) 921-0433

CA Selects: Batteries
PO Box 3012
Columbus OH 43210
(800) 848-6538

CA Selects: Stress Corr.
PO Box 3012
Columbus OH 43210
(800) 848-6538

ElectroChem
400 W Cummings Park
Woburn MA 01801
(617) 938-5300

Energy Research Corp
3 Great Pasture Road
Danbury CT 06813
(203) 792-1460

EPRI Journal
PO Box 10412
Palo Alto CA 94303
(415) 855-2000

Fuel Cell Assn
PO Box 65481
Washington DC 20035
(301) 681-3532

Home Power
PO Box 520
Ashland OR 97520
(916) 475-3179

Hydrogen & Fuel Cell Ltr
Grinnell St PO Box 14
Rhinecliff NY 12574
(914) 876-5988

International Fuel Cells
195 Governors Hwy
South Windsor CT 06074
(860) 727-2348

Intl Jnl Hydrogen Energy
Box 945
New York NY 10159
(212) 633-2730

Materials Research Society
9800 McKnight Rd #327
Pittsburgh PA 15237
(412) 367-3003

National Hydrogen Assn
1800 M Street NW, Ste 300
Washington DC 20036
(202) 223-5547

Natl Renewable Energy Lab
1617 Cole Blvd
Golden CO 80401
(303) 231-7681

New Scientist Magazine
Box 945
New York NY 10159
(212) 633-7300

Rocky Mountain Institute
1739 Snowmass Creek Rd
Snowmass CO 81654
(970) 927-3851

SAE
400 Commonwealth Dr
Warrendale PA 15096
(412) 776-4841

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

Ground zero on all this appears to be that *Hydrogen & Fuel Cell Letter*. A pair of quality books include that *Fuel Cell Handbook* by Appleby and Foulkes 1989 from Van Nostrand; or the *Fuel Cell Systems* by Blomen and Mugerwa from the Plenum Press.

There is tons of stuff on the web. Start off with all the fuel cell links on www1.usa1.com/~fuelcell/electrochem/fc_sites.html or stuff on *www.getnet.com/charity/aha/ahafcell.html*

Two useful newsgroups here now include *sci.energy.hydrogen* along with *alt.energy.renewable*

Plus possibly *sci.chem.analytical*

For alternate wishful thinking on all this, visit the *Keelynet*. Or any of those dozens of mesmerizingly awful sites on the Pseudoscience web links page of my *http://www.tinaja.com*

Build This TV Typewriter

Hmmm. It's *deja vu* all over again. For those of you that came in late, my **Radio-Electronics** *TV Typewriter* from their September 1973 issue is widely regarded as having been the opening shot fired in the personal computer revolution.

Well, there's now a brand new TV Typewriter called the BOB-5L from *Decade Engineering*. Listing at $79 in quantity and double that in singles, this smallish card can provide either a *genlocked* overlay video or else a stand-alone data display for a PIC or a PC or any other micro.

The schematic appears in figure two. Up to 10 rows of 24 characters per row could be either generated or superimposed over your input NTSC video. An optional output fader can be added for variable transparency.

Although their 128 character set is fixed, there's a surprising variety of color, outline, overlay, background, and size options. All brought about mostly by the *Rohm* BU5963AS chip. Whose original intended use was as a VCR/TV remote display.

A single +12 volt power supply at sixty mils is needed. Typically from a wall wart module.

Data Format Details

Your host computer or micro can communicate using three input lines. Plus possibly a fourth output line. These BOB-5L inputs are your usual *chip select*, *clock*, and *data* lines. An optional output returns genlock info. When CS is low, the input data gets transferred on your *positive* edge of the clock. Data transfer could go as high as 2.5 Megabaud. Which might process up to 150,000 characters per second or as many as 650 full screen refreshes per second. Far more than can possibly be viewed.

There is an internal RAM memory stashing 244 words of 12 bits each. The lower 240 words hold the screen character content data. Addressing starts with zero at the upper left and progresses rapidly left to right and slowly top to bottom.

The upper four control words give you all sorts of fancy display options, by using the *command set* of figure three. There are always *sixteen* bits in a word received from the host PC or controlling micro. Most significant bits B14 and B15 are always zero.

Bit B13 is the *mode* bit. If B13 is a one, the rest of the bits are treated as an *address* as shown. If B13 is a zero, the rest of the bits treated as *data* and get entered into the previously stored or next available address.

All sequential data words will auto increment into your next available address. Thus, you only have to set an address *once* at the beginning of a

NEED HELP?

Phone or write all your US Tech Musings questions to:

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US email: *don@tinaja.com*
Web page: *www.tinaja.com*

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NAMES AND NUMBERS

Analog Devices
PO Box 9106
Norwood MA 02062
(617) 329-4700

Decade Engineering
5504 Val View Dr SE
Turner OR 97392
(503) 743-3194

Exp Musical Instruments
1700 Old Rancheria Rd
Nicasio CA 94946
(415) 662-2182

Fair Radio Sales
PO Box 1105
Lima OH 45802
(419) 227-6573

ISD
2045 Hamilton Avenue
San Jose CA 95125
(408) 369-2400

ISSI
2231 Lawson Lane
Santa Clara CA 95054
(800) 379-4774

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

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

Parts Cleaning
84 Park Avenue
Flemington NJ 08822
(908) 778-0343

Radio Research Instruments
584 N Main Street
Waterbury CT 06704
(203) 753-5840

Rohm Corporation
2150 Commerce Drive
San Jose CA 95131
(408) 433-2225

See Sharp Press
PO Box 1731
Tucson AZ 85702
(520) 628-8720

Speleonics
Box 5283
Bloomington IN 47407
(812) 339-7305

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sequential data stream. For random access, you'll have to individually set each address and data value.

There's an unimplemented feature on the BOB-5L that just might come in handy. You can directly write data to unconnected pins 26, 27, and 28 of the BU5963AS. By using those bits shown in data word 243. This gives you up to eight more functions.

One obvious trick here would be an eight level fader or a transparency setter. By using a CMOS 4051. More details in my *CMOS Cookbook*.

By a special arrangement, lower BOB-5L pricing is available *only* to readers of this column. Contact Mike Hardwick at *Decade Engineering* for more details.

Use *tinaja* as your top secret code request for this special offer.

A BOB-5L Contest

What can you create with a third generation tv typewriter? A very easy to use one that opens true low cost genlocked color NTSC video overlay character displays to even simplest and cheapest of micros?

Decade is conducting an ongoing applications contest. Where they'll award several BOB-5L's and a few development systems to their choice of the better entries.

Just tell them a new or unusual use for their BOB-5L. Or else simply tell them why you want one.

Submit all your written entries to *Decade Engineering* per their address in the *Names & Numbers* sidebar. Or you could FAX (503) 743-2095, email *decade@worldnet.att.net* or visit the *http://www.decadenet.com* web site.

New Tech Lit

Microchip Technology has recently gathered all of their PIC papers (and everything else) together into a single free CD ROM. It is called the *1997 Technical Library, First Edition*.

Also check out the free *Designer's CD Reference Manual* from *Analog Devices*.

Two electronic speech resources: An *Instant Voice ROM Products* from *ISSI*, and that *ISD ChipCorder Data Book* from *ISD*. A few *ISD* products are also *Radio Shack* carded.

Musical Instrument Design is the new Bart Hopkin book that's got all

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LOTS OF OTHER GOODIES

Tech Musings V or VI	$24.50
Ask the Guru I or II or III	$24.50
Hardware Hacker II, III or IV	$24.50
Micro Cookbook I	$19.50
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PostScript Show and Tell	$29.50
Intro to PostScript Video	$29.50
PostScript Reference II	$34.50
PostScript Tutorial/Cookbook	$22.50
PostScript by Example	$32.50
Understanding PS Programming	$29.50
PostScript: A Visual Approach	$22.50
PostScript Program Design	$24.50
Thinking in PostScript	$22.50
LaserWriter Reference	$19.50
Type 1 Font Format	$16.50
Acrobat Reference	$24.50
Whole works (all PostScript)	$380.00
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sorts of simple construction projects. Mostly acoustical instruments. A few made from his bizarre collections of found materials. Mainly excerpts and reprints from *Experimental Musical Instruments* magazine. Published by the *See Sharp Press*.

They also have a web site at *http://echonyc.com/70/0/Music/MO/EMI*

A "new" old book from *Lindsay* on *Finishes for Aluminum*. Primarily old Reynolds annodizing formulas.

After a few missed issues, Frank Reid's *Speleonics* is back in print. This one is my favorite labor-of-love newsletter. Frank uniquely reports on "underground" subjects such as cave communications, super-bright LED's, and lamp batteries.

Surplus WWII military electronics remains available if you know where to look. For the small stuff, try *Fair Radio Sales*. And for those really big monsters (such as fifty foot tracking dishes and complete radars), try out *Radio Research Instruments*.

Both have free catalogs.

Two superb online electronic mags are at *http://www.poptronix.com* and *http://www.emags.com/electron/htm*

For most individuals or small scale startups most of the time, patents are virtually certain to end up as a total waste of time, energy, money, and sanity. Do find out why in my *Case Against Patents* package, as per my nearby *Synergetics* ad. Included are lots of tested and proven real-world alternatives and workarounds.

A reminder that my new *Guru's Lair* website that you should find at *http://www.tinaja.com* is now going great guns. You will find bunches of reprints and preprints here, surplus bargains, tinaja quests, a consultant's net and lots of annotated links.

Because we can now deliver nearly 120,000 hits per month, advertisers are newly welcome.

As usual, most of the mentioned items should appear in the *Names & Numbers* or the *Hydrogen Resources* sidebars. Do be certain to check these before you dial up my no-charge US technical helpline you'll find in the *Need Help?* box.

Let's hear from you. ✦

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