

Don Lancaster's

# RESOURCE BIN

number seven

## Unique opportunities in auto electronics.

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](http://www.tinaja.com) This is the place you'll 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 *Research InfoPack Service*.

### Automotive Electronics

Are you on a first paw basis with your local junkyard dog? Have you ever eaten a bowl of Purina together? Or woofed over the aerobic exercise potential of *Felis Domesticus*? Like that striped orange one sitting over there on that pile of wheel rims?

Automotive electronics can be a mixed bag. On one hand, much of it is primitive and specialized. Additional portions are supersecret, overpriced, and poorly documented. But on the other, there's all this great stuff just sitting there crying to be used. Some of it at giveaway prices. Or better.

We might begin by...

### Starting With the Obvious

Many used auto components offer outstanding robotics potential. Most especially for the luxury car add-ons and similar auto "peripherals". Those electric fuel pumps could make great fountains, while a typical windshield washer driver produces an incredible range for smaller liquid volumes.

Most auto relays are cheap, rugged, reliable, and have quite high current ratings. Some will offer latching and blinking; others can provide variable

speed options. And all those auxiliary motors on such accessories as power antennas, seat adjustment, tracking mirrors, cooling fans, locks, or even the power windows are crying to be applied to new uses. Miniature linear stepping motors are often a part of idle adjusters. Surely all the possible uses for fuel injectors haven't yet been thunk up.

And, of course, typical auto radios are far more rugged, better shielded, and offer much better AM sensitivity than home versions.

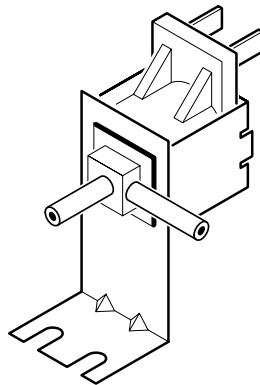
Step number one is to score some permission to wander around your local junkyard. And paying particular attention to older and more common stuff that obviously is not in current demand. Ask not what the parts are really intended for. Instead, ask what mechanical or electrical function they are actually performing.

Certainly the *least* asked-for parts in any junkyard are those...

### TCS and SCS Electronic Valves

Despite my shouting it from the rafters for two decades now, there is one auto electronics component that still goes begging. Would you believe a three-way pneumatic air valve for a quarter each?

Here's what a typical one of these dudes looks like...



When de-energized, that straight front pipe connects to a filtered vent to ambient out the rear. When 12 volts is applied, those two front pipes are connected together and the ambient vent is blocked. While intended for vacuum uses, you can apply positive pressures on up into the 10 PSI range without any cracking problems. Yes, liquids can also be handled simply by glopping over the vent. Especially as an automated barkeep.

Around 150 mils of coil current is needed at +12 volts DC. While most any old transistor will do, my favorite driver for these still remains the octal *Sprague/Allegro* ULN2813. Be certain to provide an anti-spiking diode across your coil if your driver is unprotected from transients.

These were originally known as *Transmission Controlled Spark* (TCS) or *Speed Controlled Spark* (SCS) valves. In their intended emission control uses, a spark advance was not permitted at lower speeds or in lower gears.

Their original manufacturer was *Carter Carburetor*, now renamed *Carter Automotive*. These valves (and all their newer versions) come and go in all of the surplus catalogs, with *C&H Sales* currently listing their item #SV7904 for \$2.95 in singles. *American Science & Surplus* and *Edmund Scientific* have sometimes listed these valves for as little as \$25 per hundred.

That's a quarter each!

Low pressure pneumatics in the 4-6 PSI range has yet to take off. Yet this offers absolutely outstanding hacker potential. Among other things, air "amplifies" in that your power comes from the air source, not directly from the actuator control signal itself. Air is superb for acting through a distance, especially around robotic elbows or in hazardous areas. And an air actuator is ridiculously more linear, bunches cooler, and vastly more powerful than most smaller solenoids. Besides being

far cheaper. And easier to hack.

You could use any larger aquarium pump (or even a truck tire) for your air source, and a hollow toilet bowl float as an air accumulator. Add a \$6 regulator from any of a number of *Nuts & Volts* advertisers.

One tip: You should have the best luck with your actuators by following this rule: *Never have a low pressure air seal that moves!* If your seal is any good, it robs you of all your power. If not, it robs you of all of your air.

Either way, you will lose.

Instead, use flexible actuators such as bellows or balloon-style inflators. Any time you must have a static seal, the plain old O-rings from *Small Parts* are hard to beat. Unless you try to freeze a poorly underdesigned and misapplied one on a rocket.

A second obvious tip: There's a big and very crucial difference between pneumatic and electronic circuits. If you try using a "SPST" or a *two-way* valve with pneumatics, you'll extend your actuator all right. But it will *stay* extended, because of all the air that stays stuck in the pipe.

All dressed up and nowhere to go.

Instead, you have to use a SPDT or a *three-way* air valve. To extend your actuator, you will power your valve, connecting actuator to air source and accumulator. To retard your actuator, you turn the valve off, connecting the actuator to ambient air and flushing any remaining air pressure.

One good source of traditional (but costly) miniature air components is *Clippard Minimatic*, while one bellows source would be *Bellofram*. But your actuators are easily done using found or homemade materials. Start off with those kiddie "push the button" water toys from a yard sale. These contain really fine bellows actuators. A good source for hoses and sheet rubber for custom pneumatic parts is *Hygenic Manufacturing*. Two lower cost fitting sources are *Ark-Plas* and *Value*.

### The BA1404

Sometimes, a brand new and first run automotive electronics device can be reapplied to totally different uses and solve otherwise thorny problems.

The word is finally getting out that the majority of today's FM wireless broadcaster kits and systems flat out no longer work. The problem is that nearly all premium home and auto FM receivers are totally synthesized and *demand* precisely on-channel and super stable input frequencies. While

any old FM broadcaster kit will work just fine with a \$4 FM receiver having analog AFC, it definitely won't work with a \$400 digitally synthesized one.

Because of serious drift problems.

Enter a stupendous chip and two wondrously hackable products. The magic chip is called the *Rohm* BA1404.

This is a low cost and low power high quality FM stereo broadcaster.

When combined with its crystal stabilized stereo pilot and a crystal stabilized FM carrier, the BA1404 can provide a very high quality plus a locked-to-channel compact broadcast source. One that is easily handled by any modern synthesized receiver.

The two hackable products are the *Pioneer* CD-FM-1, and the *Sony* XA7A. These were widely available at most audio stores, with pricing in the \$10 (clearance) to \$55 (list) range. Both of these intended to let you conveniently connect a CD audio player into your car audio system. To use them, you simply disconnect your antenna from the radio, plug your module in, and then reconnect your antenna. The FM stereo audio from your CD player magically appears on some lower FM broadcast frequency.

Although I do like the Pioneer unit much better, either of these will hack beautifully into a stable and precisely on-channel FM stereo limited range broadcaster. Something that none of the earlier kits or low end products can offer. Additional details on these (including full schematics) appears in [HACK52.PDF](#) at [www.tinaja.com](http://www.tinaja.com)

### Abusing Car Alternators For Fun and for Profit

Auto alternators are often available in junkyards for as little as \$5 if you don't need any specific model or the matching regulator that goes with it. Usually included are six high current and low voltage power diodes.

Your obvious thing to try with an alternator is to rewind it into a 110 volt power generator. Which is most definitely feasible, giving you an ac generator up in the 500 to 1000 watt range. But note that constant input speed will be needed for a stable 60 Hertz output frequency.

More details on practical alternator rewinding appear in several low cost info books and booklets from *Lindsay Publications*, while *J.C. Whitney* offers various alternator mod kits.

One crucial hint: The brushes on an alternator's slip rings will "explode" if you are not extra careful during your

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Norwood, MA 02062  
(617) 329-4700

**Ark-Plas Products**  
Highway 178 North  
Flippin, AR 72634  
(501) 453-2343

**Automotive Industries**  
PO Box 2056  
Radnor, PA 19080  
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**Bellofram**  
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St. Louis, MO 63132  
(800) 325-4664

**Clippard Minimatic**  
7390 Colerain Road  
Cincinnati, OH 45239  
(513) 521-4261

**Edmund Scientific**  
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Barrington, NJ 08007  
(609) 573-6250

**Hygienic Manufacturing**  
1245 Home Avenue  
Akron, OH 44310  
(216) 633-8460

**Lindsay Publications**  
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Bradley, IL 60915  
(815) 935-5353

**Motion Control**  
800 Roosevelt Road E-408  
Glen Ellyn, IL 60137  
(708) 469-3373

**National Semiconductor**  
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Mountain View, CA 94043  
(800) 632-3531

**Pioneer Electronics**  
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Long Beach, CA 90801  
(213) 835-6177

**Rohm Corporation**  
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Irvine, CA 92713  
(714) 855-0819

**SAE**  
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Warrendale, PA 15096  
(412) 776-4841

**SGS-Thomson**  
1000 East Bell Road  
Phoenix, AZ 85022  
(602) 867-6259

**Small Parts**  
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Miami Lakes, FL 33014  
(305) 557-8222

**Sony of America**  
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New York, NY 10019  
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**Sprague/Allegro**  
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(603) 224-1961

**Synergetics**  
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**JC Whitney**  
1917-19 Archer Avenue  
Chicago, IL 60680  
(312) 431-6102

disassembly. In each brush holder is a tiny hole that accepts a toothpick or a small wire. This can safely lock your brushes in place. You then pull your toothpick or wire off after assembly is complete.

Watch this detail.

Most of your larger stepper motors can end up horrendously expensive. Particularly those big sizes you might need to drive a milling machine or a sign router. Could an alternator be converted into a giant stepper motor?

The answer is yes, the alternators are fairly easily converted into large steppers. No, the final performance will not end up remotely as good as a comparable sized stepper.

But at junkyard prices, who cares? I have watched several videos of some incredible sign routers built up from junk alternators.

The trick is to remove those diodes and bring out that center of the wye connection of those three alternator stator windings. This gives you three separate stator windings that you can use to create a three-phase stepper motor. By powering ABC you will step in one direction; use ACB for the other. The rotor and the slip rings are separately used as a rotating power electromagnet.

For best results, you may want to rewind your alternator, providing more turns per slot and having each phase bridge only one slot. Ampere turns are the name of the game here.

More info on alternators as steppers appears in file [HACK44.PDF](#) found at my [www.tinaja.com](http://www.tinaja.com)

### Switched Reluctance Drives?

Innovations in power electronics all do seem to come from foreign sources these days. For several years now, Japan has had air conditioners that are ridiculously more efficient than ours. And far more comfortable. Key secrets to their 16.0 and higher SEER ratings include variable speed scroll compressors, their variable speed air handling, and fuzzy logic multi-zone controllers.

But the really big rage sweeping the rest of the world (especially Europe) are the *switched reluctance drive motors*.

The switched reluctance drive is the heir apparent replacement for the low cost single phase ac induction motor, offering fully adjustable speeds, easy reversibility, and better higher energy efficiency. All in an actually cheaper mechanical design.

A plain old car alternator can be converted into a "sort of" switched reluctance drive simply by providing some driver smarts and a few Hall Effect speed and position sensors. The

**NEXT MONTH: Don looks at all the insider's electronic trade journals and mags.**

details are more or less the same as when stepping, except you now have reversibility and will usually tend to run continuously, instead of cogging in discrete incremental steps.

More on switched reluctance drives

appeared in the February 1992 issue of *Motion Control*, on pages 50-53.

A second very useful source for SR motor info is *PCIM* magazine

### Automotive Electronics Chips

There are quite a few automotive trade journals. Two of these include *Automotive Industries* and *Automotive Electronics*. The former has a really great directory in their June 92 issue, and does include lots of the electronic chip manufacturers. Auto-oriented chips also do tend to appear in all the usual electronic trade journals.

*Electronic Components News* or else *Electronic Products* are useful choices. Most other auto trade journals can be found through the *Ulrich's Periodicals Dictionary* at your local library.

*Sprague/Allegro* has long offered lots of interesting auto-oriented circuits. Their ULN2429 liquid level chip is one example, as are all their various *Hall Effect* devices applied in and around electronic ignition boards. *National* is yet another source of auto liquid level integrated circuits.

Be sure to check these out.

*Analog Devices* seems to be newly making noises at Detroit. Their new AD22001 is a specialized lamp sensor chip which seems to have all sorts of interesting odd uses. While intended to spot burned out taillights, these are basically comparators so sensitive that millivolts of drop across a very short printed circuit run can be used as a current sensing shunt.

And their AD22180 is a precision battery charger circuit that measures



both battery voltage and temperature. It even has an input that knows when your headlights are on.

The big Detroit rage among most of the other semi manufacturers centers on new *high side driver* circuits. These are basically chips which will or will not deliver +12 volts on command.

They are smart enough to safely protect themselves, besides detecting open, short, overload, or even high temperature conditions.

The major sources include *National*, *SGS*, and *Texas Instruments*. Since the part numbers are all rapidly changing and since no clear winners are as yet emerging, just ask for their high side driver info packages.

### A Great Freebie Manual

Tektronix has been promoting their new *SDU* miniature battery operated digital storage oscilloscope. They now offer a new free *Automotive Electronic Troubleshooting Using a Digital Storage Oscilloscope* booklet.

This manual does go into the really obscure auto measurements, such as on mass flow air sensors or on those throttle air bypass valve circuits. The inherent memory of a digital scope is quite useful for recording any slower events, such as those that take place at routine engine speeds.

Digital scopes also let you record a single cycle of any event sequence, rather than smearing repeated events on top of one another. They also offer "negative time" by letting you look at things that occurred *before* triggering.

### A Really Dumb Move

I am very much a Volkswagen fan, and I consider my ultra-rare 4WD (!) Syncho van to be one of the greatest vehicles anywhere ever. At least for me. Yup, a four wheel drive VW bus.

But by far the stupidest thing VW ever did was try to come out with a "theft proof" car radio. Which clearly ends up as neither.

Here is how this miserable atrocity works: The tiniest glitch on your car battery and your radio blows up and needs recoded. You have only three shots of coding, any four of which are guaranteed to fail. And VW charges \$150 for a code reset. Not to mention the seven hour drive involved, since most of their dealerships are going belly up. Sigh.

I suspect the primary reason their dealerships are failing involves how badly and how permanently they are hacking off their customers over this

really monumentally dumb radio.

Naturally, this wonderful scheme in no manner prevents anyone from ripping off your radio. If they do, the radio blows up. So what? If they are an easy going car thief, they simply throw the radio away. If not, they'll come back, trash what's left of your vehicle, shoot your dog, and might even burn down your house.

Good thinking, kiddies.

At any rate, there is an opportunity of sorts here to provide a bypass and repair for the most abysmally stupid example of technology run amuck I have ever seen.

### Automotive Books

A very good source for technical automotive books (both electronic and otherwise) is SAE. Who used to be the *Society of Automotive Engineers*. They have both a stocking bookstore plus a new free catalog of all their publications. Sadly, their prices on some of these are rather high. These titles should also be available through interlibrary loan or similar sources.

The other day, I got one of the usual "lots more miles per gallon" inventor helpline calls who was now having trouble selling his device to either Detroit or (get this) to the EPA. The fact that he never even heard of the SAE or any of those auto trade journals or any scholarly pubs just might have been a minor cause for some of his problems.

Another fine source for auto books is *Chilton*. You contact the *Automotive Industries* address in the sidebar for a complete catalog.

Details on most current automotive books at [www.tinaja.com/amlink01.html](http://www.tinaja.com/amlink01.html)

### A Documentation Center

I get hundreds of helpline requests for all of the insider "secret" codes for auto diagnostics or emission EPROM listings. Obviously, manufacturers do not like this type of material getting out to their end users.

So, your availability ranges from the difficult to the impossible. There are also severe EPA penalties for any tampering with any emission control device. Particularly on someone else's vehicle. Yes, even if your tampering significantly *reduces* all of your auto emissions and improves your city gas mileage, the EPA will *still* stake you to the nearest anthill.

What is really needed is one single book or one single web service that offers immediate and total availability

of all codes for all manufacturers. On a continuing update basis. Preferably as shareware or otherwise reasonably priced. This info is in demand.

This is an incredible opportunity for several someones who now have insider automotive connections. I'd be happy to offer a library page from my *Guru's Lair* as a new forum for useful info exchange in this area.

Let's have your thoughts on this. A service of this type is sorely needed.

### Another Resource Contest

To make it as easy as possible for you to win, I will make this month's contest as unstructured as I possibly can. Simply send me anything that by some wild stretch of the imagination is somehow related to an automotive electronic opportunity.

The lumpier the better.

There will be a dozen of my newly republished *Incredible Secret Money Machine II* book prizes going to the best, along with an all expense paid (FOB Thatcher, AZ) *tinaja quest* for two going to the very best of all.

Any junkyard dogs submitted must be housebroken and include both a thirty day Purina supply and at least four spare cats.

Be sure to send all of your written entries directly to me at *Synergetics* per the end blurb, rather than to *Nuts & Volts* editorial.

As usual, I've gathered our *Names & Numbers* together into one sidebar. Be sure to check out the sidebar first before you contact our voice helpline for further technical help. ♦

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UPDATE: SCS & TCS valves remain available on my *surplus bargain* page. More on the BA1404 in *MUSE121.PDF* A superb alternator to stepper video is available from John Reese. Current chip info is found at [www.questlink.com](http://www.questlink.com)

*Microcomputer pioneer and guru Don Lancaster is the author of 35 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 the webmaster of his Guru's Lair found at <http://www.tinaja.com>*

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