

Tech Musings

February, 1997

How to use table lookup
That idea mortality curve
Adobe's great Acrobat 3.0
Linearizing phase controls
Vacuum tube audio sources

I have recently been listed as a *commercial invention assistance provider* in the free directories you can get from R. L Conger at *Batelle Pacific Northwest*. As you may guess, I get lots of calls.

The majority of these callers have gotten totally sucked into all of that ludicrously absurd and dead wrong urban lore surrounding patents.

Several recent callers were told by invention marketing firms that their inventions had merit. And, for a huge fee, must be immediately patented by them. Golly gee Mister Science. Go to your local used car dealer and ask if you should buy a car. Or ask your local mugger if you need mugged.

What if you genuinely believe you have got a developable concept?

What should you do?

First and foremost, recognize that any bare concept takes less than 0.1 percent of the time and effort needed to generate a net positive cash flow. If you want to succeed, an awful lot more of your own time and effort is going to be needed.

Horrendously more.

The reason for this extra effort is known as the *idea mortality curve* I have shown in figure one. Typically, only one concept in 500 ever makes it all the way through the process.

The more of these steps that you do by yourself, the better your odds of success. *Paying others to handle most of the early stages on that idea mortality curve is sheer stupidity.*

Why? Because the odds of success are so outrageously low. The further right you get on the curve, the more sellable your product becomes.

In fact, even calling yourself an "inventor" is really dumb. I prefer to focus on all the earlier stages of the mortality curve and refer to myself as a *purveyor of risk reduction*.

More on this in RISKDOWN.PDF

The names and exact sequence of the hurdles on the curve very much depend on the idea being developed. But there will *always* be around a dozen steps. Each one of which will slash the remaining candidates.

Naturally, I'll try to sell any caller my *Incredible Secret Money Machine II* or my *Case Against Patents* books. Before that, I first ask that they read and study my free WHEN2PAT.PDF on www.tinaja.com

Then, I'll have them surf the web for *everything* they can find that is even *remotely* related to their idea. *It is categorically impossible to develop any new concept without aggressive use of the net!*

Next, I'll tell them to get informal opinions from a few industry insiders familiar with how similar products are distributed and actually used.

It should go without saying that anyone developing *any* concept *must* already be a long term subscriber to *all* the field's free trade journals. As before: *It is categorically impossible to develop any new concept without aggressively subscribing to all of the essential industry trade journals!*

Just in case they did not, I steer them on through *Ulrich's Periodicals Dictionary*. Or else the *International Standard Periodicals Dictionary*. Or the *Encyclopedia of Associations*.

For instance, if your fresh concept involves retail merchandising, *POP & Sign Design* is an essential tool. You would also get catalogs from leading display suppliers.

Such as *Outwater Plastics*.

Beyond that, I do try to get them to recognize that: *Iffen you can't sell a few copies to your friends, then there is no way you will sell lots of them to your enemies.*

The process of carefully placing a few early copies of your product with end users is called *beta testing*. And a fourth crucial rule is: *Until you get out of beta test, you have absolutely zilch. Nothing. Nada.*

Protection? If you have the time to worry about such an illusory fantasy,

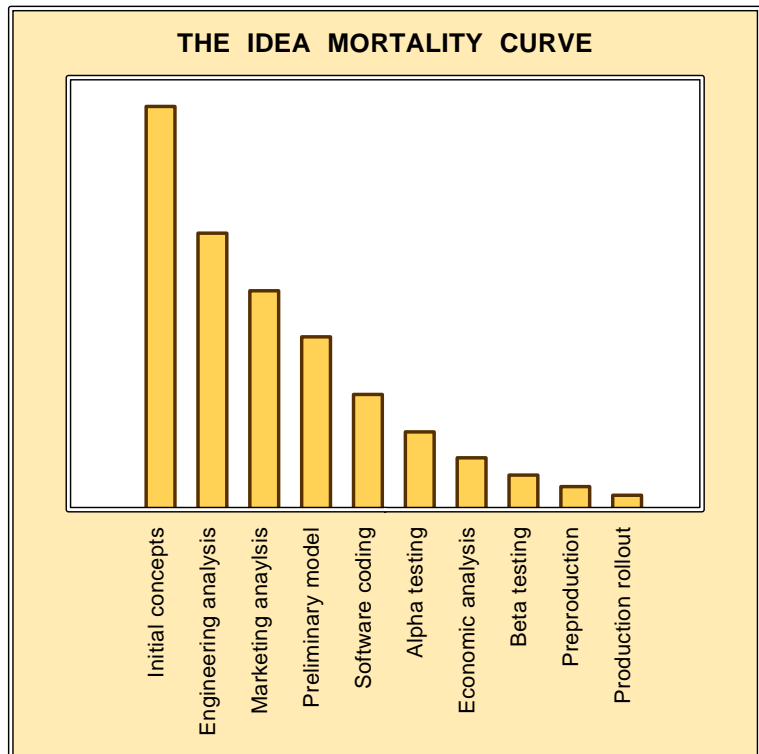


Fig. 1 – THIS "FLUSH THE LOSERS" CURVE clearly shows us why untested and undeveloped ideas are worth less than ten cents a bale in ten bale lots. Typically, less than one concept in 500 ever makes it all the way.

OPTION PICKER –

Lets you jump six ways from Sunday at some point in a program. Sometimes called a *case* command in certain languages. Here is a PostScript example...

```
[{proc0}{proc1}...{procn}] exch get exec
```

KEY FILTER –

Lets you assign a task to each and every possible user key response. Both inclusive and exclusive. Table advantages include flexibility and easy reprogramming.

HEX CONVERTER –

A sixteen entry ASCII table greatly simplifies reporting bytes as Hexadecimal. Here's another PostScript example that converts a stack numeric to a character...

```
[ (0)(1)(2)(3)(4)(5)(6)(7)(8)(9)(A)(B)(C)(D)(E)(F) ] exch get
```

MESSAGE STASH –

Usually involves a double table lookup. First you convert a message number to a starting address. From there, you output a sequential ASCII message.

SONG PLAYER –

For tune generator apps where MIDI is overkill, a table entry can hold the note to play (or a not playing pause) and its duration.

LINEARIZER –

Correction curves for temperature sensors or other nonlinear loads are easily handled with table lookups. Works particularly well with thermocouples.

UNLINEARIZER –

Similarly, intentionally nonlinear outputs can be created. Such as logs, square roots, time-to-frequency inverses, equalizations, or other fancy results.

REVERSE TABLES –

Search times of long documents can be ridiculously shortened by relisting words in an alphabetical order table. This is the key to full library fuzzy searches.

TRIG STUFF –

Digital sinewaves can be generated by entering a table with an angle and returning with the sine of that angle. Usually only one quadrant is needed.

FOURIER SERIES –

Fancy analysis of digital signals can be sped up by precalculating blocks of table based answers. Sometimes, the DFT can end up much faster than a FFT.

MAGIC SINEWAVES –

Low distortion sinewaves from serial ones and zeros. \$009034C3E6BDDF7F7 is one quadrant of a delta friendly 288-bit magic sinewave of 0.0301% distortion.

The chances are that somewhere in your next 500 designs, there will be an even better one or two.

But assume your first 2000 ideas are throwaways. An essential part of a learning and skill building process.

Table Lookups

One of my favorite software tools is *table lookup*. Using table lookup, you find a previously stashed answer. Instead of calculating it from scratch. Table lookups can be amazingly fast. Lookups also make all your software and firmware more orderly, easier to design, and far simpler to change.

A rule: *Never calculate what you can look up instead!*

Some basics: An *address* is some location in memory. *Data* gets stored into one or more sequential address locations. Separately, a *program* is a sequence of instructions to handle some task. Such as accessing the data in any table. Programs get *executed*. Data is *accessed*.

Tables are examples of *files*. But, compared to the "anything goes" of a general file, a table is usually shorter. Tables often have *fixed* content. that is generated when the program is written or compiled.

In a *direct* table, you enter your table with an address. The table then returns the data or commands at that single address. In an *indirect* table, you first go to an *address stash*. The address stash gives you the *starting location* of a *sequence* of bytes.

For instance, you can enter a direct table with an "angle" and return with the "sine" of that angle. Or you can enter an indirect table using a link to deliver message #43.

The address stash sends you to the first byte of the message. As many bytes as are needed for the message are then output. Ending with a length countout, an end-of-file character, or a shift from low to high ASCII.

Or some similar scheme.

These table lookups are extremely important in any computer language. But I especially like to apply them in the superb general purpose PostScript language. Or in PIC machine. I also did a lot with lookups back in the old 6502 glory days.

Some examples of neat things you can do with table lookups appear in figure two. A summary...

Fig. 2 – TABLE LOOKUPS are incredibly powerful software or firmware tools for any and all computer languages. Here are a few of their many uses.

then your concept is flat out not at all worth protecting. If your concept is too good, it *will* be stolen. And there is absolutely *no way* to prevent this from happening. All patenting does is

formalize and then drag out the ripoff process. At least for most individuals most of the time. Thus, you'll instead use the *hit it fast and hard; then get out* alternate approach.

```
; Enter MYTABLE with address offset of needed data in W register.
; Exit MYTABLE subroutine with needed data returned to W register.

MYTABLE    ADDWF    PC,1      ; Add offset to program counter
           RETLW    #$03      ; Data value "0"
           RETLW    #$FF      ; Data value "1"
           RETLW    #$C6      ; Data value "2"
           RETLW    #$47      ; Data value "3"
           ....
           RETLW    #$22      ; Data value "M"
           RETLW    #$5A      ; Data value "N"

; Use example:

GETDATA    MOVLW    #$06      ; Pick seventh table value
           CALL    MYTABLE    ; and get table value
```

Fig. 3 – HOW TO STASH A TABLE on the "program side" of a PIC.

The option picker– Lets you jump six ways from Sunday at some point in a program. Sometimes known as a *case* command in other languages.

The key filter– Lets you assign a task to each and every possible user key response. Easily changed.

The hex converter– A sixteen entry table 01..9A..EF greatly simplifies reporting bytes as Hexadecimal.

The message stash– A double table lookup. First you convert a message number to a starting address. Then you output sequential ASCII.

The song player– For tune apps where MIDI is overkill, a table entry can hold notes and durations.

Linearization– A correction curve for a temperature sensor or whatever can be easily done by table lookups.

Non-linearization– Similarly, some intentionally nonlinear outputs can be created. Such as logs, square roots, time-to-frequency, whatever.

Reverse tables– Your search times of longer documents can be greatly shortened by relisting words in an alphabetical order table.

Trig stuff– Digital sinewaves can be generated by entering a table with an angle and returning with its sine.

Fourier Series– Fancy analysis of digital signals ends up much faster if you precalculate answers.

Magic Sinewaves– My new scheme for low distortion sinewaves by using serial ones and zeros needs heavy use of table lookups.

You'll find bunches more on my Magic Sinewaves on www.tinaja.com Or you can write or call me for a free reprint. A development proposal is also available.

Reducing Table Sizes

An 8-bit table lookup requires 256 bytes. Not bad. A 12-bit table lookup takes 4096. Kinda ugly. 16-bit table lookup requires at least 65,536 bytes. Usually unacceptable. What can get done to shorten your tables?

There are all sorts of compaction tricks you can use. On any sinewave, you can use *symmetry* to allow a *one quadrant* lookup. For a size reduction

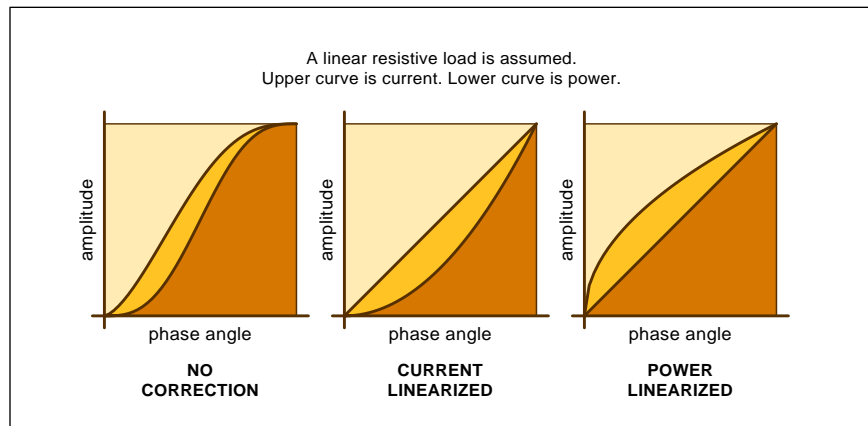


Fig. 4 – TABLE LOOKUP greatly improves the linearity of an ac phase power control. These options linearize for rms current or total power.

of 4:1. For a cosine, you simply read the same table backwards.

Other times, you can *interpolate* between entries. With interpolation, you work out the distance you went between two defined points. By using a straight line approximation. Or an even better (but slower) four point parabolic fit.

Some sort of *compression* can also be used, but this may slow you down. For instance, long English text can ultimately be squashed down into as few as 1.2 bits per character.

Yet another sneaky trick is known as *factoring*. In which you split the problem up into repeated access of one or more much shorter tables.

As a ferinstance, an 8x8 multiply needs a double wide 65536 table for direct lookup. But factor (A)(B) into

$(a_h + a_l)(b_h + b_l)$ and a single 256 byte table can be used instead. Although somewhat slower, since four passes will now be needed.

Arranging the widths and lengths of all table entries to exactly "fit" a micro bit, nibble, word, and page boundaries form other non-obvious compaction tricks. Matching address modes to the table is also a darn good idea. As can be stuffing subroutines or anything else handy around the table. To eliminate wasted bytes.

As always, your secret is to think creatively. Letting you go beyond brute force lookup.

The PIC access method

As I may have noted a time or two before, the PIC microcontrollers are *the* components of the decade. But

A hex lookup table for **LINEAR CURRENT** versus phase angle...

00	03	05	07	08	09	0B	0C	0D	0E	0F	11	11	13	13	14	16	17	17	18	19	1A	1B	1C	1D	1D	
1E	1F	20	20	21	22	22	23	24	24	25	26	27	28	28	29	2A	2A	2B	2C	2C	2D	2E	2E	2F	30	
30	31	32	32	33	34	34	35	35	36	37	37	38	39	39	3A	3A	3B	3B	3C	3C	3D	3D	3E	3E	3F	40
41	41	42	42	43	43	44	45	45	46	46	47	47	48	49	4A	4A	4B	4B	4C	4C	4D	4E	4E	4F	4F	
50	50	51	52	52	53	53	54	54	55	56	56	57	57	58	59	5A	5B	5B	5C	5C	5D	5D	5E	5E	5F	
5F	60	60	61	62	62	63	63	64	65	65	66	67	67	68	68	69	6A	6A	6B	6C	6C	6D	6D	6E	6E	
6F	70	70	71	72	72	73	74	74	75	76	76	77	78	78	79	7A	7B	7B	7C	7D	7D	7E	7F	7F	80	
81	81	82	83	83	84	85	86	86	87	88	88	89	8A	8B	8C	8D	8D	8E	8F	90	90	91	92	93	94	
95	96	96	98	99	99	9A	9C	9D	9D	9E	A0	A0	A2	A2	A3	A5	A6	A7	A7	A9	AB	AC	AE	AF	B0	
B1	B2	B4	B6	B7	B9	BA	BC	BE	C0	C2	C4	C6	C8	CB	CF	D2	D6	DB	E1	E9	EF					

A hex lookup table for **LINEAR POWER** versus phase angle...

00	14	1B	1F	22	25	28	2A	2C	2E	2F	31	32	34	35	36	38	39	3A	3B	3C	3D	3E	3F	40	41	
42	43	44	45	46	47	48	49	4A	4A	4B	4C	4D	4E	4F	50	51	52	52	53	54	54	55	55	56	56	
56	57	58	59	5A	5A	5B	5B	5C	5D	5D	5E	5F	60	60	61	61	62	63	63	64	64	65	65	66	66	
66	66	67	67	68	68	69	6A	6A	6B	6B	6C	6C	6D	6D	6E	6E	6F	70	70	71	71	72	72	73	73	
74	74	75	75	76	76	77	77	78	78	79	79	7A	7A	7B	7B	7C	7C	7D	7D	7E	7E	7F	7F	80	80	
81	81	82	82	83	83	84	84	85	85	86	86	87	87	88	88	89	89	8A	8A	8B	8B	8C	8C	8D	8D	
8E	8E	8F	90	91	91	92	92	93	93	94	94	95	95	96	96	97	97	98	99	99	9A	9A	9B	9B		
9C	9C	9D	9E	9E	9F	9F	A0	A1	A2	A2	A3	A4	A4	A5	A6	A6	A7	A7	A8	A8	AA	AA	AB	AB		
AC	AC	AD	AE	AF	AF	B0	B1	B2	B2	B3	B4	B4	B6	B6	B7	B8	B9	BA	BA	BB	BB	BD	BD	BF	C0	C0
C2	C2	C4	C5	C6	C7	C8	CA	CB	CD	CE	D0	D1	D3	D6	D8	DA	DD	E0	E5	EB	FF					

Fig. 5 – HEX TABLE LOOKUP DATA for linear ac phase controllers. Note how the point spacing expands, compresses, and then expands again.

VACUUM TUBE AUDIO RESOURCES

Antique Electronic Supply
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Tempe AZ 85283
(602) 820-5411

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Carlisle MA 01741
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B&H Pro Audio
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New York NY 10011
(800) 947-1182

Fair Radio Sales
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(718) 625-7353

Giltronics
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Glass Audio
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(503) 257-2002

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Falls Church VA 22041
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Tucson AZ 85716
(520) 326-9938

Sound Practices
Box 180562
Austin TX 78718
(512) 339-6229

Steinmetz
7519 Maplewood Avenue
Hammond IN 46324
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Svetlana
8200 S Memorial Pkwy
Huntsville AL 35802
(205) 882-1344

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1230 Peachtree St #3750
Atlanta GA 30309
(404) 874-4400

Whirlwind
99 Ling Road
Rochester NY 14612
(716) 663-8820

PIC's use a special RISC architecture which keeps program instructions in one memory area and user data in a totally separate area.

How can you stash a table when there is no table stash area?

Simply by using the PIC's unusual RETLW series of commands. RETLW is a return from subroutine. One that returns eight *internal* data bits to the W register on command.

To do a PIC table lookup, you'll string a group of RETLW commands together. Each of which has the data value for a given table entry. At the top of the table, you add an *index* or *offset* value to shift the PC program counter to the desired return.

Full details in figure three.

A Linear Power Control

Let us look into how a simple table lookup opens up entire new worlds of applications. Last month, we saw how the phase controllers for ac triac power loads were highly nonlinear.

Can table lookup help us here?

Figure 4a shows us a repeat of the nonlinear phase controller response we saw last month. Figure 4b shows us a lookup correction that gives us linear *current* with phase angle.

What happens is that you enter a table with a wanted phase angle and return with the corrected one. Being linear with current is quite handy for psychedelic lighting or other 60 Hertz

ac amplifiers. Servos even.

As an option, figure 4c shows us a table lookup correction that gives us linear *power* with input phase angle. Among other uses, this stunt can let you directly dial in the wattage of a precision soldering iron.

Figure five shows you correction tables that can be used.

Naturally, there's zillions of other possibilities here. For instance, linear current or power can be modified to compensate for load nonlinearities. Or you can use a randomized lookup to simulate a candle flame.

The new baby PIC from *MicroChip Technology* is ideal for this sort of thing. I do have consulting services available on these concepts.

Adobe's Newest Acrobat 3.0

Adobe Systems has just released their net friendly *Acrobat 3.0*. This is

NEED HELP?

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US email: don@tinaja.com
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A new compression scheme makes your files significantly shorter than before. In addition, there's a brand new option called *byte range retrieval* which can *ridiculously* speed up your online access.

Say you have a hundred page doc. With byte range retrieval, only the text for page one is downloaded and then displayed. This is followed by

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Los Gatos CA 95031
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Richland WA 99352
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Austin TX 78754
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Asheville NC 28813
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Englewood CO 80111
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Detroit MI 48226
(313) 961-2242

Environmental Building News
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Brattleboro VT 05301
(802) 257-7300

Game Developer
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(415) 905-2200

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the art for page one. Your following pages get invisibly downloaded while you are reading your first page. In this example, *less than one percent* of your file has to download before you can start to use it!

There are several elements to Acrobat 3.0. First and foremost is the free *Reader 3.0*, which lets you view and print files. There is a charge for the rest of Acrobat, which comes on a PC, UNIX, or Mac CD ROM.

Included on this CD are *Distiller*, which lets you transform PostScript files into Acrobat files; *Writer*, which lets other applications create Acrobat files; *Exchange*, which lets you edit files, print them, or convert them on back to standard PostScript.

Catalog, which lets you create an index for a group of Acrobat files; *Scan* and *Capture* which let you read existing printed pages and transform

them into .PDF format files. Plus the *Reader*, *Adobe Type Manager*, and a bunch of ap notes, drivers, examples, and other goodies.

I'm totally sold on Acrobat 3.0. To the point where I'm trying to use my www.tinaja.com as an Acrobat 3.0 showcase site. You'll find hundreds of example files here.

I do have several complaints. In both Exchange and Reader, there's this great full screen mode that shows *only* your document. Even including fancy wipes and optional "slideshow" modes. But this wonderful full screen feature has yet to get provided from inside a Netscape window.

Acrobat to Acrobat links work just fine, but it is tricky to get from an external HTML or whatever source to a particular spot and magnification inside an Acrobat document.

While you can do limited editing

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(such as correcting spelling errors or changing fonts), the editing ability is weak and poorly documented.

Those indexing file structures of Acrobat *catalog* are not documented. Catalog would be a lot more useful if you could edit word lists. Or, better yet, be able to directly extract that word and page info for a printed book index. Phrases in addition to words would sure be handy, as would intelligent hyphen removal.

Even with these problems, Acrobat 3.0 is a stupendously great watershed product. A must use.

You can download a free Acrobat 3.0 reader from www.adobe.com Info on byte range retrieval can be found at www.tinaja.com

Vacuum Tube Resources

To me, it has always seemed that all vacuum tubes can do is add hum, noise, and distortion to an otherwise clean audio channel. Tasks that are much easier done these days with a decent DSP algorithm.

Way on back when I was building tube type amplifiers, I never found any two that sounded even remotely alike. So I guess I do not have the slightest idea what a "vacuum tube sound" is.

I seriously doubt that anybody else has the faintest clue either.

At any rate, there are a lot of you out there laboring under the delusion that vacuum tube technology remains

somehow useful or desirable.

Your obvious choice for a class A output stage uses massively parallel type 957 acorn triodes. Their extreme bandwidth might dramatically reduce psychoacoustical transient crossmod cryptocrystalline antideluvian biasing skew preponderance effects.

Combining definitive mid-register voicing along with an authoritative and elusively clairvoyant bottom end.

I have gathered a lot of vacuum tube info sources together for you as this month's resource sidebar. The definitive book on all of this remains the *Radiotron Designer's Handbook*. Which is by far the greatest technical book of all time. A very few copies still remain available through antique electronic suppliers.

There's also scads of vacuum tube stuff on the net. Such as *The Vacuum Tube Audio Page* you should find at www.realttime.net/~joe/index.html Or www.qnx.com:80/~danh/info.html

By the way, I do still have a stash of classic collectible vacuum tube era test gear left. HP, Tek, B&K, Singer, Bendix, Heath. Call for details.

New Tech Lit

A free Santa Claus Machine video on rapid prototyping is offered by *DTM*. One leading source for rapid prototyping books is *SME*, short for *Society of Manufacturing Engineers*.

Two wildly different trade journals for this month are *Game Developer*

and *EMC Test & Design*. The latter is on shielding and FCC specs.

Rocketry parts and supplies are sold by *Aerocon*. Free flyer.

Exotic woods are stocked in depth by *Woodcraft* in their *Back of Rack* service. Including Anigre, Muhuhu, Bocote, Bubinga, Ovangkol, Wenge, or Paduak. Yeah, they also have Pine.

One competitor is *EDLCO*.

A superb web site for alternate or green construction materials is up at www.oikos.com You'll find lots more of the same in *Joiner's Quarterly*.

Environmental Building News is a bimonthly newsletter that zeros in on environmentally sustainable design and construction. Their website is www.ebuild.com

I guess my *CMOS Cookbook* has been a tad scarce recently. But thanks to *Butterworth Heinemann*, we now have a brand new publisher. I've now got great heaping bunches of fresh copies. As do most tech bookstores. This classic is rapidly approaching *one million* copies in print.

Autographed copies are available through my *Synergetics Press*. By themselves, or as part of my bargain priced *Lancaster Library*.

As usual, most of these mentioned names do show up in our *Names & Numbers* or *Vacuum Tube Resources* sidebar. Be sure to check these out before visiting our www.tinaja.com web site or calling our no charge US helpline service. ♦