THINK TANK

By John J. Yacono

Chips And Tips

As promised last month, we'll take a look at the characteristics of various IC architectures. We will focus on the bipolar-logic family this month. Following that, I'll present the results of our "Computer coverage: more/less/fine?" poll.

This month's letters, which will follow the poll results, all deal with technical tips. By the way, from the looks of the mail I've received, we're in for some interesting topical columns for some months to come. For now, just sit back, relax, and follow along as I present an overview of the bipolar family of chips.

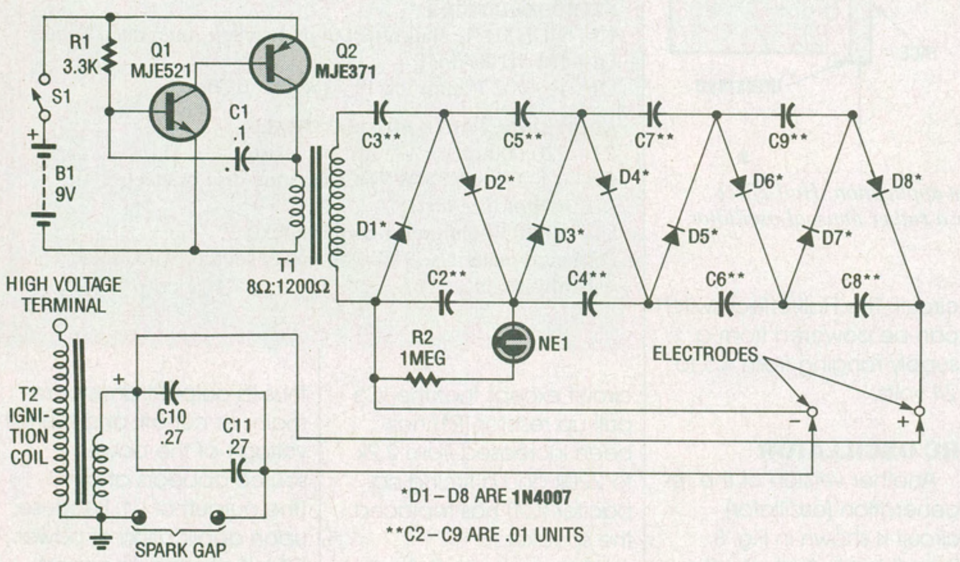

Fig. 1. This high-voltage circuit (based on a project that appeared in this magazine a couple of years ago) looks pretty lethal and probably is. Use it with great caution.

UNDER THE HOOD

Life is a matter of give and take. In engineering, that becomes evident when one has to make a design compromise. For example, when selecting chips, a designer might sacrifice low-power operation for high operating speed. That has lead to a diversity of chip architectures, each having its own strengths and weaknesses. It is left to the circuit designer to decide which type is suitable to each application.

Rather than discuss the physical attributes that make the architectures distinct (which would get really complicated, not to mention boring, really fast), I will present the names of the different chip styles and, in future columns, compare their operating characteristics. After all, it's things like current consumption, power dissipation, and load handling that determine which chip you'll use in a design; you need not know what's inside the device.

As mentioned some columns ago, logic IC's can be divided into two main categories: bipolar and CMOS. The bipolar-logic group can be further divided into emitter-coupled logic (ECL), resistor/transistor logic (RTL), diode/transistor logic (DTL), and transistor/transistor logic (TTL). The RTL and DTL formats are seldom used today, so I won't cover them. And while ECL products are still in vogue, they are only needed in the fastest circuits (with gate delays on the order of 100 or so picoseconds) and they dissipate significant amounts of power. Let's just say that they're not cut-out to be used as hobbyist parts.

However, TTL parts are overwhelmingly popular not only in industry but among hobbyists as well. They come in a variety of architectures each with its own inherent design trade-offs. That diversity is mostly responsible for TTL's widespread use; you can usually find a chip with a suitable speed/power-dissipation trade off for most applications from within this family.

In fact, the only time you must stray from the TTL series is when power dissipation is critically important (such as in portable devices composed of many logical devices). For such applications CMOS must be used. To summarize, the key advantage to using TTL over CMOS is speed; the key drawback is higher power dissipation (in the form of high current levels and heat).

Two series of chips form the TTL family: those prefixed with the number 74 and those beginning with 54. The only differences between the two series is their temperature range for guaranteed operation: 74-

series chips operate from −55 to 125°C, but 54-series devices are only useful from 0 to 70°C. Obviously for hobbyist applications, which seldom fall outside either temperature range, it hardly matters if you select a part from one family or the other.

Next month we will break the 54- and 74-series chips into smaller groups still. However for now, let me present the results of our informal poll.

POLL RESULTS

Well, the poll mail has trickled down to the point where I feel comfortable tabulating the results (I doubt I'll get many more cards or letters about it). The smallest percentage of people (18.18% to be exact) wanted more computer coverage. The next-highest percentage of readers (27.27%) wanted less. The greatest percentage, and a slight majority over both of the other categories combined, of you (54.54%) liked things the way they are!

Whew, what a relief; especially when one considers that the typical *Think Tank* reader would probably have a default preference for discrete electronics, as opposed to computers. Perhaps that accounts for the fact that the "less" group is larger than the "more" group. Regardless, its nice to know that we're pulling off this tricky balancing act fairly well.

All the demographics aside, let's turn our attention to this month's letters. There's one stray letter left over from last month's topic (high voltage), so let's get to that before moving on to the technical-tip letters.

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IT'S JUST SHOCKING!

I have been reading your column of *Think Tank* for some time now and I have always wanted to contribute something of my own. However, I am not a electronics engineer or a technical anything so I knew that this would never be, or so I thought.

One day I was browsing through a magazine rack (about four years ago) looking for something to read. I like science articles, so I picked up a few magazines and one of them was *Hands-On Electronics*, April 1988. I thought it was okay, so I bought the May issue and I thought that was okay, too. It wasn't until the end of July 1988 that (for reasons unknown to me) I had this uncontrollable feeling I should buy another one of your magazines. I bought every electronics magazine since including *Radio Electronics, Experimenters Handbook, Hobbyist Handbook, Modern Electronics,* and *Elementary Electronics.*

Today, I have a complete library from mathematics to Ku-Band satellite TV in every field of electronics. I've assembled as complete a laboratory as needed for my experiments. I have a complete IBM PC XT computer system full of programs necessary for design work (including some programs written in basic that I designed myself).

The field that interests me most is high-voltage, high-frequency electronics. I built a Tesla coil (**Popular Electronics** September 1990) that I use in some of my experiments. The output is too high for some experiments, so I picked up a violet-ray generator (**Popular Electronics** February 1990). It worked fine, that is until I tried to couple it to an unmatched circuit which, through my own fault, overloaded the secondary coil, causing it to short circuit, rendering the violet ray generator useless. I did manage to correct the problem somewhat, but the power output was never quite the same. So I needed to design something else.

I gathered up some parts from my junkbox and dug up a circuit that I assembled about 14 months back. It was a high-voltage output, 9-volt battery-supplied stun gun (*Electronics Experimenters Handbook,* 1990, "High Voltage Projects," page 45). I can tell you from experience that it works. And it works well, so be careful! I placed two automobile condensers parallel to each other across the output of the voltage multiplier (see Fig. 1). I connected the end with the wire to the distributor terminal of an automobile coil and the other end in series with a spark gap to the battery terminal. The battery terminal is then grounded.

When S1 is closed, C1 charges through R1 to the point that Q1 turns on. So Q2 turns on, connecting the power supply across the primary of audio transformer T1 and dissipating the charge on C1. The current pulse induces a high voltage across T1's secondary. Once the charge on C1 has dropped sufficiently, Q1 turns off. C1 charges again, so Q1 turns on and the cycle continues.

The rapid DC pulses are stepped-up by T1 to a voltage of about 300 volts. The voltage is rectified by the voltage-multiplier section that consists of C2 through C9, and D1 through D8. The final output is approximately 2000 volts. The neon lamp, NE1, is used to indicate that the unit is charging.

I substituted SK3080's for D1 through D8, plus an SK3190 and an SK3191 for Q1 and Q2, respectively. Also, the unit was designed to momentarily charge and retain that charge until something completed the path across the unit's output terminals. However, I allowed the unit to continually charge and discharge.

The voltage-multiplier's output is placed across the paralleled auto condensers, C10 and C11. An auto condenser is approximately 0.27 μF and the two paralleled adds to about 0.54 μF. The charge builds up in C10 and C11 until the voltage is strong enough to cause electrons to jump the spark gap to complete the path to the primary of the automobile ignition coil, T2. The sudden discharge into T2's primary induces a greater voltage in its secondary. The rate of discharge from T2's high-voltage terminal is controlled by the spacing of the spark gap.

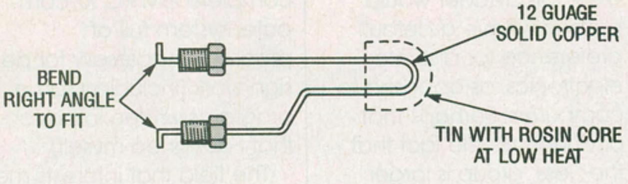

Fig. 2. If your soldering gun could use a new tip, try this heavy-gauge wire trick. Just be sure to tin the tip the very instant the tip heats enough.

The unit works well for approximately 45 to 90 seconds depending on how the spark gap is adjusted and produces a spark of 1.5 to 2 inches with a snap as loud as the sound I make when I snap my fingers.

Well there you have it, John. I said that I wasn't an engineer but maybe a little technical. Still, I feel I've come a long way from that newsstand, and I wonder just how far I'll go. The fire still burns inside me to work with electronics and I still don't know why. But one thing that I do know is that the more I know, the more I realize I need to know. Sorry for writing a novel; an electronics editor I am not, but I'm working on it. Thank you for a great magazine.

—Paul L. Piche, Cohoes, NY

Wow! I really like your "go-for-it" attitude. I would be pleased to have you as a colleague and I'm glad you've decided to join our circle of friends.

By the way, I like your modification, too; it sounds and looks like it packs quite a wallop. I'm afraid to ask what you use this thing for!

A TIP TIP

My contribution is not a circuit, but . . . well here it is: Need a new tip for your Weller soldering gun? Then try using some No. 12 copper wire configured as shown in Fig. 2.

—George T. Fogelman, EL Paso, TX

I can only assume the threaded hardware shown can be taken from the gun. It's an interesting suggestion, and I must admit, one I wouldn't have thought of. Your book is on the way.

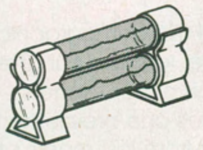

Fig. 3. If you ever need a fuse twice as capable as what you have on hand try this piggy back trick.

SAY IT WITH SOLDER

If you need to carry solder with you, but hate to carry that large, heavy spool of solder, don't despair. Make a solder pen!

Find a dried-up ink or felt-tip pen, remove the insides, throw them away, but keep the tip. I used a transparent pen so I could see how much solder I had left. Get a thin piece of wire and roll a coil of solder around it. Don't make the coil too long or thick, or it won't fit inside the pen. After you have a nice coil of solder, cut the solder, and gently insert it into the pen. Put the tip back on, leaving some solder sticking out of it. Now you'll have some solder with you wherever you go!

—Derek Fox, Sapulpa, OK

Okay, not bad. Sometimes I use an old small plastic medicine bottle (the kind with the snap-on lid) for the same purpose. It makes it easy to carry solder around in my pocket for outdoor work, or jobs in tight places.

IT AINT EASY

My name is Trevor Maicoo and I live in the Republic of Trinidad and Tobago, West Indies. I am a student of electronics and I have built a few projects, which I enjoyed immensely. The reason I am writing you is that I would very much like to get one of your books. Stores here do not sell any sort of electronics book, so the number of useful projects available to me is very limited. I know that your policy is when a letter/project is published, the writer gets a book. However, with my limited knowledge, plus the high cost of parts down here, (a 555 timer is $15.00), I cannot devise or invent any sort of worthwhile project for you. The most I can do is give a few tips that I know about in the hope that they may be useful.

Here goes: For those who do not have a small drill but have to use very fine bits to do PC-board work, wrap the shank of each bit with a few turns of masking tape. They will then fit a larger drill.

Also, homemade washers and spacers can be easily made from clear ballpoint-pen barrels or the ink tube. These can be carefully sawed to the needed size.

Third, if you do not have a 2-amp fuse on hand, solder two 1-amp fuses together in parallel, as shown in Fig. 3. It stands to reason that the current will split in two and half the total will flow through each fuse.

Those are my suggestions. I do hope, sir, that you would consider my request for a book favorably. You would be doing me a great favor and I would be truly grateful.

—Trevor Maicoo, Trinadad, West Indies

I was very affected by

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THINK TANK

(Continued from page 78)

your letter. Even though I live in a suburb of America, I am fortunate enough to be surround by parts suppliers and very large bookstores. You really opened my eyes to how lucky I am.

You'll be happy to hear that since three of your ideas made this column, I'll be sending you three books. I hope they help, and thank you for enlightening me.

Surely those of you that can get ahold of parts and such have something to contribute to this column. If so, please send your circuit ideas and hints to *Think Tank*, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735. If your work appears here, you will be rewarded with one of our books. ■