The Luxury of Choice or the Burden of Excess?

By Murray Slovick

Imagine that I handed you a plastic bag with 5,680 pieces of a jigsaw puzzle in it and asked you to find the one piece that would put a nearly completed puzzle together and to do so as quickly as possible. Supposing I also told you there while there is a picture of the completed puzzle available it's an abstract painting and instead of using visual comparison as a point of reference, you will be expected to select the proper piece based on dimensional specifications plus a description of all of its key characteristics, as well as information on how each part must fit into the completed puzzle.

Sounds like a daunting task, right? Well, in a lot of ways it describes how many engineers earn their living, by selecting the right parts for a PCB.

The number 5,680 was not chosen randomly. The specific puzzle piece I had in mind is a Schottky rectifier, used for over 25 years in the power supply industry, and 5,680 happens to be the total number of Schottky parts that are searchable in TTI's Part Builder tool (more on this shortly).

If you are surprised that TTI carries these products at all let me remind you than in 2007 the company extended its focus to include discrete semiconductors and is rapidly growing its discrete business using the same approach that established it as a distribution leader in passives and connectors.

It would amaze Walter Schottky, who in 1938 explained the manner in which a junction comprised of specific combinations of metals and a doped semiconductor material can rectify, that so many variants with so many differing packages, currents, voltages and junction temperatures have been developed as a result of his work

OK, now that we know what we're looking for, how do we start? Just as in completing a jigsaw puzzle, sorting through all of the available parts is the key to success. So the question is what would likely be the first thing we'd do to our task easier? Well, most of us would begin by sorting all of the remaining pieces into piles corresponding to small "sub-puzzles" (green pieces over here, red pieces over there).

To get an idea of the scope of the assignment let's take packaging as one sub-puzzle. As the size of consumer and industrial electronic devices continues to decrease, in turn driving demand for smaller discrete components, the associated semiconductor packages must be smaller and lower-profile to accommodate the ever-shrinking PCB real estate.

But as the power density of the package increases, greater consideration also must be placed on heat dissipation, optimizing the thermal efficiency of the individual component package, the PCB substrate and the solder pad layout. In the case of Schottky rectifiers, the maximum junction temperature must be kept below the manufacturer's specified value.

One of my favorite tidbits in product information sheets is the sentence that states "available in standard packages." That notion should be nominated for understatement of the year, and the engineer who decided to include it should be slapped silly, because it's often of zero help. Take the current example. While Schottky diodes are available in a reasonable number of through-hole configurations (e.g., TO-220AC, DO-41 axial, DO-201AD axial), the surface mount package varieties have proliferated like jackrabbits on a fertility pill.

An SMT component is usually smaller than its through-hole counterpart because it has either smaller leads or no leads at all. SMT Schottky's can be obtained (and this is by no means an exhaustive list) in a wide range of JEDEC SOD (Small Outline Diode) packages including SOD-123 (3.68 × 1.17 × 1.60 mm), SOD-123F (flat leads, lower profile), SOD-323 (1.7 × 1.25 × 0.95 mm), SOD323F (1.7 x 1.25 x 0.7mm flat lead package with shorter thermal pathway than the SOD323 gull wing package) and SOD-523 (1.25 × 0.85 × 0.65 mm). Then there's the two-lead SMA (DO-214AC), SMB (DO-214AA) and SMC (DO-214AB) package configurations as well as DPak (TO-252), D2Pak (TO-263 bigger than the DPak; basically a surface mount equivalent of the TO-220) and D3Pak (TO-268), even larger than D2Pak.

Wait, we're not done yet solving the packaging sub-puzzle. Several manufacturers offer products in either proprietary or proprietary nomenclature packaging, although in almost all cases these parts occupy traditional footprints. Here's some for instances:

- Vishay developed its eSMP high current density power efficiency surface mount package series with wide bottom plate design for improved thermal performance and reliability. eSMP parts are available in MicroSMP (2.5 x 1.3 x 0.65mm), SMPC (6.7 x 4.8 x 1.1 mm) and SMP (DO-220AA, 3.8 x 2 x 1mm) outlines.

With a 2.5 x 1.3 mm footprint and low 0.65 mm height, the MicroSMP package for Schottky rectifiers and transient voltage suppressors (TVS) has dimensions that are smaller than the SOD-123 and similar to a SOD-323 package.

Vishay's SMPC package (JEDEC TO-277A outline) was designed as a replacement for the DPak and its board area is approximately the same as an SMC package With a 1.1-mm height and 4.8-mm by 6.7-mm footprint, Vishay devices in the SMPC package are designed to provide more power in a smaller space for applications including secondary rectifiers and freewheeling circuitry for ac-dc and dc-dc converters. Vishay's just-introduced TPC Series of 1500-W Surface-Mount Automotive TVS parts in the eSMP TO-277A package are said to have the industry's lowest profile and offer a 27 % smaller footprint than devices in the traditional SMC package.

- Toshiba America Electronic Components uses an alphabet-based packaging nomenclature. Its L-Flat surface mount packages for high-power rectifier diodes, for instance, utilize a lead-clamp structure to reduce mounting area and measures a compact 4.0 x 8.2 x 1.8mm, significantly smaller than industry-standard DPak, which measures

6.5 x 10 x 2.5mm. The L-Flat mounting area of 32mm^2 is approximately 50 percent less than the DPak mounting area of 65mm^2

A direct replacement for the SOD123 package, the Toshiba S-Flat (1.6 x 3.5 x 0.95mm) package is 50 percent smaller than the SMA package, and has a flat back surface for stable mounting. Toshiba's M-Flat packages have the same footprint as an SMA and can be a direct replacement. Rectifiers housed in the M-Flat package are thinner than the conventional devices housed in the company's I-Flat package.

- With three leads and a slightly larger footprint than the original Powermite low profile architecture Powermite 3 surface mount rectifier products from Diodes Inc. and Microsemi are designed to replace SMC and DPak designs. Powermite3 shares the same basic construction as DPak with the significant difference being the size of the package, which is designed to minimize package height, width, and length. The Powermite3 PCB area requirement is 26.5 mm² compared to 47mm^2 for SMC and 61.5mm^2 for DPak.

- NXP Semiconductors' range of MEGA Schottky rectifiers are housed in its FlatPower packages SOD-123W and SOD-128. As a result of the packages' clip bond technology, MEGA devices deliver high-power capability comparable to standard SMA package. At the same time, the height of both packages is reduced by 50 percent compared to SMA packages, thus enabling much smaller designs. The SOD-123W has a body size of 2.6 x 1.7 x 1mm; the dimensions of the SOD-128 are 3.8 x 2.5 x 1mm. Both packages are footprint-compatible to SMA and SMB packages.

With all of these options, engineers who want to focus quickly on the best choice of products for their needs can be bowled over by the variety of packages available, and we haven't yet approached the key elements of forward voltage drop, reverse leakage current or junction temperature.

So what's an overworked, underpaid engineer to do to sort through it all?

There is a way out and right now you are very close to it**.** Research shows that engineers are using the web as their primary source both for information and buying and, lucky you, elsewhere on the TTI site you'll find the Part Builder tool referred to earlier, which makes it easier to find and compare parts and specs and provides additional resources for the design process.

With Part Builder you can assemble part numbers based on keywords or parametric values. In addition to filtering your search by manufacturer name, TTI has endowed its search engine with up to nine filters (e.g., package/case, reverse voltage, forward continuous current, etc.) and. then allows comparison of up to 5 parts side by side by checking the box beside each part and clicking compare. Part Comparison allows you to make a true apples-to-apples comparison of parametric data, environmental compliance, data sheets and availability, then add those parts to Quote Requests, Shopping Cart, and, if registered, Project Lists.

Try it out. And good luck with your next puzzle.