IC chip obsolescence solutions: Package converters

By Ila Pal [Ironwood Electronics, Inc.]

An obsolete integrated circuit (IC) chip is an electronic component that is no longer being manufactured or actively supported by its original manufacturer. This can be due to various factors like technological advancements, shifts in market demand, or manufacturing issues. Progress in semiconductor technology often leads to the development of newer, more efficient, and smaller ICs, making older ones less desirable for new designs. Changes in consumer demand or industry needs can cause certain ICs to become less relevant or necessary. Problems with production, supply chains, or component availability can also lead to obsolescence.

Finding replacement ICs can be difficult and expensive, as obsolete parts are often only available through specialized distributors or second-hand markets. Equipment or systems relying on obsolete ICs can face challenges in repairs and replacements, potentially leading to downtime and increased costs. When an IC becomes obsolete, designers may need to find compatible replacements or redesign circuits to utilize newer ICs. Unavailability of chips affects primarily military electronics because the average life cycle of military hardware sometimes exceeds 10 years. Chip unavailability also affects the medical industry because any changes require a long approval process and scrapping of expensive base components. A complete redesign is generally not an option because it consumes many design resources, approval loops, validation cycles, revised manufacturing costs, etc. Substitute devices and adapting to the situation by using alternate devices are the best possible options for a chip obsolescence problem.

Package converters

IC package conversion involves using adapters or converters to allow the use of ICs with different physical package types on the same circuit board. This is useful when a specific IC package is discontinued, when you need to test or prototype with different packages, or when you want to use a substitute device without redesigning the entire board. Substitute devices come in alternate packaging formats that require a simple package converter. Converting the footprint of an IC package to that of another type or size of package is required in many situations. The semiconductor industry is moving away from older through-hole packages such as the dual-inline package (DIP), pin grid array (PGA), etc., and replacing them with surface mount technology (SMT) packages such as the quad flat pack (QFP), ball grid array (BGA), chip-scale package (CSP), wafer-level packaging (WLP), quad flat no-leads package (QFN), etc.

Often a manufacturer will suddenly find a device that has been bought for years is no longer available in the package for which the system board is designed. Until the board is redone, a package converter is needed to fulfill the immediate requirement. Very often these adapters are a simple 1:1 pin mapping from the new package to the old. A few examples of package converters and how they can solve chip obsolescence issues are considered below.

QFP to PGA converter

In the QFP to PGA converter scenario, the Actel 1280KL chip packaged in a 176-pin PGA package was obsolete. The alternate IC Altera 9480, however, is available in a 208-pin QFP package. A unique technology used in the custom package converter for the Altera 9480 allows the 208-pin QFP package to connect to a target board designed for an Actel 1280KL chip, which is packaged in a 176-pin PGA package without compromising real estate. Most of the signals are 1:1 with excess power and ground pins along with a few "no connect" pins. A printed circuit board (PCB) was designed with a QFP pattern on the top side and a PGA pattern on the bottom side. Because the pattern overlaps, the PGA can't be a through-hole design, so the result was control depth hole technology. The control depth press terminal pins keep the real estate required to make the conversion at a minimum. Conventional through-hole terminal loading would require an offset as the patterns for the QFP and the PGA. The control depth pressed PGA interface pins in this custom adapter can be located directly beneath the QFP pad array because they do not penetrate the adapter board top surface. The QFP to PGA package converter shown in **Figure 1** has JTAG testing support in the form of a 0.1" center terminal header strip.

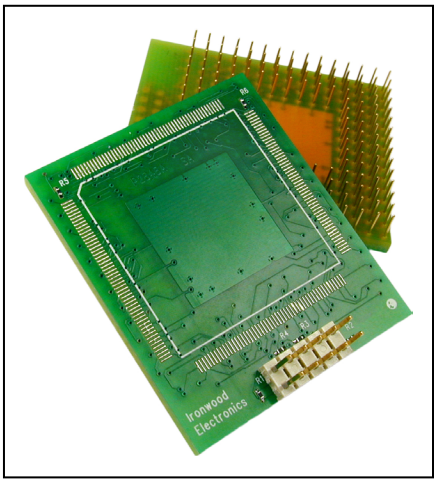

Figure 1: A QFP to PGA package converter.

QFP to QFP converter

In this next example, a target system developed for the Texas Instruments PCI2031, which is packaged in a 176-pin QFP package, can accommodate the Intel 21152 package through a custom package

converter. The custom package converter (**Figure 2**) is a two-piece pluggable adapter.

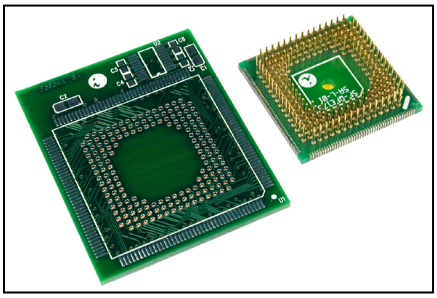

Figure 2: A two-piece pluggable adapter acts as a custom package converter to accommodate the Intel 21152 package.

A low-mass surface-mount foot solders to the target board with standard reflow processes similar to those used to solder the actual QFP chip. A set of terminal pins on the foot interconnect to four peripheral leadless contacts on the edge of the PCB, which solder to the QFP target board pads. The low-cost leadless contacts are similar to a leadless chip carrier (LCC) chip, but are designed to solder to the smaller pitch QFP pads. The top adapter, which plugs onto the foot, contains an SMT land pattern for the Intel 21152. The top adapter board has support for an IDT 1 to 10 clock driver (3.3v) and bypass capacitors.

SOIC to QFP converter

In this example, an 80QFP device was obsolete and replaced by a Micrel 20SO package with additional capacitors and resistors. As in the previous example, a two-piece pluggable solution is not feasible due to height constraints. If adapter height is critical, a solder column or bottom termination design (as shown in **Figure 3**) is the best solution. The total height of the adapter is dependent on the height of the components surface mounted to the top, but are typically less than 0.2" (5mm).

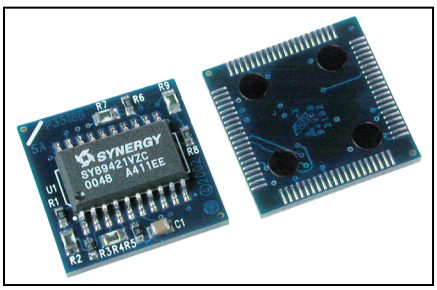

Figure 3: A solder column adapter converts an obsoleted 80QFP device pattern to a Micrel 20SO package with additional capacitors and resistors.

SOIC to SOIC converter

Fixing a target board problem because of a wrong device pin out or wrong pad location is another function of package converters. To err is human, to adapt is divine. Package converters—often called "Fix adapters" due to this particular scenario—can be made in many configurations and are usually specific to the mistake that was made. In this next example, the target PCB was designed for a 32SOIC device with two peripheral rows that were at the wrong distance. To fix that problem, a PCB was designed with right peripheral row distance where the device will be soldered. On the backside (to be specific—the edge), pads with side castellation were designed for soldering down to the target PCB. The compact design (shown in **Figure 4**) is ready for production: It can be loaded into tubes, placed in trays, or in a tape and reel for pick and place equipment.

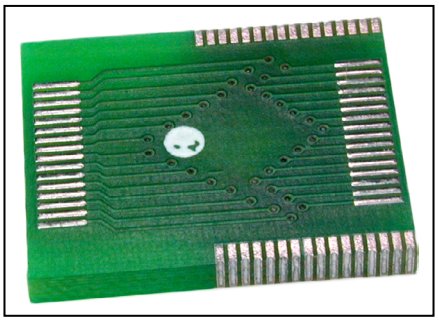

Figure 4: A "fix" adapter corrects the pad location for a 32-pin SOIC device.

Summary

When availability or performance of a given IC becomes an issue, using a package converter with substitute device(s) without redesign of the target system is the most economical option with respect to both time and cost considerations. Technology advancements, such as solder column, J-lead, edge castellation, micro- blind/buried vias, flex PCBs, and embedded capacitor/resistor enable adapters to solve any type of constraints faced by end products. Parts can be manufactured as Restriction of Hazardous Substances (RoHS)- or non-RoHS compliant depending on end-usage restrictions. Simple or complex adapters increases the average component life cycle to align with the end product life cycle, which is a must for military and medical electronics applications.

Biography

Ila Pal is CTO at Ironwood Electronics Inc., Eagan, MN, USA. He holds an MS degree in Mechanical Engineering from Iowa State U., Ames, and an MBA from the U. of St. Thomas, Minneapolis. He has received patents, presented papers, published articles, and has spent more than 30 years developing new technologies in the packaging and interconnection field. Email ila@ironwoodelectronics.com