



Adapters & Sockets for Product Life-Cycle Management- Extending the Life of Your Product

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ABSTRACT

For today's electronic module and equipment designer, product life-cycle management has become an increasingly important competitive consideration for initial product design as it relates to both ongoing manufacturing and to end-use customer application. The high rate of change in the packaging or obsolescence of IC's along with pressure to add new functions gives product managers for electronics a whole new challenge. There are two ways to leverage the investment - get to market sooner and keep the electronic module in production longer by managing the availability and new function turmoil.

High performance adapters and sockets have been used extensively to aid in shortening the design cycle by allowing test, prototype, and component interchange. The same technologies used to shorten the design phase are now being economically applied to lengthen the life cycle of electronic assemblies and modules. Handling IC obsolescence or improved performance can be achieved with a combination of specialized interconnect skills related to adapters for SMT package emulation along with electronic design. This is another weapon to handle short microelectronic component lifecycles and issues of IC availability. For the designer of electronic hardware, having adapter and socket options to extend the life of an existing product, rather than commit to a premature total product redesign, may provide the best alternative in terms of total cost and time to market.

INTRODUCTION

For the designer and manufacturer of electronic hardware it is desirable that the component supplier provide for ongoing availability of parts throughout the life of their product. This includes ICs for production to meet ongoing manufacturing needs and also includes ICs for use in the field for equipment repair, upgrade, and replacement. Given the dynamics of the marketplace, assumed IC availability may not be a practical solution for either the IC supplier or the equipment manufacturer. There are several ways this can be solved:

- **Design for future upgradeability** with new chips or sub functions at the design stage.
- **Replace Obsolete IC's.** IC is unavailable in original package but available in new package.
- **Upgrade Functionality on Existing PCB.** PCB can be upgraded by replacing an IC or IC's with an electronic module to enhance functionality.
- **Design a replaceable module:** Older chips can be replaced with newer less expensive chips without a complete PCB change.

To successfully execute these scenarios, skills and experience in connecting to the SMT or through hole pads along with integration of specialized interconnect and electronics. SMT package emulation is required for QFP, PGA, BGA, SOIC, PLCC, and MLF(QFN). An adapter with a simple or complex set

of electronics along with the SMT package interface provides the interface in all of these scenarios.

SOLUTIONS

1. Design for future upgradeability.

This involves replacing key components in the field while leaving the rest of components in place. In BGA's this can be solved with a BGA SMT adapter as shown in Figure 1. The female SMT package emulator is soldered to the IC pads with the identical process as a typical BGA attachment. IC's to be replaced are soldered to a male pin adapter and then this assembly is plugged into the target PCB. The capability to provide both a female SMT BGA emulator along with a male adapter that has as few as one IC or a complex module

is the key to keeping the functionality up to date.

- a. Provide for pluggability of key components. Old IC removed and new IC plugged in.
- b. Logical progression of product upgrades - when new IC is needed.
- c. Repairability and maintainability - fix or upgrade in the field.

2. Replace Obsolete IC's.

Many manufacturers of IC's are dropping older packages of certain parts. This is especially true of through hole technology parts but does extend to PLCC and QFP as more IC's are going to BGA and MLF to achieve smaller size. The key factors to consider are:

- Fit of the part in location, size.
- Quality and reliability
- Affordability of interconnect technology.

Upgrading a PCB by replacing one or more IC's is done to extend product life by adding functionality. In many cases, gate arrays, processors, and DSP's are not adequate to upgrade through software or logic design. Upgrading can be accomplished by connecting to the pads of the now inadequate IC(s) and adding completely new and modern capability to an otherwise serviceable PCB assembly. The key again is combining interconnect expertise to IC pads along with electronic assembly. New functions can be added into what used to be an impossible space.

3. Upgrade Functionality on Existing PCB.

Design an application specific adapter module - matches existing footprint

But adds:

- a. Enhanced product features
- b. FPGA emulation
- c. Reduce motherboard complexity

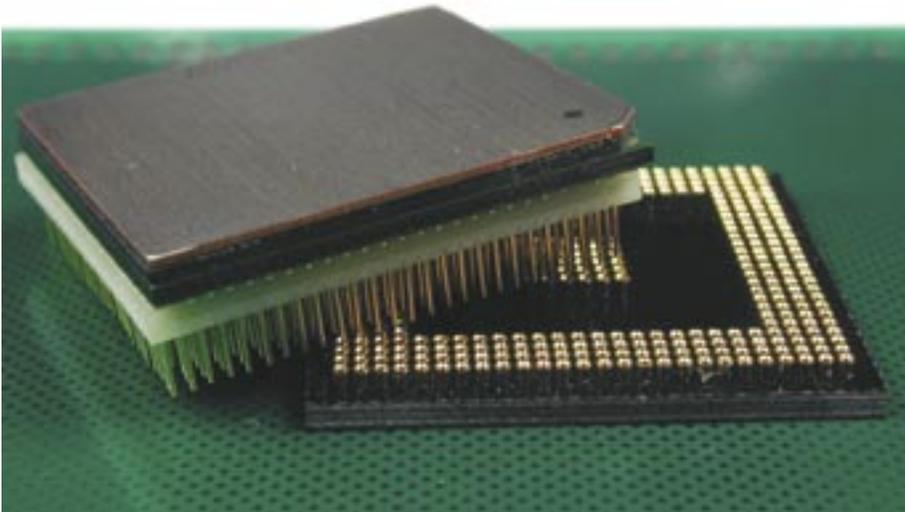


Fig. 1

Figure 1 shows a BGA IC soldered to a land socket assembly with male pins allowing the IC to be plugged into and out of a Giga-snaP BGA SMT Package Emulator. The assembly can be upgraded with a new microprocessor or FPGA throughout the product's life. The SMT adapters have the same solder ball types as the IC they are emulating. The force to mate land socket to SMT package emulator requires 0.7 Oz per pin. The electrical path of the SMT adapters is a high priority performance issue. The physical length from the point where the top connection point on the male adapter to the solder ball on the female socket is 4.5 mm. This is the shortest and lowest impedance SMT BGA socket adapter available, thereby providing better transmission of high frequency signals. Issues to consider for an SMT socket adapter are insertion force when (un)plugging, warping (some methods will warp both the adapter and your PCB), and connection reliability when installed or when reflowed for other purposes.



Fig. 2

Figure 2 is a fairly simple adapter which converts a surface mount SO package to a through hole DIP. The DIP IC is obsolete so this adapter was used to keep the board in production at very little engineering or production cost. A specialized and inexpensive press fit gold pin, along with high volume insertion of the IC, keeps the cost to a minimum.

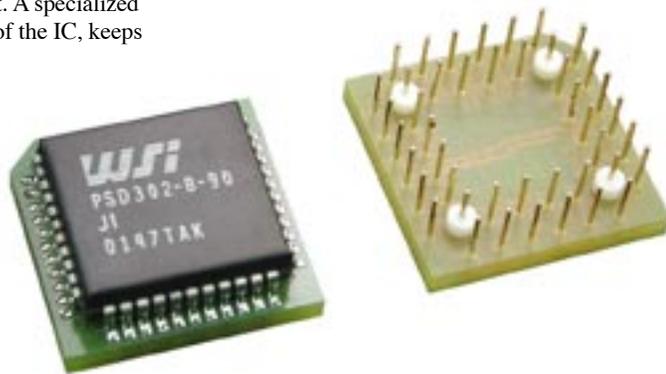


Fig. 3

Figure 3 is similar to figure 2 in function but uses a QFP to replace an obsolete PGA device. A press fit interconnect gold plated pin provides a reliable connection from the QFP to an existing PGA through-hole.



Fig. 4

Figure 4 shows a gate array that was replaced with an FPGA along with power supply and other support circuitry. The components on the top include a high density BGA, power supply chips, and discretes all built on a high volume automatic line. The bottom (lower picture) has Ironwood exclusive solder columns that allow the device to be subsequently soldered to a QFP pattern on a larger module on an automated line. New functions are added to the main PCB with just an investment in the FPGA design and the affordable adapter.



Fig. 5

Figure 5 is a very complex adapter which actually replaces two gate arrays to improve performance. The target interconnect is two PGA's (not shown) The IC's are soldered to the adapter. The adapter is then inserted into the PGA and soldered in place. The adapter is designed to withstand subsequent solder reflow processing.

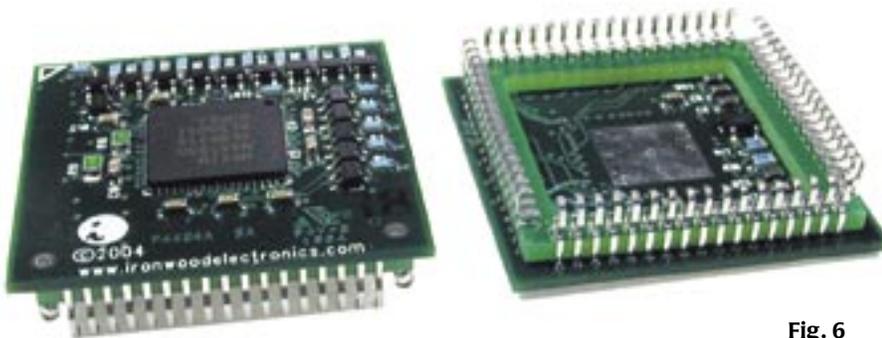


Fig. 6

Figure 6 shows an adapter which converts from a BGA package with enhanced features to a base of PLCC j-leads for attachment to a target system with the older version of the IC. A number of components including an IC in QFP package, discretes, and other IC's allow a complex digital and analog function to be accomplished. Special leads to mount to PLCC leads allow SMT attachment to the old PLCC pads which the adapter is replacing.

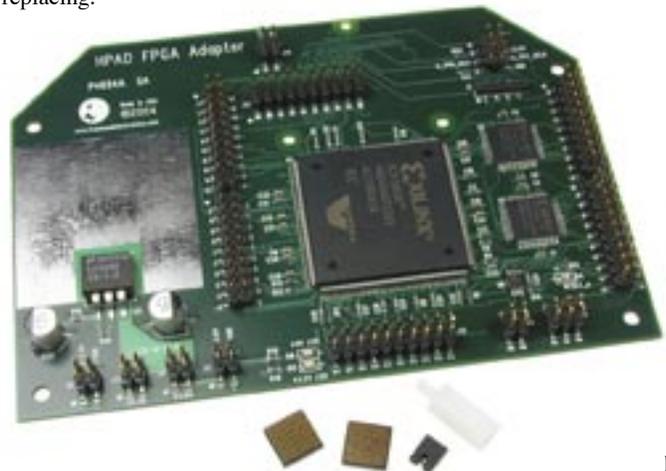


Fig. 7

Figure 7 is a pluggable upgrade adapter to a target 0.8mm BGA chip. A 0.8mm SMT BGA female adapter is soldered to the target PCB. A matching gold plated male adapter soldered on the bottom of the adapter is plugged into the BGA female SMT adapter. Significant functionality upgrade, along with interconnect to test devices, can be done when the technology to connect to SMT pads allows it.

4. Design a replaceable module: A replaceable module allows part of the PCB to be replaceable while the vast majority that is not expected to change to stay the same throughout the life of the product. A module with electronics and interface to a chip's SMT pads then allows:

- a. Overall product cost can be reduced throughout its lifetime.
- b. Older chip can be replaced with less expensive newer chip.
- c. Better performance or new functionality can be added.

Technologies discussed above passed environmental tests performed by Trace Laboratories. All tests were performed in compliance with Military Standard specifications. The samples representing different technologies were subjected to humidity, vibration, thermal shock and salt fog environments. There was no evidence of degradation to the samples as a result of exposure to the various elements. Contact resistance did not increase significantly and there was no significant decrease in

insulation resistance found. All equipment used to generate the test results meets the requirements of ANSI/NCSL Z540-1 and is in calibration and traceable to NIST.

SUMMARY

Product lifecycle management has become increasingly important and complex as issues of technological innovation and overall competitiveness drive component suppliers. Interconnect technology to SMT pads designed into specialized adapters and sockets allows for a fast and economical upgrade to extend or enhance many different types of PCB's. Fortunately several possible solutions exist beyond the option to simply hold a reserve of spare components, which may or may not be adequate for the future needs of the customer or the equipment supplier. Targeting a small part of a PCB for adaptation or upgrade keeps the system in production in many cases with a minimal investment. Cost reduction, replacing discontinued IC's, module repair, and product upgrade can all be accomplished with a well designed adapter.

Figure 8 illustrates package conversion and socketability, converting one type of QFP to another QFP pattern with a pluggable base. The interconnect technologies utilized in this adapter include a compact and inexpensive SMT package emulator foot that solders to the target PCB. The module on the left has gold plated male pins that match the gold plated female pins on the SMT foot.

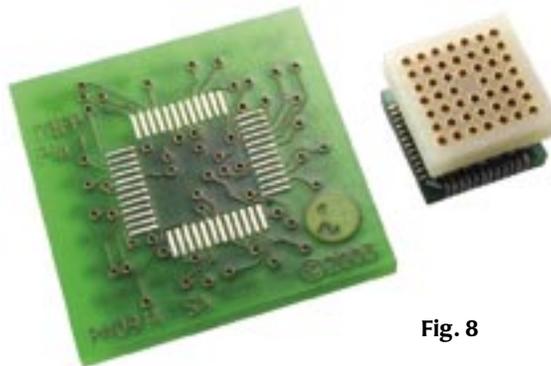


Fig. 8

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