A Rochester Electronics White Paper

Rochester Electronics' Extension-of-Life® Solutions: Not Just Replacement Parts

Worldwide Corporate Headquarters
Rochester Electronics, LLC · 16 Malcolm Hoyt Drive · Newburyport, MA 01950
phone 978.462.9332 · *web* **www.rocelec.com**

Executive Summary

Semiconductor end-of-life is an ever-present problem in every electronics manufacturing industry today, and it's not going away. The goal has always been to purchase a replacement that is the exact form, fit, and function as the original. Lately, companies have been offering a variety to aftermarket "substitute" solutions they claim to be form, fit, and function replacements; however, manufacturers are finding from experience that these parts often fall far short of that promise.

Logistically as well as technically, these substitutes are incomplete, short-lived patches rather than comprehensive, permanent solutions. Throughout the semiconductor industry, in this consumer-driven semiconductor economy, the life expectancy of any component – these substitutes included – is usually less than three years. Obsolescence is always right around the corner.

This paper will discuss some of the substitute solutions available and demonstrate how Rochester Electronics' Extension-of-Life® solutions can guarantee a never-ending supply of the *exact* components you need – authorized by the original manufacture to have the exact form, fit, and function of the originals.

The recommended end-of-life strategy

Usually the most expeditious and economical response to an end-of-life notice is to make a last-time buy (LTB) … to stockpile the number of components necessary for the life of the program. At a bare minimum, an LTB of the semiconductor wafer-level product should be made. However, that is not always possible. Sometimes inventory just is not available. Sometimes manufacturers miss the "window of opportunity." Sometimes manufacturers do not have the financing necessary to make the large, single-order purchase. Or they don't have the facilities to safely store the inventory if they could obtain it.

As for purchasing the components on an as-needed basis, manufactures are constantly warned to avoid counterfeit and substandard replacement parts by buying only from the original manufacturer or their authorized distributors. Availability can be a problem.

Substitute options may not provide exact form, fit, and functional replacements

The most commonly offered substitute solutions to support ongoing functional needs of discontinued semiconductors are:

> **Emulation** – An integrated circuit manufactured using a customized, pre-prepared silicon die. It is manufactured using a silicon technology different from the one used on the original part, and is modified to demonstrate operational functionality similar to that of the original semiconductor. An emulation simulates or mimics the functionality of the original. Emulation is expensive, and almost always requires a lengthy and expensive trial-and-error foundry process, which is usually not included the initial cost estimate. Ultimately, emulated parts must be fully re-qualified because the emulation environment simply cannot repeat the system environment for timing, noise sensitivities, power, handling, and functionality. *Note: MIL-M-38510 specification required that emulated parts must have different part numbers than the original devices.*
>
> **ASIC** – An application-specific integrated circuit that is customized for a particular use, rather than intended for general-purpose use. In order to be used as a replacement part, ASIC components must be fully customized for end use by a semiconductor manufacturer using their commercial process to replicate the electrical functionality of the original semiconductor. The manufacturing process for ASIC components can be very expensive compared to the cost of some the other approaches. An ASIC approach to obsolescence is done using gate array or standard cell technologies and methodologies.

Gate array – A prefabricated silicon chip integrated circuit made up of digital logic gates (such as standard NAND or NOR logic gates and transistors) in predefined positions. The digital gates remain unconnected, and the chip is not intended to have a particular function. To customize the chip to perform a specific function, the manufacturer adds a final surface layer (or layers) of metal interconnects that join the gates in such a way as to produce the required functionality.

Standard cell – An integrated circuit made of a combination of circuit blocks from previous designs that are combined to create a new design. Each layer is a unique design, which differentiates this from a gate array. This is one of the most expensive substitute components, but may be required depending upon design content.

Field programmable gate array – A programmable part that is customized by the user through a program resident in a companion memory device or from a processor. FPGAs can be a less expensive choice up front; however, they are particularly vulnerable to near-future obsolescence issue themselves.

Why aren't these substitutions true form-fit-function replacements?

All of these substitute solutions are created using state-of-the-art silicon foundry technology. While this sounds like a good thing, it can actually introduce some negative aspects. This new technology may be suitable to replace the functionality of the original device, but it is almost certainly does not replicate all characteristics of the original. This is because semiconductor manufacturers are always trying to get more functional elements onto their silicon, and, to do so, they are continually shrinking the geometry of the elements that go into the silicon. This can bring improved performance to systems and also lower costs, but these benefits come with disadvantages that are likely to be significant in high-reliability and safety-critical applications.

What are the differences between the substitutes and the originals?

The major difference is the smaller functional cell size used in the new technology. This leads to:

- Higher device switching speeds (more susceptibility to noise)
- Different capacitance (board-level loading changes)
- Different radiation tolerance
- Different EMC performance

These parameters are usually not recognized by the manufacturers who make the substitutes because they are not usually fully specified and tested for during device production.

What problems do these differences cause?

Higher switching speeds and different capacitance can cause devices to see spikes and signals or to produce a race condition in an application that the original parts did not. Any of these conditions could lead to equipment malfunction.

Semiconductors based on smaller cell size are usually less radiation tolerant than semiconductors produced using older technologies. This can lead to latch-up or loss of data. If such a component were used in an avionics systems operating at high altitude, for example, aircraft safety would be compromised.

Semiconductors based on smaller cell size are also usually less robust electrically. This can make them more prone to interference from radio and TV transmitter signals and more vulnerable to damage from electrostatic discharges. The latest consumer-driven semiconductor technologies are not designed for 10-year life at the full industrial/military performance limits when it comes to metal migration. These technologies compromise on environmental temperature limits and voltage ranges to achieve similar lifetime guarantees as older technologies.

Sandia Laboratories has released a study that indicates that semiconductors based on smaller cell size are likely to wear out much sooner than the originals.

Even though the replacement chips (die) themselves are smaller, the same size package must be used to retain the application fit of the original component. This requires longer bond wires or package leads to the die. In some cases, the die using latest technologies simply gets too small to fit in the same package without creating unreliable packaging and/or a complete package retooling with more aggressive bond finger spacing.

Why are Rochester Electronics' Extension-of-Life solutions a more cost-effective choice?

As a continuing manufacturer authorized by over 60 original semiconductor manufacturers, Rochester Electronics *always* manufactures components using the original silicon technology. These newly manufactured devices are exact form, fit, and function devices. Rochester guarantees that their components will work just as the originals – no surprises, no compromises. Manufacturers and design houses that deal in "substitutes" cannot make that guarantee.

Rochester maintains the world's largest inventory of silicon wafers – over 10 billion die, all of which are either purchased from the original manufacturer or manufactured by Rochester under authorization from the original manufacturer.

When die is no longer available, Rochester's Design & Technology Groups can re-create a semiconductor. Rochester's Semiconductor Replication Process™ (SRP™) produces replicated components that are physically and electrically identical to the original devices. All Rochester replications are 100% guaranteed to meet or exceed the original specifications. All of Rochester's manufacturing and replication programs are authorized and supported by the original manufacturers.

In addition, Rochester offers customizable storage and distribution programs that build long-term solutions.

Summary

Only the Rochester Electronics Extension-of-Life solutions can provide an absolute guarantee that a replacement semiconductor device will function exactly as the original.

"Substitute" solutions introduce myriad, sometimes hidden inconsistencies that cause a variety of failures – sometimes obvious, and sometimes difficult to diagnose. These failures are especially unacceptable in high-reliability and safety-critical applications.

Rochester's Extension-of-Life solutions are saving millions of dollars every day for customers in all sorts of industries – aerospace, industrial, medical, military, security, space, telecom, and transportation.

sales@rocelec.com
http://rocelec.com/