

Assembled Replacement Integrated Circuits (ARICs)



Corey Kopp (Supervisory Electronics Engineer)
Naval Undersea Warfare Center Division Keyport
360-315-3439
corey.kopp@navy.mil

Assembled Replacement Integrated Circuits (ARICs)



Problem

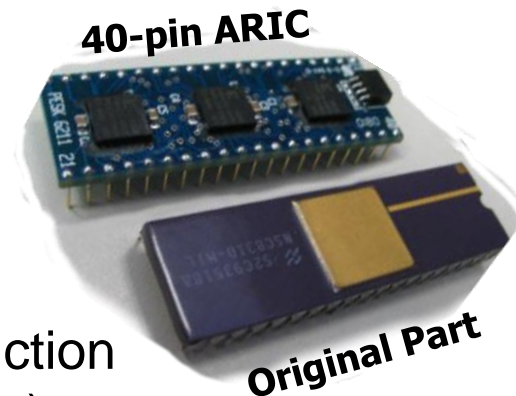
- Obsolescence driven by discontinued integrated circuits (ICs)
 - Average life-span of commercial ICs < 8.5 years, with certain microprocessors and memories obsolete in < 5 years.
- In a recent survey 88% of users confirmed the use of equipment beyond the manufacturer's obsolescence date.
 - Many users don't have a plan for when items become obsolete
- Recovery options can be expensive and time-consuming.
 - Costly design changes to assembly or system
 - Design, test & requalification, and associated time & costs
 - Documentation changes and other logistics costs
 - Can add up to millions of dollars for a single subassembly
 - System capability degradation while solutions are being worked

Assembled Replacement Integrated Circuits (ARICs)



Solution (Hardware)

- Assembled Replacement Integrated Circuits (ICs)
 - Miniature, IC-sized Printed Circuit Board (PCB) assemblies designed/fabricated to replicate the function of Obsolete Integrated Circuits (chip-level emulation)
 - Created using commonly available surface-mount components
 - ARIC PCBs include CPLDs or FPGAs programmed with custom VHDL code, integrated with other components as needed
 - Designed/manufactured using mature, industry-standard practices
 - End parts serve as drop-in replacements for failed or obsolete parts



Acronyms: CPLD – Complex Programmable Logic Device
FPGA – Field-Programmable Gate Array
VHDL – VHSIC Hardware Description Language

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Solution (Firmware)

- ARIC's use of VHDL (VHSIC Hardware Description Language)
 - In high density programmable electronic components, use of VHDL programming allows designs to be more cost-effectively transitioned to new technologies, significantly minimizing future obsolescence resolution costs.
 - Air Force Materiel Command (AFMC) reported significant cost avoidance achieved when replacing discontinued technology. For example, where VHDL was used to document F-22 ASIC designs, re-partitioning and redesign costs were approximately half the cost incurred by those who did not document ASIC designs in VHDL.



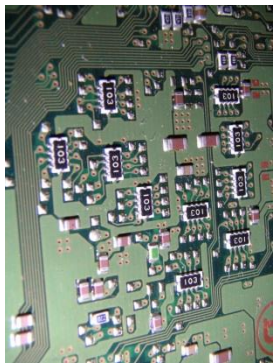
22-pin ARIC for DoD Platform

(Stock photo shown - actual image and platform details not publicly releasable)

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Solution (continued)

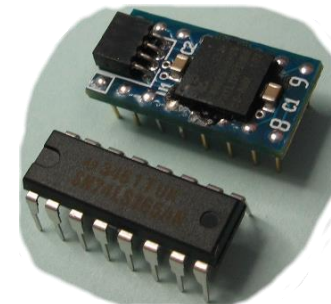
- If the specific function of any IC is known or can be determined, an ARIC can likely replace it.
 - Digital ICs, Analog ICs, Even Packaged Hybrid Circuits; DIP Packages or Surface Mount Technology (SMT)
 - Extends sustainment solutions (repair & replenishment) of existing systems



Another PCB in a DoD Platform; 20-pin ARIC with Resistors and Capacitors

(Stock photo shown - actual image and platform details not publicly releasable)

- Custom ARICs can be developed for the application, or standard components can be programmed onto ARIC blanks using a handheld programmer (current Keyport library includes all 14- and 16-pin 54/74 series 5V logic ICs)



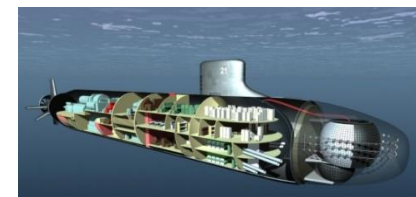
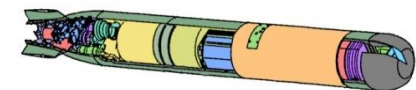
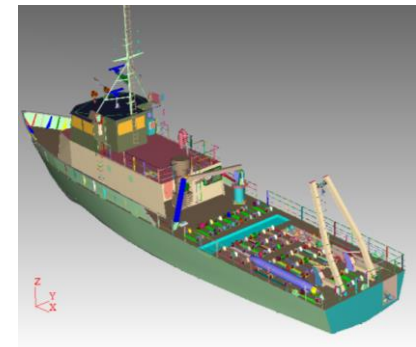
16-pin ARIC & Original Part

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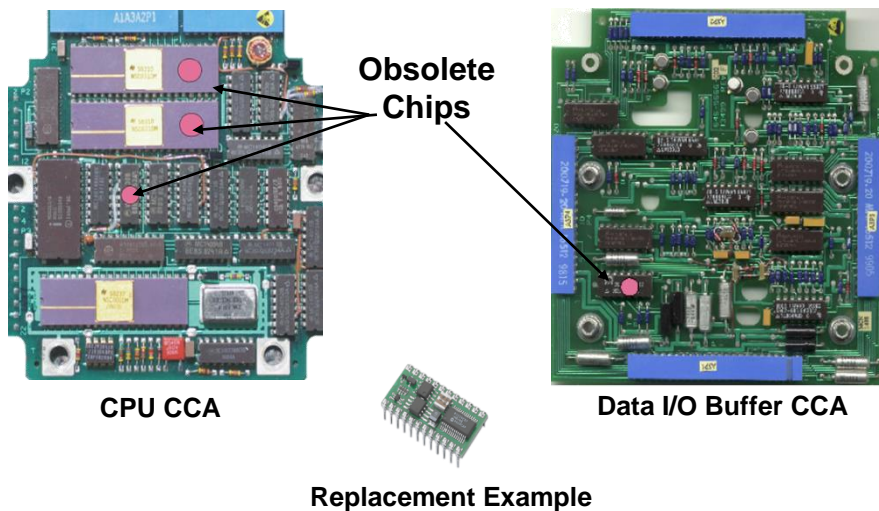
Benefits

- Sustainment “*game changer*”:
 - Mitigates component *obsolescence*
 - Preserves system *supportability* and avoids costly redesign of the subassembly or parent system
 - Enables *Service Life Extension* (SLEP) decisions
 - Avoids being held “hostage” by planned obsolescence
- Simply a *new source* for the function of an IC – everything else stays the same
 - “*Plugs and Plays*” into the same place as the original
 - *Transparent* to the higher level assembly
 - May improve component *reliability* over original part
 - *Reduced risk* of counterfeit parts (controlled resupply)
- Solutions may be *transportable* to other applications using the same ARIC (solutions may cross platforms and services) *



Assembled Replacement Integrated Circuits (ARICs)

Example: F/A-18 RT-1379 (Radio Receiver-Transmitter)



Problem:

- RT-1379 production & logistics support ends in 2007
 - 217 unique electr. components (59 no longer available)
 - Low Product Volume, Aging Test Equipment, and Diminishing Technical Expertise

NUWC Keyport Solution:

- Established Organic RT-1379 Repair Depot
- Applied ARICs to obsolete control processor & data I/O boards
 - Minimized design & documentation changes, and part requalification
 - Drop-in replacements that extend reparability
 - Feed solutions into Depot repair processes

Assembled Replacement Integrated Circuits (ARICs)



Challenges & Risks

- DoD Community Awareness/Exposure
- Identifying candidates for ARIC solutions in advance of emergency supply failures
 - Lead time associated with analysis of alternatives, selection, design, validation, and fielding
 - How to leverage existing solutions to other applications (where else is this part used, and will the same solution work in that application?)
- Acceptance of replacement ICs without requirement for system requalification (or with streamlined testing).
 - Cost/Risk/Schedule tradeoffs

Assembled Replacement Integrated Circuits (ARICs)

Innovation Status

- NUWC Keyport has been using the ARIC concept to mitigate chip obsolescence for NAVSEA, NAVAIR, and Air Force programs for ~10 years.
- ARICs have been fully qualified for military environments and are in use in the field.
- Spiral development has streamlined both the technology and the capabilities, including design of tools to simplify ARIC programming.
 - Library of solutions is continually growing
- Solutions are typically faster than more involved redesign efforts



Assembled Replacement Integrated Circuits (ARICs)



Vision / Final Thoughts

- “Game Changer” for DoD Maintenance processes.
 - Can replace multiple obsolete ICs with one newer technology ARIC, with minimally-invasive design changes
 - Minimizes impacts on documentation and part requalification
 - ARIC Redesign process faster than traditional redesigns
 - Drop-in replacement extends reparability by integrating newer technology
 - Feeds DoD-owned design into Depots for repair support
 - ARIC’s VHDL code easily transferrable to newer technology programmable devices if required at a later date (further decreases obsolescence resolution costs down the road)
- Design and programming may be portable between applications and between services
 - Cross-service parts library is key to leveraging existing solutions

Questions?



*What we do:
We fix it...
We build it...
We design it...
We manage & resolve
obsolescence...
We keep it running...*

*"Those who say 'It cannot be done' should not interrupt those who are doing It."
Anonymous Quote*