Welcome to the JTEG Monthly Teleconference

Topic:
Integrated Circuit Test, Repair & Re-Manufacture

19 January 2016
1300-1309: Welcome and JTEG Background - Greg Kilchenstein (OSD-MPP)

1309-1310: Administrative Notes – Debbie Lilu (NCMS)

1310-1335: Circuit Card Test and Repair Systems (CCTARS) Team - Chris Zarycki (Lakehurst)

1335-1400: Assembled Replacement Integrated Circuits (ARICs) from - Corey Kopp (NUWC Keyport)


1450-1500: Wrap Up and JTEG Principals’ Comments
Technology Forum Protocol

- Please keep your phones on mute unless you are presenting. Do **NOT** put your phone on hold. Should you have to temporarily drop off please hang up and call back.

- Questions will be addressed via “Private Chat” on DCS. Send questions to “Langlais, Raymond R Jr”.

- Presenters - slides will be advanced by Greg / Ray

- This is an open forum. Briefs and Q&A are available for public release and will be posted on the JTEG website.

http://jteg.ncms.org
CIRCUIT CARD TEST AND REPAIR SYSTEMS (CCTARS)
PROGRAM BRIEF

PREPARED BY:
Chris Zarycki & Mike Dunne
4.8.1.3, 4.8.6.7
CCTARS/MTR PROGRAM BACKGROUND

- Huntron evaluated and deployed in the 80’s
- MTR Program initiated in the early 90’s
- CNO Designates NAVSEA 04DS 2M/ATE/MTR/CASS Program Manager for NAVSEA/SPAWAR
- Huntron DS5100 deployed in 1993 – 1994
- NAVAIR Lakehurst started test routine development in 1999
- Huntron Protrack deployed in 2004
- NAVAIR PMA260 deployed 20 PinPoint II testers in 2003 – 2004
- NAVAIR PMA260 started CCTARS IPT in 2007
- SECA Requirement for PinPoint at APN-7 Conference 2009
- PMA260 Purchased and deployed more Pinpoints 2011 – 2012
- President Obama’s initiative:
  - Bring more workload in-house
  - Less reliance on private contractors
Program Overview

- The CCTARS Program is designed to improve equipment Operational Availability (Ao) and eliminate the turn-in of No Failures Evident (NFE)/Can Not Duplicate (CND) of certain Electronic Modules (EMs) and Shop Replaceable Assemblies (SRAs) to the Depot.
- The AN/USM-676(V)2 PinPoint, AN/USM-674(V)3 Protrack and the CCR2000 systems are the support equipment tools identified for use in the CCTARS program.
- The Protrack and PinPoint systems provide:
  - Low cost SRA Test Routines (TRs) that can be developed and fielded quickly
  - TRs that can screen SRAs for failure, so that only bad units are designated as Beyond Capabilities of Maintenance (BCM)
  - TRs that isolate to a single failed component
  - TRs that can be modified easily when SRA configuration changes occur
• CCTARS is always expanding efforts to other weapons platforms (P-8, JSF, ALRE, NGVLA, etc.)
CCTARS Program Equipment

- Consists of all COTS hardware
- Huntron and PinPoint contain COTS software (TestVue and Workstation)
- MTR Suite is GOTS software (NAVSEA NUWC)
AN/USM-674(V)3
PROTRACK STATION

EQUIPMENT
Huntron PROTRACK Model 20B, Scanner I & Controller
Windows based tester using COTS H/W and GOTS S/W
Compares a suspected faulty circuit card assembly using a Test Routine developed from three “A” condition CCAs
Non-powered testing of circuit cards and modules using analog signature analysis, referred to as VI
Test Routine contain assembly drawings, schematics, piece parts logistics and VI signatures, published quarterly on DVD

Model 20B nearing obsolescence, replacement would be a Model 32 currently under development

BENEFITS
Low cost relative to alternative SRA-test capable ATS
Shorter development time
Fault isolates to a single component or node
Isolate failed CCAs from ambiguity groups
Reduce BCM rates including PBL items
Reduce CND, NFF, and A799 rates
Excellent BCM interdiction tool
Addresses obsolescence issues

BACKGROUND
NAVSEA’s primary maintenance program Module Test and Repair Program (2M MTR)
PMA260 provided initial outfitting of Huntron System AN/USM-646 (DS-5100) to I-Level maintenance activities ashore and afloat
Lakehurst established first NAVAIR development activity 1999
Upgraded to AN/USM-674 (PROTRACK) circa 2004
NUWC DET FEO Norfolk who is the ISEA for the AN/USM-674
Today there are 94 PROTRACK Systems in the fleet (NAVAIR)
AN/USM-676 PINPOINT IIR
IN-CIRCUIT FUNCTIONAL TESTER

EQUIPMENT

Diagnosys PinPoint IIR In Circuit Functional Tester
Windows based tester using COTS H/W and S/W
Tests a suspected faulty circuit card assembly using a Test Routine
developed from three “A” condition CCAs
Power on testing of circuit cards utilizing digital and analog testing
along with analog signature analysis, referred to as VI
Includes virtual instrumentation, shorts locator, LCR Bridge
Capable of reverse engineering and schematic generation
Uses MTR S/W Test Routine uses MTR Database Utility for
schematics, piece parts logistics published quarterly on DVD

BACKGROUND

A 1999 Commercial Operations and Support Saving Initiative
COSSI effort with the PinPoint I
The PinPoint II was a result of the COSSI
Tech Evaluation successful in 2004
PMA260 procured 16 PinPoints as a trial program
SECA established a requirement to outfit all sites in 2009
Hardware upgraded to PinPoint P2R in 2010
Today there are 84 systems in the fleet (NAVAIR)

BENEFITS

Low cost and Test Routine development
Shorter development time
Fault isolates to a single component
Identify the failed CCA from ambiguity groups
Reduce BCM rates including PBL items
Reduce CND, NFF and A799 rates
Excellent BCM interdiction tool
Addresses obsolescence issues
PinPoint IIR Overview

The PinPoint IIR in-circuit functional tester (AN/USM-676) augments Weapon System circuit card analysis and troubleshooting. With PinPoint, the Navy and Marine Corps technician is now able to analyze circuitry and reduce fault isolation ambiguity size, and in most instances, “pinpoint” the actual cause of failure.

Narrowing circuit card and circuit card electronic component ambiguity is the **key to lowering AVDLR cost through BCM interdiction.**

The PinPoint Program provides a means for optimizing Navy CCA Maintenance
Technical Advantages/Differences between PinPoint and Protrack

**AN/USM-676 PINPOINT IIR**

Windows 7-based tester using COTS H/W, COTS S/W, and GOTS S/W

**DIGITAL and ANALOG circuit cards** can be tested using the Pinpoint (such as digital circuit cards and devices, component access or electrical equivalent test points (connector, other devices), and ancillary hardware (Custom IDs, etc.))

Provides in-circuit, power-on functional testing of circuit cards utilizing digital and analog testing, along with analog signature analysis, referred to as VI

Includes virtual instrumentation, shorts locator, LCR Bridge

Capable of reverse engineering and schematic generation

Uses MTR S/W Test Routine and MTR Database Utility for schematics and piece parts logistics published quarterly on DVD

**Pinpoint capable of serving as the future Naval Aviation Maintenance solution for newer aircraft SRAs (Joint Strike Fighter, EA-18G, P8, H60, X-47B UAV DRONE, newer weapon systems/support equipment)**

**AN/USM-674 PROTRACK Model 20B**

Windows XP-based tester using COTS H/W and GOTS S/W

**ANALOG** circuit cards and modules can be tested using the Protrack (includes power supplies, mostly discrete component populated circuit cards, etc.)

Non-powered testing of circuit cards and modules using analog signature analysis, referred to as VI

Test Routine contain assembly drawings, schematics, piece parts logistics and VI signatures, published quarterly on DVD

Works well with older aircraft CCAs/SRAs (this includes P3, older FA-18 variants (A/B/C), EA-6B, H1, etc.)

Digital capability is NON-EXISTANT with the Protrack – will provide VI capability; outcomes will not justify digital cards are labeled no fault found/RFI
PinPoint IIR vs. Protrack
Significant Difference

The most significant difference between the PinPoint IIR and Protrack is the fact that the PinPoint IIR will “Functionally Test” components according to their operational states.

PinPoint IIR

- Well suited for functional testing of digital and analog components (i.e. OP AMP circuits)
- Capable of dynamic testing, Tri-State Condition Testing, and V/I testing
- Capable of testing data bus/address bussed circuitry – Isolate bad component on a bus
- Memory testing including ROM dumping
- A to D and D to A converter testing
- Out of circuit functional testing to verify faults
- Eliminates false failures due to internal circuitry structure testing
- Integrated virtual instrumentation (O-scope, multi-meter, function generator, LCR bridge, programmable power supply, etc..) provides a more robust troubleshooting capability
- Higher procurement cost

Protrack Model 20B

- Well suited for testing of analog circuit cards
- The Protrack Model 20B performs a static V/I testing of the electrical components
  - Relying solely on V/I testing may lead to proper functioning devices being labeled as faulty due to signature differences between component manufacturers, internal structures and production runs
- Smaller footprint
- Less costly piece of equipment
- Ease of use

Note: VI becomes less effective as the device becomes more complex due to the difficulty detecting internal failures of complex devices, also the tri-state condition is unable to be tested functionality. Bussed circuits can not be tested with V/I.
Test Routine Development Process

Identify & Investigate

Parent Equipment

3 RFI CCAs

Analyze Source Data

ILS Data

Assembly Drawing

Schematics

Design & Develop

Huntron Test Routine
VI Signatures & Instructions

MTR Test Routine Database
Used for Huntron and PinPoint TRs

PinPoint Test Routine
Functional Tests, VI Signatures, Instructions & Assembly Drawing

Test & Implement

Test Routine Development Process

Request SM&R Code Change to NAVSUP
Need for PMA & FST Involvement
EI, ECP, Degraders

TR Verification
Huntron TR Verification by NUWC, MTR Program ISEA

TR DVD Distributed Quarterly To All Repair Facilities
(Next distribution will be in Oct and is 15-3)
Test Routine Capabilities

- Protrack and PinPoint provide:
  - Easy TR modification to facilitate Shop Replaceable Assemble (SRA) configuration changes
  - In circuit testing, components are not removed from circuit card
    - Functional testing of digital devices
    - Functional testing of analog devices or cluster testing of devices
    - Static and Power On measurements with virtual instrumentation
    - Analog Signature Analysis (ASA) aka VI
    - Full control of test execution
    - Provides complete step by step instructions for technician
  - Reverse engineering capability (Schematics, Gerber Files, etc.)
  - Extract PROM, EPROM & EEPROM data
  - Standardized development requirements
  - Boundary Scan Capability with JTAG specific components
The Need For Improved SRA Fault Isolation

• I-Level Circuit Card Assembly (CCA) Problems
  – Automatic Test Equipment (ATE) is only required to fault isolate to an ambiguity group of CCAs
  – Data confirms an ambiguity group will typically only have one faulty CCA
  – Failure to properly fault isolate increases BCM and CND/NFF (A799) rates
  – CASS SRA TPSs are not only time consuming for the Fleet to use, but are also much more costly to develop.
  – CASS SRA TPSs have poor fault isolation, as well as larger ambiguity group sizes because of “black-box” testing methodologies
  – SRA testing reduces the CASS station availability for WRA testing
  – Many WRAs do not have SRA TPSs and therefore troubleshooting must be done by plug and play
  – Obsolescence issues – Throw away’s (PAGZZ) losing support by OEM
  – Device obsolescence – PROM, EPROM & EEPROM (proprietary program data)
  – PBL – Identify the faulty CCA to BCM (BCM 1 instead of 3 CCAs)
CCTARS Program Advantages

• Low cost SRA test routines
• Shorter development time, Quicker fielding of test routines
• Small footprint, currently fielded ashore and afloat
• Excellent BCM interdiction tool
• Identify a faulty SRA from an ambiguity group
• BCM only the failed SRAs from an ambiguity group
• Provides in circuit fault isolation to a single component
• Reduce BCM, CND, NFF and A799 rates
• Hardware can be independently used as a troubleshooting tool
• Quarterly distribution of test routines to fleet on DVD
• Piece parts logistics updated on each distribution
• Test routine development cost provides excellent ROI
• Addresses obsolescence issues – discontinued OEM support
RTOC Initiative - Cost Savings

From FY09 to the present, a total of $4.4M has been invested to develop test routines. A total of $44.7M in cost avoidance has followed in this timeframe due to the cumulative effect of the CCTARS program, for an ROI of 9.1.
Ready For Issue (RFI)

- Conformal coating removed and power stimulus
- Next higher assembly required
- Platforms responsibility to run CCA after repairs performed
- CCAs need RFI Certification to be put back into aircraft

**NOTE:** The Next Higher Assembly requirement is the responsibility of the platform to facilitate the Ready For Issue (RFI) qualification after the repairs are performed.

There is the possibility that some platforms that use the OEM for service will not have any way to check the repairs

Fleet can't put anything back into the plane that does not have the RFI Certification tag.
A/C Program Involvement

- Third party involvement
  - Fleet repair sites
    - Poor candidate selection
    - Unaware of the entire scope
    - Only concerned with local issues
  - Boots on ground efforts
  - NAVICP
  - RTOC

- Direct program involvement is the most effective in reducing costs
  - Top degraders
  - CCA Variances – Revision, OFP, ECP
  - WRA Compatibility
  - Obsolescence issues
  - Improved asset availability
CCTARS Program Expertise

- Lakehurst has been the lead in aviation test routine development
  - Over 15 years PinPoint experience and 20 years Protrack experience
  - The only NAVAIR activity certified to verify PinPoint test routines
  - Authored the PinPoint development requirements
  - Certify new software builds for release to the fleet

- Other activities just starting test routine development
  - Non-engineering fleet repair activities such as FRCs
  - Higher development cost, longer development time
  - Lack the quality of testing required for superior fault isolation

- Independent contractors developing test routines (NOT RECOMMENDED)
  - Develop test routines to provide repair services
  - Test routines are not verified
  - Test routines are not distributed to the fleet – where is the cost savings?
  - Duplication of effort, no input to the Test Routine Database
  - Lacks piece part logistical support
  - No communication with the CCTARS program
  - Few have been completed by other activities increasing development cost
  - Subject to escalating costs


PMA260 TEST ROUTINE DATABASE

- Tracks planned & developed TRs
- Mirrors CIP Database
- Sites can request TR development
What Are Your Top Degraders?

• **Provide us a list of your top degraders**
  - List 10 or 20 circuit card assemblies
  - Consider asset availability

• **We will provide you**
  - Engineering analysis of the circuit card assemblies
  - ROM
Questions??

POC Info:
Christopher.zarycki@navy.mil
x4015
**CCR2000**

**CONFORMAL COATING REMOVER**

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**EQUIPMENT**

CCR Company Conformal Coating Remover

- Fully self-contained, non-chemical bench top workstations designed for the removal of conformal coatings applied to CCAs
- All the necessary safety features required for both the operator and the printed circuit board are designed into each workstation
- The CCR2000 will remove most types of conformal coating including Epoxy, Urethane, Parylene, Silicone and Acrylic

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**BACKGROUND**

- Requirement arose to remove conformal coating for attaching clips to circuit cards used on the PinPoint In Circuit Tester
- Tech Evaluation successful in 2005
- Only deployed to sites with PinPoint
- Today there are about 50 systems in the fleet (NAVAIR)

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**BENEFITS**

- Simple effective method for removing conformal coating
- No need for harsh chemicals
- Eliminates the storing and removing of harsh chemicals
- Effective on most types of conformal coating
770 Pinpoint and Protrack Test Routines (TR) currently available in Navy/USMC inventory for use

<table>
<thead>
<tr>
<th>Aircraft Platform T/M/S</th>
<th>Pinpoint TRs</th>
<th>Protrack TRs</th>
<th>Total TRs Deployed</th>
<th>*Unique Pinpoint TRs</th>
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- *88 Unique PinPoint Test Routines fielded
  - Those not shared by Protrack
## Fielded CCTARS Locations

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<th>Location</th>
<th>Pin</th>
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Assembled Replacement Integrated Circuits (ARICs)

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Distribution Statement A: Approved for Public Release; Distribution is unlimited.
NUWC Keyport #15-030
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
Assembled Replacement Integrated Circuits (ARICs)

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.
Assembled Replacement Integrated Circuits (ARICs)

2015 DoD Maintenance Innovation Challenge

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

- 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)
Assembled Replacement Integrated Circuits (ARICs)

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) *

* Engineering analysis required to make this determination
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
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
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

Distribution Statement A: Approved for Public Release; Distribution is unlimited. NUWC Keyport #15-030
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
The Detection and Prevention of Counterfeit/Defective Electronic Integrated Circuits using the NOKOMIS ADEC Sensor System

Bryan J. Neva, Sr., BSEE, MBA
Avionics Engineer
NAVAIR FRCSW
NAS North Island, CA
• Aviation Maintenance Repair Overhaul (MRO) facility
• F/A-18, E-2, C-2, AV-8, H-53, H-60 etc.
• Over 4000 civilian/military personnel
• In-Service Support Center (ISSC) provides Research, Engineering & Logistical support for the Navy and Marine Corps
• AAT Integrated Product Team (IPT) comprised of Subject Matter Experts to bring innovation to FRCSW

• Leverages FRCSW Navy Federal Lab Designation with Office of Research and Technology Applications (ORTA) for Cooperative Research and Development Agreements (CRADA)

• Avionics & Radar: currently exploring technologies to prevent Counterfeit/ Defective ICs at FRCSW IAW DoD Policy
  • DoD Instruction 4140.67
Counterfeit IC Background

- Most ICs Manufactured Overseas
- e-waste is “recycled”
- DoD is Relatively Small Consumer of ICs
  - Does not have “trusted” manufacturers
  - Can’t regulate industry
- Big risk that ICs acquired will not meet specifications for performance and reliability
- Counterfeit ICs cost DoD $100s Millions per year
Counterfeit Issues at FRCSW

• Obsolescence DMSMS Issues
  • Increases Risk of Counterfeit/Defective ICs for aging equipment

• Defects Not Discovered Until Soldered into PCB
  • Requires Costly Rework
  • Estimated $30,000 per incident
  • Estimated 228 incidents per year
  • Estimated cost $6.84 Million per year!

• Old ICs sold to Navy as new only work for a short time
  • Causes Early Life Failure (ELF) of WRAs

• Increased Lifecycle Costs in Tight DoD Budget
Counterfeits and IC Lifecycle

Most likely to be targeted by counterfeiters

Electronic Component Lifecycle
1) Pedigree Inspection (MilSpec)
   • Primary method used at FRCSW/Military Supply System
   • PROS: Qualified Product, Manufacturer, Supplier, Distributor
   • CONS: Pedigree does not guarantee authenticity; Open market purchases bypasses this method; DoD cannot regulate IC manufacturing industry

2) Visual External Inspection
   • Secondary method used at FRCSW and DoD
   • PROS: Cheap, easy, widely used
   • CONS: Only as good as the person inspecting; Does not catch substandard/defective ICs; Mostly shown to be ineffective

3) Electrical Testing
   • FRCSW Tests PCBs/WRAs after Repairs Completed
   • PROS: Widely Used; Relatively Effective
   • CONS: Costly, Time Consuming; Not Easy; Can’t detect substandard/defective ICs or Old chips sold as New
Other Legacy Counterfeit Detection Methods

4) Microscopic Inspection

5) X-Ray Inspection

6) X-RF Inspection

7) De-capsulation Inspection

8) SAM Inspection

9) DNA Markings (not available for obsolete ICs)

---------------------

- **Pros:** Aggregate effectiveness **only 86%**
- **Cons:** Require huge investment; Expensive; Time Consuming; Require Advanced Training and Personnel; **Cost/Benefit Ratio too Large**; Impractical to use at FRCSW
FRCSW Technology Gap

- Pedigree & Visual methods Ineffective
- Electrical testing works but increases repair costs
- Legacy Counterfeit Detection Methods impractical at FRCSW
- FRCSW needs is a fast, affordable, automated, practical, user-friendly, fool-proof technology to identify Counterfeit and Defective ICs
- AAT IPT learned of a new Counterfeit & Defective IC Detection technology developed from over $16 M in DoD SBIR funding: NOKOMIS ADEC System. It is 99% Effective!
- AAT undertook initial pilot in FY2014 with NAVSEA and Nokomis related to counterfeits for parts used at FRCSW (Presented at DMSMS 2014)
2015 DoD Maintenance Innovation Challenge

NOKOMIS ADEC
Supporting America’s Advanced Technology
Advanced Detection of Electronic Counterfeits

ADEC Historical Timeline

2016
FRCSW Pilot & Integration Activities

2015

AFSC Wide Pilot
(Hill, Robins, Tinker AFB)

2014

NAVSEA/NAVAIR Pilot at FRCSW
(Navy Evaluates FRCSW Stock Intended for System Installation)

2013

Initial Air Force Pilot
(Hill AFB)

2012

NAVSEA Completes 3 Successful Blind Pilots

2011

$15 Million in Phase I, II, & III to Develop Core Sensor

2006

SBIR Success Story

NAVSEA IWS Repurposes Core Sensor
(For Advanced Detection of Electronic Counterfeits)
Costs, Benefits, ROI

- LTG Patrick O’Reilly, Former Director of MDA, estimated the cost per counterfeit incident for the THAAD missile system at $2.78 Million (Testimony to Senate Armed Services Committee, November 2011)

- Bruce Mahone, Director of SAE, estimated the cost per counterfeit incident at $2.8 Million (SAE G-19A meeting, December 2013)
  - Note: The following estimates are based on Bruce Mahone’s estimates.

- FRCSW AAT Estimated Costs/Savings/ROI:
  - Cost of NOKOMIS ADEC System ~ $3 Million
  - Cost per unscheduled maintenance repair incident ~ $30,000
  - Number unscheduled maintenance repair incidents per year ~ 228
  - Savings per year ~ $6.84 Million
  - ROI over 10 years ~ 2000%
The Path Forward…

- Capitalize on over $16 Million in DoD SBIR Investment

- Consider LP-CRADA for further system evaluation
  - AAT is a Federal Lab

- Consider SBIR Phase II.5 project for additional R&D as determined after evaluation

- Eventually introduce this technology into all DoD Depot Repair Facilities as the standard Counterfeit IC Detection technology
Miniature/Microminiature (2M) Module Test & Repair (MTR) Program

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COM 202-781-3259 DSN 326-3259
Rich McConnell@navy.mil
What is the NAVSEA 2M MTR Program?

- NAVSEA 04RM3 provides 245 ships and shore activities with capabilities to repair circuit card assemblies (CCA) and electronic modules (EM) which results in reduced OPTAR expenses and averts/corrects CASREPs (casualty reports).

- Technicians are provided with special purpose test equipment, 2M repair equipment, **Gold Disk** diagnostics and repair procedures and piece parts to support CCA and EM repairs.

- 3 training courses taught at six Navy training sites, 5 NEC (Navy Enlisted Classification) codes and certification/inspection processes for technicians, 2M MTR work centers/shops and training sites.

- The Module Test & Repair Tracking System (MTRTS) is a 2M MTR reporting system resident on the AN/USM-674 test system. MTRTS provides quarterly program metrics IAW Joint Fleet Maintenance Manual (JFMM) policy.
Benefits of 2M MTR Utilization

- Improves readiness & sustainability of systems/equipment
- From 1 Apr. 1996 to 30 Jun. 2015 Navy commands outfitted with MTR capabilities reported 191,754 repairs completed, which resulted in 12,348 CASREPS averted/corrected and nearly $700M in OPTAR cost avoidance.
- Results in reduced requirements for wholesale and retail spares
- Minimizes diminishing manufacturing sources and material shortages (DMSMS) issues
- Minimizes “No Failure Evident” cards being sent to depots
- Reduces tech assists from off ship/base tech reps
- Sailors/Marines are eligible for a $2,000 Monthly CNO Gold Disk Award and a LOC (letter of commendation) from OPNAV N4.
- Module Test and Repair quarterly reporting can provide system PM/ILSM/Engineering agent/OEM with repair and failure data
Engineering Agents, Customers and Sponsors
484 Total DOD Commands

HQMC (I&L) / 64 Commands
MARCORSYSCOM TMDE
Saudi Arabia
Japan
Spain – Rota
Spain - Ferrol
Kuwait
Switzerland
Korea – Upcoming
Australia – Upcoming
Poland - Upcoming

USMC (ground)
Echelon 3 & 4 Commands
597 Gold Disks
202 Test Systems*

Surface Ships, Subs, Shore Commands
5,854 Gold Disks
448 Test Systems*

NUWCDET
FEO NORFOLK
NSWC CRANE

Naval Aviation:
AIMDs, MALs & FRCs
389 Gold Disks
133 Test Systems*

OPNAV N431/274 CMDS
NAVSEA 04RM3

OPNAV (N88)/64 CMDS
NAVAIR (PMA 260)

Other Customers
Nat’l Guard/5 CMDS
USAF/37 CMDS
USCG/39 CMDS
USA/1 CMD
FMS/various

GOALS
1. Maintain standard 2M MTR HW/SW/ILS processes
2. Obtain maximum synergy from shared and unique infrastructure

* AN/USM-674

5,854 Gold Disks
448 Test Systems*
2M MTR Navy Technicians

- 9 rates are eligible
- Most are ETs and ATs
- Technician proficiency is maintained through a 18-month recertification requirement
- The benches are also inspected on a 18-month cycle
AN/USM-674 Test Station
AN/USM-676 PinPoint Test Station
Standard 2M Workstation Configuration (PRC 2000-SMT)

Microscope, tools, ESD material and consumables not shown.
2M Repair Station Equipment

Supplemental Lighting Source

Microscope Assembly
Gold Disk DVDs

MTR TEST ROUTINE DVD-ROM used with USM-674 & USM-676 Test Systems

Distributed quarterly to over 500 DoD and USCG commands

Contains all Gold Disk diagnostics test routines for the 2M/MTR Technician

DVD (15-4) distributed Jan 2016 includes approximately 7,000 Test Routines

➢ The MTR GOLD DISK developed and maintained by NUWCDETN Norfolk provides logistics information and computer aided diagnostics procedures in support of 2M MTR processes.
TEST ROUTINE DEVELOPMENT

COMBINE SIGNATURES OF THREE KNOWN GOOD CIRCUIT CARDS

SCHEMATIC DATA

LOGISTICS DATA (ILS)

C1 M39014/01-1513 5910-00-010-8717
C2 M39014/01-1513 5910-00-010-8717
R1 RLR05C1001GR 5962-00-012-2824
R2 RLR05C2201GR 5962-00-166-3181
U1 5767286-25 5962-01-285-9726
U2 5767286-26 5962-01-285-9727
U3 5767286-27 5962-01-285-9161

QUALITY ASSURANCE FINAL VERIFICATION

DISTRIBUTION ON DVD
Training for 2M MTR

Completion of first 3 individual courses results in NEC 1591 (Navy/Coast Guard), MOS 8641 (USMC), MOS94Y (Army)

AN/USM- 674
A-100-0076
5 days
NEC - N/A

Miniature
Electronic Repair
A-100-0072
26 days
NEC 9527

Microminiature
Electronic Repair
A-100-0073
12 days
NEC 9526

2M MTR Pipeline
A-100-0008
47 days
NEC 1591
(only at Navy Training Sites)

School Locations
CNATTU Whidbey Island / CNATT Det Atsugi

USMC (1): MCCES 29 Palms, CA

USAF (2): 372nd Training Squadron, Detachment 11 (AETC) Davis Monthan AFB/372 TRS/ DET 17
Spangdahlem AB, Germany

USCG (1): TRACEN Yorktown

Starts 1-Oct-2011
Surface Ships have two Piece Part APLs (Parts located in 2M MTR Work center and Supply storerooms). SSBNs, SSGNs, MCMs and shore commands have one APL.

NUWCDET develops the piece parts APL (allowance parts list) based on ship class Gold Disks, piece parts reported utilized in MTRTS and Fleet Readiness Action Team (FRAT) requests. FRAT is Fleet’s piece parts help desk which identifies and supplies piece parts not available in the supply system.

Piece part inventories are on the USM-674 test system controller via MTR application software.
Commands with 2M MTR repair capability use the MTR Tracking System (MTRTS) to document 2M repairs on electronic CCAs/EMs. Each quarter Navy commands submit MTRTS reports to NUWC Det FEO. These data metrics are combined to produce MTRTS totals reports for distribution to TYCOMs, ISICs and PMs.
Ongoing Initiatives

• Develop Gold Disks for Fleet nominated and high cost/high failure, out of production and low in stock CCA/EMs.
• Phased replacement of existing 2M equipment and test systems (ongoing)
• Upgrade Pinpoint test systems (AN/USM-676) to IIR configuration.
• 3rd Generation Gold Disk Test system (USM-726)
• Improve Fleet (O/I level) 2M MTR utilization
  - Restart 2M Progressive Repair Enhancement Program (PREP) and Gold Disk traps.
Backup slides
Program Policy & Responsibilities

OPNAVINST 4700.7L (Encl 5)
OPNAVINST 4790.13A
NAVSEA 4790.17B (draft)
Joint Fleet Maintenance Manual (USFFCINST 4790.3)
Volume VI Chapter 8
DMSMS Lessons Learned

• CCA/EM DMSMS situations normally occur because OEMs or their suppliers stop production and contractor depots repair support.

• Use of Gold Disks may not always be the best solution but is normally the least expensive and quickest short term solution.
MTR SOFTWARE REVISION

MTR SOFTWARE 5.0

- MTR DISPATCHER
- MTR GRAPHICS VIEWER
- SIGNATURE VIEWER HW4.3 FUNCTIONALITY
- SIGNATURE UTILITY HW4.3 FUNCTIONALITY
- MTR DATABASE UTILITY

HUNTRON WORKSTATION (HW) 4.3

TEST ROUTINE CONVERSION 7000+
HW 3.5 (CURRENTLY FIELDED) -> HW 4.3 (REVISION)
TEST ROUTINE VERSION 3.5 DISTRIBUTION (15-4)
TEST ROUTINE VERSION 4.3 DISTRIBUTION (16-1)

OPERATOR DIFFERENCE VIDEO

(WIN XP/WIN 7 64 ENTERPRISE COMPLIANT)
Model 32 Development

PROTOTYPE DESIGN (AN/USM-726)
PROTRACK OBSOLECENSE
FRONT PANEL TRI-STATE BENCHTOP OPERATION
FOOTPRINT REDUCTION
  • 456 CUBIC INCHES (PROTRACK/SCANNER ~ 1700 CUBIC INCHES)
  • APPROX. 10 LBS (PROTRACK/SCANNER ~ 28 LBS)

PROTOTYPE MODEL 32-FIRMWARE STABLE FEB 2014
MODEL 32 DESIGN IMPROVEMENTS DELIVERY OCT 2014
MODEL 32 SAP ACQUISITION FY16
TEST INSTRUMENT COST $10K
MODEL 32 IDIQ CONTRACT PLANNED COMPLETION FY17
HUNTRON MODEL 32
TF 500 (Shore IMA) Fine Pitch Rework Station
SODRTEK ST-400 RADIANT PREHEATING SYSTEM WITH ST-550 CIRCUIT BOARD HOLDER
2M Repair Station Tools and Accessories

Tools & Consumables

Circuit Card & Workpiece Holder
ESD Prevention Material
Integrated Circuit Test, Repair & Re-Manufacture

Review & Wrap-Up

19 January 2016
Next JTEG Technology Forum

Maintenance Innovation Challenge Finalists

26 January 2016