JTEG
Joint Technology
Exchange Group
Joint Solutions for Depot Maintenance

Welcome to the JTEG Monthly Teleconference

Topic:
Integrated Circuit Test, Repair & Re-Manufacture

19 January 2016

AGENDA

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)

1400-1425: Detection & Prevention of Counterfeit / Defective Electronic Integrated Circuits using NOKOMIS Advanced Detection of Electronic Counterfeits (ADEC) Sensor System - Bryan Neva (FRC-SW)

1425-1450: Miniature/Micro-miniature (2M) Electronic Repair and Module Teat & Repair (MTR) Gold Disk Programs - Rich McConnell (NAVSEA 04RM33)

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 & RTOC Test Routine Development

Program Scope

- 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)

CCR2000
CONFORMAL COATING
REMOVER

AN/USM-674
PROTRACK

AN/USM-676
PINPOINT

AN/USM-674(V)3
PROTRACK STATION

Model 20B

Model 32 Concept

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

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)

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

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

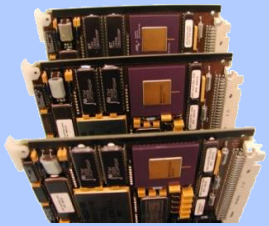
Note: VI becomes less effective as the device becomes more complex due to the difficulty detecting internal failures of complex devices, also the tri-state condition is unable to be tested functionality. Bussed circuits can not be tested with V/I.

Test Routine Development Process

Identify & Investigate

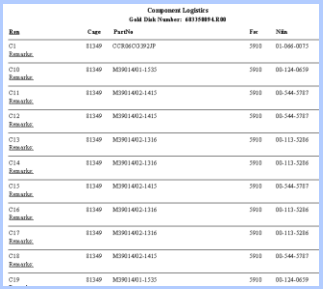
Parent Equipment

3 RFI CCAs

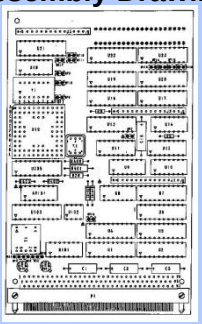


Analyze Source Data

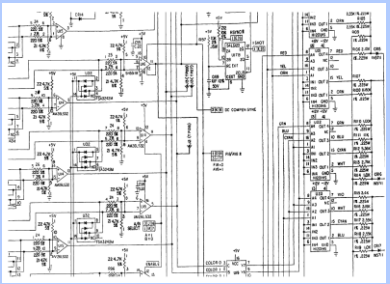
ILS Data



Assembly Drawing



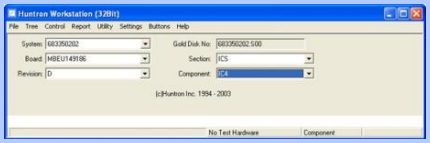
Schematics



Design & Develop

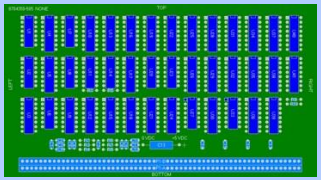
Huntron Test Routine

VI Signatures & Instructions



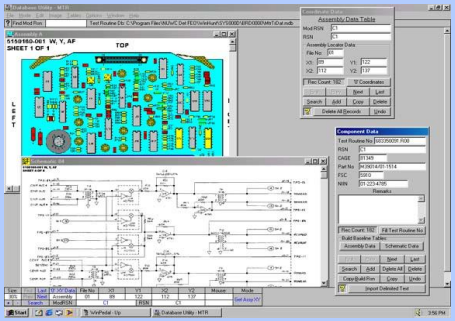
PinPoint Test Routine

Functional Tests, VI Signatures, Instructions & Assembly Drawing



MTR Test Routine Database

Used for Huntron and PinPoint TRs



Database Contains:
Piece Parts Logistics
Searchable Schematics
Searchable Assembly Drawings
(Assembly Drawing for Huntron TRs Only)

Test & Implement

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

NAVAIR PinPoint TR Verification by Lakehurst or NUWC

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

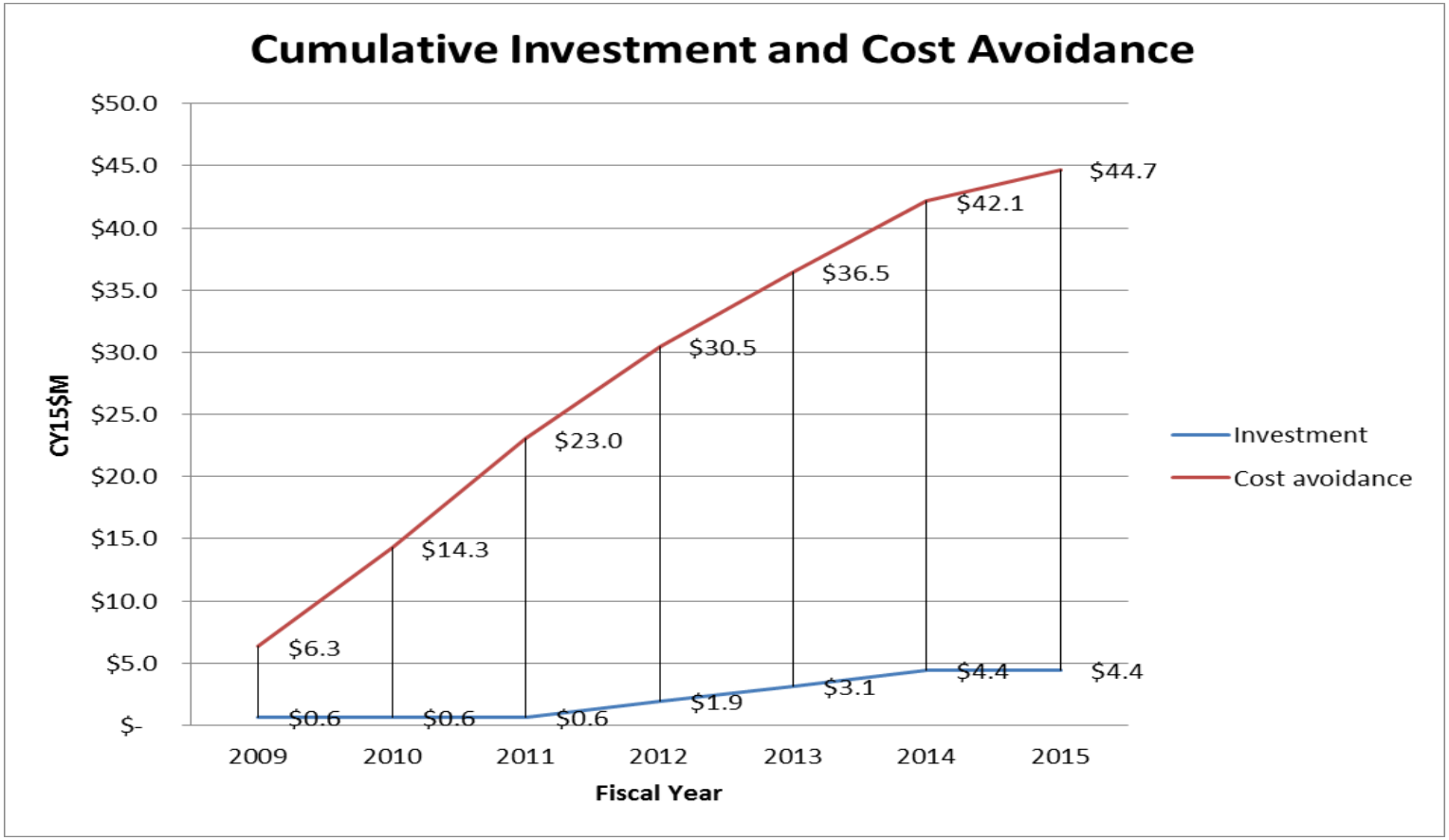
- I-Level Circuit Card Assembly (CCA) Problems
  - Automatic Test Equipment (ATE) is only required to fault isolate to an ambiguity group of CCAs
  - Data confirms an ambiguity group will typically only have one faulty CCA
  - Failure to properly fault isolate increases BCM and CND/NFF (A799) rates
  - 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.

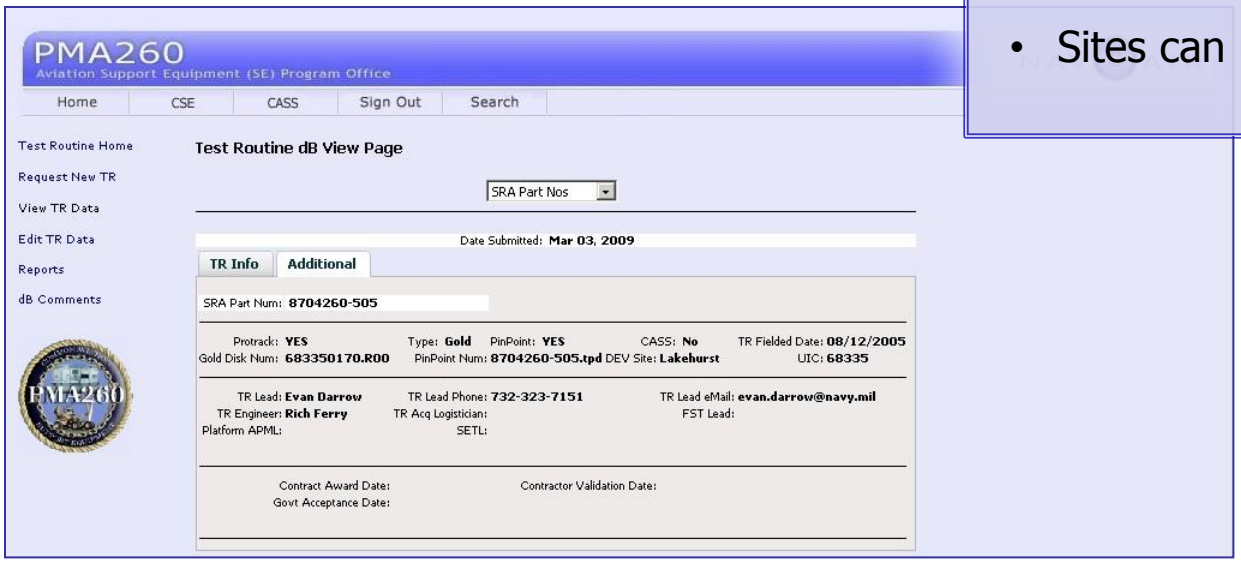
A/C Program Involvement

- 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:

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x4015

CCR2000
CONFORMAL COATING REMOVER

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

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)

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

CCTARS Test Routines by Platform

- 770 Pinpoint and Protrack Test Routines (TR) currently available in Navy/USMC inventory for use

Aircraft Platform T/M/S	Pinpoint TRs	Protrack TRs	Total TRs Deployed	*Unique Pinpoint TRs
F/A-18A/B/C/D/E/F	57	303	360	27
CH-53D/E	33	34	67	21
E-2C	4	45	49	3
H-60F/R/S	8	40	48	0
AV-8B	6	24	30	6
V-22	25	3	28	24
EA-6B	21	92	113	6
OTHER	22	53	75	1
TOTAL	**176**	**594**	**770**	**88**

- *88 Unique PinPoint Test Routines fielded
  - Those not shared by Protrack

Fielded CCTARS Locations

SECA	Location	Pin	Pro	CCR
L	FRCMA Norfolk, VA	1	2	1
L	FRCMA Norfolk 146E12	0	1	0
L	FRCSE Jax, FL	2	2	1
L	FRCSE Key West, FL	0	1	0
L	FRCSW North Island, CA	1(2)	2	1
L	USS NIMITZ (CVN-68)	1	2	0(1)
L	USS DDE (CVN-69)	1	2	1
L	FRCSW Point Mugu, CA	1	1	0(1)
L	PMRF TRGT DEPT-Missle DI, HI	0	0	0
L	USS Carl Vinson (CVN-70)	1	2	1
L	USS Theodore Roosevelt (CVN-71)	1	2	1
L	USS Abraham Lincoln (CVN-72)	1	2	1
L	USS George Washington (CVN-73)	1	2	1
L	USS John C. Stennis (CVN-74)	1	2	1
L	USS Harry S. Truman (CVN-75)	1	2	1
L	USS Ronal Reagan (CVN 76)	1	2	1
L	USS George H. W. Bush (CVN-77)	1	2	1
L	CNFJ Targets Okinawa, JA	0	0	0
L	Navy Activity Kaneohe Bay, HI	0	1	0
L	FRCNW Whidbey Island	2	3	0
L	COMFAIRFWD DET AIMD Iwakuni, JA	0	1(2)	0

SECA	Location	Pin	Pro	CCR
L	COMFAIRFWD DET AIMD GUAM	0	1	0
L	COMSTRATCOMMWING One Tinker	0	0(2)	0
L	FRCMA Oceana, VA	2	3	1
L	FRCSE Mayport, FL	0(1)	2(1)	0(1)
L	FRC WEST DET Fallon	0	1	0
L	COMFAIRFWD DET AIMD Atsugi, JA	0	1	0
L	COMFAIRFWD DET Sigonella	0	0	0
L	FRC WEST Lemoore	3	3	1
L	CFAF DET AIMD MISAWA/KADENA	0	1	0
L	HM-14 I LVL DET 1 Norfolk	0	0(1)	0
L	HM-15 I LVL DET 1 Norfolk	0	0(1)	0
L	HM-15 I LVL DET 2 Norfolk	0	0(1)	0
L	MALS-11 MAG-11 3MAW	1	1	1
L	MALS-11 TSA MAG-11 3MAW	0	1	0
L	MALS-12 MAG-12 1MAW	1	1	1
L	MALS-13 MAG-13 3MAW	1	1	1
L	MALS-14 MAG-14 2MAW	2	0(1)	1
L	MALS-14 TSA MAG-14 2MAW	0	0(1)	0
L	MALS-16 MAG-16 3MAW	1	2	1
L	MALS-24 MAG-24 1MAW	1	1(2)	0(1)
L	MALS-26 MAG 26 2MAW	1	1(2)	1

Fielded CCTARS Locations (cont.)

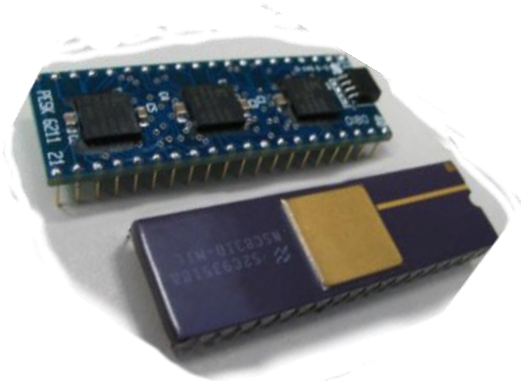
SECA	Location	Pin	Pro	CCR
L	MALS-26 TSA MAG-26 2MAW	0	0(1)	0
L	MALS-29 MAG-29 2MAW	1	2	1
L	MALS-29 TSA MAG-29 2MAW	0	0(1)	0
L	MALS-31 MAG-31 2MAW	2	2	1
L	MALS-36 MAG-36 1MAW	1	1	0(1)
L	MALS-39 MAG-39 3MAW	1	2	1
L	MALS-39 TSA MAG-39 3MAW	0	0(1)	0
L	HMX-1 IMA MCAF Quantico	1	1	1
L	VMR-1 MCAS Cherry Point	0	0(1)	0
L	USS Peleliu LHA-5	0	0	0
L	USS America LHA-6	0	1	0
L	USS WASP LHD-1	0	2(1)	0
L	USS Essex LHD-2	0	1	0
L	USS Kearsarge LHD-3	0	2(1)	0
L	USS Boxer LHD-4	0	1	0
L	USS Bataan LHD-5	0	1(2)	0
L	USS Bonhomme Richard LHD-6	0	1	0
L	USS IWO JIMA LHD-7	0	1	0
L	USS Makin Island LHD-8	0	1	0
N	NTWL FRCMA Patuxent River	0(1)	1	1
N	FRC-SE Jacksonville	2	0(4)	1

SECA	Location	Pin	Pro	CCR
N	FRCSW Depot	2	1	1
N	FRCE Depot Cherry Point	6	2	2
N	NAWCAD Engineering Dept.	4	4	1
N	BCMI FRCW Lemoore	0	5	0
N	BCMI FRCMA Oceana	0	1	0
N	BCMI FRCNW Whidbey Island	0	1	0
N	In-Service Support Center CP	3	0	0(1)
N	In-Service Support Center SE	1	0	0(1)
N	In-Service Support Center SW	1(3)	0	1
N	RW VIP R5 Program	2	1	0
R	MALS-41 MAG-41 MAW	0	1	0
R	NAS JRB Fort Worth	1	1	0(1)
R	FRC Mid Atlantic New Orleans	0	0(1)	1(0)
R	NAF Washington, AIMD	0(1)	0(1)	1(0)
S	Lakehurst NJ Staging Activity	26	3(0)	14(0)

2015 DoD Maintenance Innovation Challenge

Assembled Replacement Integrated Circuits (ARICs)

NAVSEA WARFARE CENTERS KEYPORT



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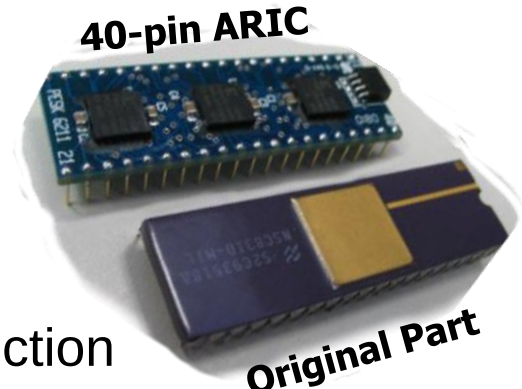
Assembled Replacement Integrated Circuits (ARICs)

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)

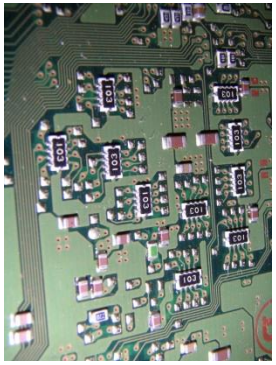
- ARIC's use of VHDL (VHSIC Hardware Description Language)
  - In high density programmable electronic components, use of VHDL programming allows designs to be more cost-effectively transitioned to new technologies, significantly minimizing future obsolescence resolution costs.
  - Air Force Materiel 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.

22-pin ARIC for DoD Platform

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

Assembled Replacement Integrated Circuits (ARICs)

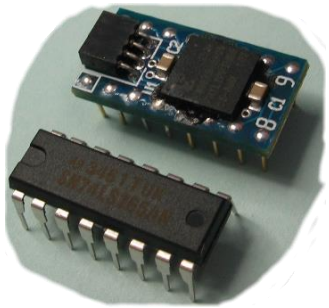
Solution (continued)



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

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

- 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)



16-pin ARIC & Original Part

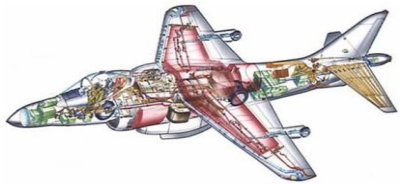
2015 DoD Maintenance Innovation Challenge

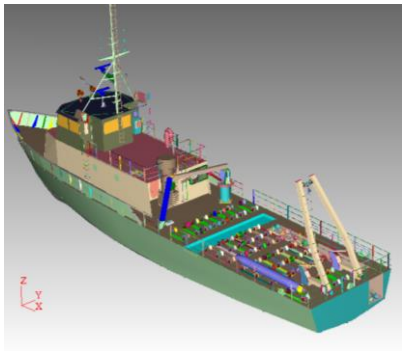
Assembled Replacement Integrated Circuits (ARICs)

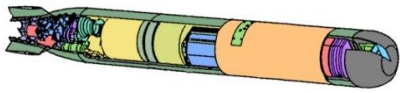
NAVSEA WARFARE CENTERS
KEYPORT

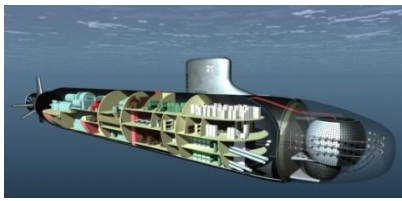
Benefits

- 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) *









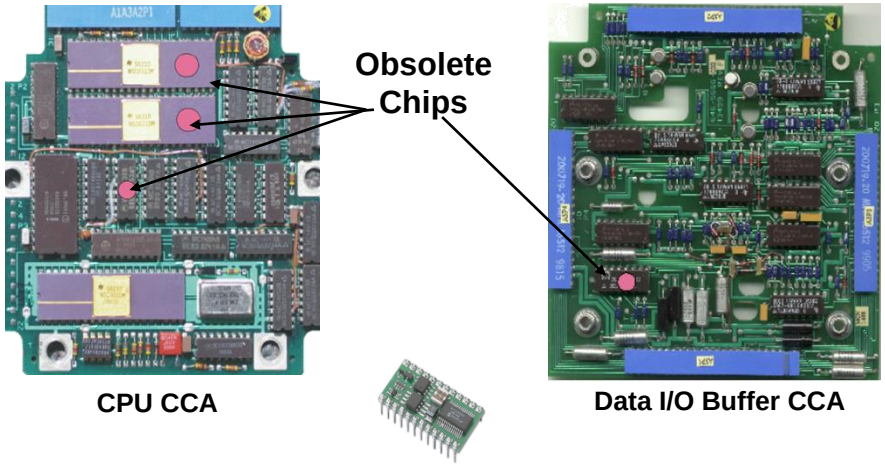
* Engineering analysis required to make this determination

2015 DoD Maintenance Innovation Challenge

Assembled Replacement Integrated Circuits (ARICs)

NAVSEA WARFARE CENTERS KEYPORT

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

2015 DoD Maintenance Innovation Challenge

NOKOMIS ADEC

Supporting America's Advanced Technology

Advanced Detection of Electronic Counterfeits

FLEET READINESS CENTER SOUTHWEST FRC EFFICIENS · AGILIS · VELOX

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

2015 DoD Maintenance Innovation Challenge

Fleet Readiness Center Southwest

- **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**

2015 DoD Maintenance Innovation Challenge

Advanced Aircraft Technologies IPT

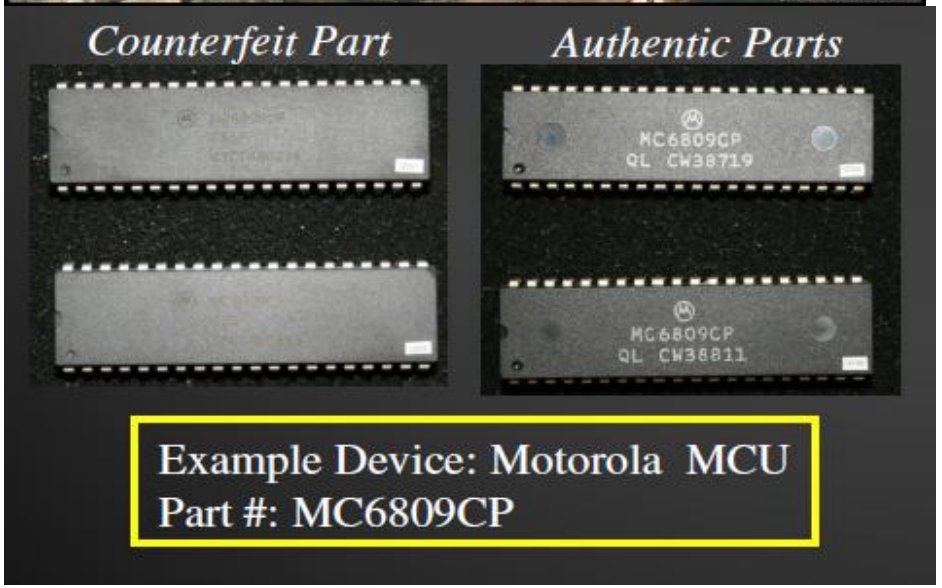
- AAT Integrated Product Team (IPT) comprised of Subject Matter Experts to bring innovation to FRCSW

- 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
- <u>Counterfeit ICs cost DoD $100s Millions per year</u>

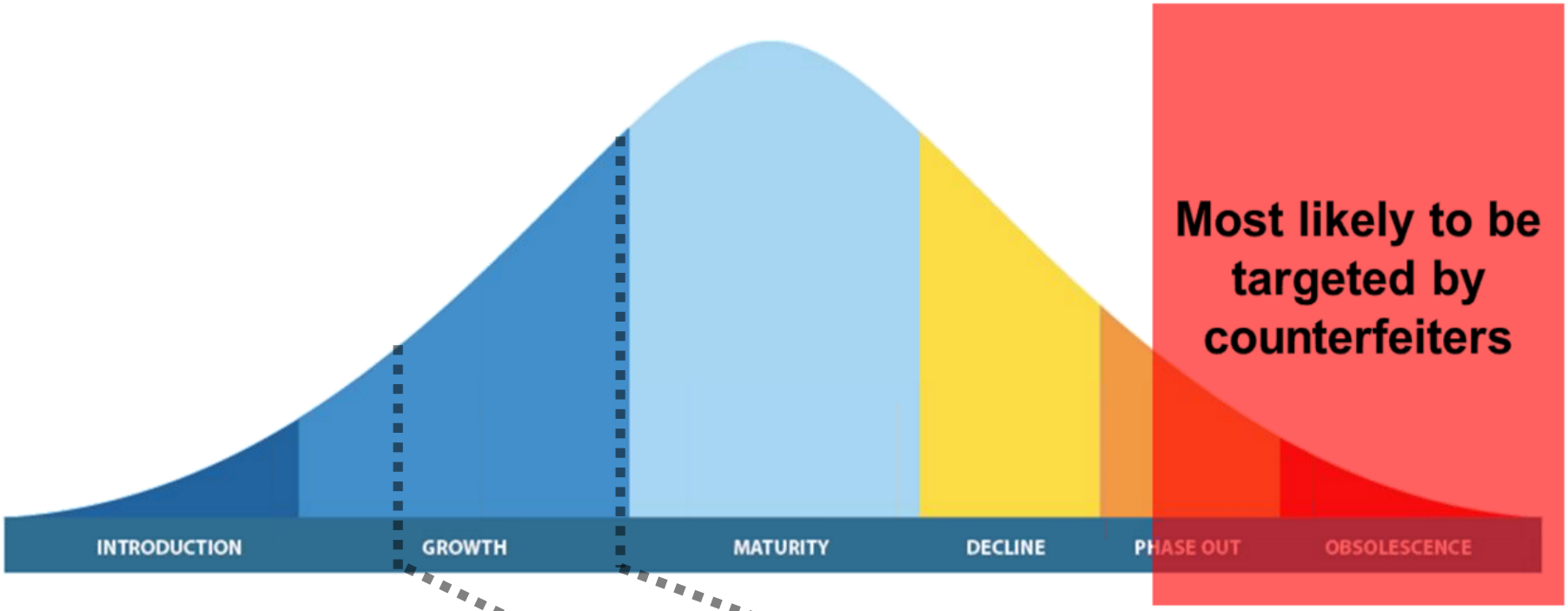


2015 DoD Maintenance Innovation Challenge

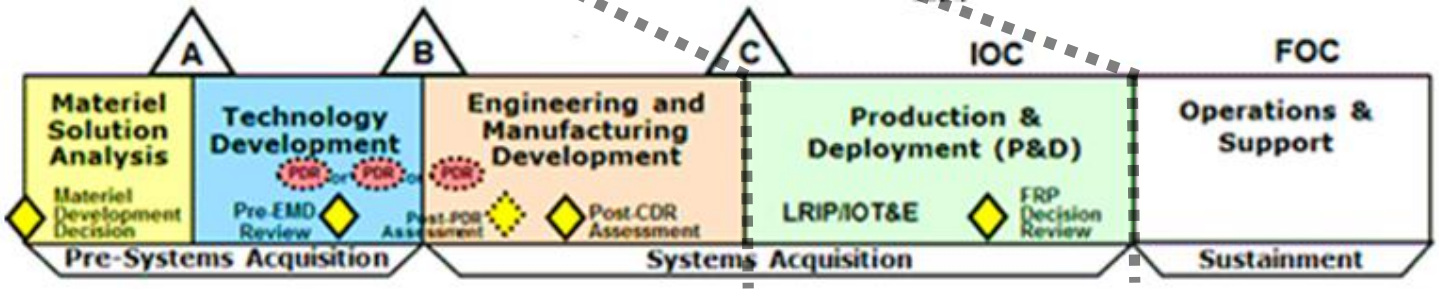
Counterfeit Issues at FRCSW

- **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



Electronic Component Lifecycle



2015 DoD Maintenance Innovation Challenge

Current FRCSW Counterfeit Detection Methods

1) **Pedigree Inspection (MilSpec)**
   - Primary method used at FRCSW/Military Supply System
   - PROS: Qualified Product, Manufacturer, Suppler, 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

FLEET READINESS CENTER SOUTHWEST FRC EFFICIENS · AGILIS · VELOX

ADEC Historical Timeline

2006

SBIR Success Story

2012

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

2013

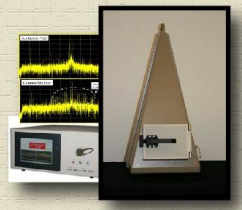
NAVSEA IWS Repurposes Core Sensor

(For Advanced Detection of Electronic Counterfeits)

2014

NAVSEA/NAVAIR Pilot at FRCSW

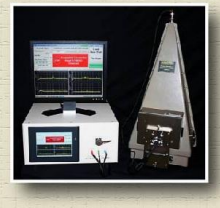
(Navy Evaluates FRCSW Stock Intended for System Installation)



2015

Initial Air Force Pilot

(Hill AFB)



NAVSEA Completes 3 Successful Blind Pilots

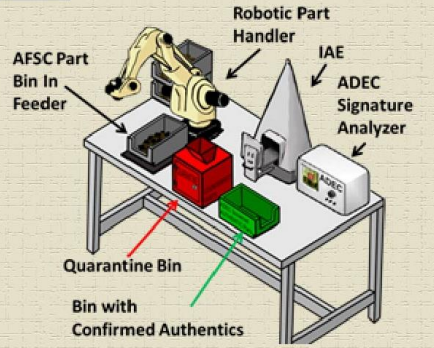
Criteria	Performance
Pd	100%
FAR	0%
Specificity	100%

2016

AFSC Wide Pilot

(Hill, Robins, Tinker AFB)

FRCSW Pilot & Integration Activities



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**

2015 DoD Maintenance Innovation Challenge

NOKOMIS ADEC

Supporting America's Advanced Technology

Advanced Detection of Electronic Counterfeits

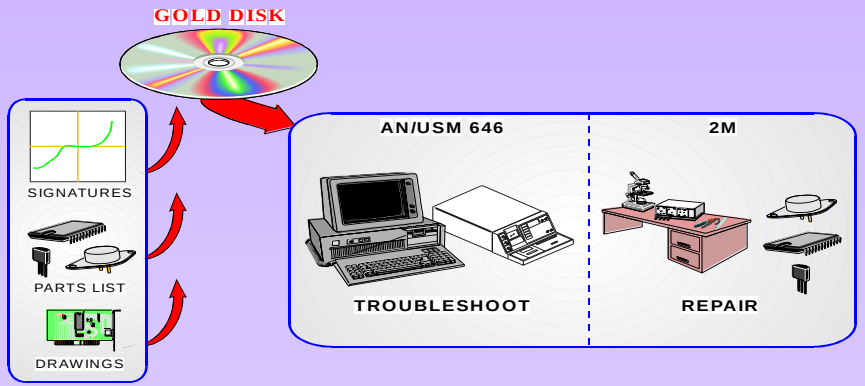
FLEET READINESS CENTER SOUTHWEST FRC EFFICIENS · AGILIS · VELOX

Play Video Here (length 1:50)

NAVSEA

NAVAL SEA SYSTEMS COMMAND

Miniature/Microminiature (2M) Module Test & Repair (MTR) Program



Rich Mcconell, SEA 04RM33
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

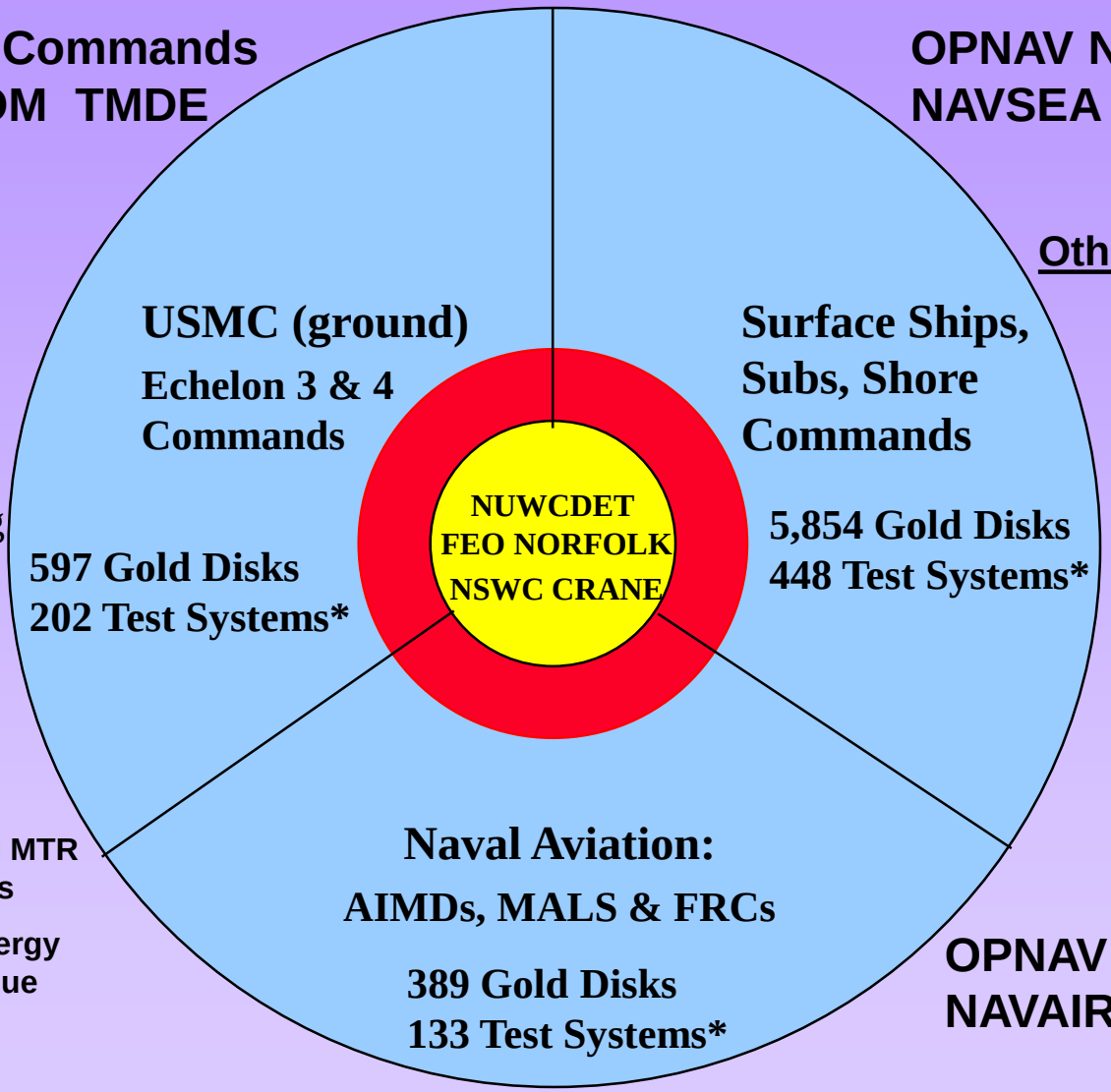
- Improves readiness & sustainability of systems/equipment
- From 1 Apr. 1996 to 30 Jun. 2015 Navy commands outfitted with MTR capabilities reported 191,754 repairs completed, which resulted in 12,348 CASREPS averted/corrected and nearly $700M in OPTAR cost avoidance.
- Results in reduced requirements 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

OPNAV N431/274 CMDS
NAVSEA 04RM3



Other Customers

Nat'l Guard/5 CMDS
USAF/37 CMDS
USCG/39 CMDS
USA/1 CMD
FMS/various

* AN/USM-674

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

GOALS

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

2M MTR Navy Technicians

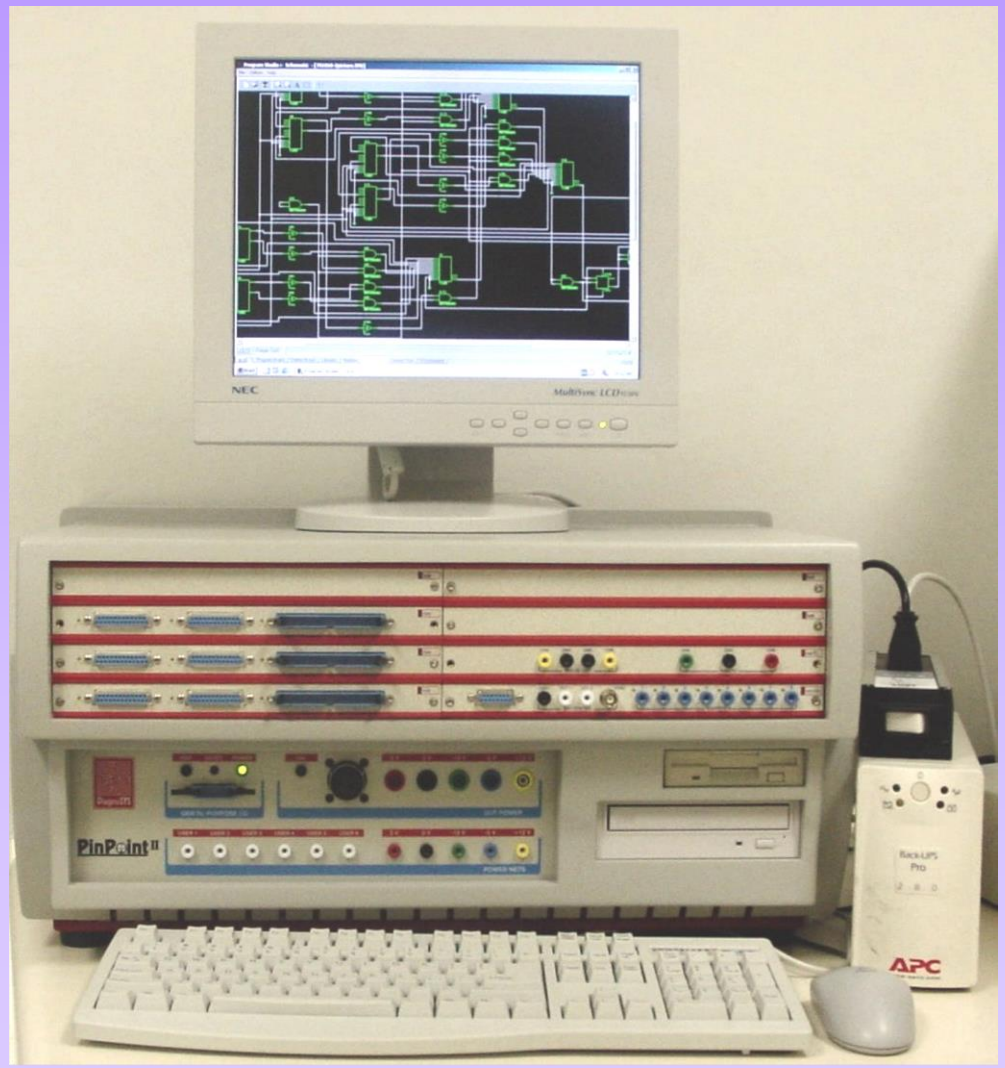
- 9 rates are eligible
- Most are ETs and ATs
- Technician proficiency is maintained through a 18-month recertification requirement
- The benches are also inspected on a 18-month cycle

NAVSEA
NAVAL SEA SYSTEMS COMMAND

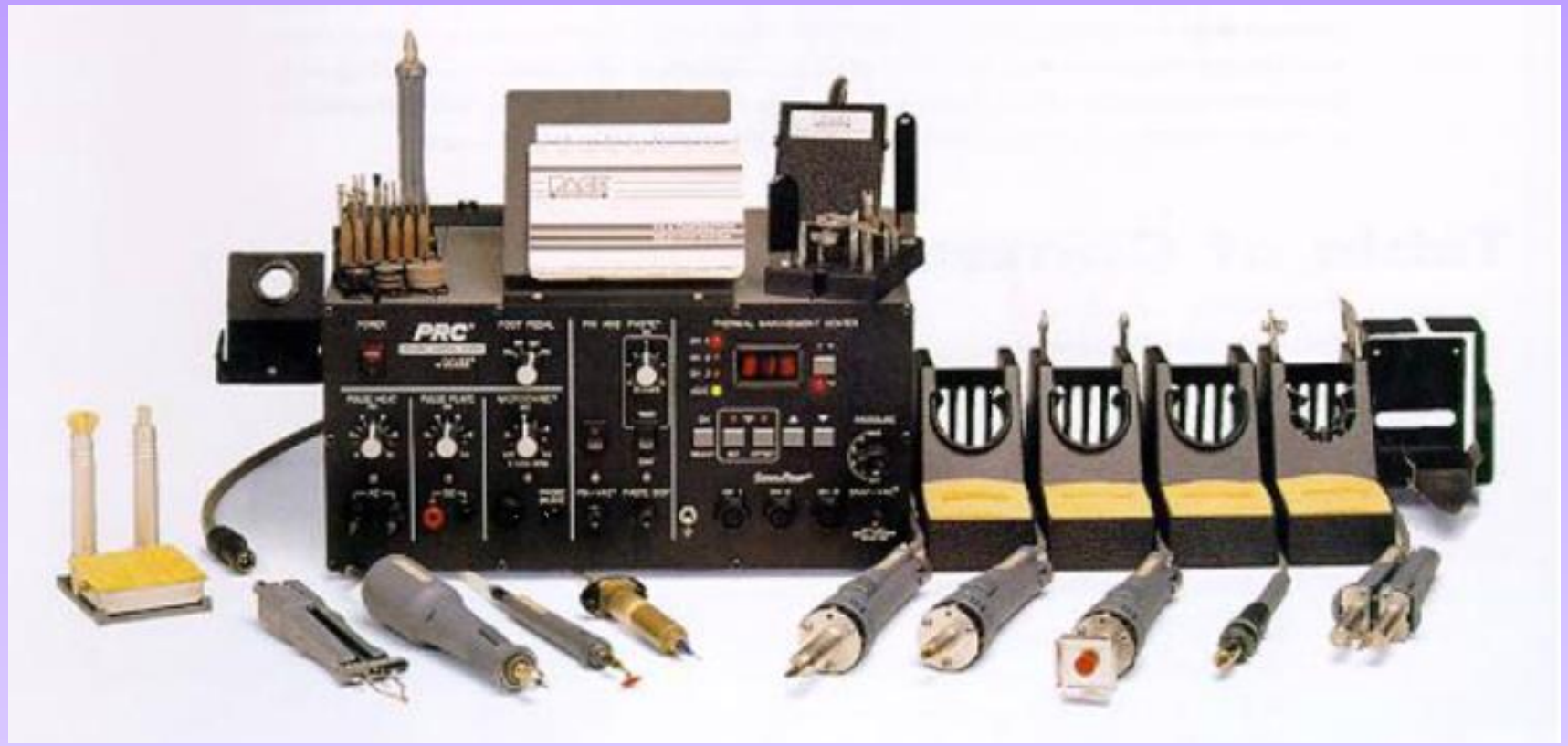
AN/USM-674 Test Station

NAVSEA
NAVAL SEA SYSTEMS COMMAND

AN/USM-676 PinPoint Test Station



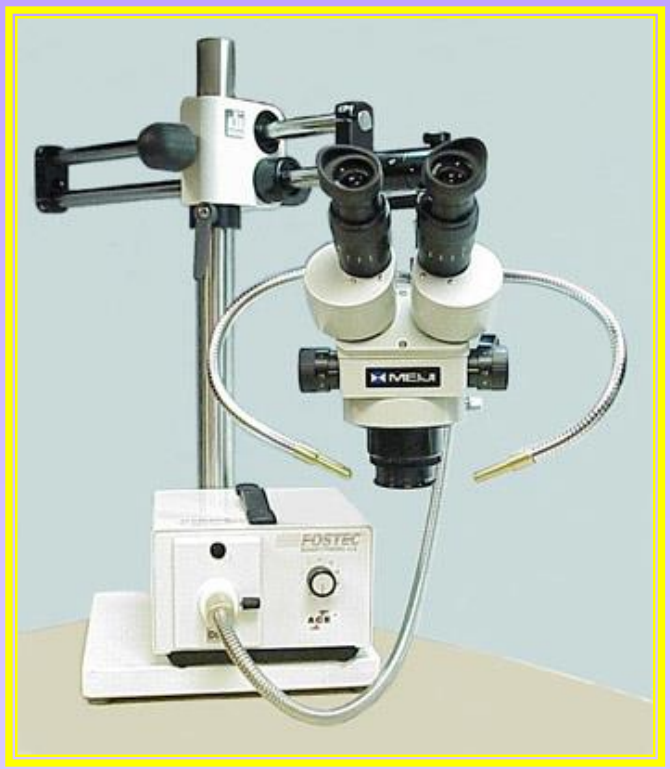
Standard 2M Workstation Configuration (PRC 2000-SMT)



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

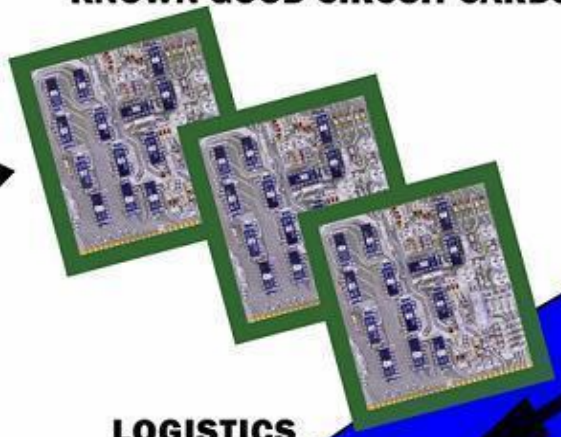
DVD (15-4) distributed Jan 2016 includes approximately 7,000 Test Routines

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

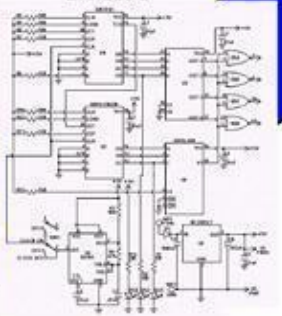
TEST ROUTINE DEVELOPMENT

PARENT EQUIPMENT

COMBINE SIGNATURES OF THREE KNOWN GOOD CIRCUIT CARDS



SCHEMATIC DATA

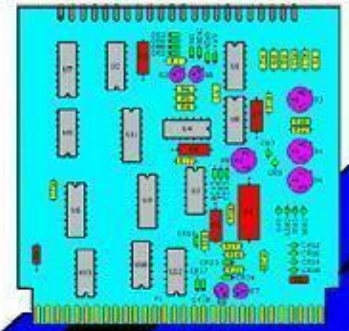


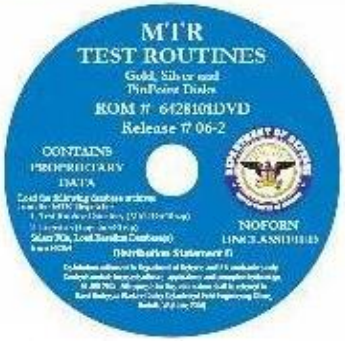
MERGE

LOGISTICS DATA (ILS)

C1	M39014/01-1513	5910-00-010-8717
C2	M39014/01-1513	5910-00-010-8717
R1	RLR05C1001GR	5905-00-012-2824
R2	RLR05C2201GR	5905-00-165-3181
U1	5757298-25	5962-01-283-9726
U2	5757298-26	5962-01-283-9727
U3	5757298-27	5962-01-283-9161

CCA ASSEMBLY DRAWING





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

Starts 1-Oct-2011

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

School Locations

Navy (6): CSCS LS Norfolk / CSCS LS San Diego / CSCS Det Mayport /CSCS Det Pearl Harbor 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

2M Piece Parts

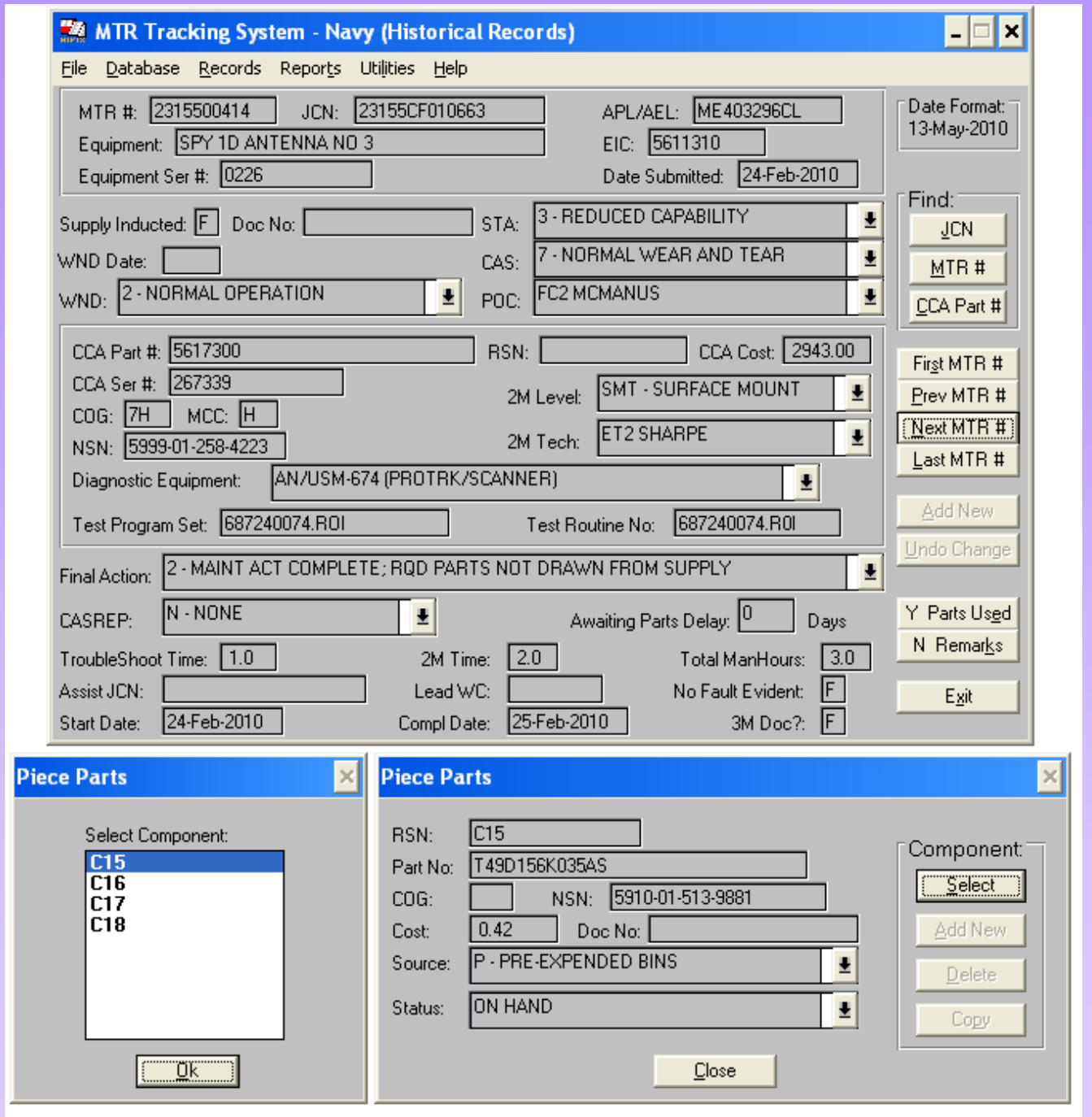
Surface Ships have two Piece Part APLs (Parts located in 2M MTR Work center and Supply storerooms). SSBNs, SSGNs, MCMs and shore commands have one APL.

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.

NAVSEA
NAVAL SEA SYSTEMS COMMAND

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/Test Routine Distribution

MTR SOFTWARE REVISION

MTR SOFTWARE 5.0

- MTR DISPATCHER
- MTR GRAPHICS VIEWER
- ~~SIGNATURE VIEWER~~ HW4.3 FUNTIONALITY
- ~~SIGNATURE UTILITY~~ HW4.3 FUNTIONALITY
- 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

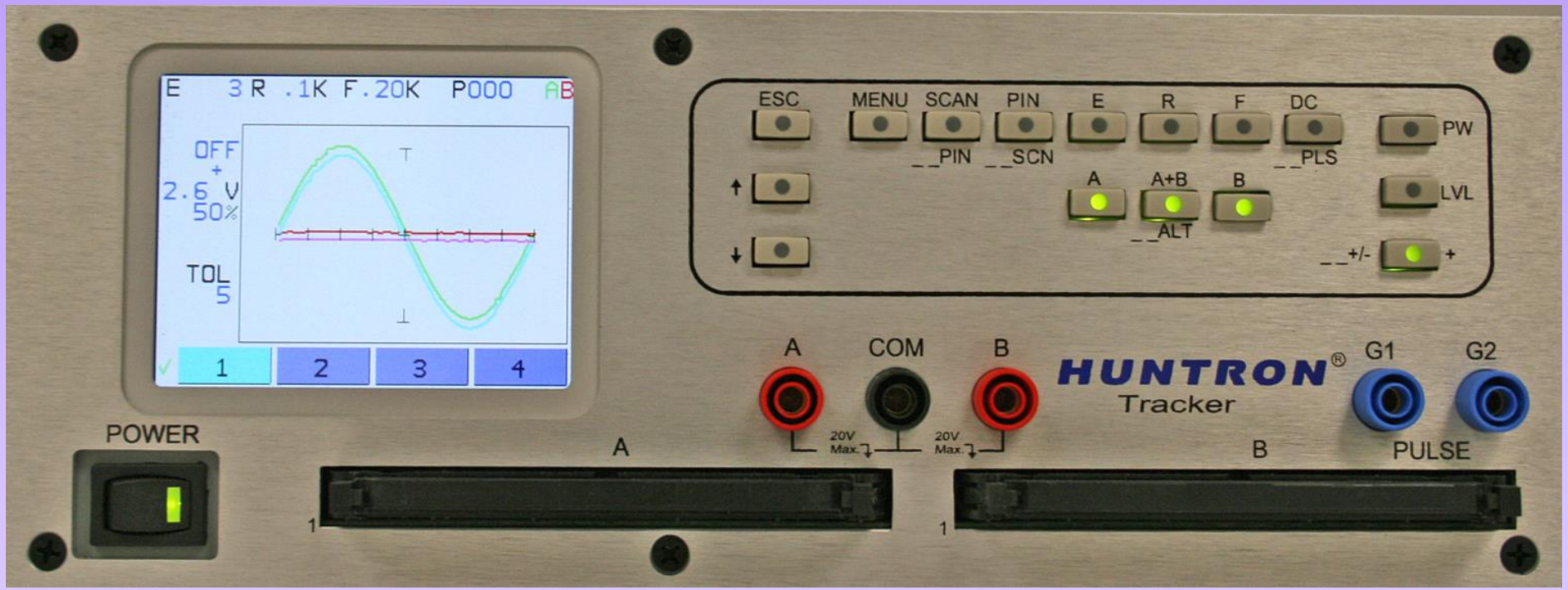
MODEL 32 SAP ACQUISITION FY16

- TEST INSTRUMENT COST $10K

MODEL 32 IDIQ CONTRACT PLANNED COMPLETION FY17

NAVSEA
NAVAL SEA SYSTEMS COMMAND

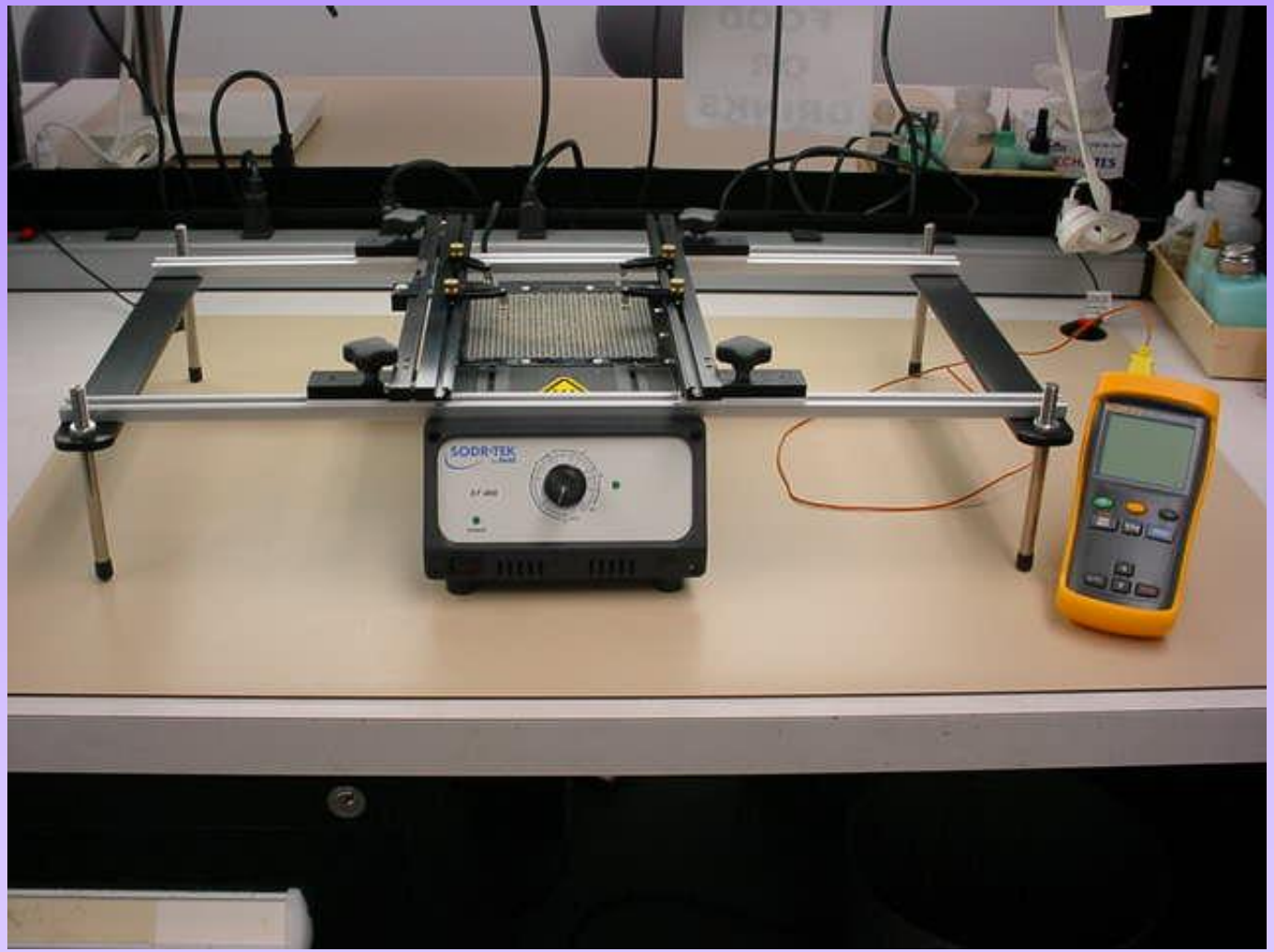
HUNTRON MODEL 32



TF 500 (Shore IMA) Fine Pitch Rework Station)

NAVSEA
NAVAL SEA SYSTEMS COMMAND

SODRTEK ST-400 RADIANT PREHEATING SYSTEM WITH ST-550 CIRCUIT BOARD HOLDER



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2M Repair Station Tools and Accessories

Tools & Consumables

Circuit Card & Workpiece Holder

NAVSEA
NAVAL SEA SYSTEMS COMMAND

ESD Prevention Material

JTEG Joint Technology Exchange Group

Joint Solutions for Depot Maintenance

Integrated Circuit Test, Repair & Re-Manufacture

Review & Wrap-Up

19 January 2016

JTEG Joint Technology Exchange Group

Joint Solutions for Depot Maintenance

Next JTEG Technology Forum

Maintenance Innovation Challenge Finalists

26 January 2016