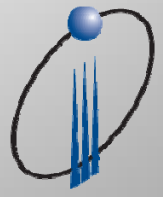
NEPP Workshop at NASA Goddard
June 26 -29, 2017

Integra Technologies Update

Sultan Ali Lilani - Integra Technologies LLC

Ph 510-830-9216
Email: sultan.lilani@integra-tech.com
Web: www.integra.com



INTEGRA
TECHNOLOGIES

INTEGRA TECHNOLOGIES

TECHNOLOGY QUALITY OVER 30 YEARS ON-TIME DELIVERY

Integra Technologies LLC
Wichita, KS

Analytical Solutions LLC
Albuquerque, NM

800-622-2382
www.integra-tech.com

Integra Technologies History – 33 Years of History

NCR CETC
Component Evaluation Technology Center

1983
Founded by NCR

1992
AT&T buys NCR/CETC (part of Bell Labs)

1996
AT&T Trivestiture

1998
Integra spun off from Lucent

2000
Amkor buys Integra Technologies

2005
Integra Technologies spun off from Amkor

2008
Integra becomes an Employee Owned Company

2013
Integra acquires Analytical Solutions, LLC

2016
Integra purchases a 40% stake in Aurora Semiconductor

1983 | 1992 | 1996 | 1998 | 2000 | 2005 | 2008 | 2013 | 2016

Integra Supports a Variety of Programs

Historical Programs	Customers Supported	Services Provided
Boeing/Airbus commercial aircraft	BAE, Crane, HW	Upscreening, parts procurement, CF authentication
Various missile programs (THAAD, PAC3, EKV, HARMS, ATACMS, etc)	LMC, Raytheon, BAE, UTAS, HW, L3. Boeing	Qualification testing, upscreening, FA, DPA, CF authentication, parts procurement
Various space level programs (Orion, MSL Rover, MAVEN, etc)	NASA, JPL, Ball Aerospace, LMC, BAE, SEAKR, NG, Boeing, APL	Screening, qualification, parts procurement, FA, DPA
Missile Defense Agency (MDA)	MDA	FPGA characterization
DoE programs	HW NSC, Sandia	Qualification testing, FA, DPA
Other DoD programs	HW, BAE, LMC, Raytheon, UTAS, Rockwell, L3, NG,	Upscreening, qualification testing, parts procurement, obsolescence solutions, FA, DPA, CF authentication

- Practically; every major Space and Military program uses Integra's value added
- services directly or indirectly.
  - ✓ We perform almost 70% of all PEM quals
  - ✓ We perform almost 100% of cu bond wire quals

INTEGRA TECHNOLOGIES

Integra Highlights

Stability

- 33+ year history
- Now the largest value added services provider by considerable margin
- Diversified customer base with 400+ active customers from avionics, military, aerospace, medical, automotive, commercial and industrial sectors
  - No single customer is more than 5% of our business
  - 20-30 year relationships with many of our customers
- 250+ total employees
  - Experienced management team with average tenure of 20 years

Domain

- Now all EEE devices as defined by NASA (Microcircuits; Discrete; Passives; Magnetics; Connectors etc.)

Performance

- Delivery performance and Customer satisfaction rating of 97%
- Delivery performance of 100% for inventory mgt. services

INTEGRA TECHNOLOGIES

Broad Scope of Customers Served

Lqwhjud#vxssruw#ryhu#733#dfwlyh#LF#p dqxidfwxuhuv#dqg#R HP v#lq#wkh# whchfrp /#p hglfdo/#p lolwdu|/#dhurvsdfh/#dqg#frp p hufldo#qgxvwu|1##

EVERSPIN TECHNOLOGIES
The MRAM Company™

Rockwell Collins

BAE SYSTEMS

Honeywell

QUALCOMM

Raytheon

LOCKHEED MARTIN

HARRIS

GOODRICH

Hamilton Sundstrand
A United Technologies Company

NASA

BROADCOM

Proteus
Biomedical

NORTHROP GRUMMAN

BOEING

NASA JPL
Jet Propulsion Laboratory
California Institute of Technology

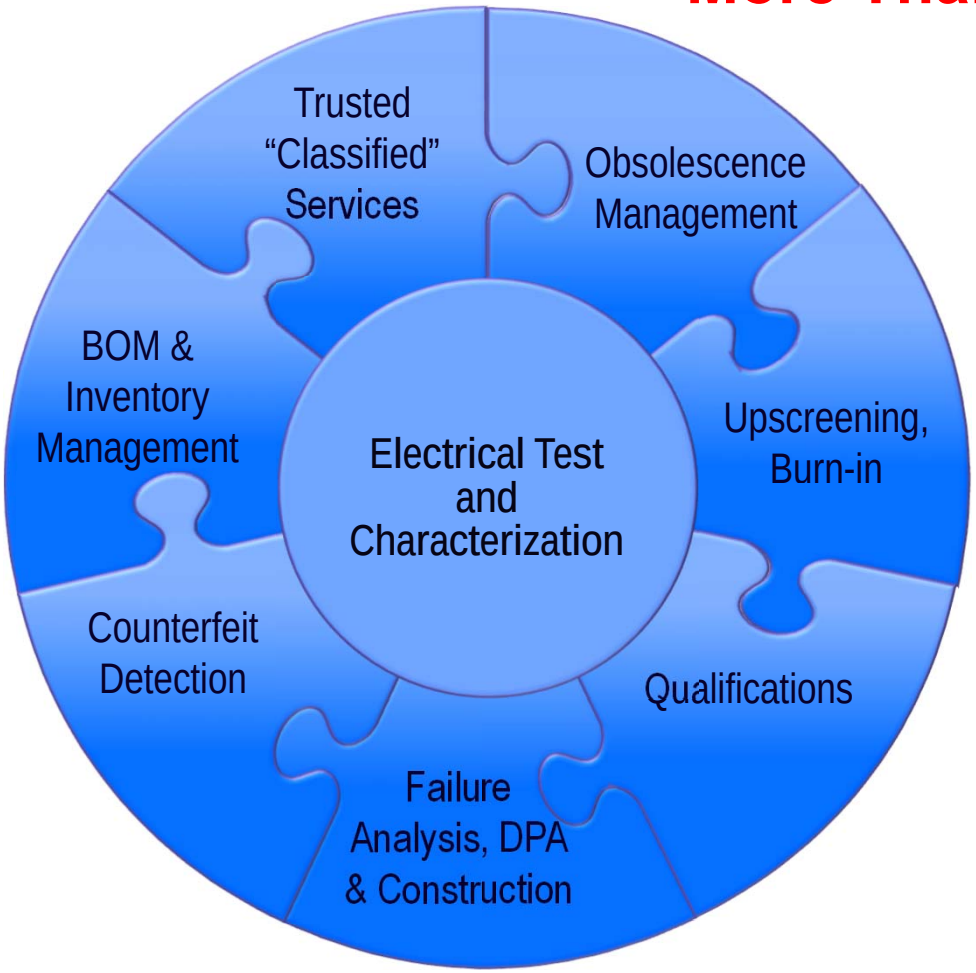
GE

Ball

INTEGRA
TECHNOLOGIES

Total Solutions Provider

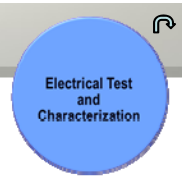
More Than a Test House



Our core strength of electrical test becomes the foundation for added value beyond test

INTEGRA TECHNOLOGIES

Integra is More than a Test Facility….



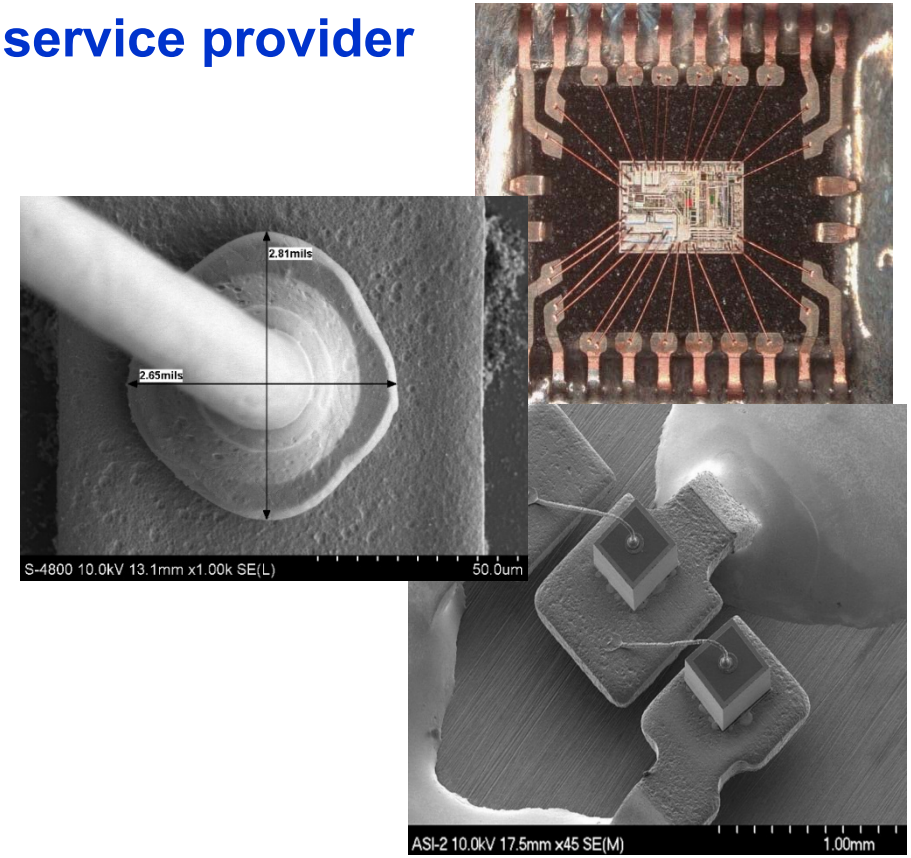
- **Procurement of Parts**
- **Receiving Inspection**
- **Supplier Management**
  - AVL & Site Audit
  - Scheduling
- **Qualifications**
- **Screening**
- **Solder Tinning**
- **Tape & Reel**
- **DPA**
- **Failure Analysis**
- **SCD Creation**
- **Engineering Data Review**
- **Obsolescence Management**
  - End of Life Notifications
  - Life Time Buy
  - Alternate Part Solutions
- **Engineering Data Review**
- **Inventory Locations**
  - OMS capability to mange inventory
  - Security
  - Environmental conditions
- **Kitting**

INTEGRA TECHNOLOGIES

Analytical Solutions Acquisition – A Full Mil Std 1580

- **An Integra Company since 2013**
- **Located in Albuquerque, NM**
- **30 year history as a value added service provider**

- **New Portfolio of Services**
  - Failure Analysis (FA)
  - Construction Analysis (CA)
  - Destructive Physical Analysis (DPA)
  - Laser Ablation Decap (for Cu wire)
  - Cross Section
  - Real Time/3-D X-Ray
  - Scanning Acoustic Microscopy (SAM)
  - Bond Pull / Die Shear
  - FIB Editing
  - SEM Inspection
  - Optical Inspection
  - PIND
  - Fine & Gross Leak (Krypton 85)

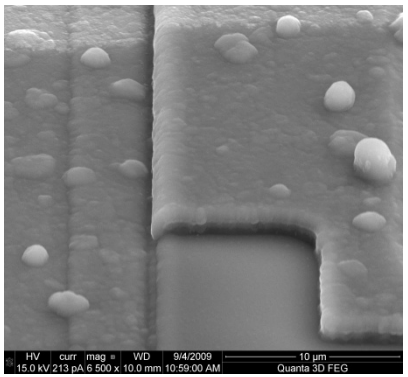


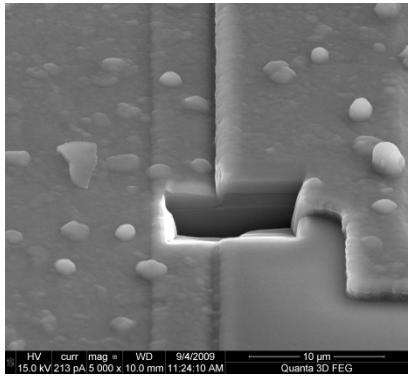
INTEGRA TECHNOLOGIES

Full DPA, Failure and Construction Analysis Support

➢ Types of Analysis

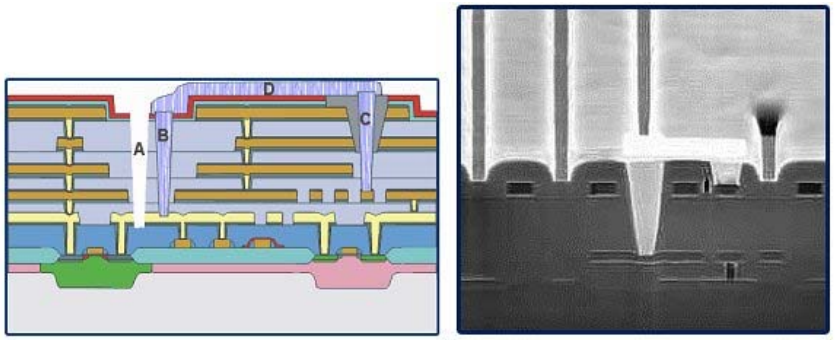
- Construction Analysis
  - New Designs, Products and Processes
    - Wafer Fabrication
    - Packaging
    - Assemblies
  - Competitor Bench-Marking
- Qualification Failures
- Low Yield Analysis
- Field Failures / Returns / System Failures
- Counterfeit Detection





➢ Fully Compliant DPA

- Per Mil-Std-1580 DPA (B and S Level)
- Per NASA SSQ25000



Drilled-Hole (A) Allowing for End-Point Analysis To Determine When Metal Layer is Reached and Filling With W To Create Vias (B, C) and Jumper Wire (D)

➢ Packages Covered

- Packaged ICs, Discretes, Passives
- Connectors, Cables, Wires
- PCBs
- Sub-assemblies

INTEGRA TECHNOLOGIES

Aurora Semiconductor Partnership

Valuable Partnership

- **Larger role in Trusted supply chain (testing)**
- **iUHD MCM Test & Qualification support**
- **Draper R&D relationship for existing and future products**

Aurora Offerings

- **iUHD MCM (Integrated Ultra High Density Multi-Chip Module)**
  - Worlds Most Advanced MCM Technology
- **Custom Back End Wafer Processing**
  - Wafer/Die Thinning
  - RDL
- **Die Harvesting**
- **Cleanroom space available for Customer-owned tooling**
  - Possibilities: Bump Fab, Plasma Dicing tool, Assembly

INTEGRA TECHNOLOGIES

Aurora MCM – Complete System Solution

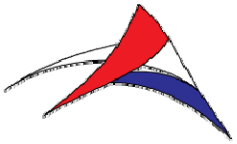
DRAPER

- R & D
- Design
- System Modeling
- Physical Design/ Layout

DRAPER

Aurora

- Small to Medium volume Manufacturing
- Accessible, US – based, Trusted facilities
- Specialty Processes geared to performance-driven customers
- Transfer of existing customer proprietary processes
- Customization of process steps
- Quality Assurance System



AURORA SEMICONDUCTOR

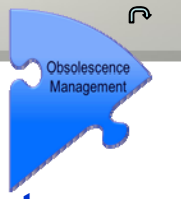
"Bridging the Gap" in Wafer Foundry Services™

Integra Technologies

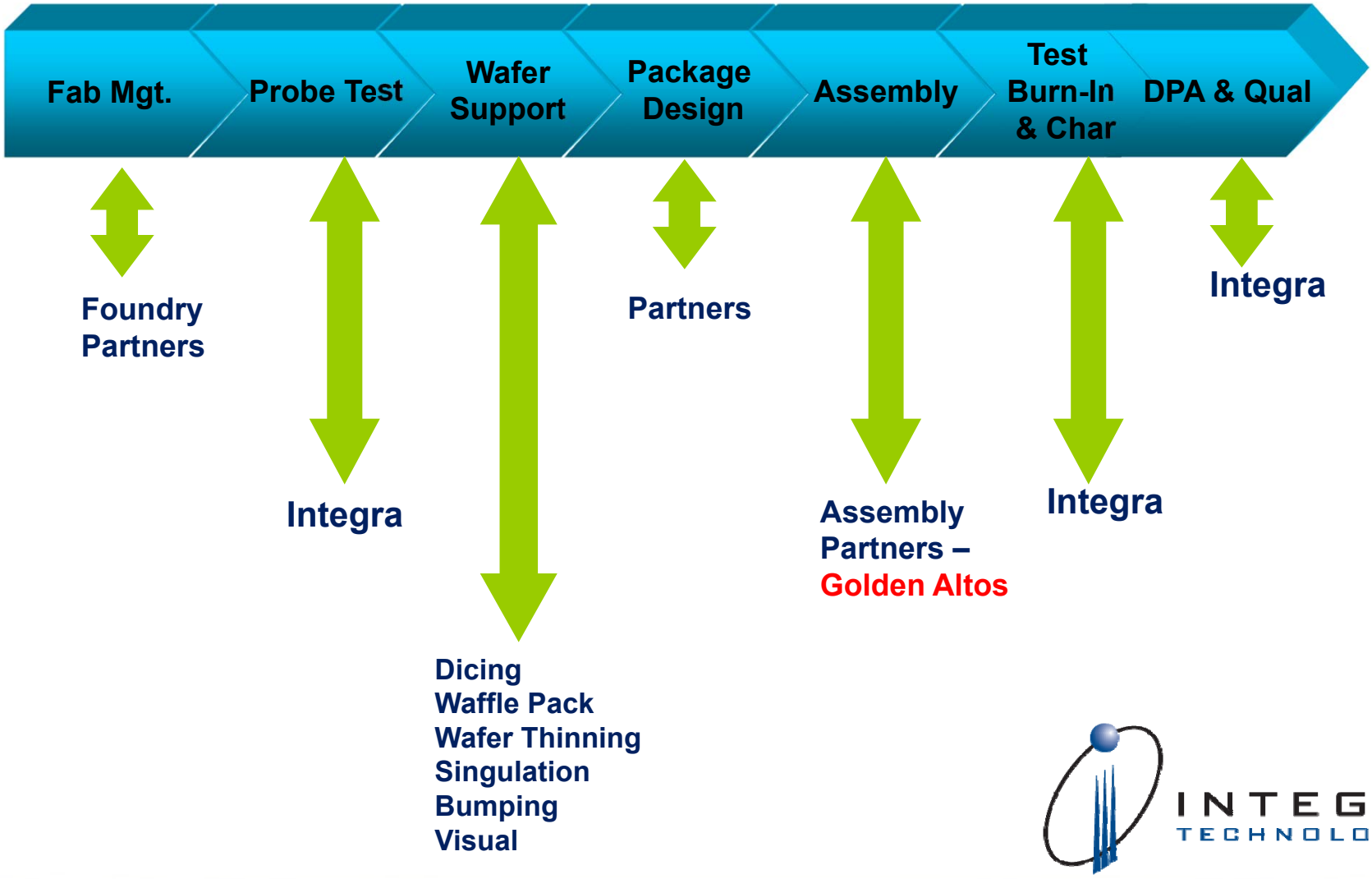
- Die level and MCM Level final Testing
- Reliability Testing
- Qualification
- Analytical FA Service

INTEGRA TECHNOLOGIES

Full Turnkey Solution



Established, proven full turnkey solution – From Silicon Foundry to Assembly to Test



INTEGRA TECHNOLOGIES

BOM & Inventory Management Program - Key Features

➢ Integra will buy the parts

- Buy product from franchised distributors
- Inventory management and kitting
- Forecast management

➢ Integra will procure and bank wafers / die

- Assembly and test of die as needed
- Full device level qualification as needed

➢ Integra will manage your BOM by supporting all required Value Added Services with a single PO

- Write SCD / SIDs / VIDs
- Incoming Inspection
- DPA
- CSAM
- Assemble die
- Upscreening
- Qualification
- Failure Analysis
- Solder Dip
- Tape / Reel
- Dry Pack Bake
- Out-going Inspection

INTEGRA TECHNOLOGIES

BOM & Inventory Management Program - Experience

➢ Experience and History of Success

- Started managing parts buys in 1991
- Currently manage parts BOM and procurement programs for many customers, including: BAE, Honeywell, Crane Aerospace, Moog, Plexus, Celestica, Benchmark, Hamilton UTC, MDA, Orbital

➢ MRP system in place to inventory and manage volume orders

- Integra procured components on ~1,100 orders in 2015
- Currently tracking ~ 4,000 finished good inventory locations
- Currently tracking ~ 6,000 WIP and raw material inventory locations
- All inventory tracked by part, date code, processing flow, PO, DPAS, etc

Part Number	Mfg Part Number	Customer Lot ID	Integra Lot ID	Job Type	Customer Purchase Order	Receive Date	Quantity on Hand	Scheduled Ship Date
AR340-01DNG	LM139AD	E022429	140540	Production	696903-915	15-DEC-15	2,000	31-MAY-16
AR347-01DNG	CMP04FS	E022000	139852	Inventory	696903-933	28-OCT-15	2,000	12-JUL-16
AR365-08E	LM4050AIM3-2.5NC	E022218	140173	Production	696903-911	19-NOV-15	1,000	27-MAY-16
AR385-03DNG	LM293DG	E023423	142740	Production	696903-935	09-MAY-16	280	22-JUN-16
AR386-03DNG	LM2904DG	E023255	142180	Production	757363	04-APR-16	100	31-MAY-16
AR386-05DNG	LM2902DG	E023251	142807	Production	696903-925	13-MAY-16	100	13-JUN-16
AR416-01DNG	OP291GSZ	E023308	142230	Production	696903-930	06-APR-16	560	24-MAY-16
AR416-01DNG	OP291GSZ	E023430	142683	Production	696903-934	04-MAY-16	560	05-JUL-16
AR416-01DNH	OP291GSZ	E021773	139735	Inventory	696903-937	20-OCT-15	560	17-JUN-16
AR426-01DNG	TL431AID	E023478	142676	Production	696903-938	04-MAY-16	130	14-JUN-16
AR426-01DNG	TL431AID	E023538	142851	Production	696903-943	18-MAY-16	130	05-JUL-16
AR435-01DNG	TL7705BQD	E021756	139355	Inventory	BOND	23-SEP-15	270	TBD
AR439-03G	LM239DG	E022376	140178	Inventory	BOND	20-NOV-15	150	TBD
AR439-03G	LM239DG	E022376	140179	Inventory	BOND	20-NOV-15	150	TBD
AR461-03GL	LM2937IMP-12.0	E022377	140329	Inventory	BOND	02-DEC-15	495	TBD
AR465-03DNG	DG413DY+	E022325	140319	Inventory	760886	01-DEC-15	200	19-AUG-16
AR500-01DNH	AD820BRZ	E022977	142179	Production	734891-3	04-APR-16	500	01-JUN-16
AR517-02DNH	UCC2917D	E021823	139117	Inventory	BOND	08-SEP-15	150	TBD
AR517-02DNH	UCC2917D	E021823	139118	Inventory	BOND	08-SEP-15	150	TBD
AR522-01G	HIP0081AS2	J2001080	142808	Production	760721	16-MAY-16	96	06-JUN-16
AR522-01G	HIP0081AS2	J2001080	142809	Production	760721	16-MAY-16	96	23-JUN-16
AR554-01DWG	UC2834DW	E023162	142499	Production	696903-910	25-APR-16	512	TBD
AR576-01DNH	UC2572D	E022871	141463	Production	753202	19-FEB-16	110	06-JUN-16
AR596-01DNG	LTC1726IS8-5#PBF	E023428	142973	Production	696903-934	23-MAY-16	300	05-JUL-16
AR682-01G	LT4256-3IGN#PBF	E022395	140283	Inventory	696903-943	30-NOV-15	400	23-MAY-16
AR682-01G	LT4256-3IGN#PBF	E022395	140284	Inventory	696903-942	30-NOV-15	400	23-MAY-16

Example of Customer Inventory Status Report downloaded from Oracle DB

INTEGRA TECHNOLOGIES

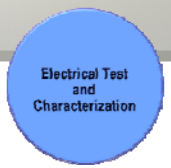
Dedication to the Quality standards that our industry demands

- **AS9100:2009 Rev. C, ISO 9001:2008 Certified**
- **ITAR Registered**
- **DLA Lab Suitability**
  - MIL-STD-883
  - MIL-STD-750
  - MIL-PRF-19500P
- **ANSI/ESD S20.20-2007**
  - Class 1 Product Handling
- **DMEA Category 1A "Trusted"**
- **Flows**
  - Customer specific, Source Control Drawing (SCD)
  - ITAR Process
  - JEDEC Standards for Plastic

ISO 9001 CERTIFIED · ABS Quality Evaluations, Inc. Management System Certification AS9100C Certificate No: 48366 · ANSI/ESD S20.20-2007 Certificate No: 47925 · ITAR Compliant International Traffic In Arms Regulations · erai MEMBER

INTEGRA TECHNOLOGIES

Leader in Advanced Technology Testing



- **High Frequency RF Testing**
  - Multiple 20GHz to 40GHz testing projects
  - Membrane probe at 40GHz / Cantilever RF Probe at 20GHz
  - S Parameters/Gain, P1dB/Phase Noise, Noise Figure, IP3, ACPR, Vtune, Frequency Range
- **14-24 Bit ADC/DAC**
  - **Integra has tested 24 bit ADC at temp for NASA**
- **High Voltage testing and burn in expanded (experience up to 10KV)**
- **SERDES**
  - Developed capabilities to test high speed SERDES with BERT and Sub-Pico second Jitter measurements (183 femto seconds)
- **Advanced Memories (NAND Flash, NOR Flash, DDR3, MRAM, etc)**
  - First test facility to test 128G NAND Flash & DDR3 at full speed
- **Microprocessors, Microcontrollers, FPGAs, CPLD**
  - Full uP development from scratch
  - Wide breadth of FPGA development expertise (Xilinx, Microsemi, Altera, etc)
- **ASICS**
  - Testing up to 2,000 I/Os and 1 GHz+ Digital / 50 GHz RF

INTEGRA
TECHNOLOGIES

Missile Defense Agency Selects Integra for Counterfeit FPGA Evaluation

➢ MDA project requirements

- Research a robust set of advanced electrical tests for counterfeit parts screening
- Using the research, rigorously test and analysis many different types of FPGAs to evaluate the effectiveness of the developed tests
- The end product for this research is a new set of advanced electrical tests that will authenticate FPGAs at a high confidence level

➢ Integra was selected because

- We have the largest number of test engineers, so projects happen in parallel
- The broadest range of equipment – can match tester to device specs
- The largest existing FPGA test library – over 250 existing FPGA test programs
- We have the experience and capacity to execute a project this large

➢ MDA project is ~2 years long and consists of 3 phases

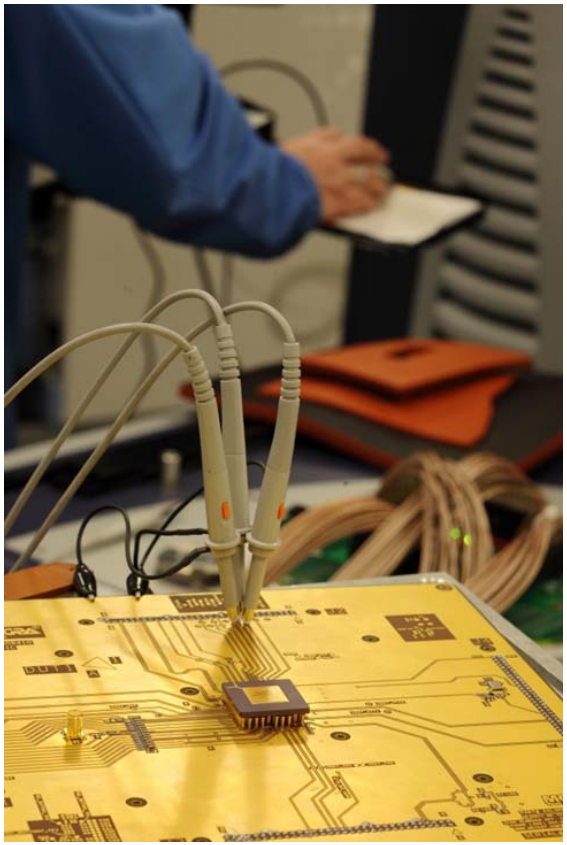
- Phase 1 – Establish test capability for initial list of devices that are important to MDA programs and are likely targets for counterfeiters
- Phase 2 – Research electrical test techniques that are effective in screening out counterfeit types expected to be encountered in the aftermarket
- Phase 3 – Develop advanced and/or nontraditional electrical test techniques that target counterfeits not able to be screened by Phase 2 techniques

INTEGRA
TECHNOLOGIES

Discrete Devices – Full Suite of Testing

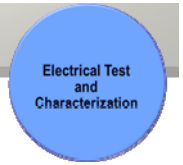
Electrical Test and Characterization

- **Device Types**
  - General purpose Diodes, Transistors, Power FET, MOSFET, J-FET, TVS, Rectifier, Zener, TRIAC, SCR, Opto-Coupler, Microwave Diode
- **Full Electrical Testing at Extended Temps**
  - -150˚C to +200˚C
- **Tester Platforms**
  - ASL-3000 / ASL-1000
  - Scientific Test 5300HX- Automated Tester: Programmable; 0.1na Resolution
  - RFT Custom Test System for RF Testing
- **Dedicated Test and Reliability Engineers for Discrete Products**
- **MIL-PRF19500/MIL-STD-750 DLA Suitability for 62 Different Test Methods**
- **Full MIL-STD-1580 DPA for Military and Space Grade Products**
- **DMEA Approved Trusted Processing**



INTEGRA TECHNOLOGIES

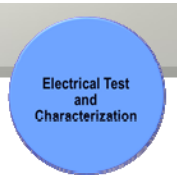
Passive Devices - Engineering Technical Expertise



- **Recognized as an Industry leader in testing for passive units in both the Aerospace & Military sectors**
  - MIL-PRF-55342 (Caps)
  - MIL-PRF-27 (Resistors)
  - MIL-PRF-28861 (Filters)
  - MIL-STD 1344 (Connectors)
  - MIL-O-55310 (Crystals)
  - MIL-C-55361 (Inductors)
  - MIL-T-27 (Transformers)
  - MIL-R-39016 (Relays)
- **Burn in capacity in place for capacitors in many package styles**
- **High/Low Temp Testing to MIL-STD 202, TM301, 302, 303, 304 & 309**
- **Custom designed processing trays for many package styles**

INTEGRA TECHNOLOGIES

Connectors – Comprehensive Suite of Testing

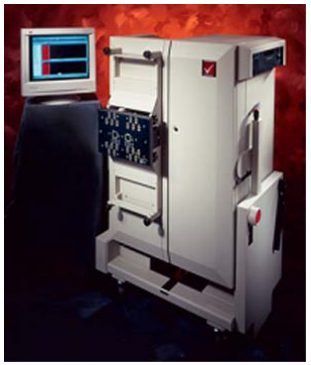


- **Full Range of Qualification, Design Verification and Reliability Testing**
  - Space and Military
  - Rugged and Harsh Environment
- **Qualification Plans utilizing IPC, EEE-INST-002, MIL-DTL-38999, MIL-STD 1344 & MIL-STD 202 for Mechanical & Reliability Testing**
  - Vibration / Shock
  - Temperature Cycling / Thermal Shock
  - Contact Retention, Stability and Engagement
  - Separation, Mating and Un-mating Force
  - High Temperature Exposure and Humidity
  - Insert Bond Strength and Insert Retention
  - Coupling Torque
  - Shell-to-Shell Conductivity
  - Working Voltage, Dielectric Withstanding Voltage
- **Dedicated Test and Reliability Engineers for Connectors**
- **Full MIL-STD-1580 DPA for Military and Space Grade Products**

INTEGRA TECHNOLOGIES

Cost Effective Equipment for Every Technology

Electrical Test and Characterization



Test Platforms

High End Mixed Signal & Digital
- Verigy 93K & 83K
- Credence Quartet
- Credence Diamond

Digital Testers
- Verigy 93K & 83K
- Credence Diamond
- Teradyne J750
- Nextest Maverick(PT/GT)
- Trillium Micromaster
- MCT 2020

Linear & Mixed Signal
- Credence ASL-1000
- LTX TS88 DX90

Memory Testing
- Verigy 93K & 83K
- Teradyne J937
- Nextest Maverick(PT/GT)

Discrete Testing
- Credence ASL-1000
- STI 5300 HX
- Custom Set-Up

RF Testing
- ASL-3000
- RFT (custom eq set)

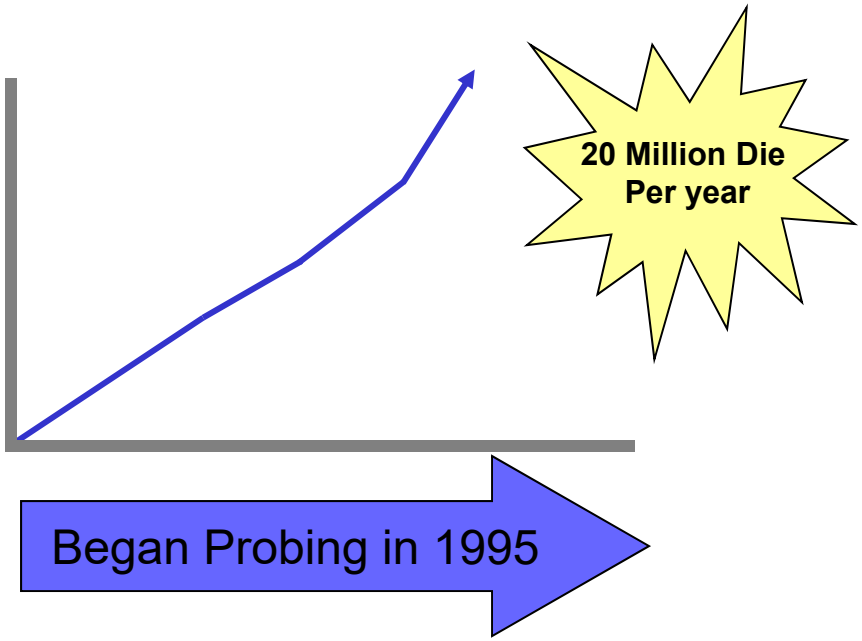
Auto Handlers

- SEIKO NS6040 (Parallel Test)
- SYNAX 1211 (Dual Site)
- MULTITEST 9510 (Tri Temp)
- MULTITEST 8704
- MCT 3608
- AETRIUM V6
- PROBERS (3” to 12”)

INTEGRA TECHNOLOGIES

Extensive Wafer Probe Experience

Electrical Test and Characterization



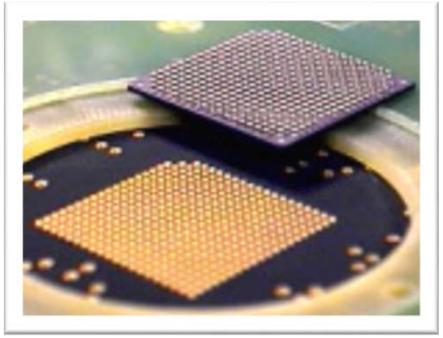
- 3” to 12” capability
- Probe card design, fab and verification
- Bumped probe
- Al, Au pads and Pb, Pb free bumps
- Vertical, Cantilever & Membrane probe
- High pin count, fine pitch

- N2 and vacuum wafer storage
- Elevated probing up to 200C
- Data analysis capability
- Handle wafers back grind to 6 mils

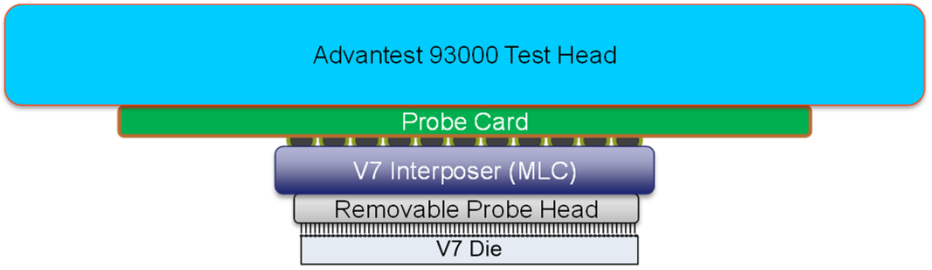
INTEGRA TECHNOLOGIES

Diced Bare Die Probe - Xilinx Virtex 7 Example

Electrical Test and Characterization

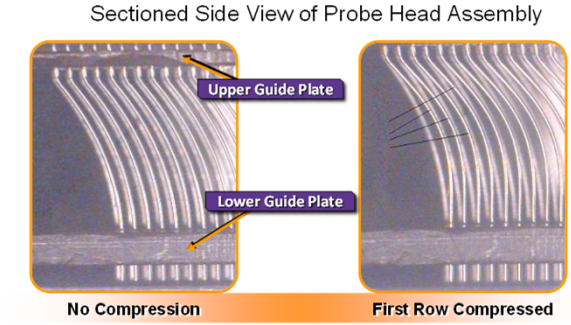


Interposer brings the pad geometries out from the die to the ATE

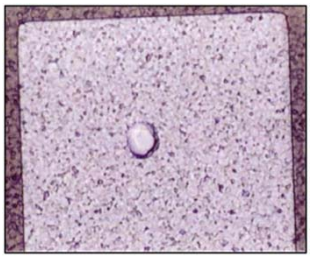


Test Stack Up

Diced bare die probe on 8000+ pads @ -55C to +125C with 1GHz test rate



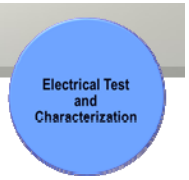
Probe Head Assembly



10-15µm Typical Scrub Mark

INTEGRA TECHNOLOGIES

Largest Engineering Test Development Organization

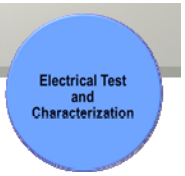


Engineer	Years	Area of Expertise	93/83K	RFT	Quartet	J750	Mav	STE	Trillium	Sentry	J937	Xincom	LTX88/90	MCT2020	ASL-1000	ASL-3000	Burn-In
Engineer 1	25	Digital/Mixed Signal	X		X	X		X	X					X			
Engineer 2	26	Digital/Mixed Signal							X	X							
Engineer 3	30	Memory/Digital	X			X	X	X			X	X					
Engineer 4	19	Memory/Digital				X	X				X	X					
Engineer 5	19	Digital					X		X	X				X			
Engineer 6	22	Digital/Mixed Signal				X		X	X								
Engineer 7	17	Digital/Memory				X			X		X	X		X			
Engineer 8	3	Mixed Signal											X		X		
Engineer 9	23	Mixed Signal											X		X		
Engineer 10	4	Mixed Signal											X		X		
Engineer 11	3	Mixed Signal													X	X	
Engineer 12	6	Digital/Mixed Signal							X				X				
Engineer 13	12	Mixed Signal			X								X		X	X	
Engineer 14	28	RF/Mixed Signal	X	X	X		X								X	X	
Engineer 15	5	RF/Mixed Signal		X											X	X	
Engineer 16	17	Digital/Mixed Signal															X
Engineer 17	4	Digital/Mixed Signal															X
Engineer 18	3	Digital/Memory					X										
Engineer 19	3	Digital/Mixed Signal							X				X		X	X	
Engineer 20	11	Digital/Mixed Signal	X			X		X	X								
Engineer 21	10	RF/Mixed Signal					X						X		X	X	
Engineer 22	4	Mixed Signal													X		X
Engineer 23	3	Mixed Signal											X		X	X	
Engineer 24	3	RF/Mixed Signal		X											X	X	
Engineer 25	2	Mixed Signal													X		
Engineer 26	1	Digital/Memory					X										
Total: 26			4	3	3	7	8	4	8	2	3	3	8	3	14	8	3

- Over 300 man-years of combined experience
- Low Turnover
- >17000 test programs developed
- Over 25 other degreed technical personnel
- Engineering mgmt team of 4 with over 100 years combined experience

INTEGRA TECHNOLOGIES

Enhanced Burn-In and Life Test Capabilities



- High max temp of 260ºC for static and dynamic burn-in
- Small, non-interrupt custom burn-in ovens, 8 power supplies per board
- Up to 192 digital channels per board - expandable to multiples of 192 digital channels
- Extremely high pattern depth (supporting loops, repeats and subroutines) to support most complex FPGA, Microprocessors and Microcontrollers
- Customizable FPGA logic in oven for flexibility
- Extensive real time monitoring for voltage, current & temperature including dynamic output stimulus on a device by device basis
- Analog instrumentation ports for easy interface of any programmable GPIB equipment
- Extremely high frequency burn-in and life test for complex ASICs, FPGA, Microprocessors and Microcontrollers; both RF and Digital
- Very high power air cooled burn-in achieving 200W per device to a 0.1 sq inch device pad

INTEGRA
TECHNOLOGIES

New Equipment/Capability Additions

- **Krypton 85 Fine/Gross Leak capability**
  - Supports preferred method for characterizing small leak rates
  - Supports the proposed tightened Hermeticity tests limits

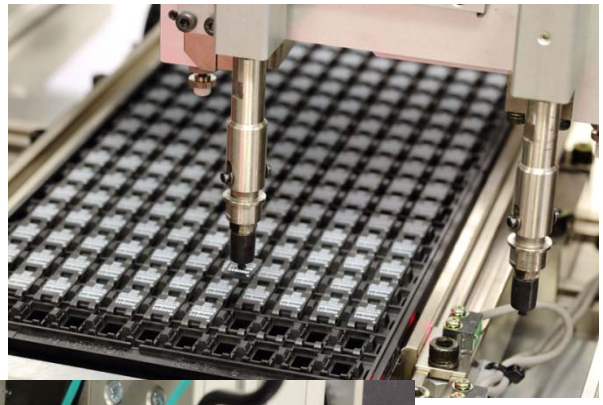
- **Laser Ablation for Cleaner Plastic Device Decapsulation**
  - Cleanly remove mold compound using laser technology (primarily) with secondary shorter acid etch
  - Expose to secondary wire bonds without measurable damage

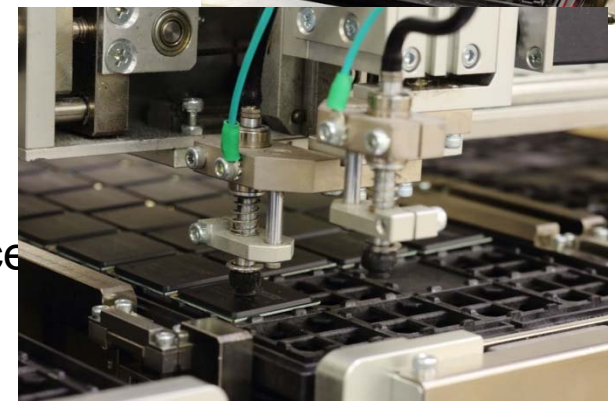
- **Failure mode analysis & understanding of physics behind potential Cu wire failures**
  - IMC failure mode analysis
  - Bond wire / pad splash phenomenon
  - Break mode understanding
  - Implications of pad lifting
  - Hidden micro-crack damages
  - Die cracks & corrosion

INTEGRA TECHNOLOGIES

Upscreening

The definition of up-screening is testing a device to a wider temperature range than the original manufacturer specified. The only way to assure commercial temperature range devices can operate at the extended temperature ranges is to perform full AC/DC/Functional testing to "Upscreen" them for these harsher environments.





Electrical Testing at Temperature Ranges of -75C to 225C

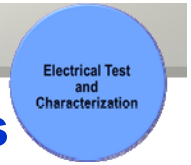
- Up-Rating Commercial Devices to Military and Industrial Grade
- Up-Rating Industrial grade to Military Grade
- Speed sorting for memory devices
- Burn in

Back end processing to complete your value add requirements

- Part marking to uniquely identify up rated device
- Solder dip
- Bake, dry pack and tape/reel
- Parts procurement and Inventory Management
  - Stock tested inventory to fulfill your JIT inventory needs

INTEGRA TECHNOLOGIES

Volume Production Support & In Depth Technical Support



➢ Production capacity to support all your test & qualification needs

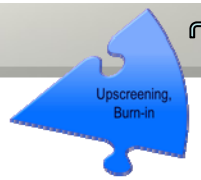
- Volume production test experience (wafer probe & package test)
  - Tested 55,000,000+ units in 2014/15
  - 147,000,000 insertions in 2015 alone
- Leader in PEM qualification testing (medical, military and aerospace focus)
  - Completed 1100+ qualifications in 2014/15
  - Co-Chair of G12 PEM Task Force Meeting
- 24 x 7 operation with on site equipment maintenance support
  - Off shift maintenance and engineering support
- Redundancy on all test equipment

➢ Technical Expertise

- 26 engineers & 4 management and 55+ total technical staff with over 300 years combined experience
  - Test, Product, Reliability & Failure Analysis Engineers
- Support all technologies – digital, RF, memory, linear, discretes, passives, capacitors, resistors, microprocessors, magnetics, connectors, etc.
- Multiple engineers in each technology
- Expertise in developing test plans that meet your requirements and are cost effective
- Written over 17,000 test programs
- Recognized worldwide as industry leader in test expertise

INTEGRA
TECHNOLOGIES

Upscreening



- Integra has been upscreening devices for commercial aircraft and military programs since 1985.
  - Key customers are: Boeing, Honeywell, BAE, Crane Aerospace, LMC
- Integra has upscreened over 15 million units since beginning the program in 1985
  - 35 million+ test insertions
  - 1,800+ part numbers
  - 30+ manufacturers
  - Every device technology
- Integra has extensive data on fail rates by technologies and supplier
- All test programs were written in house to the customer's device specification
- Automated handlers and temp forcing units to maximize throughput

INTEGRA
TECHNOLOGIES

Integra Advantage for PEM Qualification

➢ Capabilities

- Electrical test @ temp
- Construction Analysis
- DPA/FA
- Bond pull & Bond Shear
- HTOL, HAST, THB
- Temp Cycle
- Copper Wire Evaluation

➢ Qualification performed to:

- NASA's PEM-INST-001
- Marshall Space MSFC-STD-3012
- Class Y & N per Mil-PRF-38535
- JEDEC
- Other industry standards

➢ Experience

- Performed 1,000+ quals on:
  - 110,000 devices
  - 165 package types
  - 425 device types
  - 75 manufacturers
- Knowledge of all EEE products
  - Discretes, Passives, Linears, Memory, FPGA, SERDES, Microcontrollers, A/D, D/A, Inductors, Magnetics & more

INTEGRA TECHNOLOGIES

Integra PEM Qual Data Overview

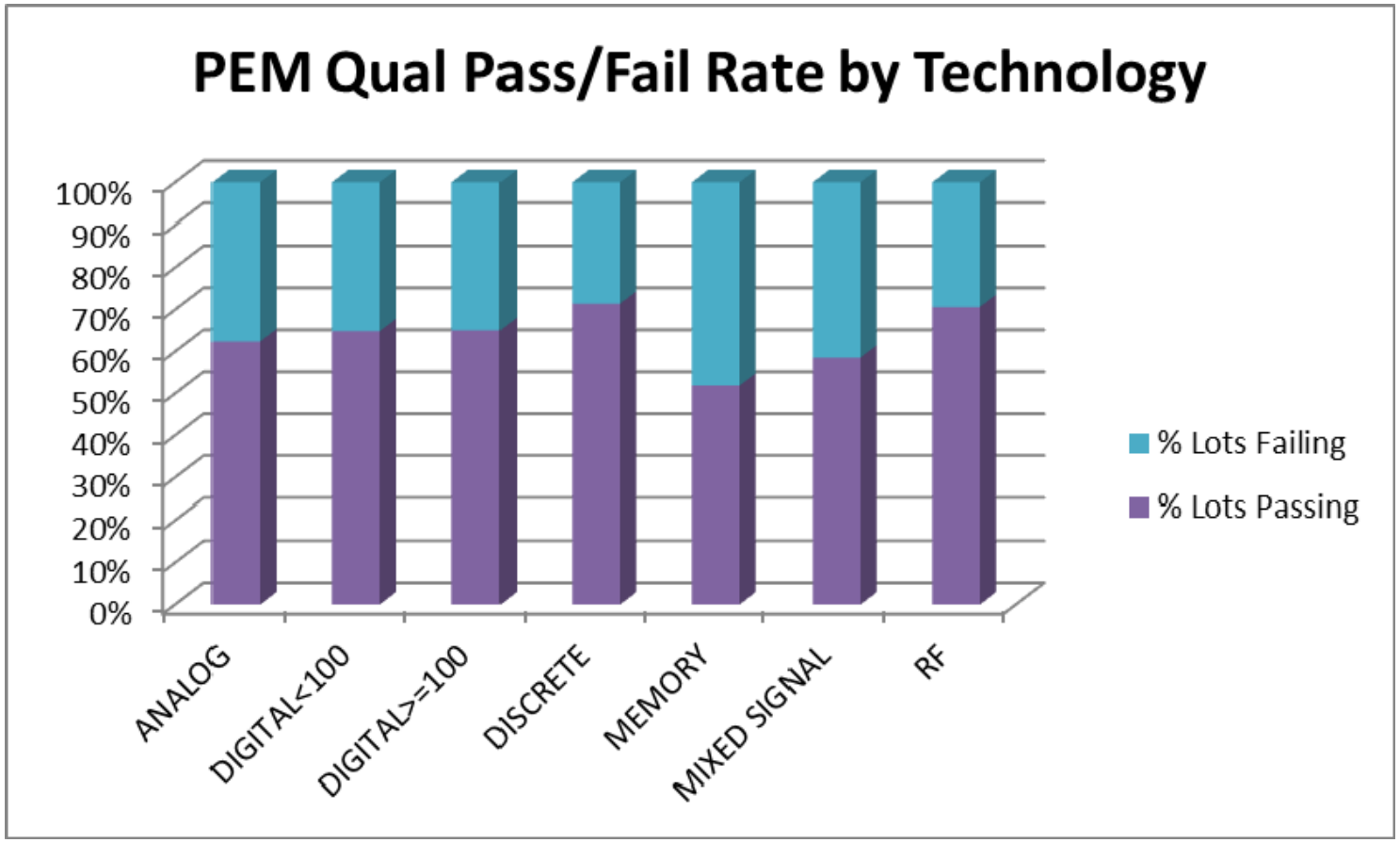
Time Period Covered:	**1998 through August of 2013**
Total Number of Parts Processed:	**111,183**
Total Number of Lots:	**791**
Total Number of Passing Lots:	**496**
Passing Lot Percentage:	**63%**
Total Number of Failing Lots:	**295**
Failing Lot Percentage:	**37%**
Total Customer Part Numbers:	**455**
Total Manufacturer Part Numbers:	**410**
Total Number of Manufacturers:	**73**
Total Number of Customers:	**42**
Unique Pin/Package Combinations:	**165**

Notes:

- No qualifications conducted by semiconductor manufacturers are included.
- Plastic packaged semiconductor devices only - no passives.
- Predominant test temperatures are -40, 25 85 and -55, 25 125.
- Testing temperature order is usually room, cold, hot.
- Once a qual fails it is usually stopped.
- Failures are for electric test only (no mechanical failures).
- Vast majority of testing performed to manufacturers datasheet limits.
- Virtually all electrical test programs written by Integra Technologies.

INTEGRA TECHNOLOGIES

Overall PEM Qual Success Rate by Device Technology



There is not a great deal of sensitivity to technology, with the exception of memory. It should be noted that the memory devices we evaluated tended to more often come in packages that were previously shown to be less reliable.

INTEGRA TECHNOLOGIES

Summary

- Over 30 years in business
- Employee Owned Company
- Dedication to Quality
- Stable & Experienced Management Team
- Capacity Model Supports Significant Growth
- ERP System second to none
- Largest and most experienced engineering team
- More than Just a Test House

- Parts Procurement
- BOM Management
- Failure Analysis/DPA
- Obsolescence Solutions
- Inventory Management
- PEM Qualification

INTEGRA TECHNOLOGIES

Integra Supports a Variety of Programs

Historical Programs	Customers Supported	Services Provided
Boeing/Airbus commercial aircraft	BAE, Crane, HW	Upscreening, parts procurement, CF authentication
Various missile programs (THAAD, PAC3, EKV, HARMS, ATACMS, etc)	LMC, Raytheon, BAE, UTAS, HW, L3. Boeing	Qualification testing, upscreening, FA, DPA, CF authentication, parts procurement
Various space level programs (Orion, MSL Rover, MAVEN, etc)	NASA, JPL, Ball Aerospace, LMC, BAE, SEAKR, NG, Boeing, APL	Screening, qualification, parts procurement, FA, DPA
Missile Defense Agency (MDA)	MDA	FPGA characterization
DoE programs	HW NSC, Sandia	Qualification testing, FA, DPA
Other DoD programs	HW, BAE, LMC, Raytheon, UTAS, Rockwell, L3, NG,	Upscreening, qualification testing, parts procurement, obsolescence solutions, FA, DPA, CF authentication

INTEGRA TECHNOLOGIES