

A decorative graphic on the left side of the slide, consisting of a network of light blue lines and circles that resemble a printed circuit board (PCB) layout. The lines are vertical and horizontal, with some diagonal connections, and the circles represent vias or components.

CAF

Where we are and where we are going?

JASON FURLONG

PWB INTERCONNECT SOLUTIONS INC.

Agenda

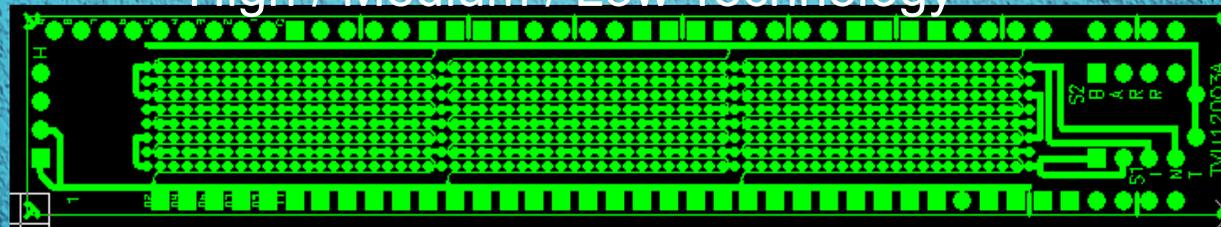
- PWB INTERCONNECT – CORPORATE OVERVIEW
- WHAT IS CAF
- CURRENT TESTING METHODS
- FUTURE TESTING METHODS
- PWBI TVS
- PWBI EQUIPMENT AND TEST SERVICES
- REVIEW OF RESULTS
- CONCLUSIONS
- Q & A

PWB INTERCONNECT SOLUTIONS – CORPORATE OVERVIEW

- IST technology originated at Nortel/Digital Equipment in early 1990's
- PWB Interconnect Solutions incorporated in 1996
- Business – IST/DELAM/FACE equipment / IST reliability test services
- IST method accepted into IPC TM-650 manual (2.6.26A) in 2000
- Global Representation throughout Asia and Europe
- PWB USA Incorporated - ITAR Certified
- Currently 250+ IST systems globally deployed and supported
- Responsible for major consortium reliability testing programs
- All business segments now specifying IST performance criteria
- Strategic global IST test services partnership with UL LLC
- Introducing standardized IST designs and CAF capability

Example of Cross Functional/Industry Test Vehicles

12 Layer PTH Coupons
High / Medium / Low Technology



Coupon Name	Grid	Drill	Pad	Clearance
TVU12001A	0.8	0.203	0.457	0.660
TVU12002A	1	0.305	0.610	0.864
TVU12003A	1.27	0.406	0.813	1.118
all dimensions in millimeters				

Possible Industrial Segments = Consumer / Computer + Peripherals / Low End Telecom / Industrial and Automotive (passenger) / Commercial Aircraft

PWB INTERCONNECT SOLUTIONS RELIABILITY TESTING

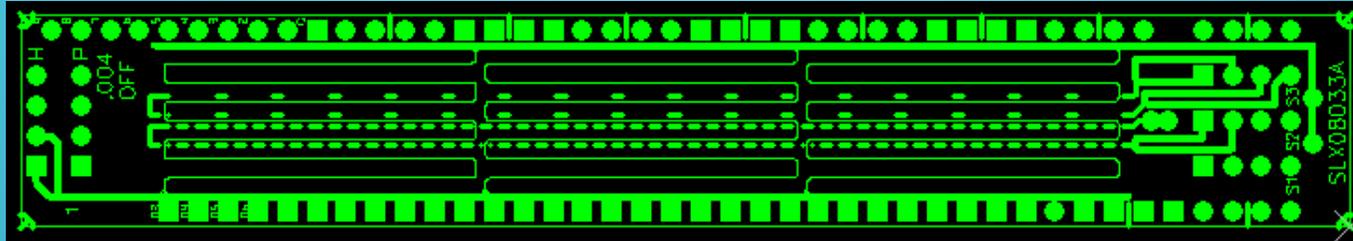
- The PCB is the foundation of the system
- If three pillars support the foundation, It only takes one weak pillar for the foundation to collapse

PWB Reliability Testing Looks at:

- 1 - Via and interconnect reliability - IST
- 2 - Material and construction confirmation - DELAM
- 3 - Shorting and parasitic leakage - CAF System

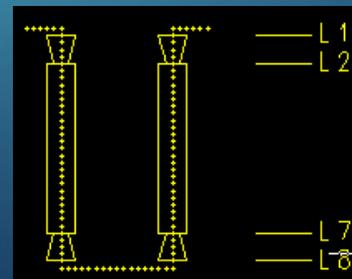
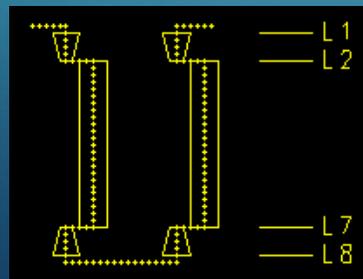
Example of Automotive Industry Test Vehicles

8 Layer Buried + Microvia Coupons
High / Medium / Low Technology

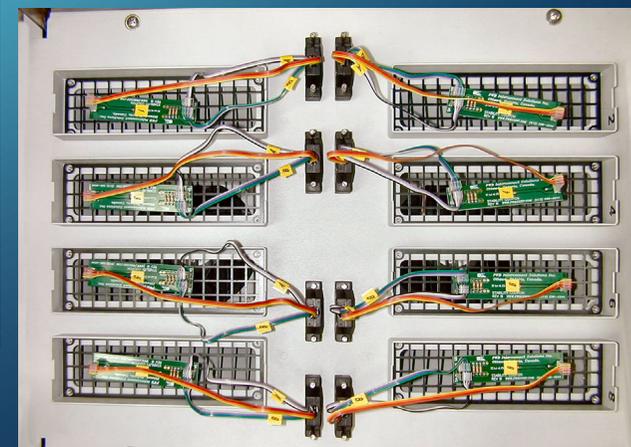
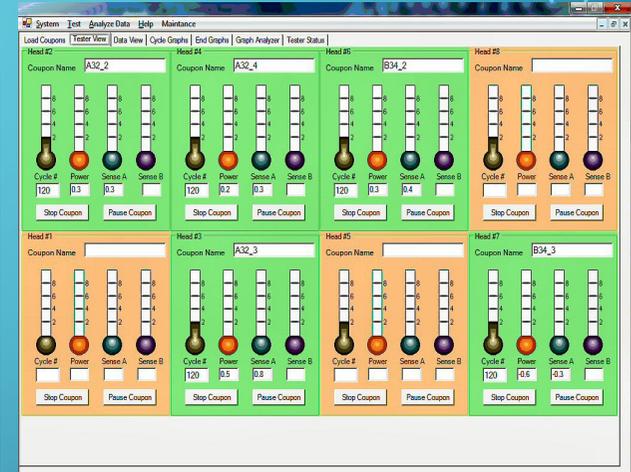
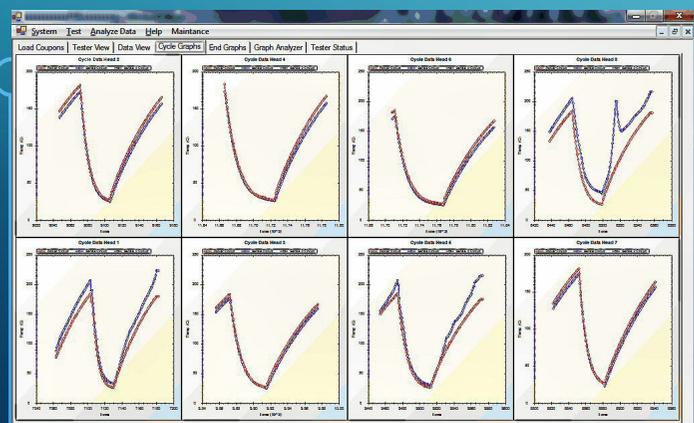
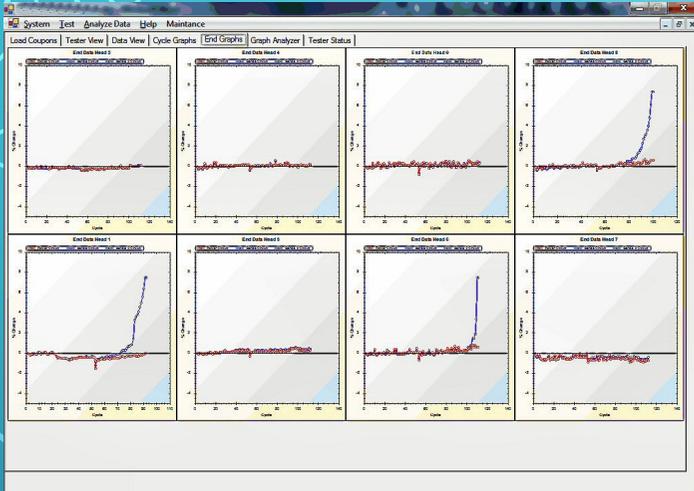


Coupon Name	Description	Grid	MicroVia	
			Hole	Pad
slx08033a	micro staggered off buried	0.8	0.10	0.33
slx08034a	micro staggered off buried	0.8	0.13	0.33
slx08035a	micro staggered off buried	0.8	0.15	0.33
slx08036a	micro stacked on buried	0.8	0.10	0.33
slx08037a	micro stacked on buried	0.8	0.13	0.33
slx08038a	micro stacked on buried	0.8	0.15	0.33

all dimensions in millimeters

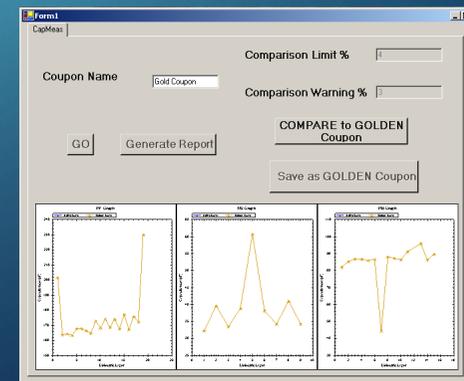
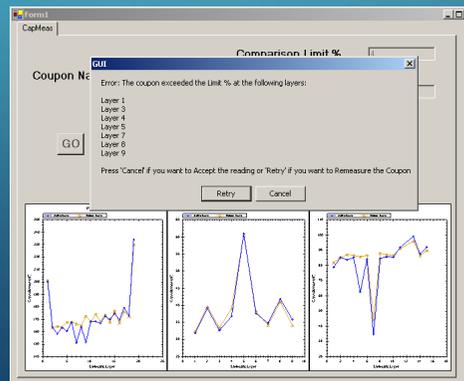
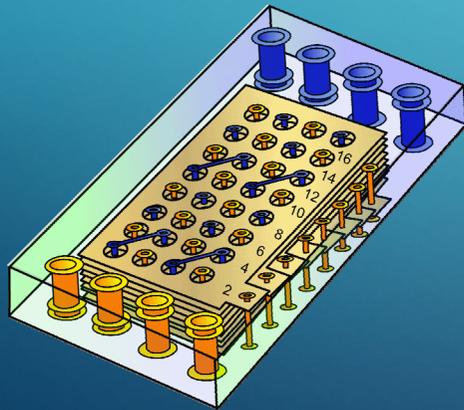


AUTOMATED **IST** HARDWARE AND SOFTWARE



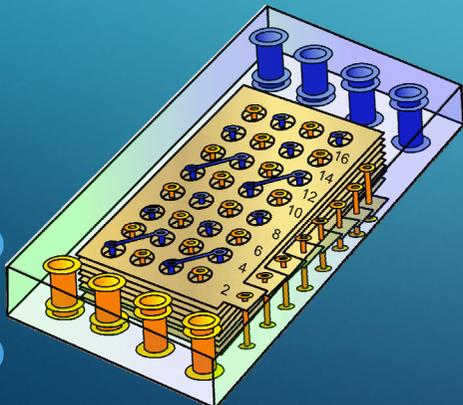
DELAM TESTER

Dielectric
Estimation
Laminate
Assessment
Method



FULLY AUTOMATED CAF EQUIPMENT

- RH control
- Temperature control
- V Bias control
- Custom profiles
- Remote reporting



Test Phase	Temperature	Humidity	Duration(Hrs)
<input type="checkbox"/> Dry Bake	105	0	0.50
<input type="checkbox"/> PreCondition	23	50	0.50
<input type="checkbox"/> Initial Measurement			
<input type="checkbox"/> Stabilization	85	87	96.00
<input type="checkbox"/> Test Measurements	85	87	1000.00
<input type="checkbox"/> Post Test	85	50	24.00
<input type="checkbox"/> Post Test Measurement			

What is CAF

- CONDUCTIVE ANODIC FILAMENT
- IDENTIFIED IN 1970'S
- SUB-SURFACE SHORT
- DELAYED FAILURE FOUND IN POPULATED BOARDS
- ELECTROCHEMICAL INDUCED FAILURE
- CONDUCTIVE COPPER-CONTAINING SALT



A decorative graphic on the left side of the slide, consisting of a network of light blue lines and circles that resemble a printed circuit board (PCB) layout. The lines are vertical and horizontal, with some diagonal connections, and the circles represent vias or components.

What are the influences of CAF

- THB (TEMPERATURE HUMIDITY AND BIAS)
- MANUFACTURING ISSUES
- CLEANLINESS
- DRILL DAMAGE
- MECHANICAL STRESS
- DESIGN
- MATERIAL
- CONDUCTOR SPACING
- PROCESSING TEMPERATURE

A decorative graphic on the left side of the slide, consisting of a network of light blue lines and circles of varying sizes, resembling a printed circuit board (PCB) layout or a neural network diagram. The lines are vertical and horizontal, with some diagonal connections, and the circles are placed at various points along these lines.

Current CAF Test methods

-IPC TM 650 MOST COMMON (2.6.25)

6 X 260°C SIMULATED REFLOW

BAKE SAMPLES 30 MINS 105°C

65°C/87% RH OR 85°C/87% RH

10V OR 100V DC BIAS

96 HOUR STABILITY NO BIAS

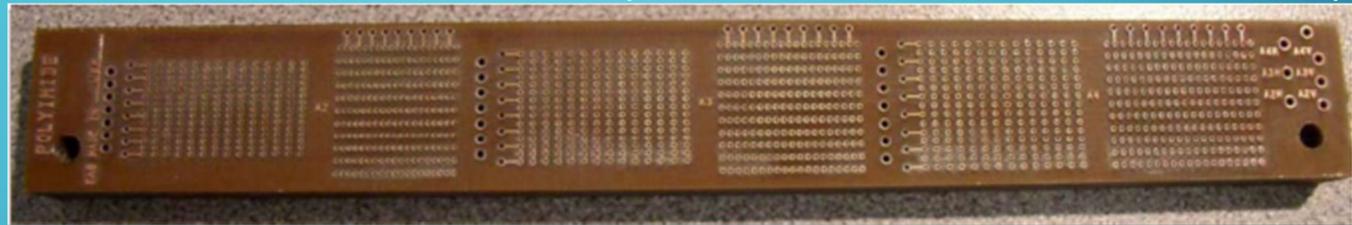
500 HOURS OR 1000 HOURS WITH BIAS

MEASUREMENTS TAKEN 24/100 HOURS

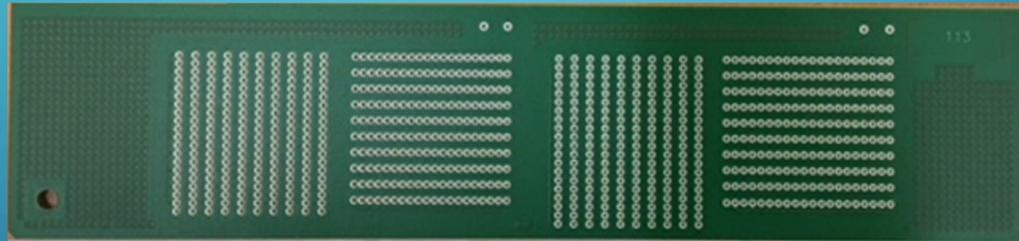
ONE DECADE DROP CONSIDERED FAILURE

Currently used CAF Test vehicles

-IPC HW-HW .26MM - .65MM (DRILLED HOLE .75MM - .37)



MRT5 TEST PANEL (.4MM AND .5MM HW-HW)



-OEM???

Future CAF Testing

-HDPUG (WWW.HDPUG.ORG)

-BETTER CAF ACCELERATION EQUATIONS

- CAF TV FOR MATERIAL CHARACTERIZATION

-IPC

- SURFACE FLASHOVER MITIGATION

-OEM

-BASED ON PRODUCT??

Future CAF Reliability

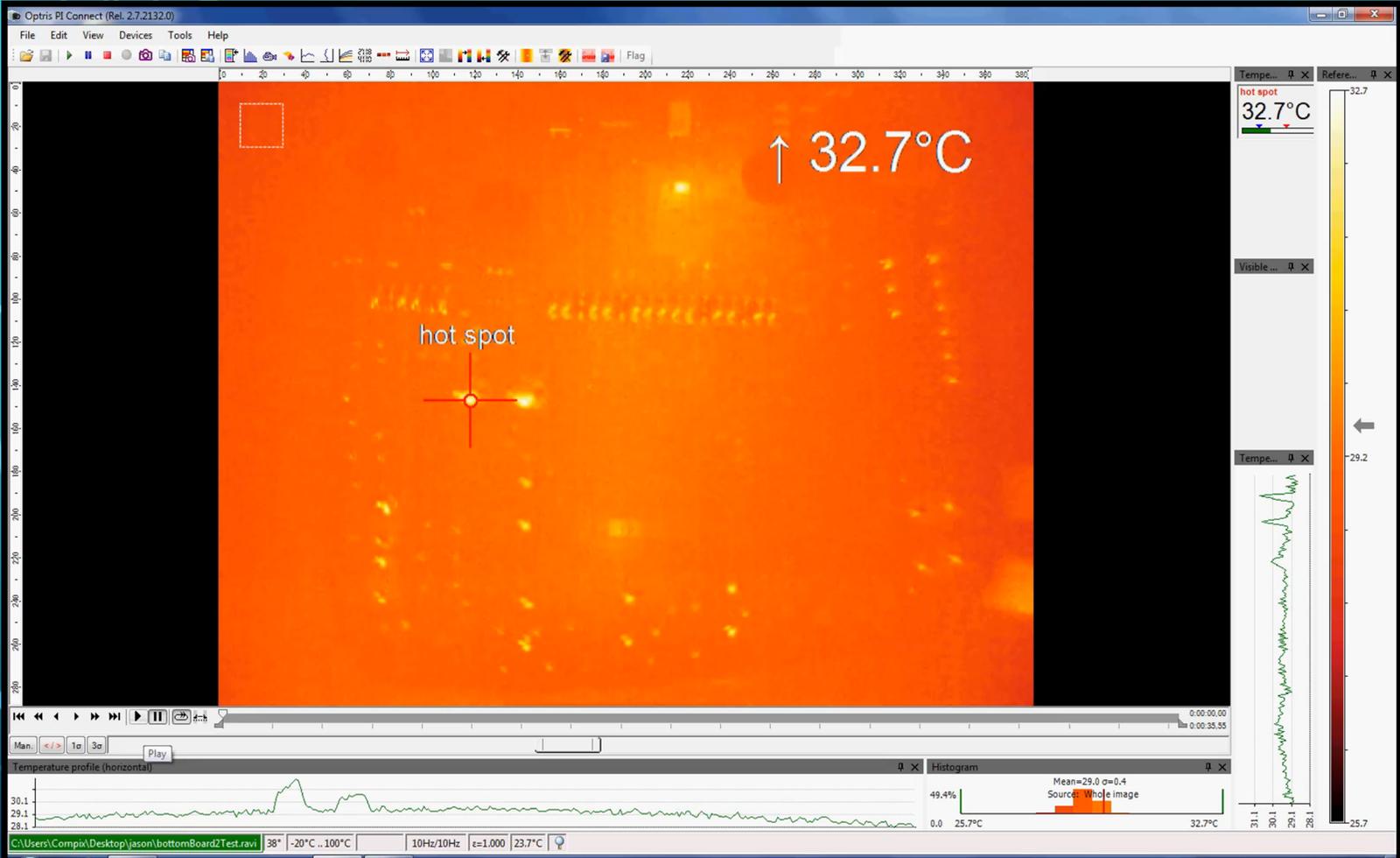
DESIGN CAN LEAD TO CAF FAILURE.....



Future CAF Reliability

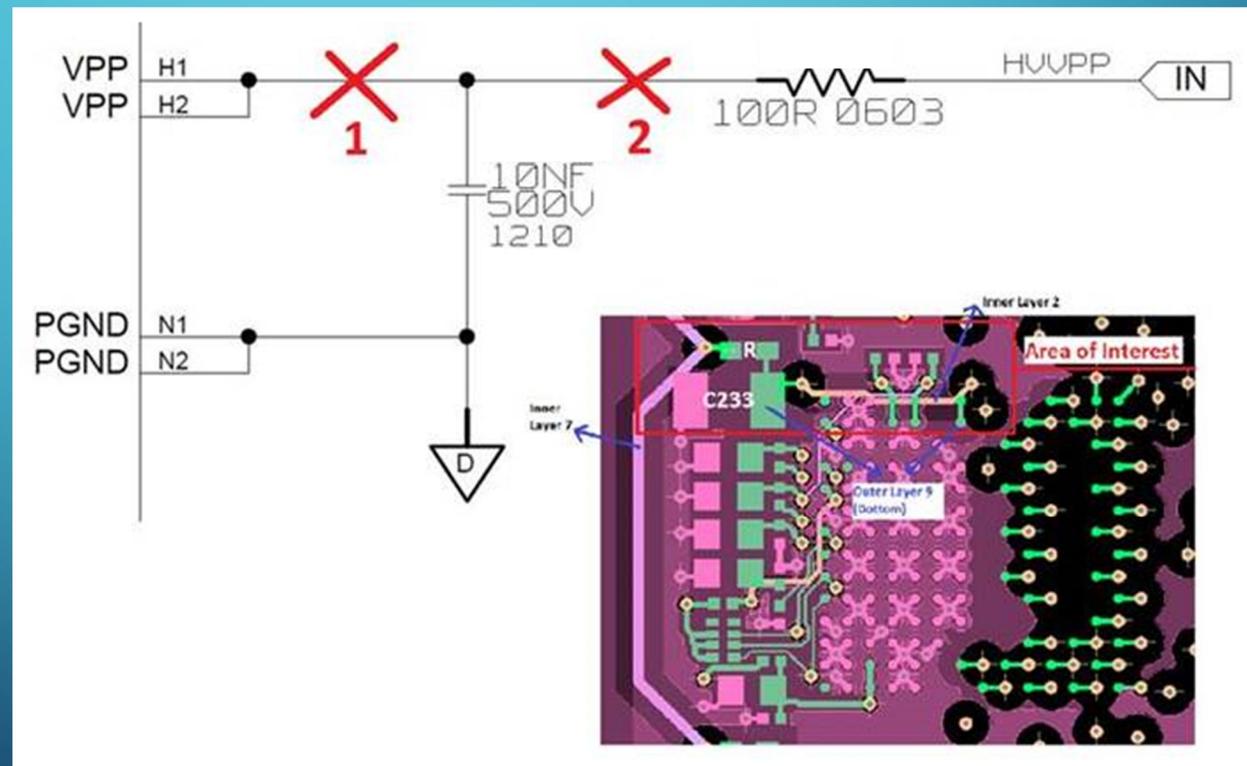


Future CAF Reliability



Future CAF issues

DESIGN CAN LEAD TO CAF FAILURE.....

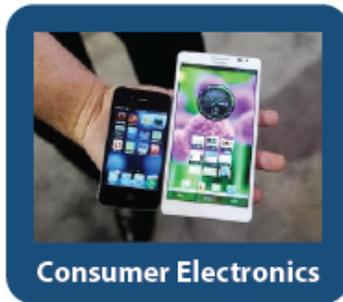




PWBi CAF Test vehicles

- USER DEFINED
- REPRESENTATIVE
- BUILT WITH THE SAME CONSTRUCTION AS BOARD
- BUILT WITH THE SAME PROCESS AS BOARD
- CONTAINS STRUCTURES FOUND IN THE BOARD
- FLEXIBLE
- TEST BOARD OR INDIVIDUAL COUPON

Increasing Demand for Demonstrated Reliability



Consumer Electronics



Telecom



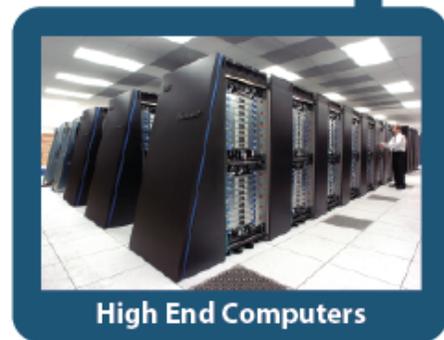
Aerospace



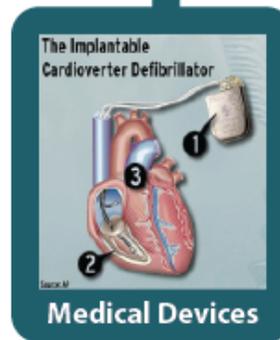
Automotive

50 100 150 200 250 300 350 400 450 500

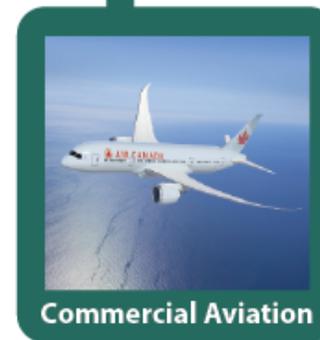
Customer Spec's for Minimum IST Cycles to Failure After Assembly



High End Computers



Medical Devices



Commercial Aviation



Space

Characteristic Design Rules by Segment

Via to Via Spacing (Pitch) 2016

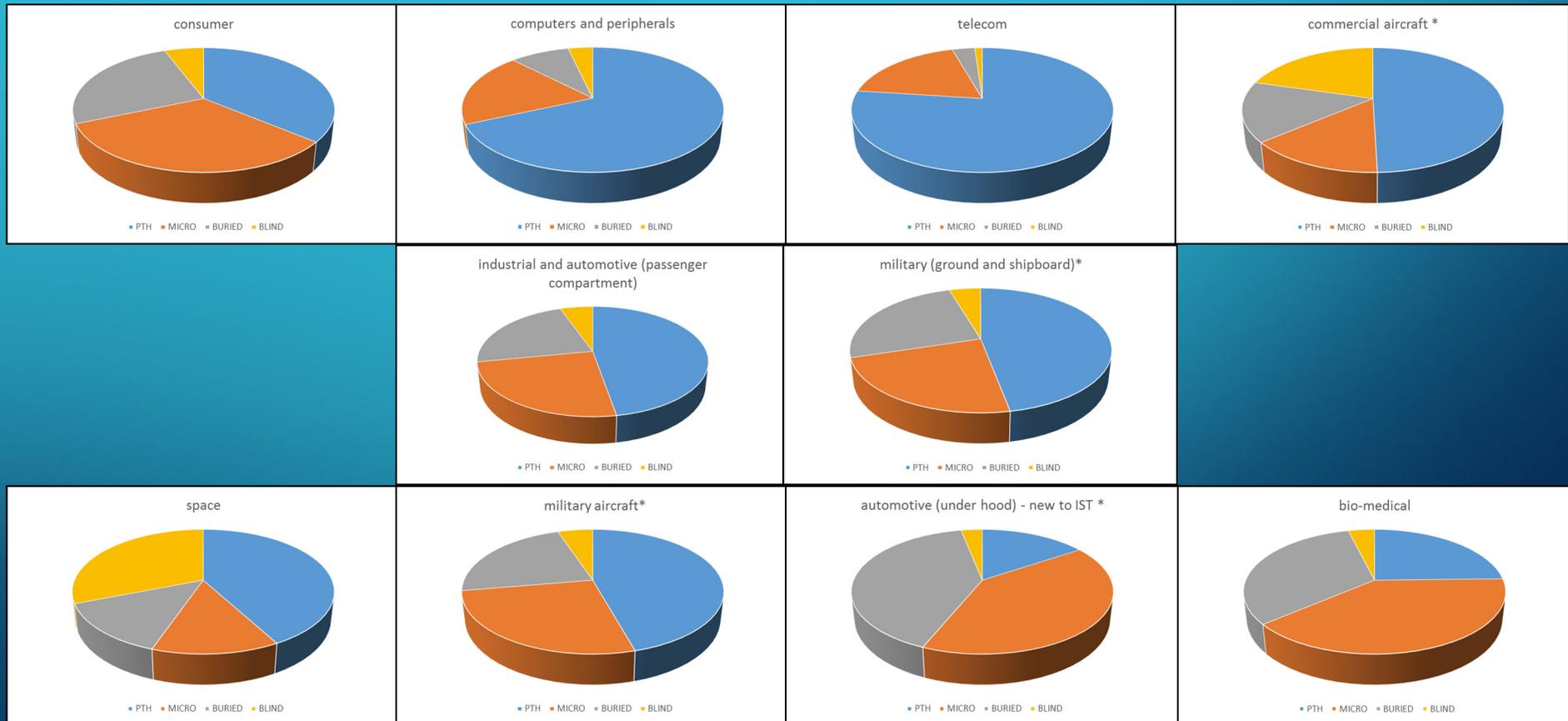
IPC categories	Grid (mm)										
	0.4	0.5	0.8	1	1.14	1.27	1.4	1.83	1.91	2	2.54
consumer		X	X								
computers and peripherals	X	X	X								
telecom			X	X			X		X		
commercial aircraft *			X	X		X			X		
industrial and automotive (passenger compartment)			X	X					X	X	X
military (ground and shipboard)*			X	X		X					
space				X		X			X	X	
military aircraft*				X		X		X	X		
automotive (under hood)*			X	X	X						
bio-medical		X	X								
* product end-use difficult to determine											

Characteristic Design Rules by Segment Via to Via Spacing (Pitch) as of September 2018

IPC Categories	Grid(mm)																		
	0.203	0.254	0.305	0.356	0.4	0.5	0.61	0.635	0.65	0.8	1	1.14	1.27	1.4	1.83	1.91	2	2.54	
consumer		x	x	x		x	x		x	x									
computers and peripherals		x	x	x	x	x	x		x	x									
telecom			x	x		x		x	x	x				x			x		
commerical aircraft *						x				x			x				x		
industrial and automotive (passenger compartment)					x	x				x							x	x	x
military (ground and shipboard)*										x			x						
space										x	x		x				x	x	
military aircraft *										x	x		x		x		x		
automotive (under hood)*						x	x		x	x	x	x							
bio-medical	x				x	x		x		x									

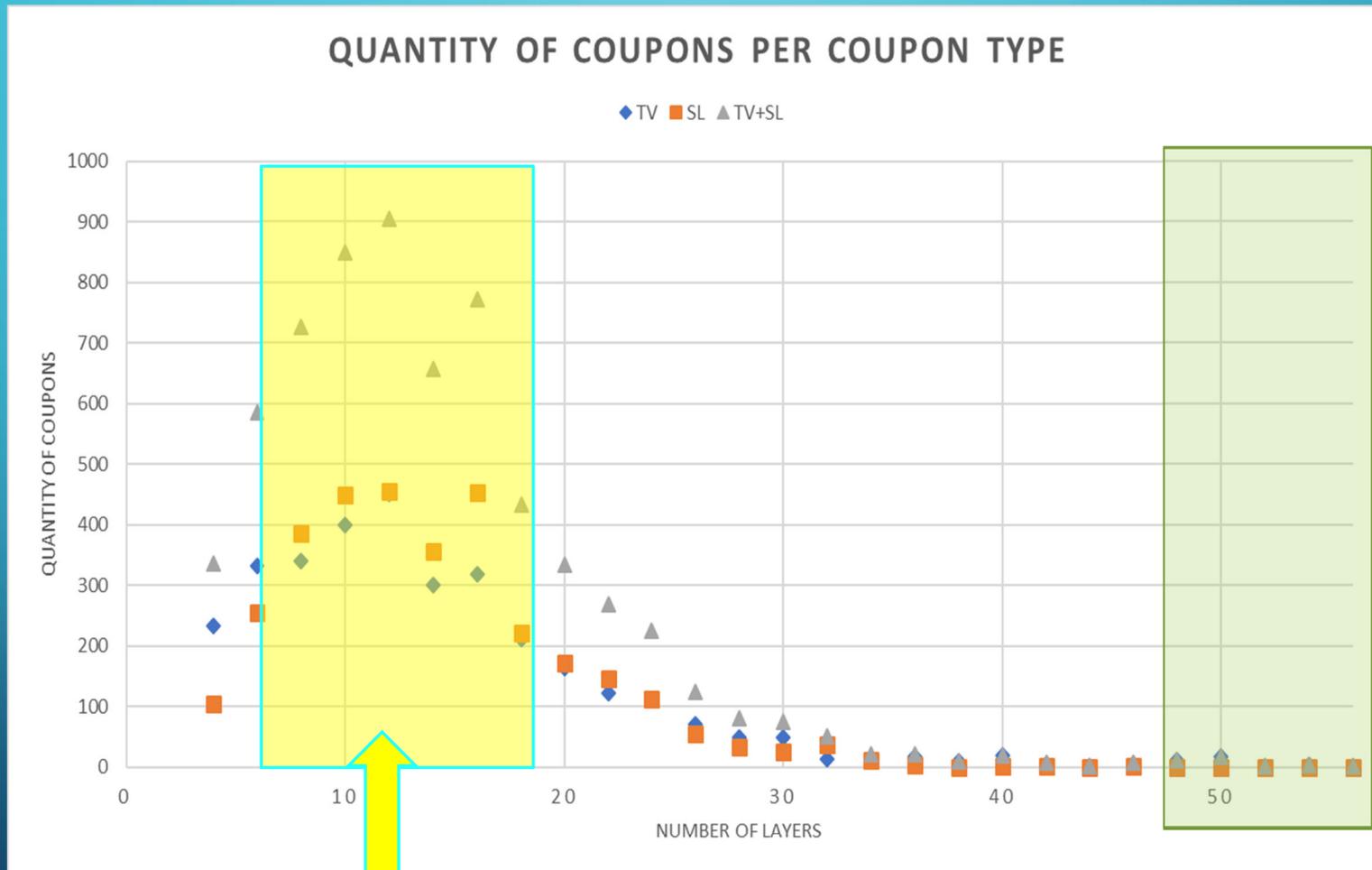
VIA STRUCTURES BY INDUSTRIAL SEGMENT

Every industry is unique, common base-lining would be impossible



Every chart must then be further dissected by layer count, thickness, construction, hole size, material type, etc. to fully understand the levels of complexity involved.

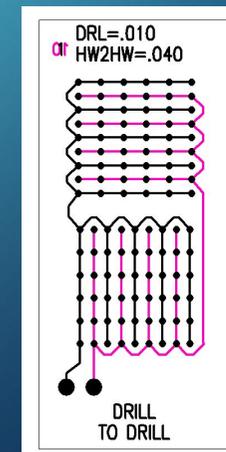
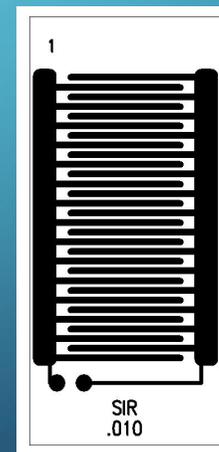
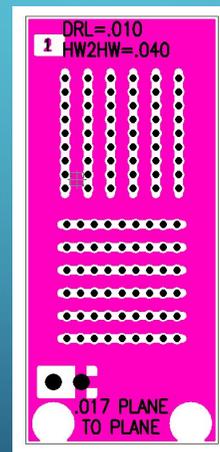
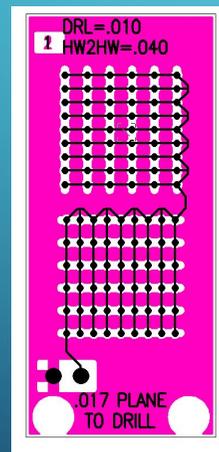
Most Recent - 2011 to Current - Layer Count and Type



12 layers

PWBi CAF Test vehicles

- DESIGNED TO MATCH CUSTOMERS CONSTRUCTION
- DESIGNED TO MATCH CUSTOMERS VIA STRUCTURES
- DESIGNED TO MATCH CUSTOMERS SPACINGS
- SIZE IS 18MM X 40MM (WIDTH OF AN IST COUPON)



PWBi CAF Test Vehicle

REV	DESCRIPTION OF CHANGE	DATE	ENG
A	ORIGINAL ISSUE	JUN 13 2018	JG

This design is property of PWB Interconnect Solutions Inc.
Modifications to be approved by PWB Interconnect Solutions Inc.

LAYER BAR			
SG	PLN	THK	FINISH
●	01	0.50	
●	02	0.50	
●	03	0.50	
●	04	0.50	
●	05	0.50	
●	06	0.50	
●	07	1.00	
●	08	2.00	
●	09	2.00	
●	10	2.00	
●	11	0.50	
●	12	0.50	
●	13	0.50	
●	14	0.50	
●	15	0.50	
●	16	0.50	
	17		
	18		
	19		
	20		
	21		
	22		
	23		
	24		
	25		
	26		
	27		
	28		
	29		
	30		
	31		
	32		
	33		
	34		
	35		
	36		
	37		
	38		
	39		
	40		
	41		
	42		
	43		
	44		
	45		
	46		
	47		
	48		
	49		
	50		

This drawing is for IST coupon information only
Coupon to be manufactured in accordance with the customer drawing
Coupon locations: -within one inch of circuit pattern
-greater than one-half inch from panel edge

See readme.txt for PWB INC. contact information and other details
All files "Viewed from top"
All artworks are produced in a 'POSITIVE' polarity
See layer bar to identify specific product construction
All soldermasks are supplied 1 to 1 and should be adjusted as necessary
All drill data is contained in one file (see drill graphics)
All holes are plated unless otherwise specified
See drill table for tool/layer assignment ['SDL'=Start drill layer, 'EDL'=End drill layer]

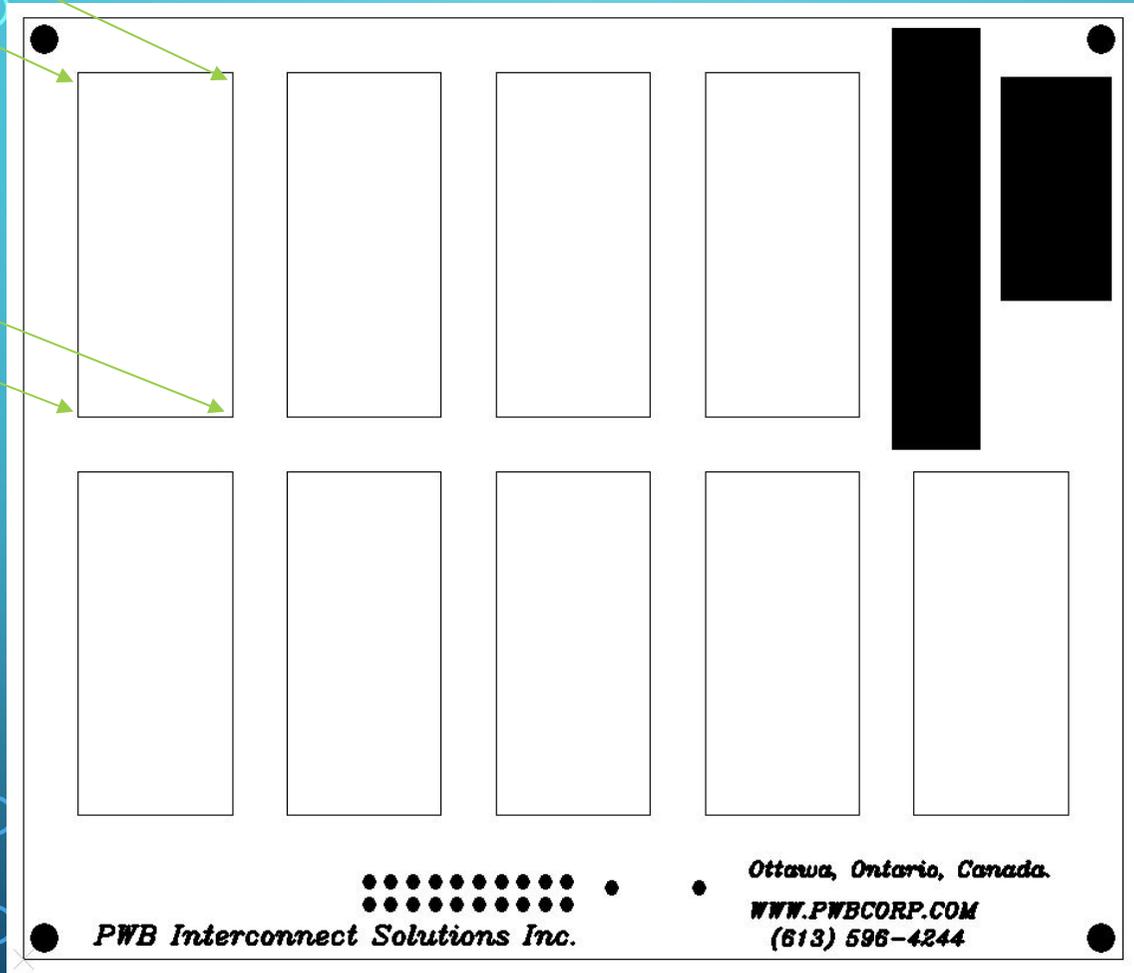
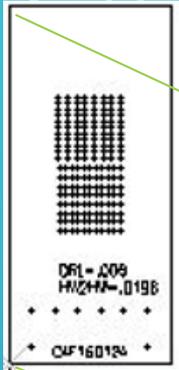
Layers: 16
Coupon size: .700 x 1.550 Inches
Grid spacing: .0256
Nonfunctional pads are: Removed
Hole/Pad: .006/ .016
Hole Edge to Hole Edge (HW2HW): .0196

**** .043 MUST BE DRILLED .043 (1.1MM or #57 DRILL)

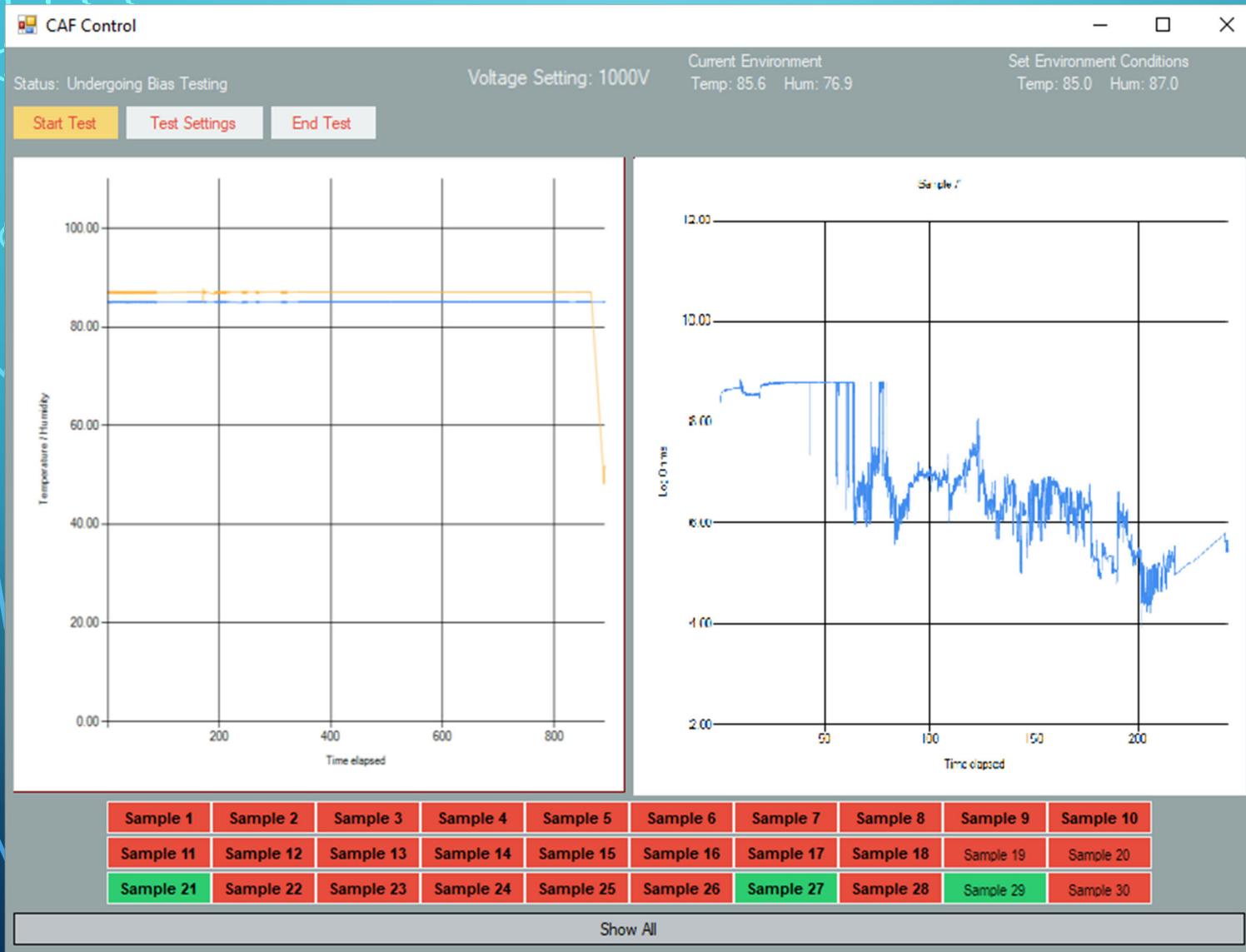
Drill File	SYM	TOOL	DHS	FHS	QTY	SDL	EDL	CKT
ncdthru	-	T1	.043	****	6	1	16	COM
ncdthru	-	T2	.006		176	1	16	S
ncdthru	-	T3	.125		2	1	16	MTC

PART NO.			
PWB Interconnect Solutions Inc. Ottawa, Ontario, Canada. WWW.PWBCORP.COM 613 596-4244			
Title INTERCONNECT STRESS TEST COUPON			
Number	CAF16012	Rev	A
Size	A		
Date	JUNE 13 2018	Sheet	1 of 1

PWBi CAF Test Vehicle Panel

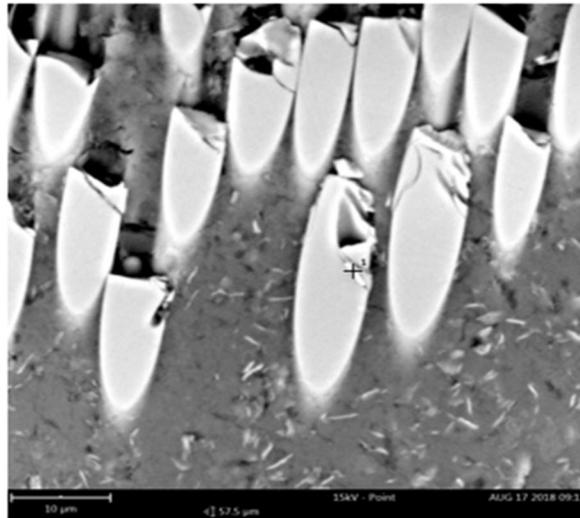


Review of results data



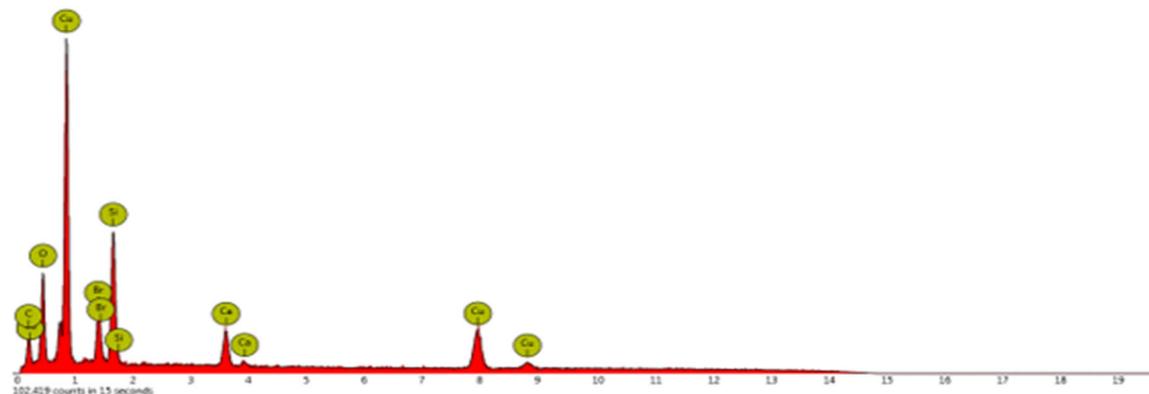
Review of results images

1. spot

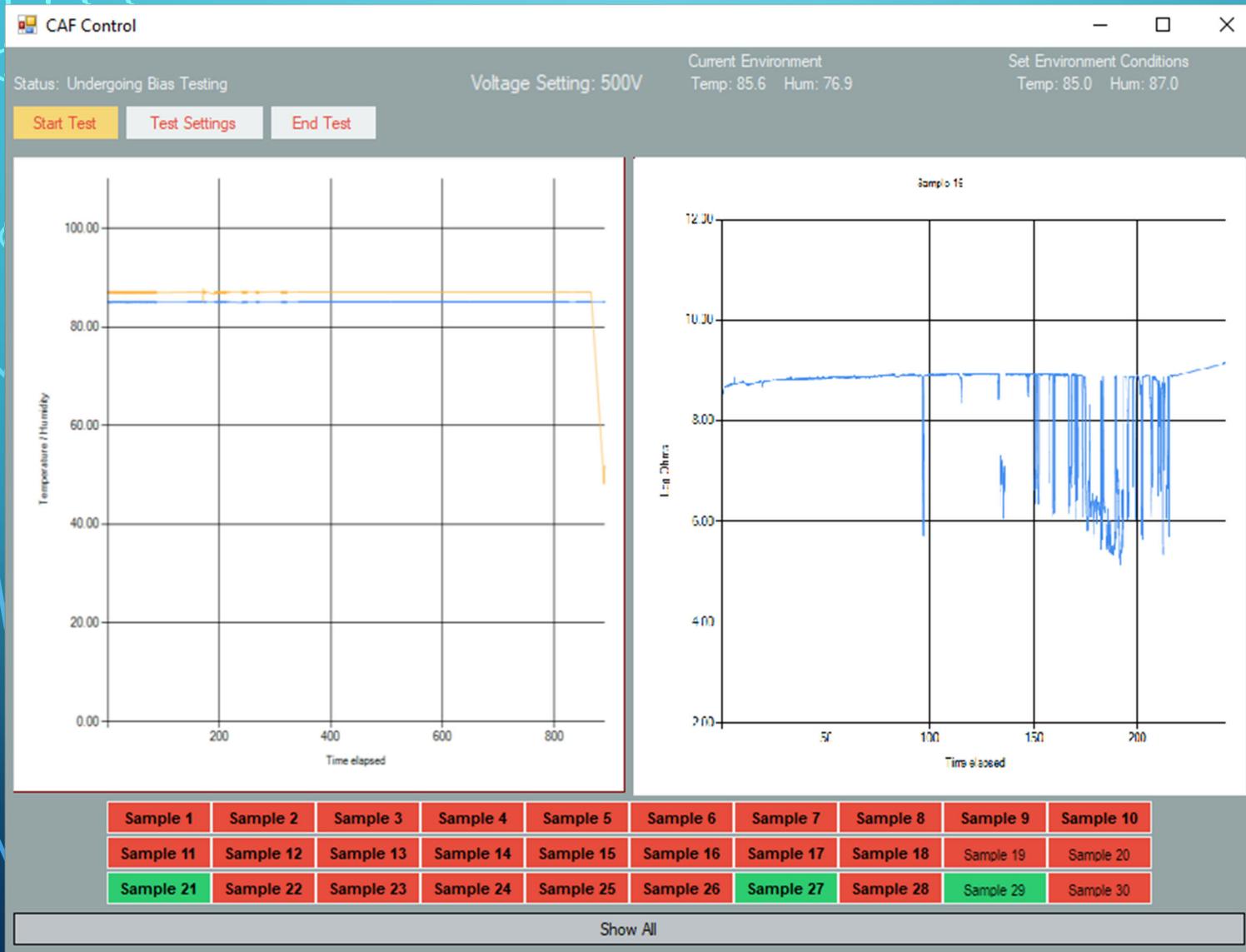


Element Number	Element Symbol	Element Name	Atomic Conc.	Weight Conc.
6	C	Carbon	42.07	20.09
8	O	Oxygen	27.79	17.68
29	Cu	Copper	14.09	35.59
14	Si	Silicon	10.01	11.18
35	Br	Bromine	3.68	11.70
20	Ca	Calcium	2.36	3.76

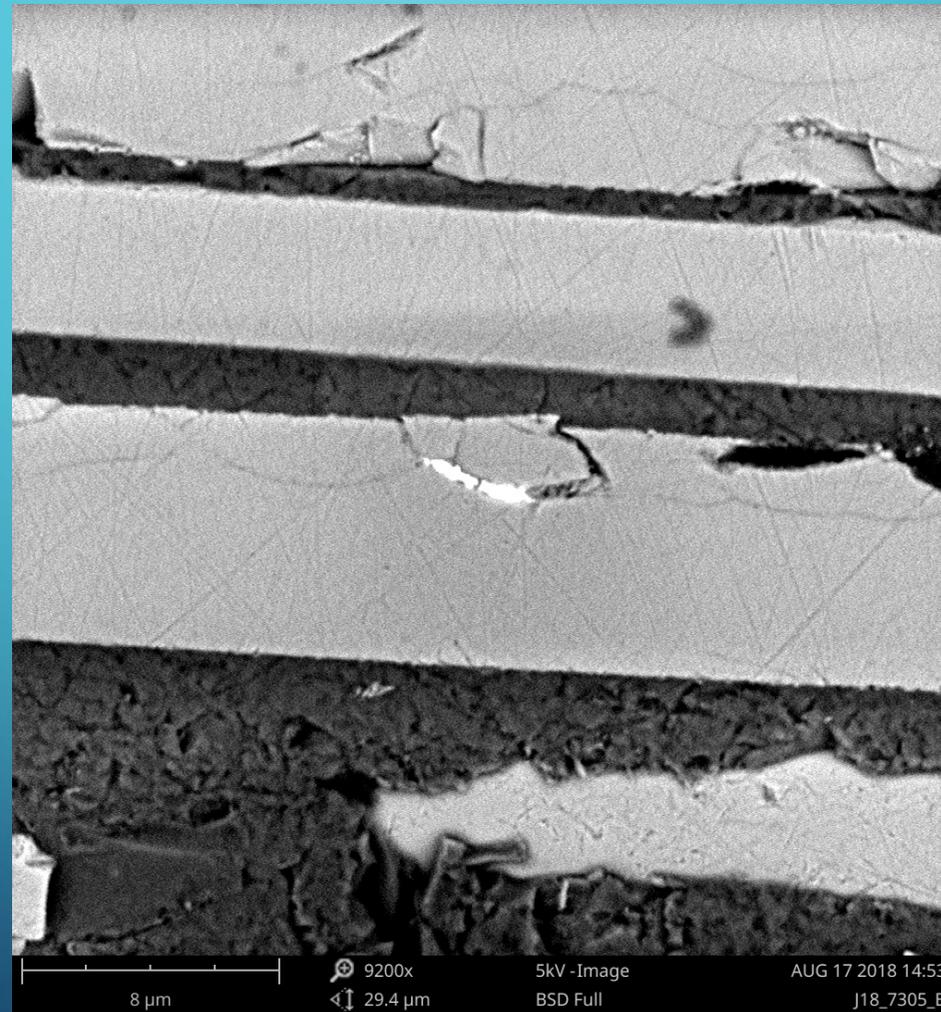
FOV: 57.5 μm, Mode: 15kV - Point, Detector: BSD Full, Time: AUG 17 2018 09:13



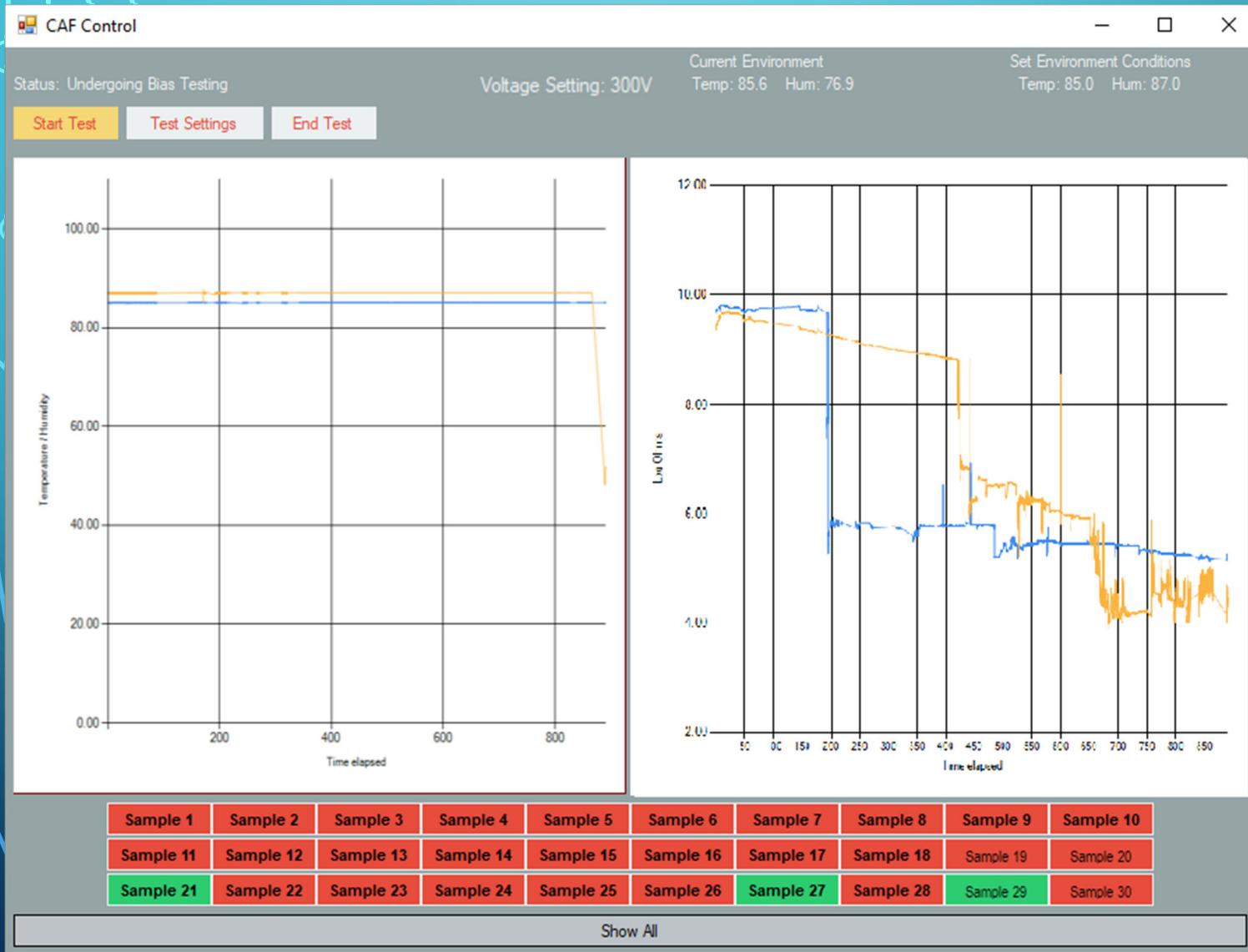
Review of results data



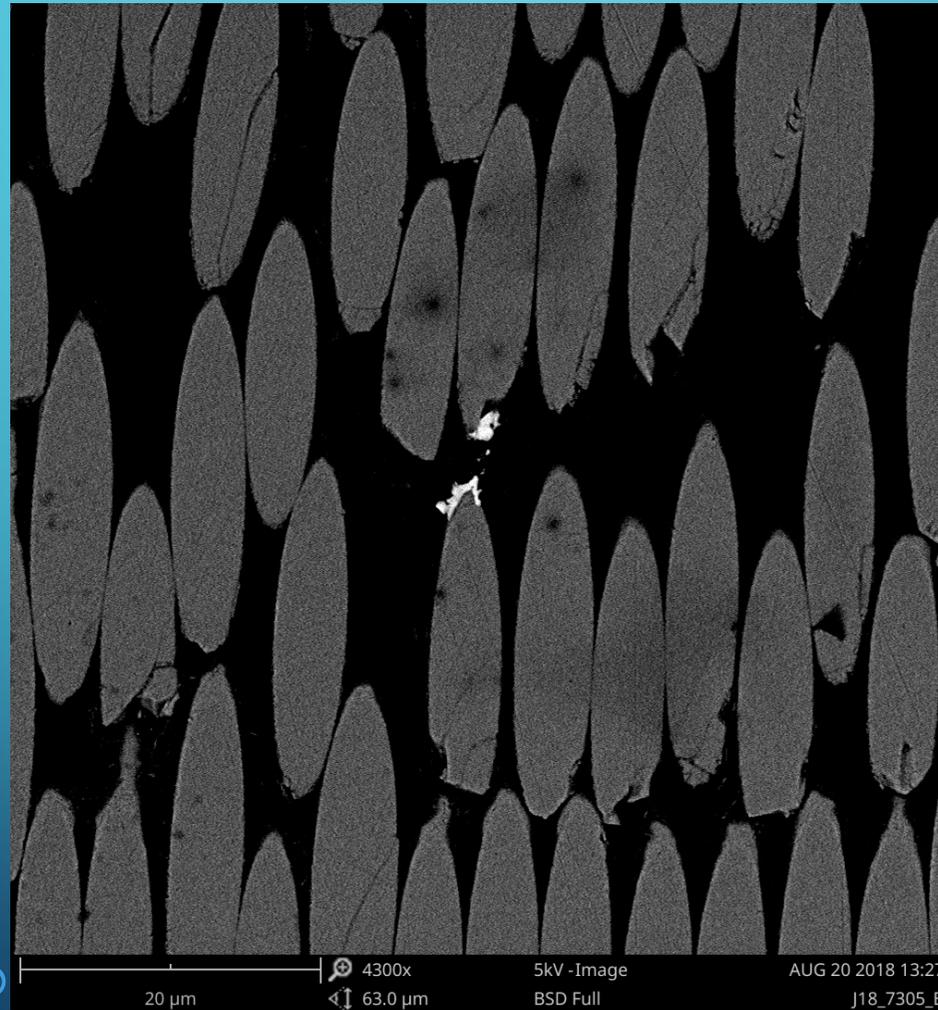
Review of results images



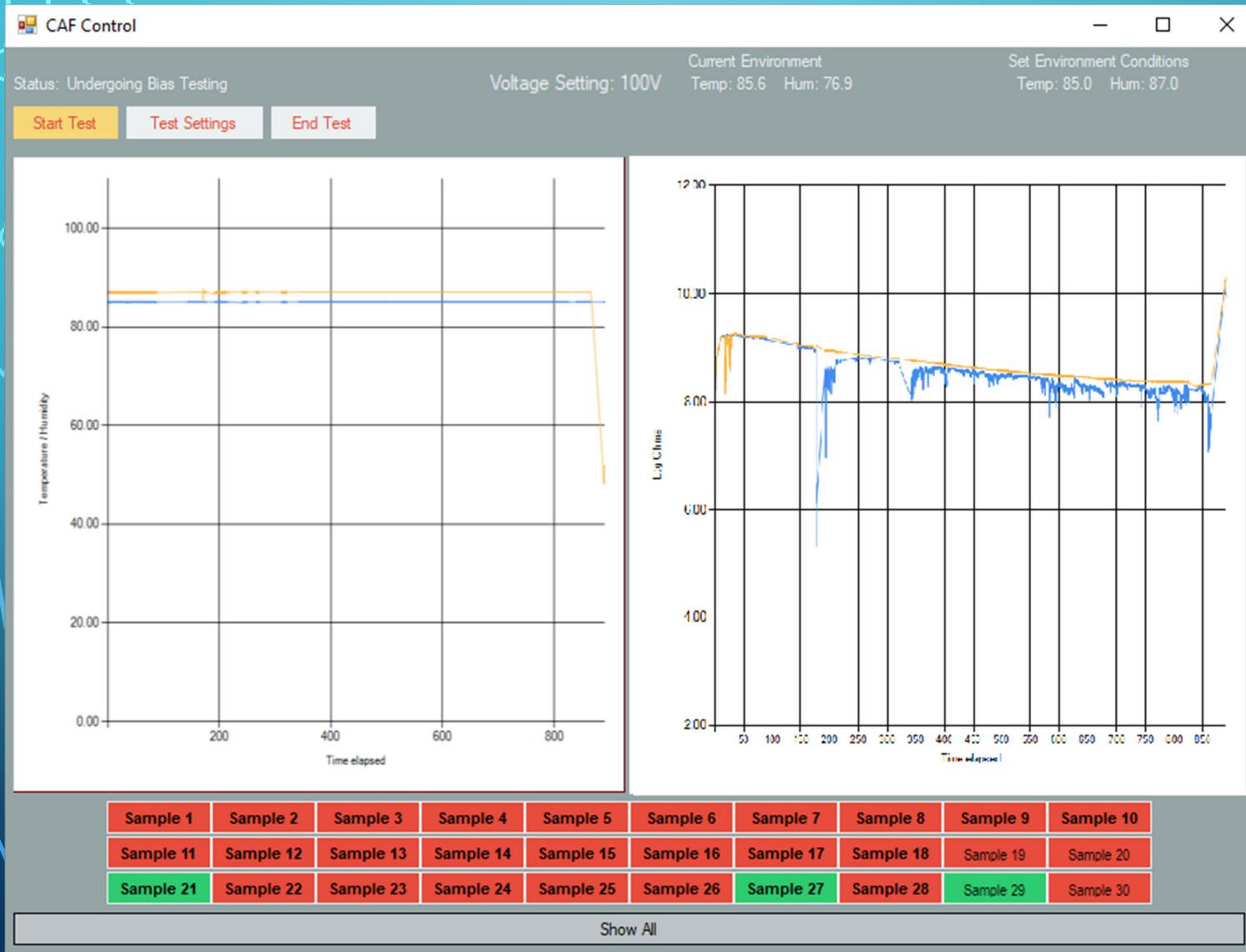
Review of results data



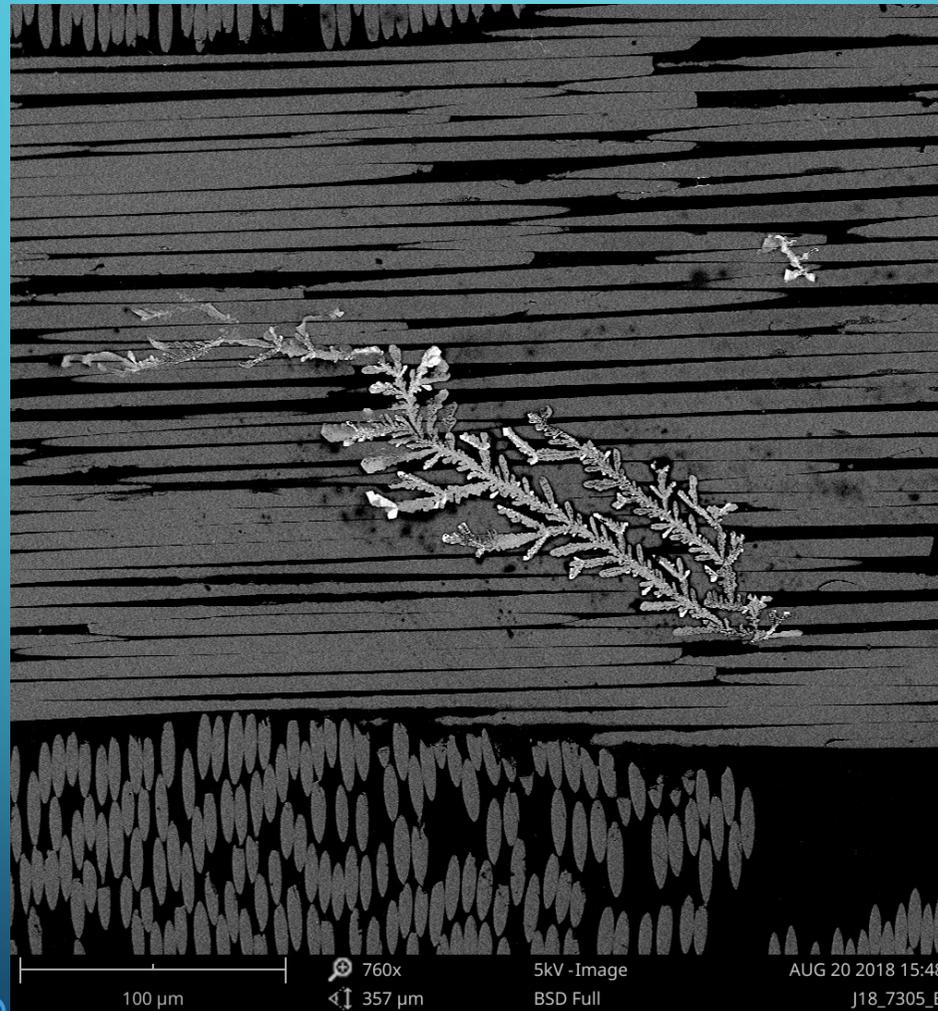
Review of results images



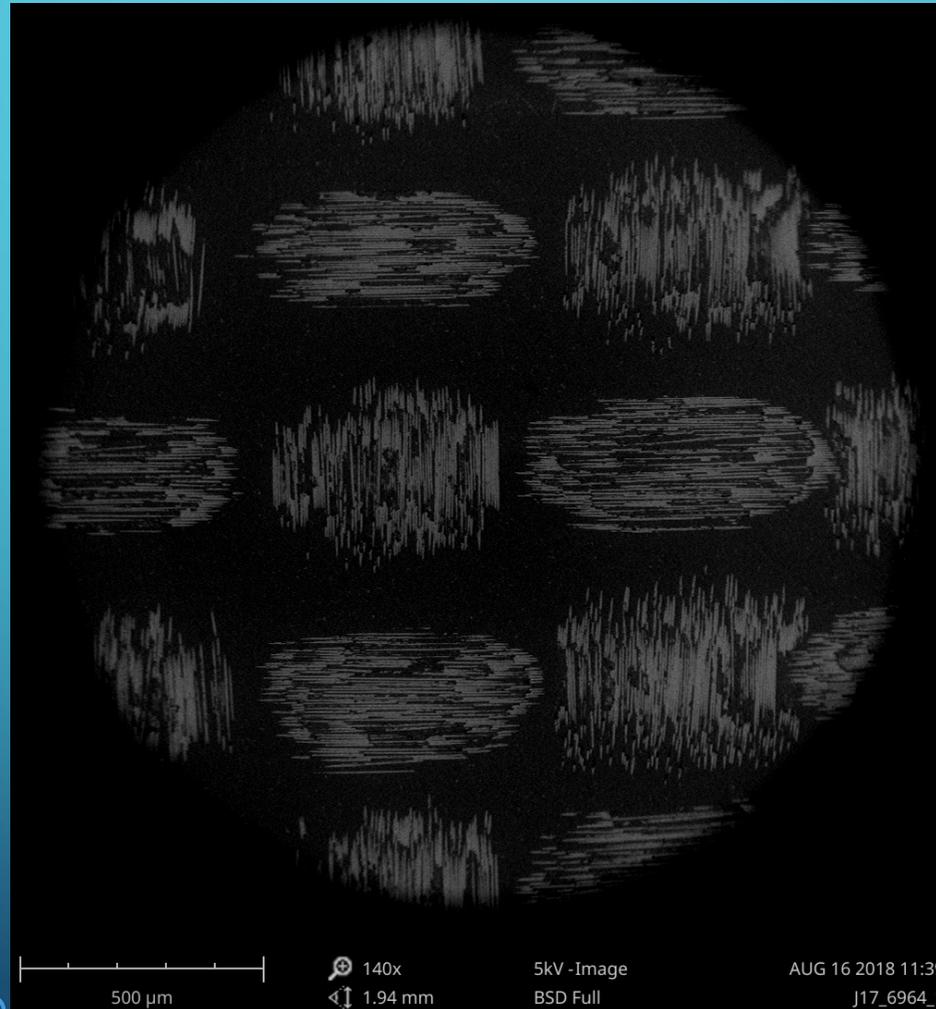
Review of results data



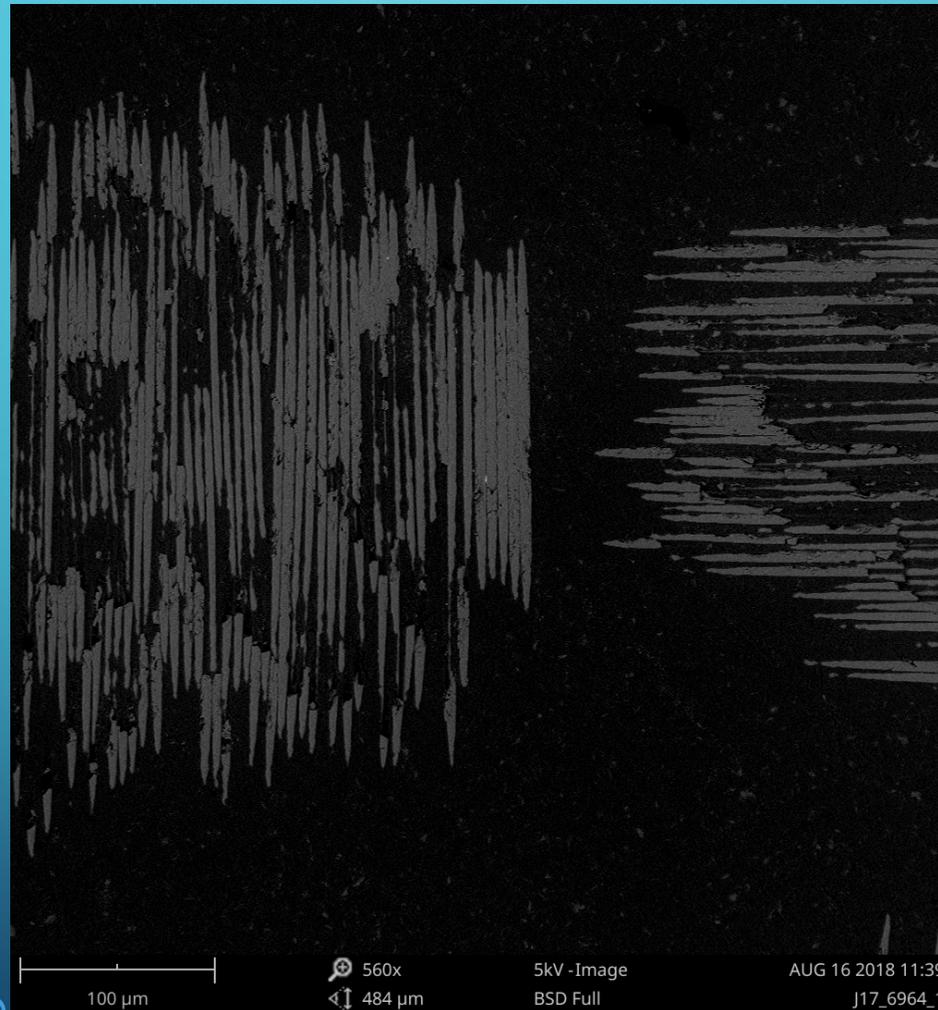
Review of results images



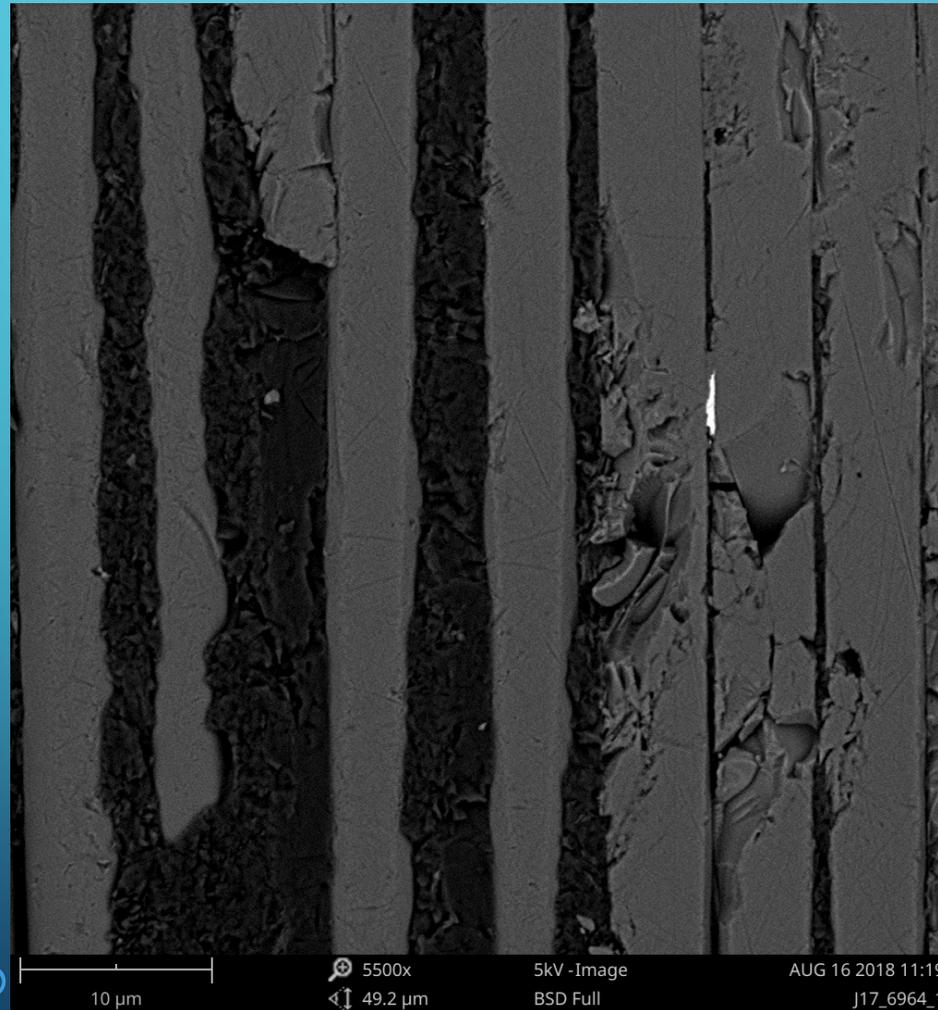
Difficult to identify visually



Review of results images



Review of results images



Conclusions

- IF CAF TESTING IS BEING DRIVEN TO PRODUCT LEVEL WE MUST REPRESENT THE PRODUCT WITH THE TESTING

- WE HAVE TO CUSTOMIZE TEST VEHICLE

- WE HAVE TO CUSTOMIZE TEST ENVIRONMENT

- FAILURE DIFFICULT TO LOCATE IN MICROSECTION

- FAILURE MAY GO THROUGH A RECOVERY

- REVIEW OF RESULTS

- CONCLUSIONS

- Q & A

ARE INDUSTRY STANDARDS FOR CAF PERFORMANCE POSSIBLE?

- Performance testing SHOULD be based on the industry segments product's life cycles – NOT one size fits all philosophy
- Each industry (Consumer, Computer, Telecom, Medical, Automotive, Avionic, Aerospace, etc.) has unique end-use environments, representative criteria is critical.
- PWB Performance Standardization must have :–
 - Standardized (but flexible) test vehicle designs
 - Universally available automated test equipment and protocols that quantify both materials and via structure capability
 - Documented methodologies with common data reporting format
 - Includes stresses applied during assembly/rework process
 - Performance levels that (ideally) correlate between both quality and reliability specifications

Conclusions

- PWBIS Inc. design/performance database can be used to establish effective industry segment test vehicles and performance criteria.
- All industry segments are now specifying IST testing for measuring and confirming PWB performance/reliability.
- Standardized designs, protocols, reporting formats and performance criteria's have been developed.
- With 250+ IST test systems located at the majority of major/global PWB manufacturing facilities IST has effectively established itself as the globally accepted methodology for determining PWB reliability and material performance.
- IST Test Services will be expanded to achieve a global presence that meets the growing volume demands.

Thank you for your attention; any Questions?

For further information please contact:

Mr Jason Furlong
PWB Interconnect Solutions Inc.
235 Menten Place, Unit 103
Nepean, Ontario, Canada
K2H 9C1

1-613-596-4244 ext. 223
Jasonf@pwbcorp.com

Or visit our web site: www.pwbcorp.com