



Advanced Material Solutions

for Tomorrow's
Technology Requirements

Park Electrochemical (Advanced Materials)

Sophisticated
Electronics
Systems

Military

Aerospace

Industrial /
Commercial

Wireless
Communi-
cations

New

Markets

Nelco /
Neltec

Neltec /
Nelcote

Nelcote/
Neltec

Nelcote

Neltec /
Nelcote

?

Global Operations



Global FR-4 Electronics Materials

N4000-2	Standard Multifunctional Epoxy System, Tg 140°C
N4000-6	High-Tg, High Performance Epoxy System, Tg 180°C
N4000-6 FC	Fast Cure, High Performance Epoxy, Tg 175°C
N4000-6(FC) BC [®]	Buried Capacitance, High Tg Performance Epoxy Laminate
N4000-7	CAF Resistant *, Low Z-CTE Epoxy, Tg 155°C
N4000-7 SI [®]	CAF Resistant *, Low Z-CTE Epoxy, Signal Integrity
N4000-7 EF [®]	Environmentally Friendly Epoxy ,CAF Resistant *, Lead Free, Tg >165°C
N4000-11	Lead Free, CAF Resistant *, Low Z-CTE Epoxy, Tg 175°C
N4000-11 BC [®]	Buried Capacitance, High Tg Epoxy Laminate
N4000-29	Lead Free, CAF Resistant *, Low Z-CTE Epoxy, Tg 185°C
N4000-29 BC [®]	Buried Capacitance, High Tg Epoxy Laminate
LD [®] Prepregs	Modified Glass Reinforcement for Improved Laser Drilling

*CAF Resistance of >625 hours under Tellabs Test Method GR-78-CORE PAR. 13.1.5 using a Sun Microsystems Test Vehicle #1, CAF TV1 6/15/00.
BC[®], ZBC-2000[®], and Buried Capacitance[™] are trademarks of Sanmina-SCI Corporation

High Speed Digital Materials

N4000-12	High-Speed, Low-Loss, CAF Resistant, Lead-Free Epoxy, Tg 190°C
N4000-12BC	Buried Capacitance, High Tg Epoxy Laminate
N4000-12SI	Next-Generation Signal Integrity
N4000-13	High-Speed, Low-Loss CAF Resistant Epoxy, Lead Free, Tg 210°C
N4000-13 BC [®]	Buried Capacitance, High-Speed, Low-Loss Epoxy
N4000-13 SI [®]	Next-Generation Signal Integrity
N5000	BT Epoxy, Tg 185°C
N5000-30 / 32	High-Performance Chip-Packaging BT
N7000-1	MDA-Free Polyimide, Tg 260°C
N7000-2HT / -3	Toughened Fracture-Resistant Polyimide 94V-1, Tg 250°C
N7000-2 V0	High-Tg Toughened Polyimide 94V-0, Tg 250°C
N8000	Cyanate Ester, Tg 250°C

Advanced RF Microwave Materials

N4380-13 RF	Microwave Performance, Modified Epoxy
N4350-13 RF	Microwave Performance, Modified Epoxy
NH9000	Woven, Glass / Ceramic loaded PTFE D_k 2.94 to 3.50 (2.94, 3.00, 3.20, 3.38, 3.48, 3.50)
NX9000	Woven, Glass-Reinforced PTFE D_k 2.40 to 3.20 (2.40, 2.45, 2.50, 2.55, 2.60, 2.94, 3.00, 3.20)
NY9000	Woven, Glass-Reinforced PTFE D_k 2.08 to 2.33 (2.08, 2.17, 2.20, 2.33)
N9000-13 RF	Next-Generation PTFE Performance Blended Laminate (Multilayers)

Alcatel Lead Free Supplier Meeting

- Fabricator & Laminate suppliers of Alcatel present their lead free offerings and supporting data
- 16 Fabricators & 8 Laminators from NA & Asia
- Much confusion on lead free testing
 - Laminate – DSC, TMA, Td, T260, T288, CTE (50-260), moisture absorption %
 - Fabricator – Thickness of board, copper weight, resin content, design & complexity, copper thickness in via, copper elongation, thermal requirements (reflow profile, ramp rate, max reflow temperature, thermal excursions)
 - EMS – Reflow equipment, oven profiling, rework procedure
- **Only A Guideline, Not A Guarantee Of Lead Free Capability**

Alcatel Lead Free Supplier Meeting

- Nelco recommended lead free offerings
 - N4000 -7, N4000-11, N4000-12, N4000-13 & N4000-29
- Fabricators had different methods to determine if a material was lead free
 - Real production boards
 - TV with CAF, IST, HATS, T260/T288, liquid to liquid or air to air testing
 - Reflow through an oven (235, 245, 250 or 260)C
 - Multiple reflows (5X, 6X, 7X or 9X)
- Reliability of vias – Little data exists on real life applications (all theoretical based on models)
- Systems have to have 20 – 25 year survival rate out in field
- **Much Work Remains To Understand Lead Free & It's Impact On Long Term Reliability**

OEM PWB Fabrication Technology Drivers

- Rapidly Increasing Bandwidth
- Higher signal transfer rates
 - Broader dielectric material sets
 - New resin chemistries
 - Focus on manufacturability and signal integrity
 - Lower Cu tooth profile
 - Different etch techniques
 - Tighter impedance control
 - Changes in signal routing
 - Optoelectronic integration
 - Dialed in Dk and lower Df
 - Stable Dk/Df
 - Across Frequency
 - Over Environmental Impact



OEM PWB Fabrication Technology Drivers

- Enhanced product reliability
- Improved thermal stability
- Enhanced shock resistance
- CAF resistance
- Improved IST performance
- HATS testing
- Improved buried via filling
- Enhanced integrity of electroplated Cu
- Minimum PWB performance change during useful product life
- Higher Thermal Cycling Requirements
- More Sequential Laminations





N4000-12

High Speed / Low Loss Lead-Free Solution

N4000-12 Product Highlights

- ◆ High-Tg enhanced epoxy FR-4 resin system
- ◆ Superior thermal resistance / stability
- ◆ High speed (low Dk), low loss (low Df)
- ◆ CAF resistant
- ◆ Lead-free assembly compatible
- ◆ Low Z-axis CTE
- ◆ Stable loss profile across frequencies
- ◆ High peel strength and ILBS
- ◆ Processing window is similar to other enhanced epoxy materials
- ◆ Reduced wicking / crazing
- ◆ Available in SI glass
- ◆ Meets UL 94 V-0

N4000-12

Property Comparison-Thermal

Property	N4000-11	N4000-12	N4000-13
T _g (DSC)	175°C	190°C	210°C
T _g (TMA)	170°C	180°C	200°C
T _g (DMA)	195°C	210°C	240°C
T ₂₆₀	28 min.	113 min.	58 min.
T ₂₈₈	6 min.	15 min.	8 min.
T ₃₀₀	2 min.	6 min.	4 min.

N4000-12

Property Comparison-Thermal

Property	N4000-11	N4000-12	N4000-13
Degradation Temp (TGA)	360°C	370°C	350°C
Solder Float (4"x4" Cu Clad 288°C-time to failure)	>550 sec.	>400 sec.	>470 sec.
Pressure Cooker (1 hr.)			
Moisture Gain	0.24%	0.13%	0.10%
Solder Dip (288°C)	>600 sec.	>300 sec.	>500 sec.

N4000-12

Property Comparison-Mechanical

Property	N4000-11	N4000-12	N4000-13
X/Y axis CTE (-40 to +125°C)	12-14 ppm/°C	12-15 ppm/°C	10-14 ppm/°C
Z axis CTE (below Tg)	65 ppm/°C	75 ppm/°C	70 ppm/°C
Z axis CTE (above Tg)	265 ppm/°C	270 ppm/°C	283 ppm/°C
Z Expansion (50 to 260°C)	3.2%	3.6%	3.5%

N4000-12

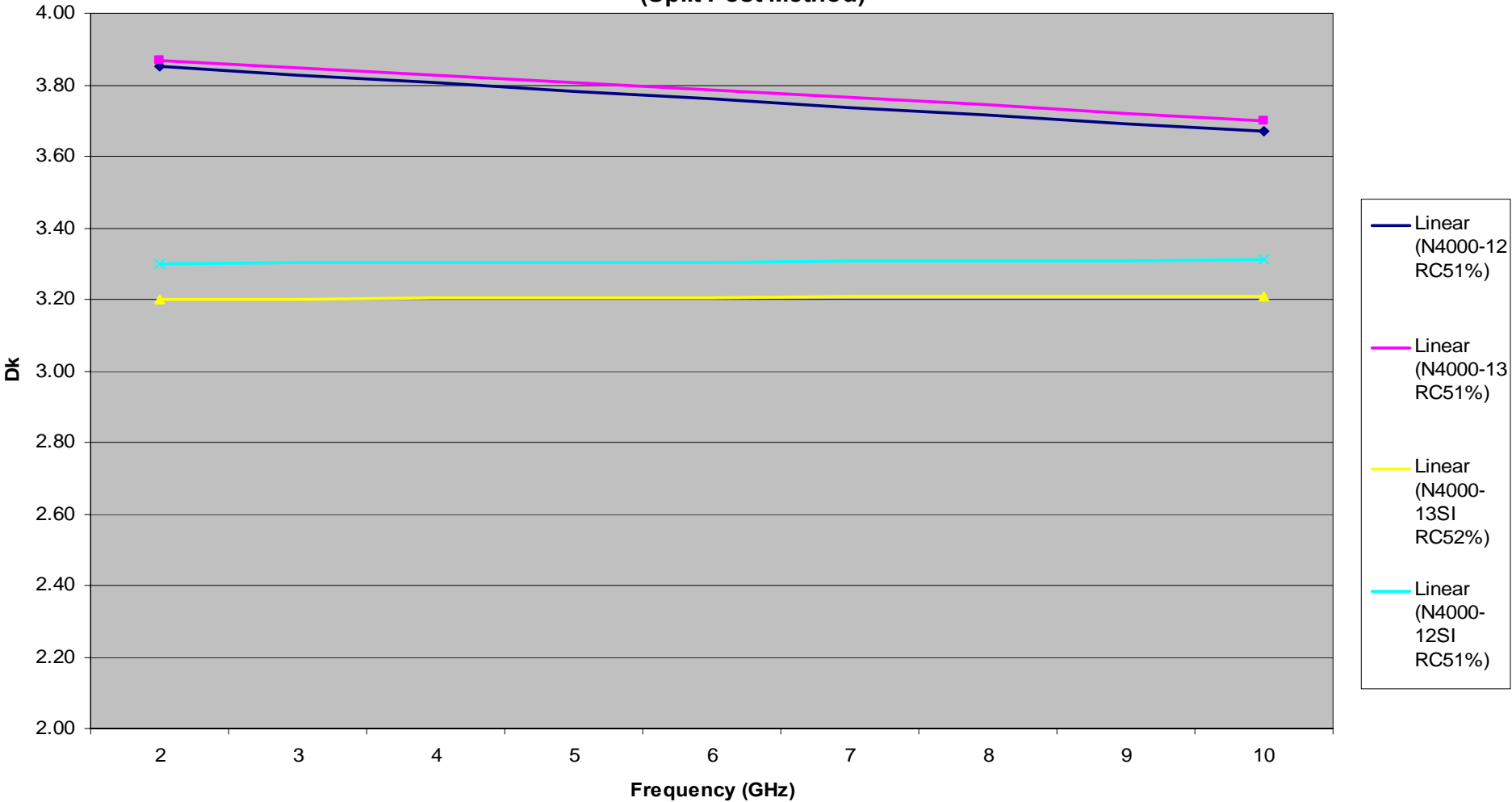
Property Comparison-Electrical

Property	N4000-11	N4000-12	N4000-13
Dielectric Constant (1 GHz) (Parallel Plate Method)	4.1	3.7	3.7
Dielectric Constant (10GHz) (Stripline Method)	3.7	3.6	3.6
Dissipation Factor (1 GHz) (Parallel Plate Method)	0.016	0.010	0.008
Dissipation Factor (10 GHz) (Stripline Method)	0.016	0.008*	0.008

* N4000-12 10 GHz Dissipation Factor by Split Post Cavity Method

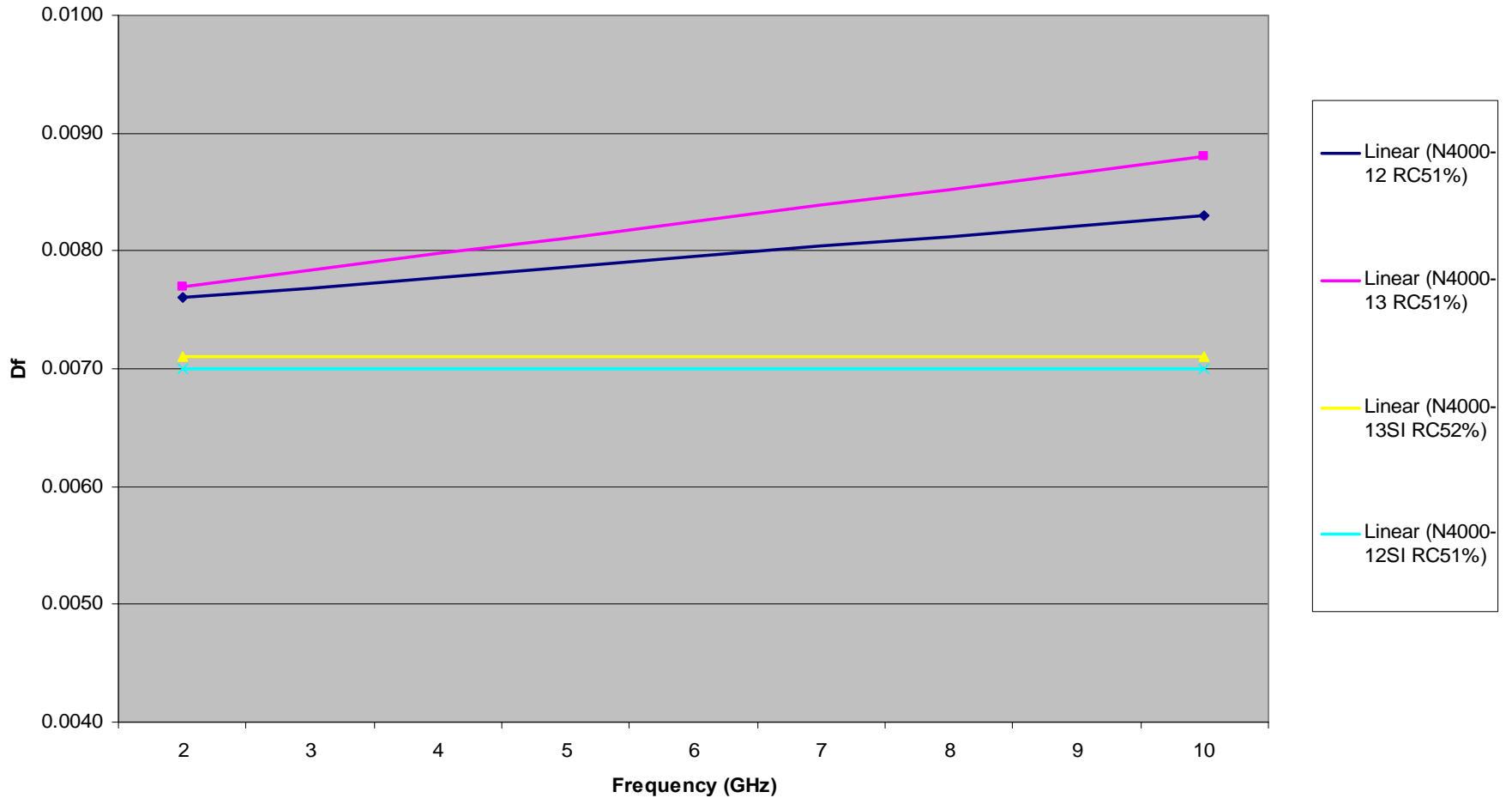
N4000-12 Electrical Comparison

Dk Comparisons of High Performance Materials
(Split Post Method)

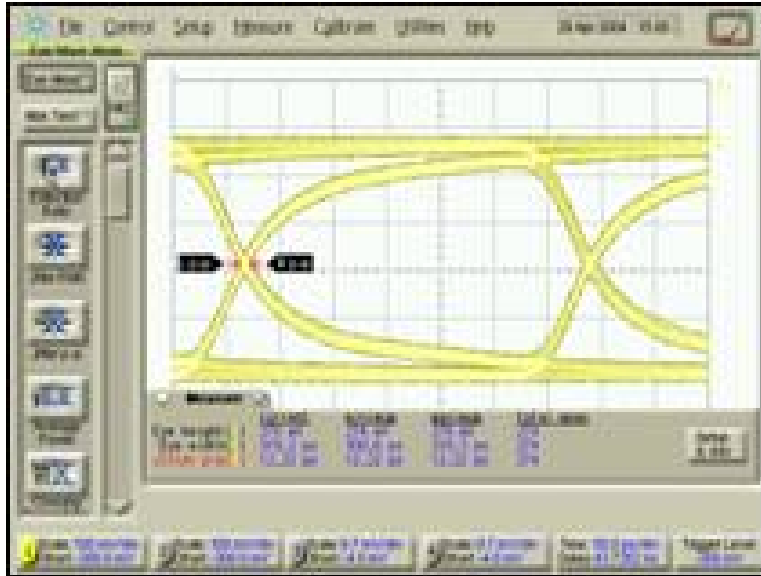


N4000-12 Electrical Comparison

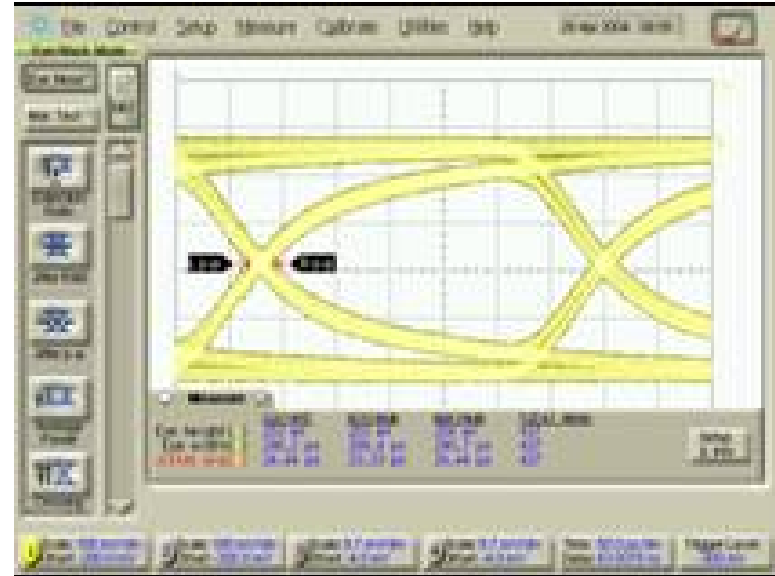
Df Comparisons of High Performance Materials
(Split Post Method)



N4000-13, N4000-12 at 3.125 Gb/s

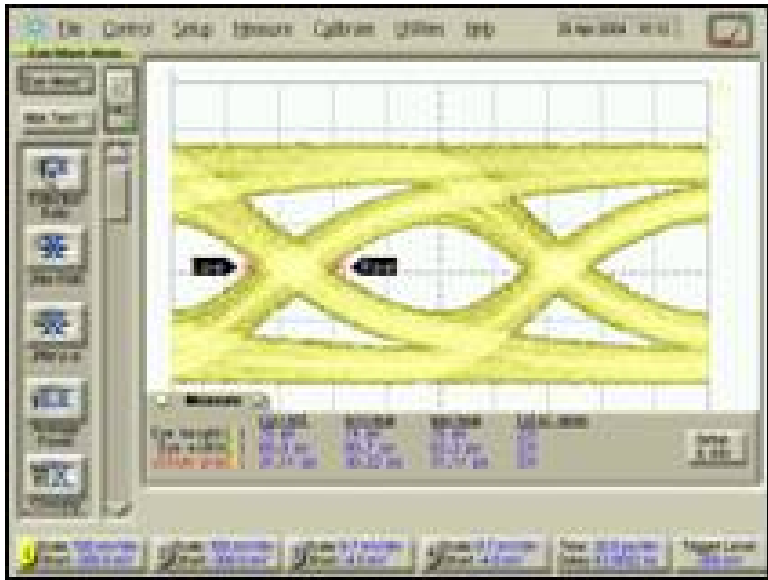


N4000-13

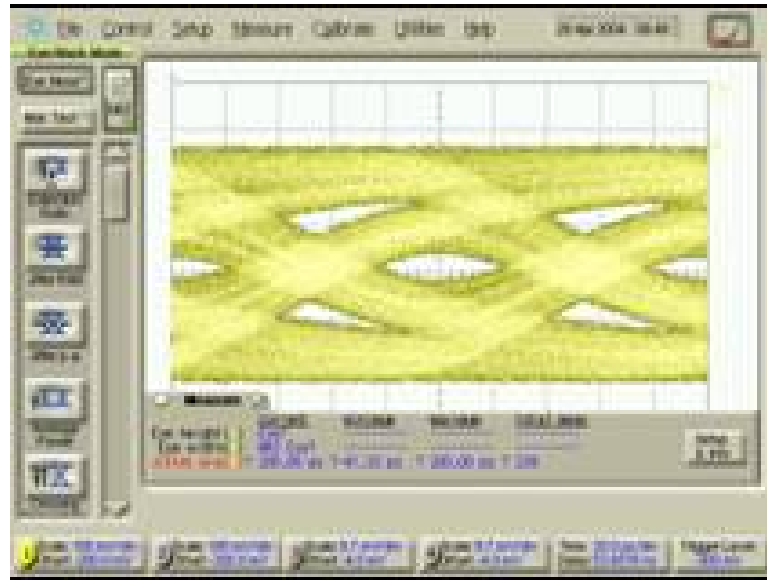


N4000-12

N4000-13, N4000-12 at 10 Gb/s



N4000-13



N4000-12

N4000-12

Real World Usage Customer Evaluations

Customer Test Results

- ◆ 28 Layer Construction
 - ☐ 0.0025" outer and 0.004" inner cores with 106 and 1080 prepreg
 - ☐ Laminated @ 193°C for 90 minutes
- ◆ Desmear same as N4000-13
 - ☐ Light plasma followed by chemical desmear
- ◆ Excellent Overall Results
 - ☐ Tested for Lead Free Assembly Compatibility

Tg DSC		
	As Is	197.9°C
	Baked 60 min. @193°C	202.5°C
Tg TMA		
	As Is	182.5°C
	Baked 60 min. @193°C	184.9°C
Z-Exp.	50°C-260°C	4.4%/4.5%
	50°C-288°C	5.2%/5.1%
T-260 without innerlayer		98.4 min.
T-288 without innerlayer		13.2 min.
T-260 with innerlayer		35.7 min.
T-288 with innerlayer		3.9 min.

Lead-Free Assembly Compatibility / IST Performance

- ◆ Independent Hewlett-Packard test
- ◆ N4000-12 resin system on E-glass reinforcement
- ◆ 28 layer 0.230" (5.84 mm) thick test vehicle
- ◆ Up to 6x precondition at 230°C and 260°C
- ◆ After pre-conditioning, coupons exposed to IST testing under standard conditions
- ◆ Results:
 - ▢ At 6x, 230 °C, 6 of 6 coupons passed 500 cycles IST (Test terminated at 500 cycles)
 - ▢ At 5x, 260 °C, 6 coupons averaged 534 cycles IST
- ◆ Results indicate high reliability under simulated lead free assembly conditions with a high layer count design

Lead Free Compatibility Test N4000-12

Reflow 6X245 & 6X260

PCQR² Test Coupon Design

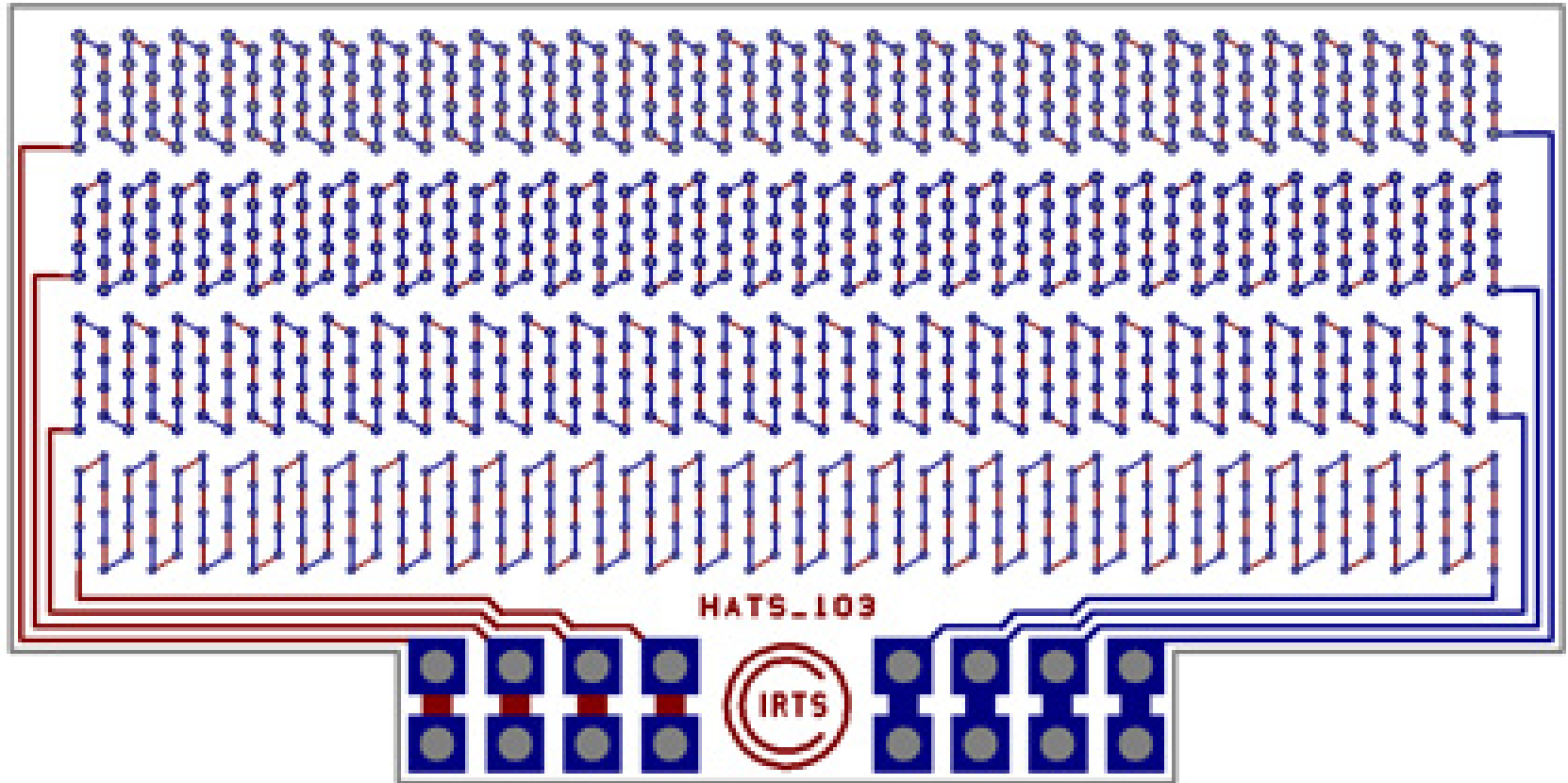
What is actually measured?

1. Resistance (0.4 to 1.0 Ω)
2. Resistance at 23°C is baseline
3. A 10% resistance increase from baseline value counts as failure
4. Resistance above 20 Ω is considered an open connection
5. Above 3% resistance increase from baseline counts as tendency to fail
6. Allowed tolerances $\pm 10\text{m}\Omega$

Coupon Design

- ◆ 12 layer construction
- ◆ No surface finish except solder-mask
- ◆ Oxide Circuit Bond II (Shipley (Rohm & Hass))
- ◆ Coupon is 1 inch x 1 inch
- ◆ Coupon Thickness is 0.093 inch
- ◆ 4 Through Hole Via Net structures with selectable hole and annular ring sizes
- ◆ Via to Via distance is 40mils
- ◆ Expected resistance of each net between 0.4 and 0.7 Ω

Via Net Concept



Four Different Via Nets

Net 1

- ◆ 117 Through Hole Via's
- ◆ 8mil Hole
- ◆ 18mil Pad with tear drops
- ◆ Interconnect:
1·7·2·8·3·9·4·10·5·11·6·12

Net 3

- ◆ 117 Through Hole Via's
- ◆ 12mil Hole
- ◆ 22mil Pad with tear drops
- ◆ Interconnect:
1·7·2·8·3·9·4·10·5·11·6·12

Net 2

- ◆ 117 Through Hole Via's
- ◆ 10mil Hole
- ◆ 20mil Pad with tear drops
- ◆ Interconnect:
1·7·2·8·3·9·4·10·5·11·6·12

Net 4

- ◆ 117 Through Hole Via's
- ◆ 13.5mil Hole
- ◆ 23.5mil Pad with tear drops
- ◆ Interconnect:
1·7·2·8·3·9·4·10·5·11·6·12

N4000-12

Tendency to fail after 6th Reflow at 245°C and 260°C

Panel #1

Panel #2

	% change between Avg Nets 1 Initial and 1st Reflow	% change between Avg Nets 2 Initial and 1st Reflow	% change between Avg Nets 3 Initial and 1st Reflow	% change between Avg Nets 4 Initial and 1st Reflow		% change between Avg Nets 1 Initial and 1st Reflow	% change between Avg Nets 2 Initial and 1st Reflow	% change between Avg Nets 3 Initial and 1st Reflow	% change between Avg Nets 4 Initial and 1st Reflow
245°C	0.000	1.754	0.000	1.031	245°C	0.800	0.000	0.000	1.031
245°C	0.000	0.000	1.961	0.000	245°C	0.000	0.000	0.000	0.000
245°C	1.563	0.870	0.000	2.000	245°C	0.781	0.855	0.000	1.000
245°C	1.587	0.870	0.000	2.000	245°C	1.550	0.855	0.000	1.961
245°C	1.587	0.855	0.952	0.000	245°C	0.769	0.840	1.852	0.000
245°C	1.538	0.862	0.952	0.000	245°C	0.758	1.667	0.000	0.000
260°C	0.775	0.000	0.935	0.990	260°C	-0.763	0.000	-1.887	0.000
260°C	0.000	0.847	0.943	1.923	260°C	1.481	1.639	1.818	1.887
260°C	0.820	0.000	0.000	1.020	260°C	0.000	1.724	-0.971	2.000
260°C	1.587	0.877	0.000	0.000	260°C	1.550	0.862	0.952	1.961
260°C	0.000	0.000	0.971	2.000	260°C	0.000	0.000	0.935	0.000
260°C	0.000	0.862	0.000	0.000	260°C	0.000	0.000	0.000	0.000

N4000-12 PWB Processing

◆ Oxide Processing

- ❏ No known issues with any commercial oxides or oxide alternatives
- ❏ Recommended oxide wt. gain is 0.2-0.4 mg per sq. cm.
- ❏ Oxide to prepreg peels measured at >3.5 lbs.
- ❏ Innerlayer baking after oxide strongly recommended

◆ Re-lamination

- ❏ Shorter lamination process than N4000-13
- ❏ 75 minutes at 380°F (193 °C) cure temp.
- ❏ 4 - 8°F (2 – 4°C) per min heat rise recommended
- ❏ Pressure of 200-300 psi recommended

N4000-12 PWB Processing

◆ Drilling

- ☐ Chipload of 0.5 – 1.0 for small via diameters (<0.020")
- ☐ Chipload of 1.0 – 2.0 for larger diameter vias (>0.020")
- ☐ Undercut drills strongly recommended
- ☐ Post drill bake recommended for critical applications

◆ Desmearing

- ☐ Plasma desmear preferred for critical board designs
- ☐ NMP desmear systems should be avoided
- ☐ If NMP solvent sweller is used in desmear line, skip this process step and employ oxidation only
- ☐ N4000-12 will be less prone to smear generation than traditional epoxies due to resin formulation

Advanced Materials

N4000-29

**Next Generation
Lead Free
High Tg Epoxy**

Designed for Lead-free Assembly

N4000-29 Property Comparison

Property / Condition	N4000-7	N4000-6FC	N4000-11	N4000-29
Tg (DSC)	155°C.	175°C.	175-195°C	≥185°C
Tg (TMA)	150°C.	170°C.	165-185°C	≥175°C
Degradation Temp (TGA)	330°C.	300°C	345°C	350°C
X axis CTE (-40 to +125°C.)	15.5 ppm/°C	14.0 ppm/°C	15 ppm/°C	17 ppm/°C
Y axis CTE (-40 to +125°C.)	12.5ppm/°C.	12.0 ppm/°C	12.0 ppm/°C	17 ppm/°C
Z axis CTE (below Tg)	55 ppm/°C.	70 ppm/°C.	60 ppm/°C.	55 ppm/°C.
Z axis CTE (above Tg)	250 ppm/°C.	320 ppm/°C.	235 ppm/°C.	237 ppm/°C.
Z CTE (50 to 260°C.)	3.70%	4.10%	3.20%	3.00%
Dielectric Constant (1 MHz)	4.5	4.3	4.3	4.5
Dissipation Factor (1 MHz)	0.018	0.023	0.016	0.016
Moisture Resistance (24 hr.)	0.07%	0.15%	0.15%	0.15%

N4000-29 Property Comparison

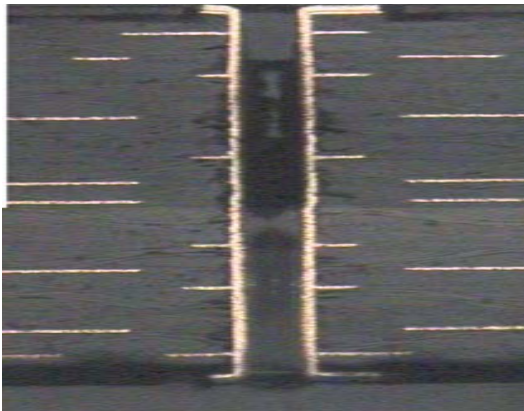
Property / Condition	N4000-7	N4000-6FC	N4000-11	N4000-29
T260	16 min.	7 min.	30 min.	>60 min.
T288	1.4 min.	1.4 min.	6 min.	15 min.
Solder Float (4"x4" Cu Clad) (288°C. - time to failure)	263 sec.	230 sec.	>600 sec.	>600 sec.
Pressure Cooker (1 hr.) Moisture Gain	0.23%	0.25%	0.24%	0.18%
Solder dip (288°C.)	240 sec.	150 sec.	>600 sec.	>600 sec.
Volume Resistivity (96 / 35 / 90) Megaohm-cm	3.9x10 ⁸	1.80x10 ⁸	1.0x10 ⁷	1.0x10 ⁷
(24 / 125) Megaohm-cm	2.6x10 ⁷	5.00x10 ⁹	1.0x10 ⁷	1.0x10 ⁸
Arc Resistance	124 sec.	67 sec.	124 sec.	129 sec.
Lamination Cure Time (10°F/min. heat rise)	45 min @ 340°F	60 min. @ 360°F	60 min @ 365°F	75 min @ 365°F
CAF Resistant	YES	NO	YES	YES
Contains Bromine	YES	YES	YES	YES

N4000-29 Product Summary

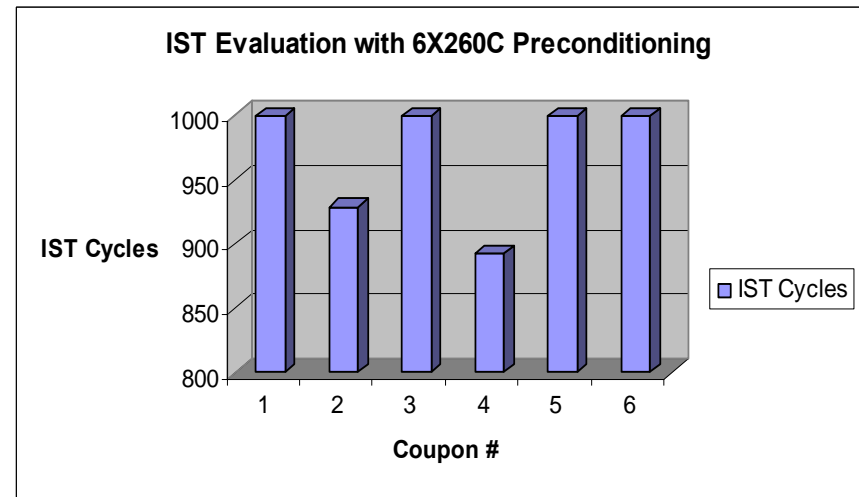
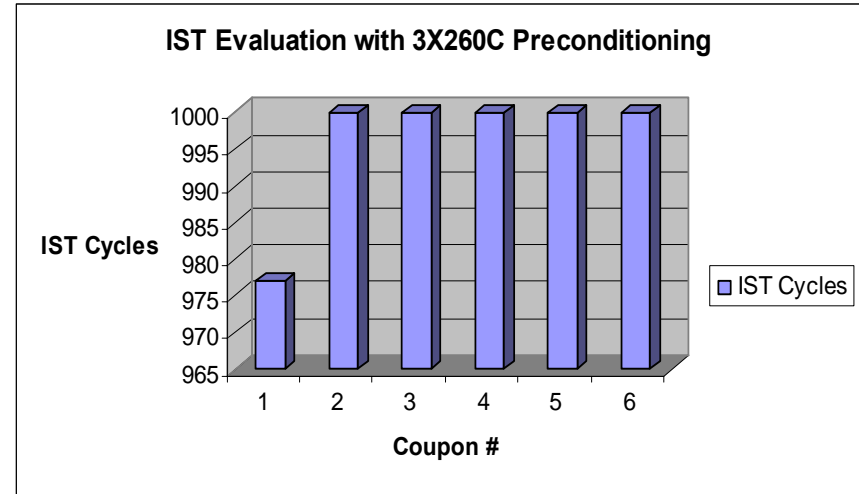
- Fully commercialized product (January 4, 2006)
- FR-4 epoxy laminate and prepreg system with a wide variety of constructions and glass styles available (2.5 mils & up)
- Buried Capacitance qualified & available(2 mil)
- Standard High Tg FR4 processing with -13 drill parameters
- Filled dielectric
- Superior thermal performance
- Low Z-Axis expansion
- Superior moisture resistance
- Outstanding IST and lead free reflow assembly results
- CAF resistant material
- UL recognition under Nelco N4000-11 FR-4 family
- Currently manufactured in North America and Asia
- No plans to obsolete N4000-11
- Would meet proposed IPC /99 & /126 Lead Free slash sheet

N4000-29 Lead Free High Tg Epoxy IST Evaluation

- Evaluation A
- 18L 0.093" with 10 and 12 mil vias
- Test terminated at 1000 IST cycles
- Multiple Lead-Free preconditioning tests
- 3X – 6X (230°C, 245°C, 260°C)
- 6 coupons tested for each condition
- Most coupons lasted 1000 cycles

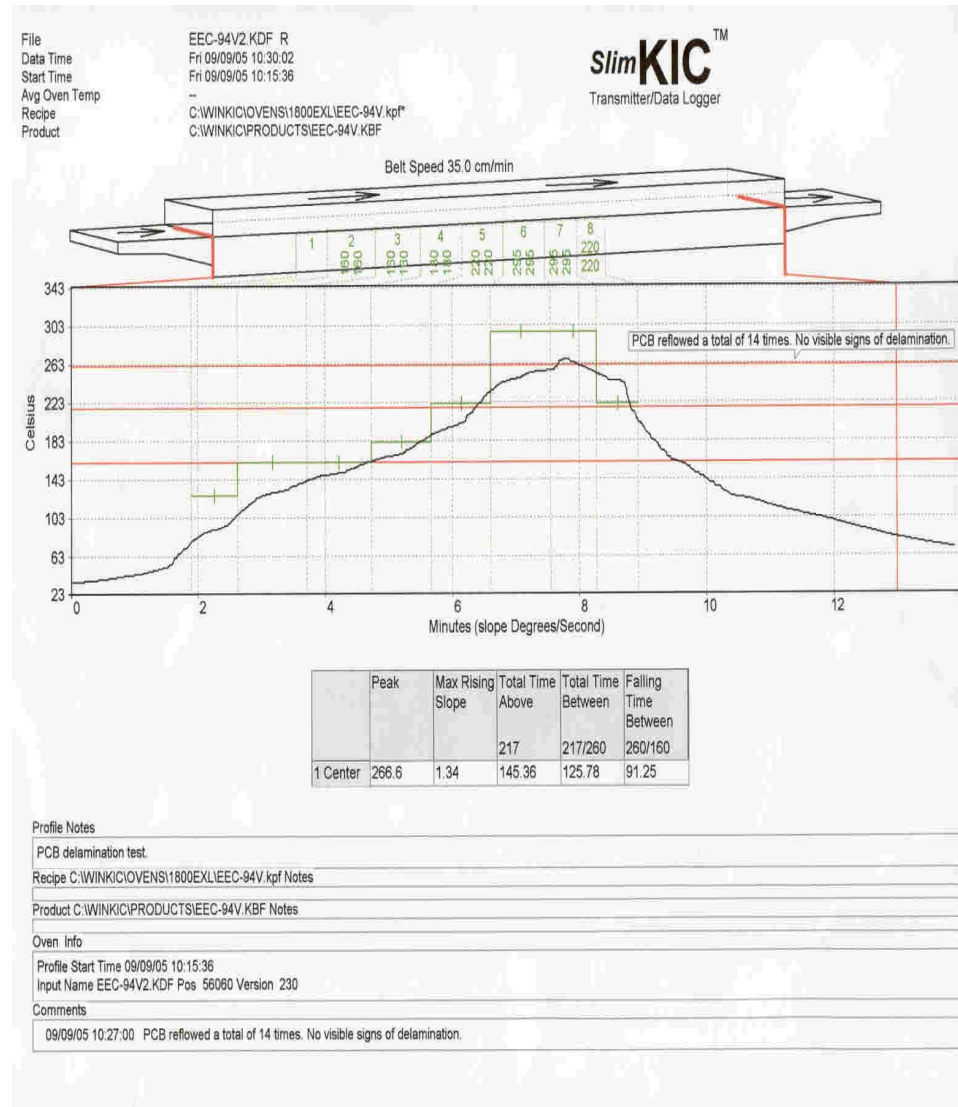


6 x 260°C
cross section



N4000-29 Reflow Evaluation

- Finished PCB (22L, 0.115") sent through a conventional forced air reflow oven
- 2116 cores and 1080 & 106 prepreg glass construction
- Heller 8 zone (air/nitrogen capability)
- Board was reflowed 14 times @ peak of 266°C
- 6 additional reflows between (240°C-265°C)
- No delamination! (1mm BGA's on board)
- DSC (TgI / TgU) = 184/203°C
- TMA (TgI / TgU) = 167/186°C
- TGA = 374°C
- Z-CTE% 50-260 (TgI/TgU) = 3.58 / 3.32%
- CTE < Tg (TgI / TgU) = 66/75 ppm/°C
- CTE >Tg (TgI / TgU) = 306/309 ppm/°C
- T260 = 30 min no delamination
- T288 = 11.3 min



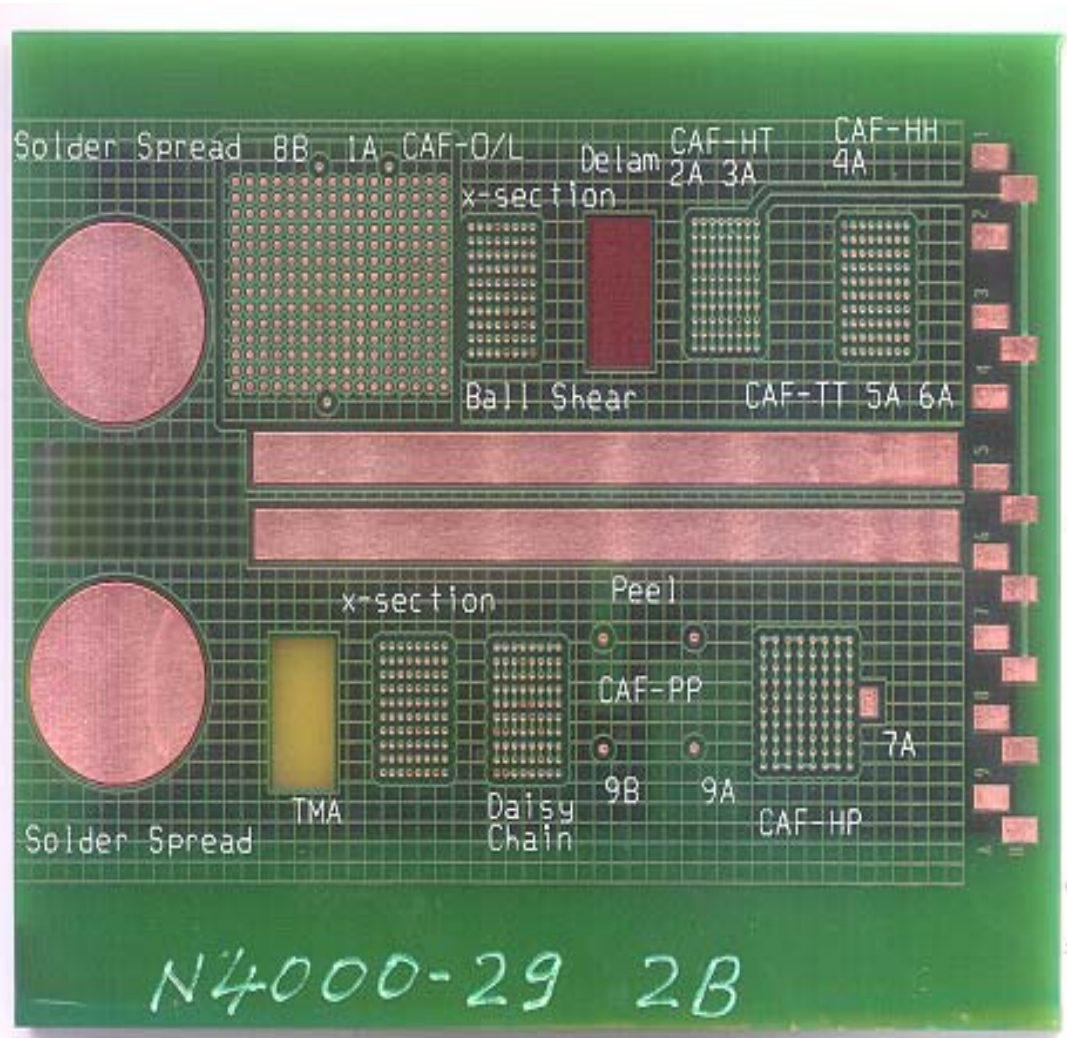
N4000-29 Customer Reflow Evaluation

20L .093" PCB with 1/2 oz & 1 oz innerlayers

4 coupons from 4 different boards evaluated for lead free reflow 6X240C

Inspection was performed visually and by DC resistance (before and after reflow)

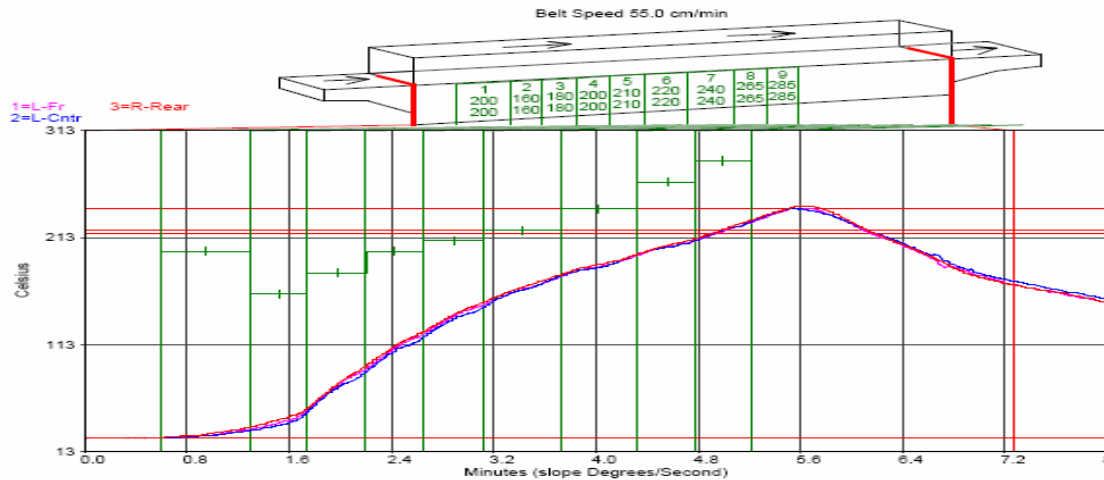
DC measurements were taken on 9 mil daisy chain holes



S/N	Location	Initial Resistance Ohms	Reflow 1 Ohms	Reflow 2 Ohms	Reflow 3 Ohms	Reflow 4 Ohms	Reflow 5 Ohms	Reflow 6 Ohms	Resistance Change %
1A	Daisy Chain	0.241	0.249	0.25	0.252	Visual inspection only done. OK	Visual inspection only done. OK	0.25	0.90%
2A	Daisy Chain	0.254	0.27	0.268	0.265			0.262	0.80%
3A	Daisy Chain	0.264	0.28	0.27	0.284			0.274	1.00%
4A	Daisy Chain	0.25	0.255	0.264	0.274			0.257	0.70%

Summary:

- All Coupons passed visual inspection after 6X Lead free reflow, and didn't show resistance increase of more than 10%.
- Passed 6X solder floats at 288 Deg C, using SAC (Lead Free) Solder. This was done per IPC TM650, 2.4.13.
- TMA results of the coupon are shown below and are acceptable for lead free application.



	Peak	Max Rising Slope	Rising Time Above 25	Rising Time Between 25/217	Total Time Above 217	Total Time Above 220	Total Time Above 240
1 L-Fr	240.8	1.70	334.47	296.28	72.49	65.00	6.45
2 L-Cntr	240.0	1.86	332.38	296.15	75.26	67.41	0.00
3 R-Rear	242.7	1.69	346.98	303.70	75.86	68.27	16.96

N4000-29 Customer Evaluation

26L, 130 mil TV with 8 mil vias (16:1 AR)

A Delamination Test

Purpose is to observe delamination resistance of 0.8mm and 1.0mm BGA pitch area

Test panel size = 9" x 11"

Pre-condition parameters = 3x260C followed by 2x245C lead-free reflow

0.8 mm pitch	Pass
1.0 mm pitch	Pass
40 X-sections taken from four pieces of 9x11" test panels	0

B Inter-Plane Separation Test

Purpose is to determine I/L post integrity with plated copper

Test panel size = 1 x 1", 40 mil vias

Pre-condition parameters = 6x10 sec.solder float at 288C

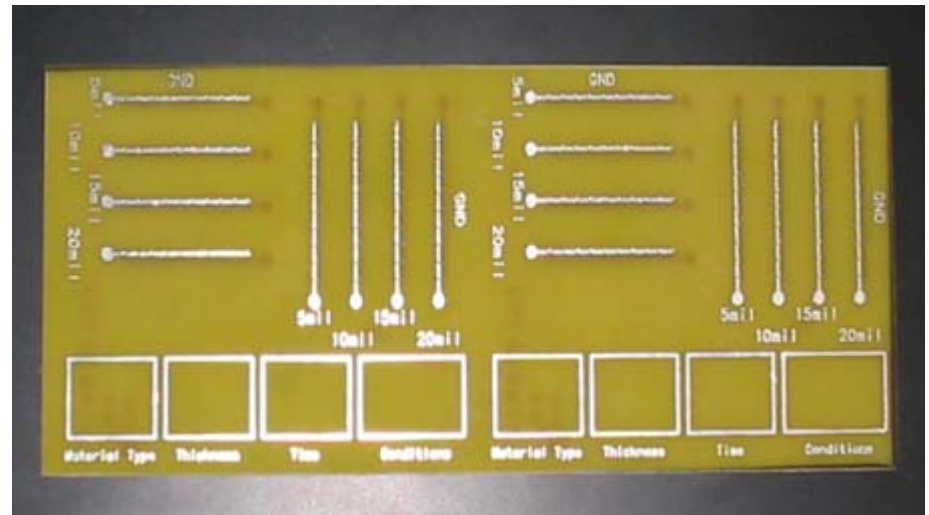
% IP	none
Pad lifting 1=none, 3=acceptable, 5 = reject	1

C Tg Verification

Tg by DSC	Tg (1) = 185.58 C
	Tg (2) = 198.97 C
Tg by TMA	171 38 C
T260 (With inner layer)	29.55 min
Z-CTE	Alpha 1 = 63.4 ppm/C
	Alpha 2 = 296 6 ppm/C
Z-CTE (50 C to 260 C)	3.33%

IPC / Sun TV1 CAF Test

- Independent fabrication site
- Test Conditions:
 - 85°C
 - 85% RH
 - 100 VDC bias
- Tests concluded at 600 & 1100 hours



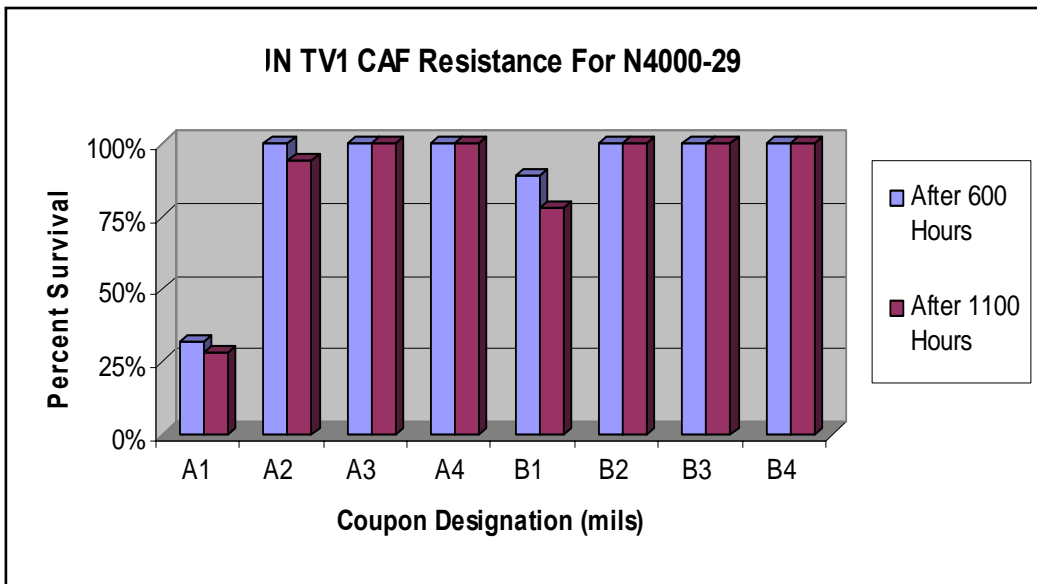
N4000-29 2116-Finish Evaluation (85RH/85C/100V, 596Hrs)

Failure Percentages - overall:

NELCO CAF => % Failures out of sixteen (16) sample circuits opportunities

% failures for each circuit	7 mil spacing	10 mil spacing	15 mil spacing	20 mil spacing
N4000-29.P4 <u>2116-Finish A</u> R&D LAB hand pulls	0% (0 of 16)	0% (0 of 16)	0% (0 of 16)	0% (0 of 16)
N4000-29.P4 <u>2116-Finish B</u> production run dated 06.24.05	0% (0 of 16)	0% (0 of 16)	0% (0 of 16)	0% (0 of 16)

IPC / Sun TV1 CAF Results

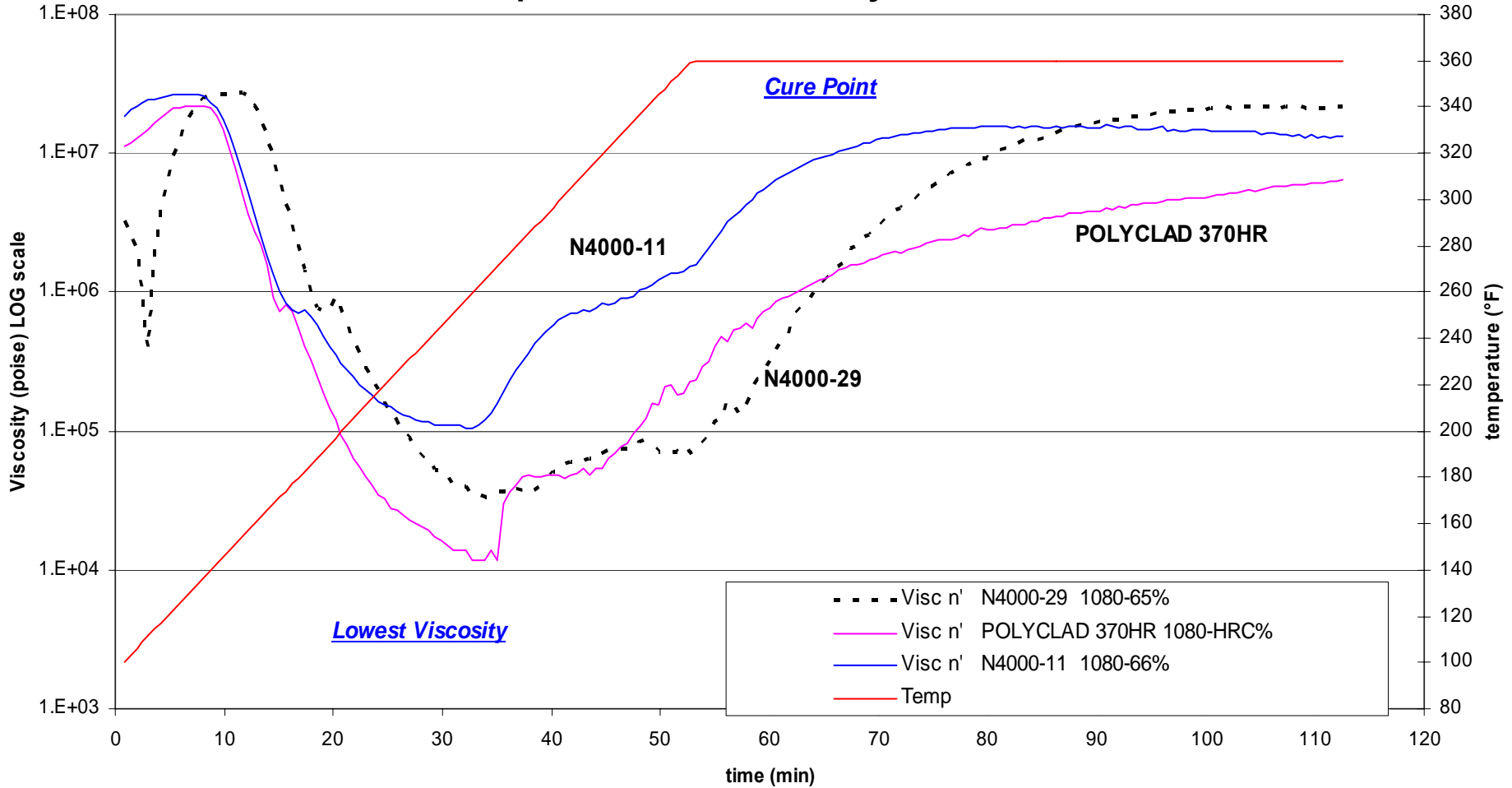


Coupon	% Surviving 600 hours	% Surviving 1100 hours
A1	32%	28%
A2	100%	94%
A3	100%	100%
A4	100%	100%
B1	89%	78%
B2	100%	100%
B3	100%	100%
B4	100%	100%

N4000-29 Prepreg Rheology

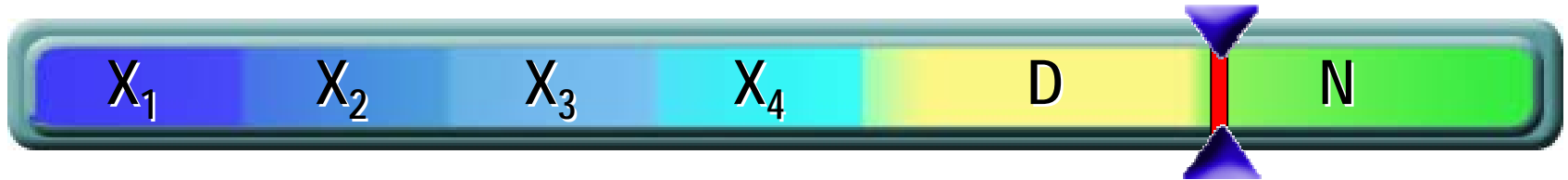
N4000-29 Viscosity Curve

1080 comparison - Lamination cycle => 60/360F-5Fmin



N4000-29

Product Development Status



- Buried Capacitance™ available
- Buried Resistance testing in progress
- Sequential lamination testing ongoing – First evaluation results very good (1+12+1)
- Chemistry compatibility complete
- IST complete
- SUN TV1 CAF complete – 3X260 preconditioning
- UL qualification complete
- Commercialized January 06'



Improved -13

-13 Improvement Program Charter

● R&D Formulation in Singapore

● Toughened resin system without changing the FTIR signature so UL requalification is not necessary

● Primary Targets

● Improve Pb-free compatibility (6X260)

● Improve CAF resistance

● Secondary Targets

● Improve material toughness and reduce crazing

● Increase degradation temperature


● Reduce Z-CTE

● Improve ILBS

Improved-13

Internal Testing

-  Compare thermal/mechanical/electrical properties to standard -13 laminate

-  30 mil 6L multilayer PCBs (all 1080 glass) survived 9-11 reflow cycles at 260C without blistering. Standard -13 lasted 6-9 reflow cycles.

-  Nelco Quick CAF Testing

-  North American/Asian Fabricators & OEMs

-  Based on results, approach UL?

Singapore Material Comparison

Laminate Performance

8X7628

Properties

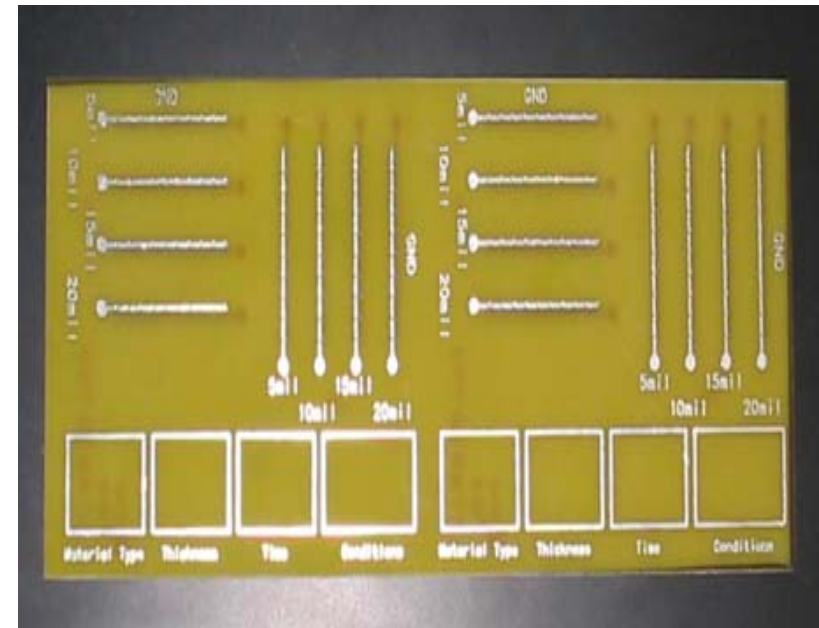
Standard -13

Improved -13

DSC ©	218	217
TMA ©	205	211
CTE (50-260)	3.20%	3.20%
CTE<Tg (ppm)	43	49
CTE>Tg (ppm)	285	268
T260 (min)	90	90
T288 (min)	12.4	13.1
Td	365	365
PCSD (min)	2.6	19.1
ILBS W/F (2X7628)	5.1/5/4	5.5/5.9
Dk (1MHz)	4.6	4.5
Df (1MHz)	0.006	0.007

Improved -13 on Nelco Quick CAF

- ◆ Independent fabrication site
- ◆ Test Conditions:
 - ☞ 85°C
 - ☞ 85% RH
 - ☞ 100 VDC bias
 - ☞ Finish A (Asia) and Finish B (NA)
 - ☞ 106,1080 & 2116 styles
 - ☞ Chemical Desmear & Plasma
- ◆ Test concluded at 600 hours



% failures for each circuit	7mil spacing Chemical & Plasma DS	10mil spacing Chemical & Plasma DS	15mil spacing Chemical & Plasma DS	20mil spacing Chemical & Plasma DS
N4000-13 std 106 Glass, Finish A	0% (0 of 12)	0% (0 of 12)	0% (0 of 12)	0% (0 of 12)
N4000-13 imp 106 Glass, Finish A	0% (0 of 12)	0% (0 of 12)	0% (0 of 12)	0% (0 of 12)
N4000-13 imp 106 Glass, Finish B	0% (0 of 12)	0% (0 of 12)	0% (0 of 12)	0% (0 of 12)
N4000-13 std 1080 Glass, Finish A	0% (0 of 12)	0% (0 of 12)	0% (0 of 12)	0% (0 of 12)
N4000-13 imp 1080 Glass, Finish A	0% (0 of 12)	0% (0 of 12)	0% (0 of 12)	0% (0 of 12)
N4000-13 imp 1080 Glass, Finish B	0% (0 of 12)	0% (0 of 12)	0% (0 of 12)	0% (0 of 12)
N4000-13 std 2116 Glass, Finish A	0% (0 of 12)	0% (0 of 12)	0% (0 of 12)	0% (0 of 12)
N4000-13 imp 2116 Glass, Finish A	0% (0 of 12)	0% (0 of 12)	0% (0 of 12)	0% (0 of 12)
N4000-13 imp 2116 Glass, Finish B	0% (0 of 12)	0% (0 of 12)	0% (0 of 12)	0% (0 of 12)

Improved-13 (North America Testing)

- OEM Evaluation
- Test 1 – 24L MATV with all 106 and 1080 glass with .5, 1 and 2 oz innerlayers
- Evaluate for CAF resistance, lead free compatibility (IST and HATS) and thermal/mechanical/electrical coupons (DSC, TMA, Peels, Td, Dk, T260, T288)
 - 24L TV with improved-13 & Finish A (85/85/100V, 596 HRS)
 - 24L TV with standard -13 & Finish B (85/85/100V, 596 HRS)
- Test 2 – Built 20L production part number with improved-13. No delamination was seen after 2X224C reflow.
- Test 3 – Subjected same 20L production part with both improved-13 and standard -13 with Finish B were subjected to HAST testing (85/85/low voltage bias for 1300 HRS).
- None of the improved-13 boards showed an increase in impedance. One standard -13 board did see a decrease in resistance and was classified as a failure.
- Test 4 – Build 10L production part with 2 oz innerlayers. Boards to be subjected to 4X260, 5X260 & 6X260 and then cross sectioned for delamination

Improved-13 (Asian Fabricator Evaluation)

TV = 26 layer, 130 mils, 8 mil vias (16:1 AR)

A Delamination test

Purpose is to observe delamination resistance of 1.0mm BGA pitch area

Test panel size = 9" x 11"

Pre-condition parameters = 3x260C followed by 2x245C lead-free reflow

	N4000-13i
1.0 mm pitch	Pass

B Inter-plane separation test

Purpose is to determine I/L post integrity with plated copper

Test panel size = 1 x 1", 40 mil vias

Pre-condition parameters = 6x10 sec.solder float at 288C

% IP	10%
Pad lifting 1=none, 3=acceptable, 5 = reject	2.5

C Tg verification by E&E

DSC [C]

210

CAF Testing - 50C/85RH/15V/600HRS

5x245C LF reflow pre-conditioning before CAF test.
CAF coupons placed in chamber
5/15

Improved -13

- What's next?
 - Move ahead to have 13i added to -13 UL file
 - 10 customer evaluations ongoing
 - North America – 6
 - Europe – 1
 - Asia - 3
 - Schedule a Neltec run to verify manufacturing capability in North America
 - Decision on commercializing product

Technical Data

- Most data available on line
- www.parkelectro.com
- Users can register as a “web customer”
- Web customers can access all data such as MSDS, processing guidelines and technical data as it becomes available
- Technical resource library

