A DBC VIA TECHNOLOGY

Stellar Industries Corp

JOLT
Via Technology
A Building Block Approach to DBC

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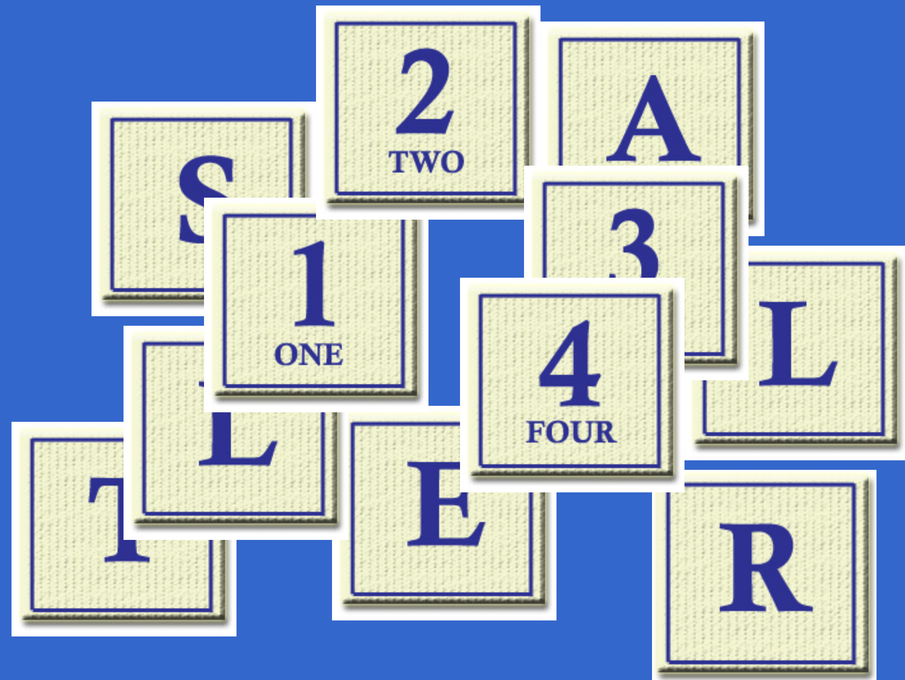
Presented by Eric Brown



INTRODUCTION

* Presentation: High Power Copper Via Coupled with
- Direct Bond Copper
* Direct Bond Copper Review
  Process
  Benefits
* Via Technology Coupled with Direct Bond Copper
  Process
  Benefits
* Via / DBC = Building Blocks for High Current Thermal
- Conceptual Substrate Designs

Direct Bond Copper (DBC) Features & Benefits

- High Thermal Conductivity
- High Electrical Conductivity
- Good CTE Match with Active Devices
  (Silicon, etc.)
- Excellent Heat Spreading
- Tremendous Adhesion Strength
- High Dielectric Ceramic
- PC Board Etchable

DBC versus Thick versus Thin

DBC versus Thick and Thin Film

Typically Quoted Electrical Conductivity:

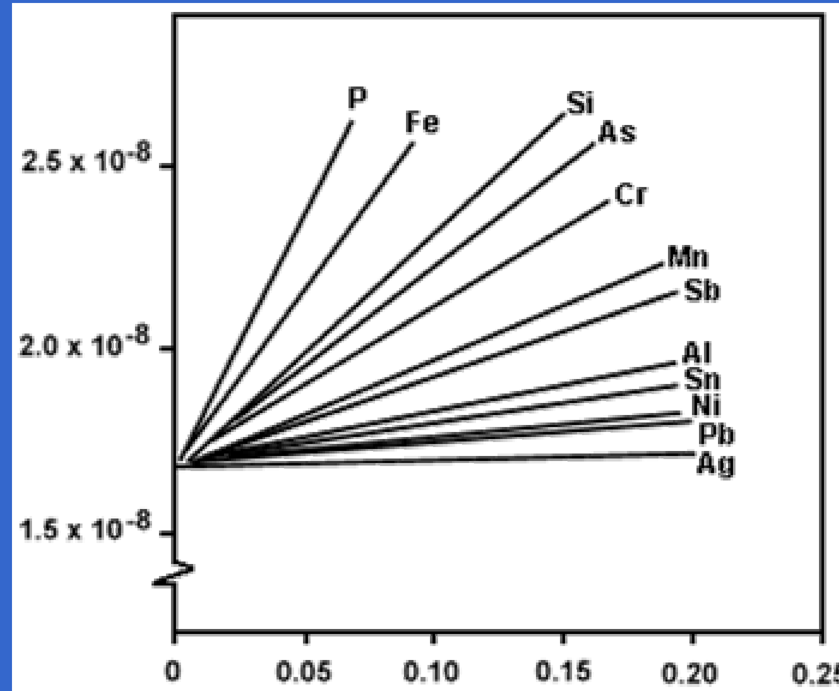
DBC (10 mil Cu):	.06 milli-ohms/sq
Thick Film: (8-12um Au)	3–5 milli-ohm/sq
Thin Film: (5 um Au)	5 -6 milli-ohm/sq

Direct Bond Copper (DBC) Critical Materials

- Pure Copper Foil Technology 99.99% Pure
- Type 102 OFHC or Type 110 Tough Pitch (ETP)
- Graph of purity vs. other contaminants
- Graph of conductivity vs. oxygen

Copper Resistance vs. Impurities

Resistivity
ohm-meters



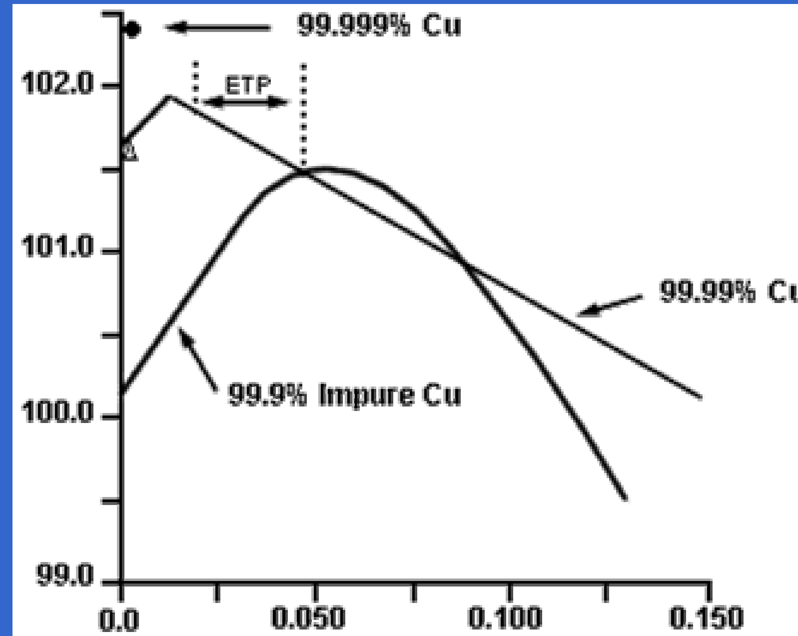
Percent impurity by weight

Influence of solute elements upon the electrical resistivity of copper at ambient temperature

From *The Metallurgy of Copper Wire* by Dr. Horace Pops

Copper Conductivity vs Oxygen

Electrical Conductivity, % IACS

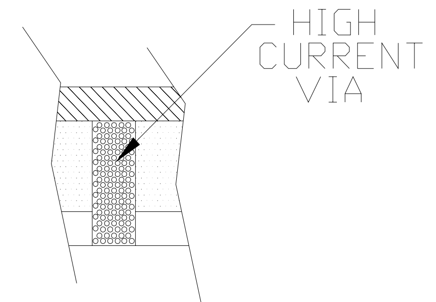


Oxygen Content, Weight %

From *The Metallurgy of Copper Wire* by Dr. Horace Pops

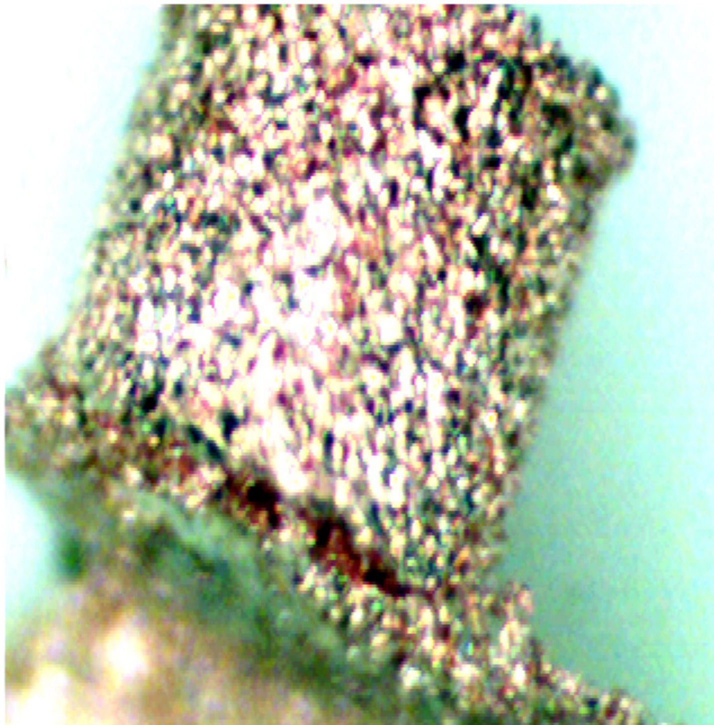
JOLT – Via Technology

- Direct bond copper high current feed-thru
- 0.040″ diameter in 0.040″ Al_2O_3
- 300 amp DC capability
- High thermal conductivity



Mechanical Integrity

- Copper Via



- Elasticity –
  Temperature Cycling
  Thermal shock
- Sinter Aids for Metal Oxide adhesions
- Controlled Oxygen Doping for Conductivity
- Capability for Hermeticity

Theoretical Via Resistance

Theoritical Calculation of Solid Filled Copper Feedthru							
	1 mm diameter filled via in 1 mm thick Alumina substrate						
		Resistance of Via = resistivity * Length/Area					
				=1.47E-6 ohm-cm *0.1 cm/3.14(0.05cm)^2			
				1.87261E-05			
				18 micro-ohms			
	For 300 Amp DC operation						
		Power = Current^2 * Resistance					
		Power = 300 amps 2* 18 micro-ohms					
			=300^2*18E-6				
			1.62E+00				
			1.62 Watts				

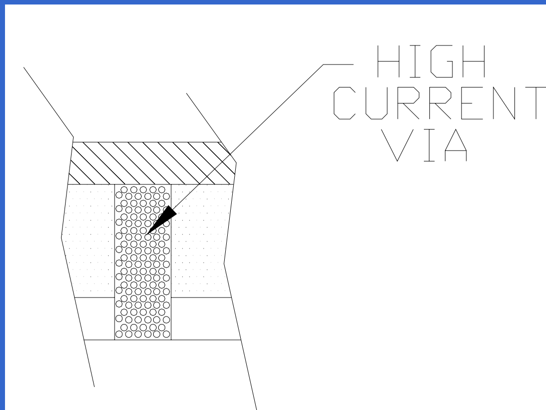
Via Specifications

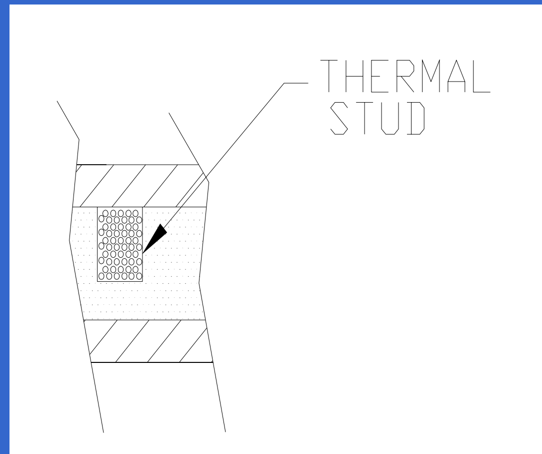
- Hole size 0.040″ diameter in Al_2O_3 or BeO
- Copper to have a 10 mil wide minimum ring around hole
- Pitch limited to 100 mil centers
- Future development for 0.020″ and 0.010″ diameters for pitches of 50 and 30 mil respectively sized for current applications

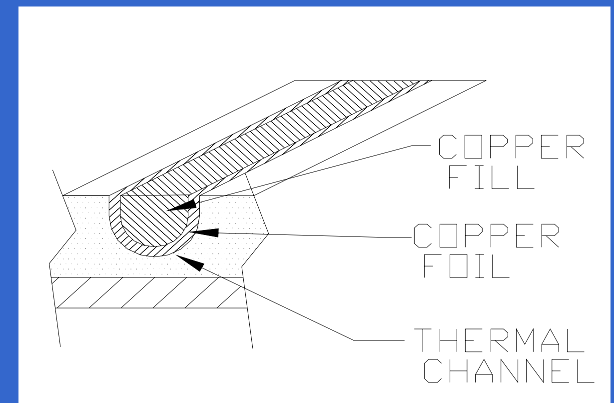
Pricing

- Small quantity costs of $25.00 per square inch of vias.
- Future Automation to reduce costs to $5.00 a square inch of vias

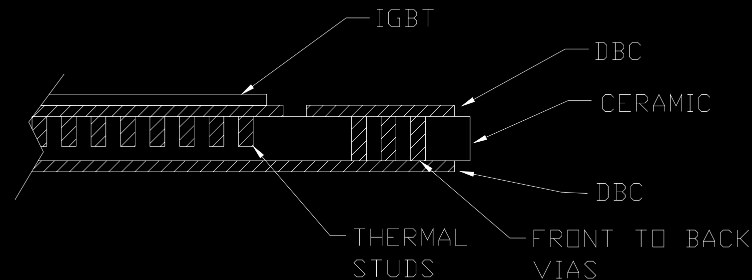
Jolt – Via Variations
Thermal Vias and Channels







Concept Approach:
Thermal Studs and High Current Vias



DBC BUILDING BLOCKS

Concept Approach:

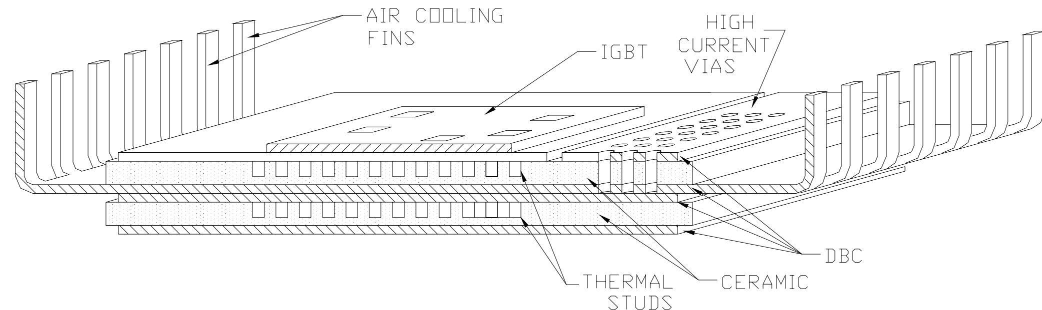
POWER PLANES

IGBT
COPPER POWDER
DBC
CERAMIC
THERMAL CHANNELS

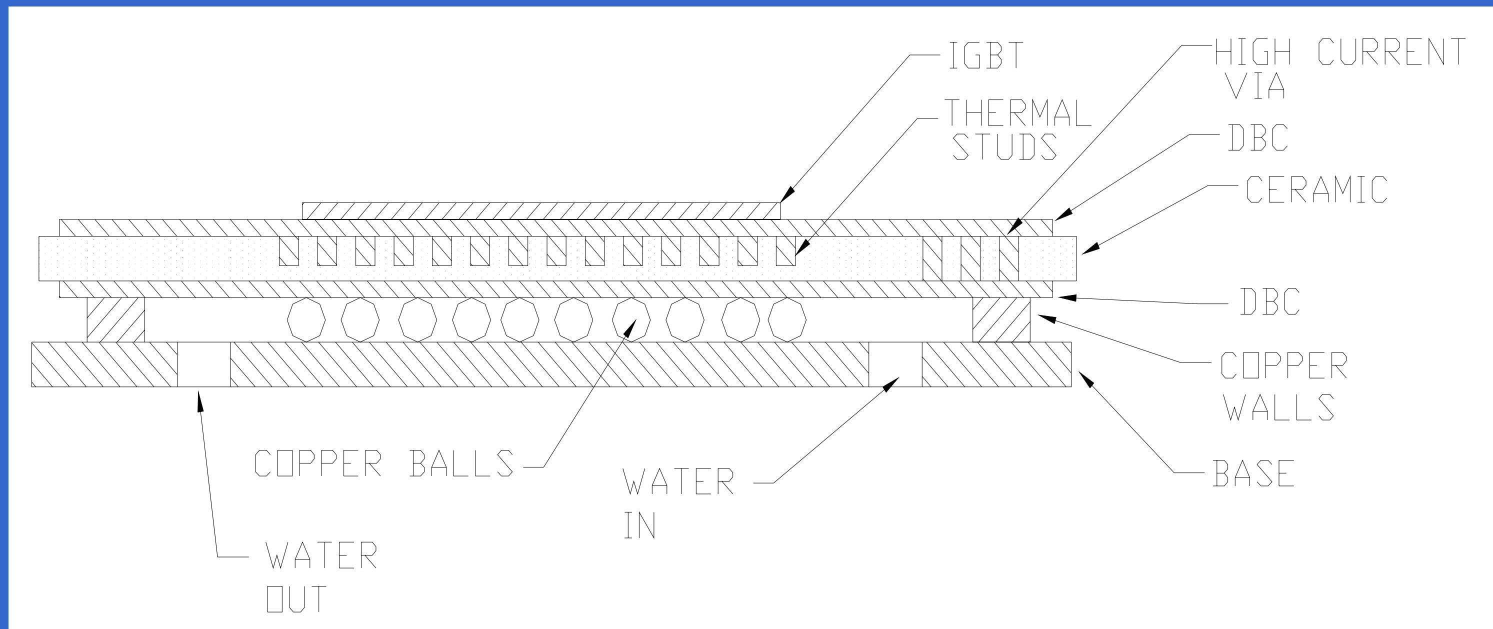
Power Plane sandwiched between DBC

DBC BUILDING BLOCKS Concept Approach: Flying Leads

- Power Plane
- Flying Leads



DBC BUILDING BLOCKS
Concept Approach:
Liquid Cooling



Applications

- Power Supplies for F16 and F22 Radar systems
- Motor Speed Controllers
- Power Supplies
- IGBT Modules

Conclusion

DBC Technology is a well known proven, widely used process with Power Packaging

Via Technology coupled with the DBC provides a powerful combination to enhance power packaging requirements

This combination provides the building block approach to provide opportunities to support the ever increasing thermal and electrical conductivity loads associated with today's Power markets.

DBC
A BUILDING BLOCK APPROACH