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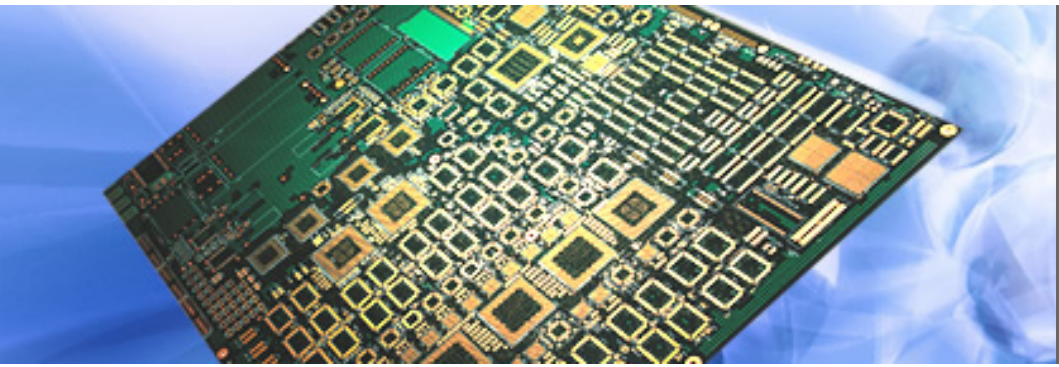
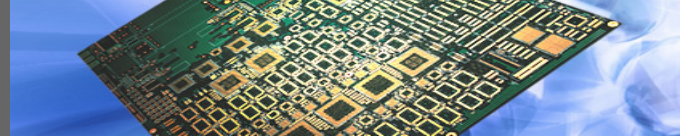
PCB Fabrication

Buried Capacitance® Technology



ELECTRONICS
MANUFACTURING
SERVICES

BC™ Benefits



Buried Capacitance® technology

will improve your power distribution system (PDS) noise margin

and improve EMC levels!

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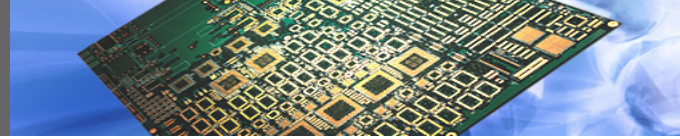
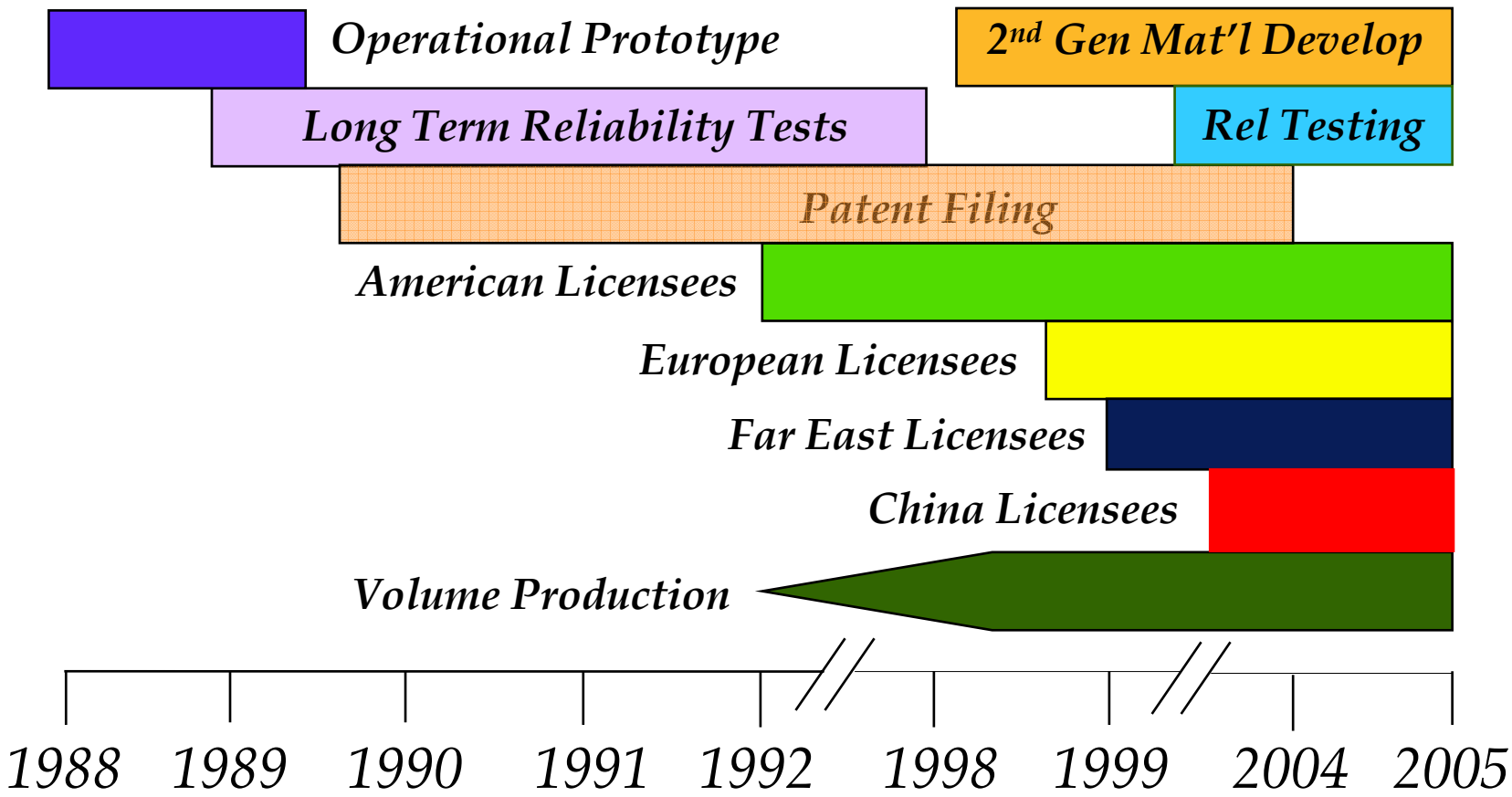
History of Buried Capacitance®





Greater than 13 years production in volume.

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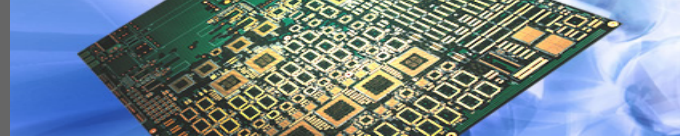
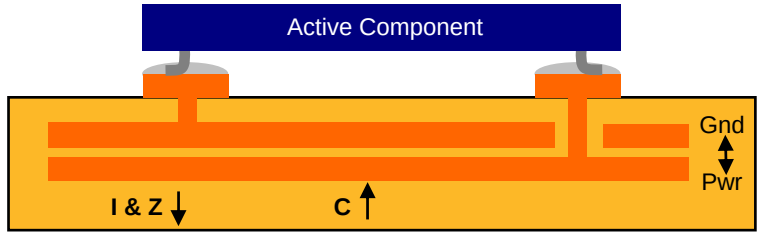
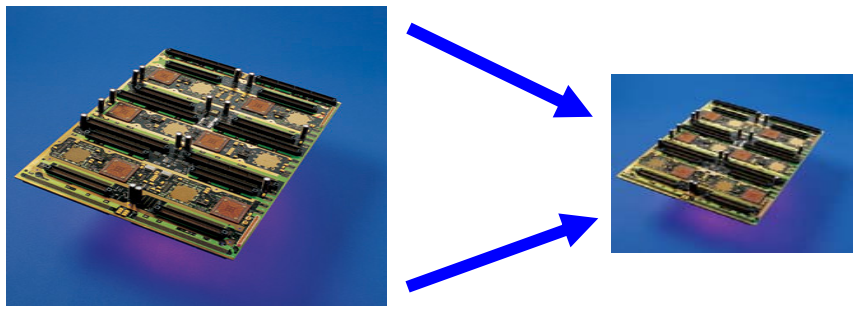
Buried Capacitance® Drivers



Decreased Plane Inductances & Broad Band Impedance

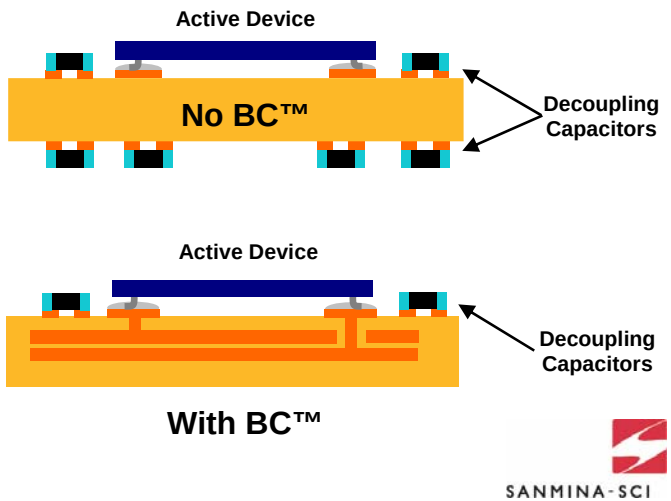


Reduced Size or Increased Functionality at Same Size



Lower Assembly Costs & Higher Reliability

- Fewer Components = Less Solder Joints



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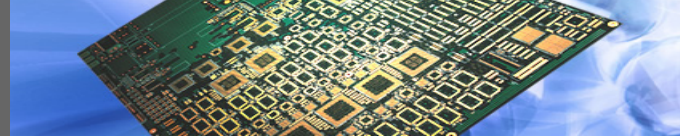
Buried Capacitance® Product Family



Plane Capacitance pf/in² (pf/cm²)

11,000 (1,705)	0.6 mil (16 µ)	BC16T™
4500 (698)	0.5 mil (12 µ)	BC12TM™
3100 (481)	0.3 mil (8 µ)	BC8™
1900 (310)	0.5 mil (12 µ)	BC12™
1600 (233)	0.6 mil (16 µ)	BC16™
1000 (155)	1.0 mil (25µ)	BC24™ & ZBC1000™
800 (124)	1.0 mil (25µ)	HK-04™
500 (78)	2.0 mil (50µ)	ZBC2000®

BC12, BC16, BC8, BC16T, BC12T are all trademarks of Oak Mitsui Technologies
HK-04 is a trademark of DuPont Electronic Materials

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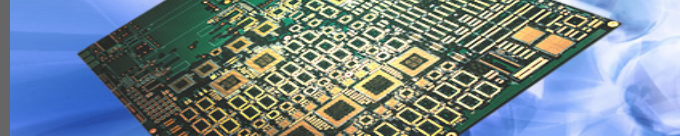
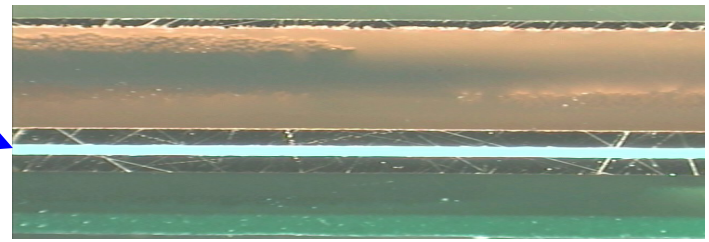
BC™ Material Constructions



FaradFlex™ BC-16T and FaradFlex™ BC-12TM

- Ceramic filled/ modified FR-4 epoxy dielectric



FaradFlex™ BC-24, BC-16, BC-12 and BC-8

- Modified FR-4 epoxy dielectric

HK-4

- Polyimide dielectric

ZBC-2000® and ZBC-1000™

- FR-4 epoxy dielectric with fiberglass reinforcement

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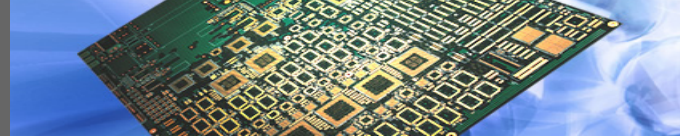
Buried Capacitance® Portfolio



Sanmina-SCI has 9 US Patents & 22 International patents

- **Covers dielectric thicknesses: 0-4 mils (0-101 µm)**
- **Covers Distributed Capacitance with Power/Ground configuration (structure)**
- **Covers the use of nanopowders to increase Dielectric Constant (Dk)**
- **Covers the use of prepreg (B-stage) with Power/Ground configuration to form Distributed Capacitance**
- **Covers the surface treatment of foils (Double Treat and RTF) used in the formation of Buried Capacitance Laminates to promote adhesion**

The IPC has acknowledged these patents in proposed Standards

Patents were issued after a careful review by the patent examiners

- **Patents have withstood legal challenge**

Global network of licensees attests to the value of these patents

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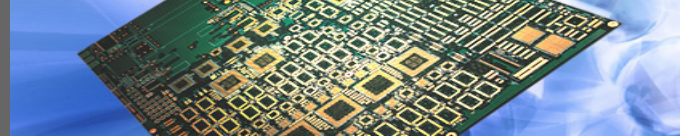
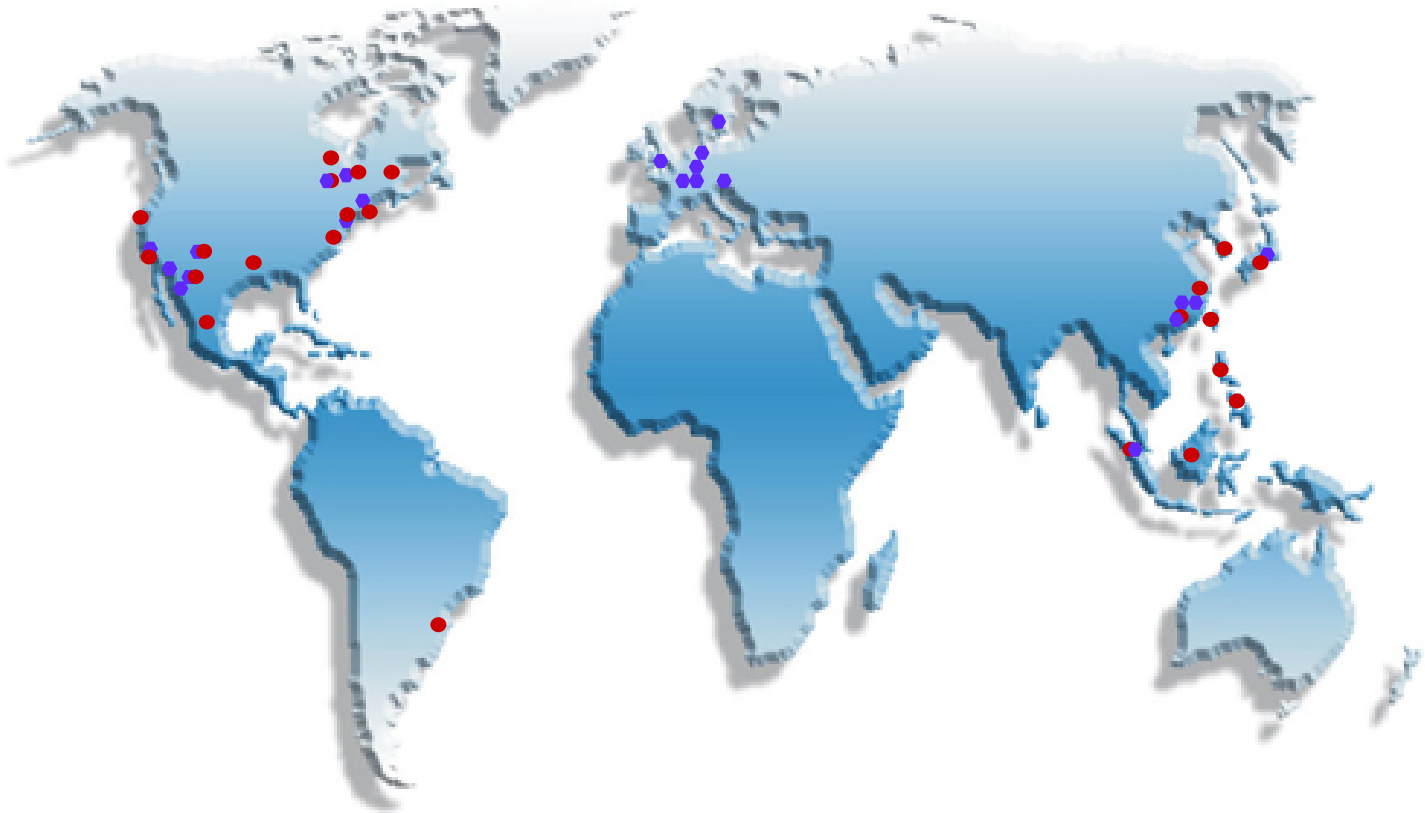
Global licensed manufacturers





21 Licensed fabricators (52 mfg locations)

8 Licensed material laminators (25 mfg locations)

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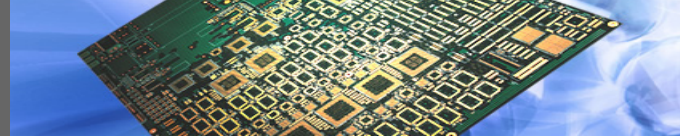
Approved material suppliers



Product	Supplier	Material Family
ZBC-2000®	Matsushita	FR-170, FR-140, Megtron, FR-1755CZ
	Hitachi Chemical	MCL-E-679, MCL-BE-67G, MCL-E-679F, MCL-679WZ
	Isola	FR-408, FR-406, IS-140, P-96
	Park Nelco	4105-6, 4103-13, 4105-2, N4000-6FC, 4105-11
	Polyclad	PCL-FR-226, PCL-FR-370T, PCL-FR-370, PCL-FR-370HR
	TUC	TU722-7
ZBC-1000™	DuPont	HK-04 (Interra™)
	Oak Mitsui	BC24 (FaradFlex™)
BC16™	Oak Mitsui	BC16 (FaradFlex™)
BC12™	Oak Mitsui	BC12 (FaradFlex™)
BC 8™	Oak Mitsui	BC-8 (FaradFlex™)
BC12TM™	Oak Mitsui	BC12TM (FaradFlex™)
BC16T™	Oak Mitsui	BC16T (FaradFlex™)

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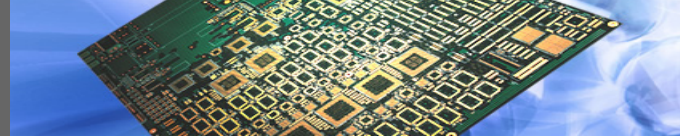
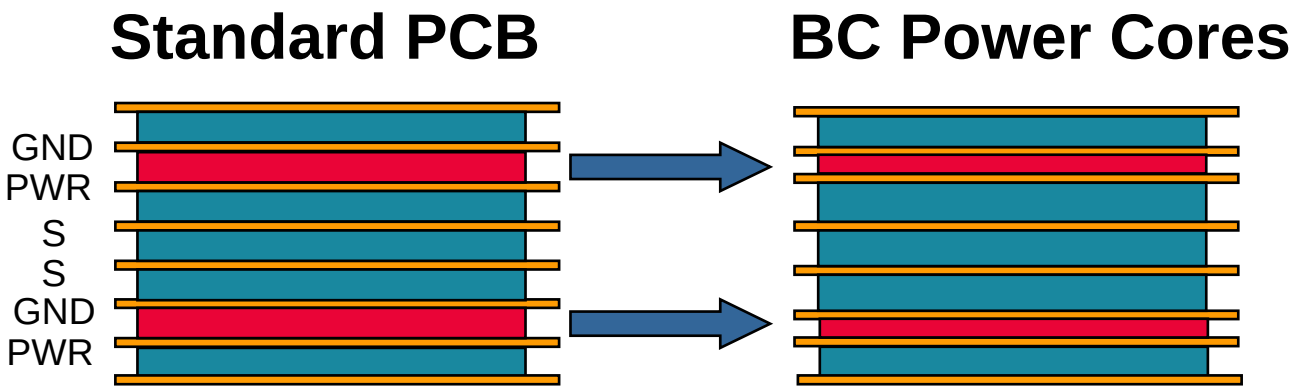
Buried Capacitance® Conversion





Decrease power plane spacing below 0.004”

Dramatically improves high frequency capacitance

Closer adjacent power/ground planes reduces plane ΔV due to:

- Increased capacitance at lower frequencies
- Decreased inductance at higher frequencies

Provides additional Z-axis room to increase signal impedances

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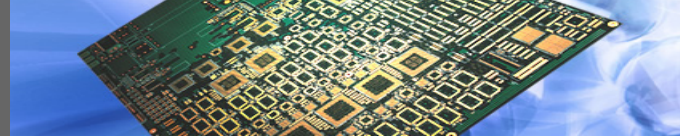
Representative ZBC Design Examples (Capacitor Elimination)



# Caps Before	Product	# Caps After	% Eliminated
48	ZBC 2000	17	64 %
48	BC 24	13	72 %
48	BC 16	12	74 %
48	BC 12	11	75 %
48	BC 8	10	77 %

Based on 1156 Pin BGA Array, 3.3 V Power Distribution, 603 Style Bypass Caps

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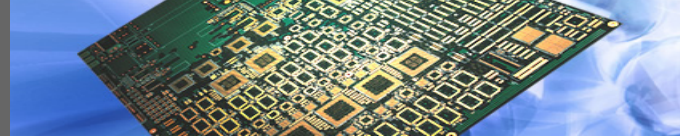
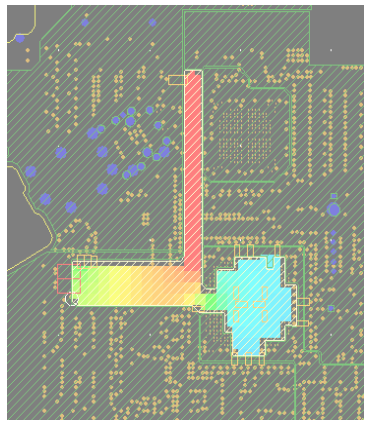
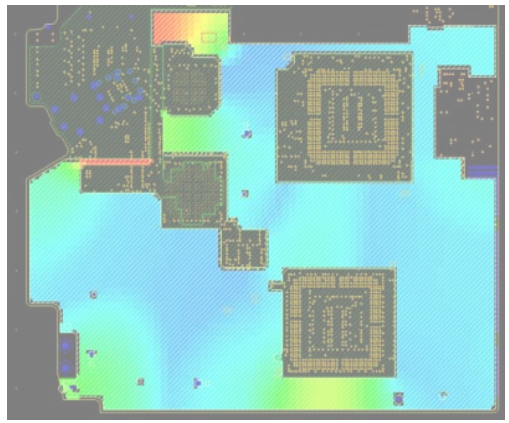
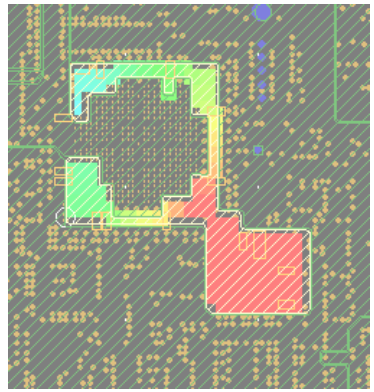
Representative ZBC Design Examples (Plane Resonance Reduction)

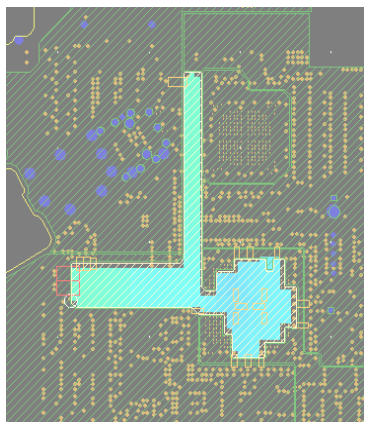


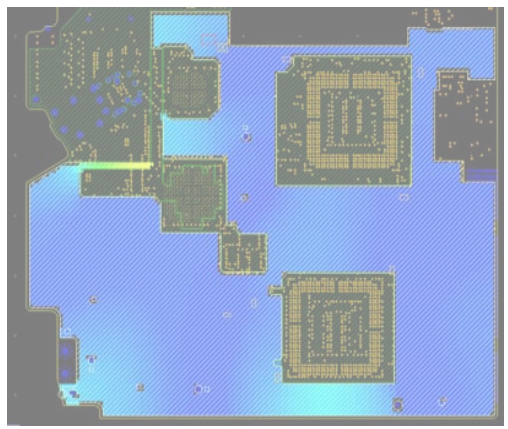
W/O ZBC

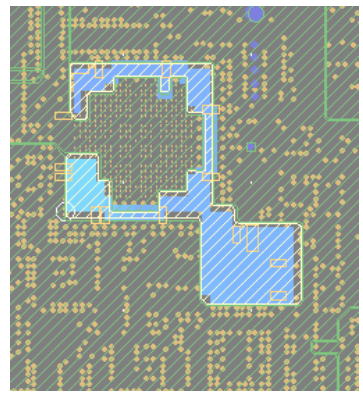












With BC-24

With ZBC-2000®

With BC-12TM

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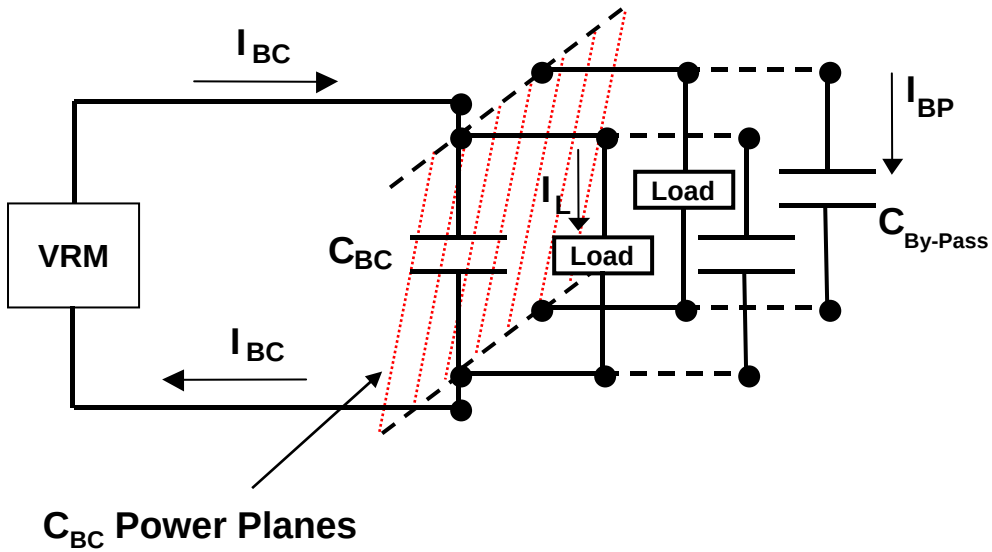
High Frequency Power Distribution



- **Digital power distribution is composed of a hierarchal capacitance**
  - **Aluminum Electrolytic – low frequency**
  - **Tantalum – low & mid frequency**
  - **Ceramic – high frequency**
  - **Adjacent PCB Power Planes**
- **BC™ is the broad band platform that networks all caps to power source and load.**

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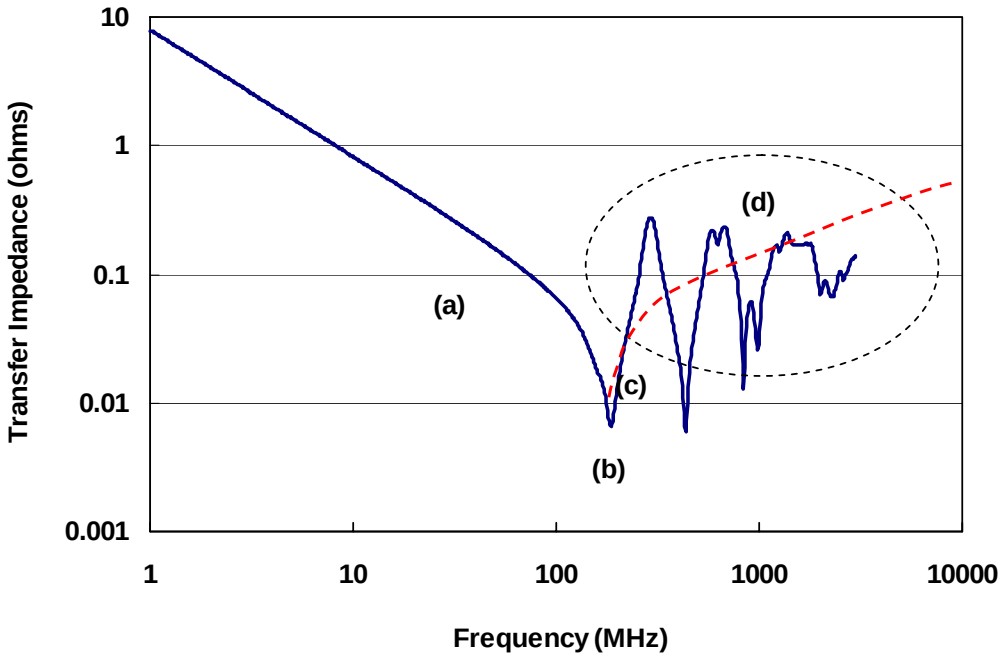
Distributive Capacitance Behavior



Region

a	**Impedance is dominated by capacitive reactance**
b	**Capacitive reactance equals inductive reactance**
c	**Impedance is dominated by inductive reactance**
d	**Plane resonance modes, affected by dielectric constant and geometry**

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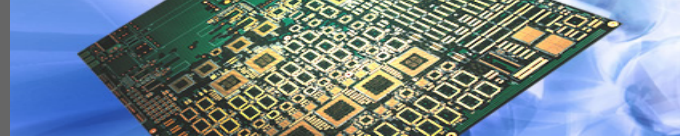
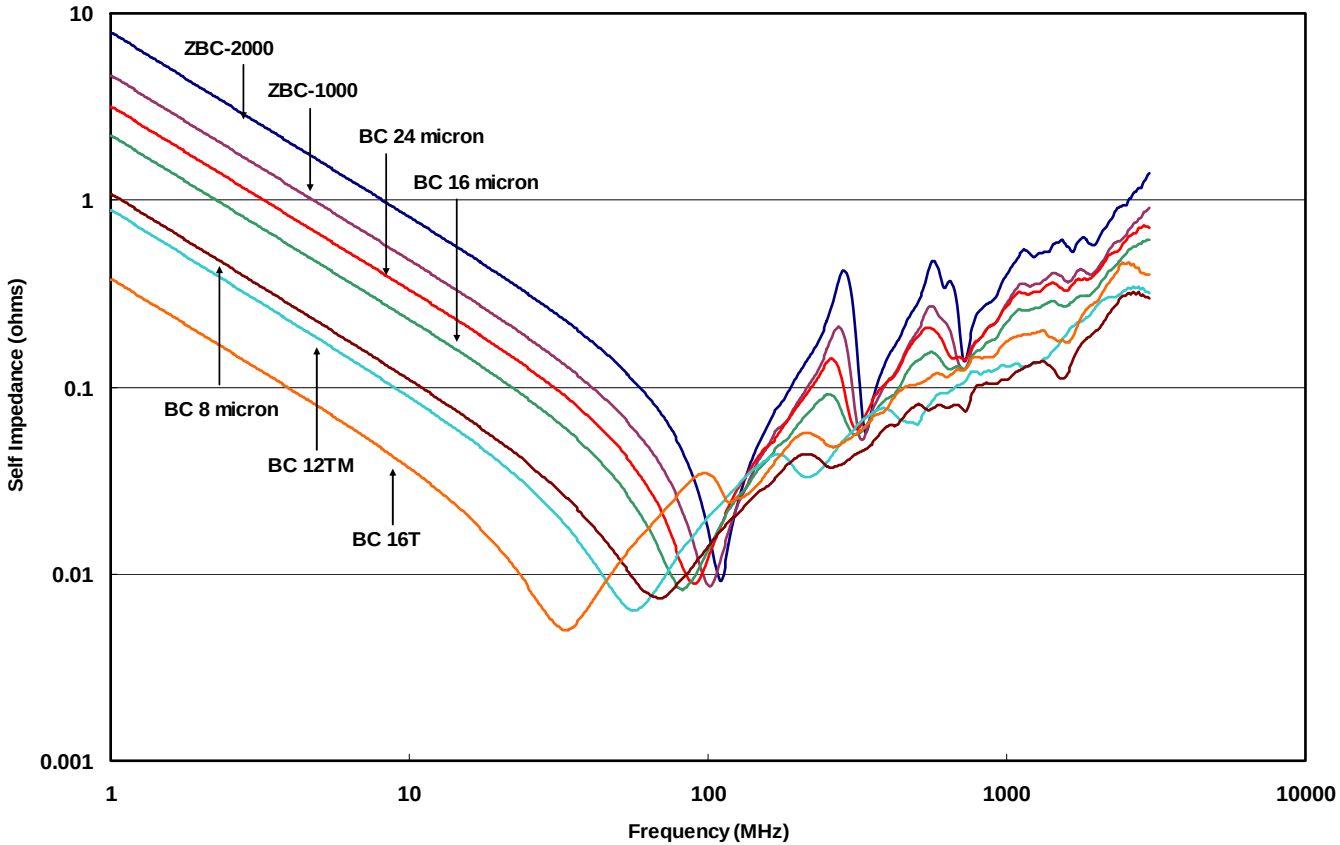
BC™ Laminates Impedance





Capacitance increases as dielectric thickness decreases

Noise improves as the impedance is reduced

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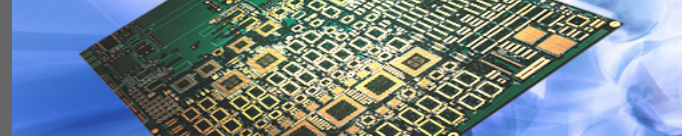
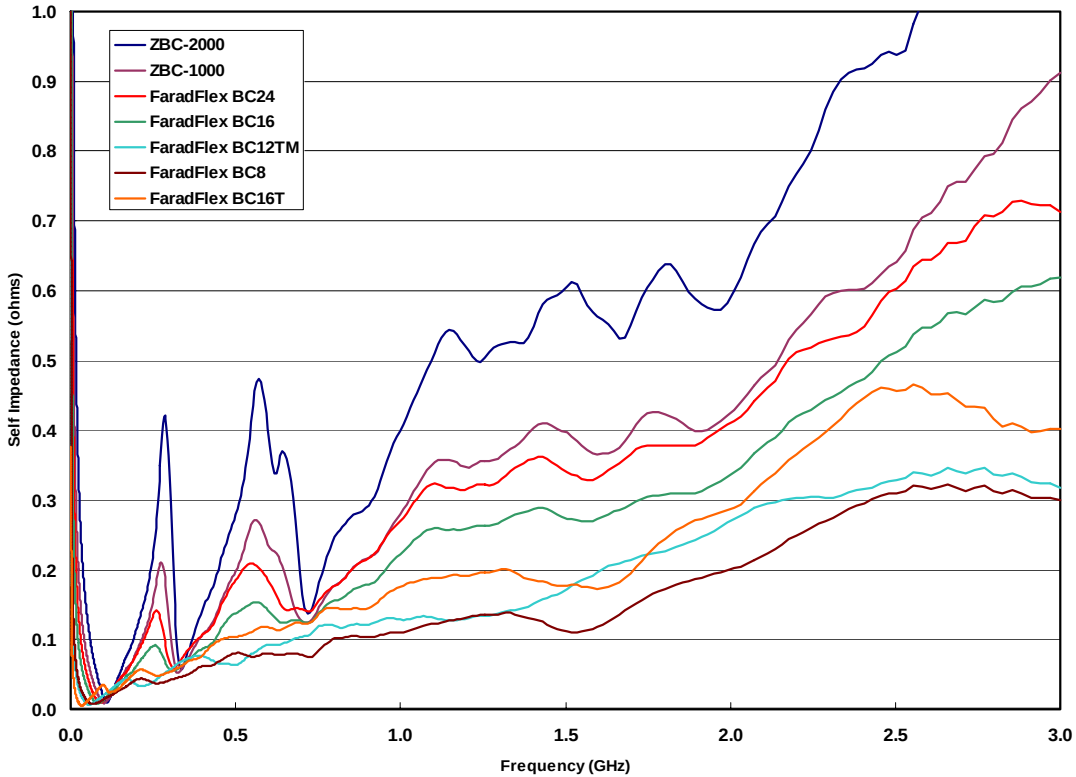
BC™ Laminate Inductive Impedance





Plane inductance is reduced as dielectric thickness decreases

Plane resonances are reduced as dielectric thickness decreases

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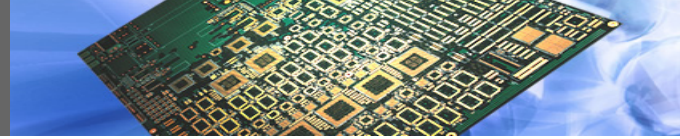
Supported Laminate Material Characteristics



Property	Condition	Unit	ZBC-2000®	ZBC-1000™
Dielectric Resin	----	----	FR-4	FR-4
Dielectric Reinforcement	----	----	e-glass	e-glass
Hi-Pot Test	DC Volts	Volts (DC)	500	500
Electro-migration	85°C/85% RH (DC Volts)	Hours @ (Volts)	2000 (50)	2000 (50)
Thermal Shock	-35°C / 125°C 400 cycles	N/A	Pass	Pass
Peel Strength	As received	lb/in^2	>6.0	>6.0
Dielectric Breakdown	1 kV/sec	Volts (DC)	>2500	>2500
UL Rating	----	----	94-V0	94-V0
Bellcore/Telcordia Exception	TR-NWT-000078	N/A	Granted	In progress

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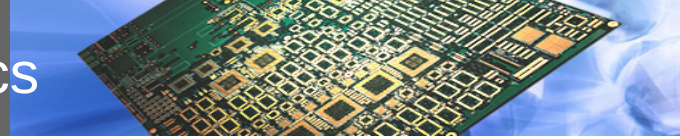
Unsupported Laminate Material Characteristics



Property	Units	BC24	BC16	BC12	BC8*	BC16T*	BC12TM*	HK-04
Dielectric Thickness (µ)	Nominal	24	16	12	8	16	12	25
Peel Strength	lbs/in	8	8	8	8	6	4	9.0
Dielectric Strength	KV/mil	5.3	7.3	5	5	2.8	6.2	6-7
Tensile Strength	Mpa (kpsi)	152 (22.0)	164 (23.8)	194 (28.2)	126 (18.3)	NA	110 (16.0)	>345 (>50)
Elongation	%	18.5	16.5	11.5	8.5	NA	6.0	>50
Hi-Pot Test	DC Volts	500	500	500	500	100	500	500
Thermal Shock	-35°C/125°C 400 Cycles	Pass	Pass	Pass	TBD	TBD	TBD	Pass: -65°C to 125°C- 100 Cycles
Thermal Stress (20Sec @ 288°C)	# Times	>10	>10	>10	>10	>10	>10	Pass: 10 sec @ 288°C
Electro Migration	85C/85%RH, 35VDC	>1000 Hours	>1000 Hours	>1000 Hours	>1000 Hours	>1000 Hours	>1000 Hours	1000 Hours @ 100VDC
Flammability Temp Rating	UL-94/ UL-746	V0 130°C	V0 130°C	V0 130°C	V0 130°C	Provisional	V0 130°C	V0
Double sided core process						Sequential Lamination	Double Sided Core Process	

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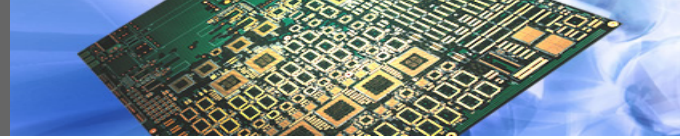
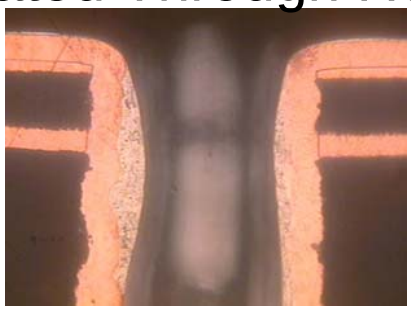
Solder shock results

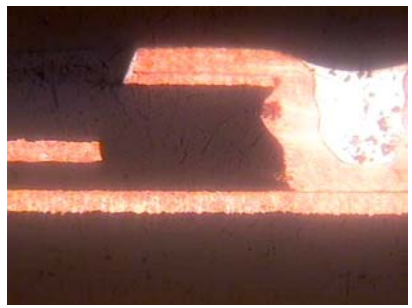


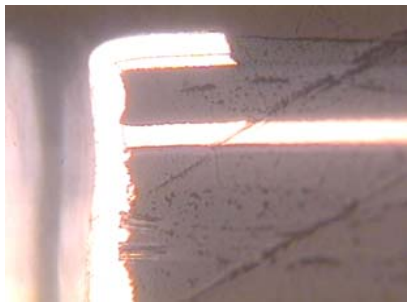
Plated Through Holes

Blind Vias (L1-3) Holes

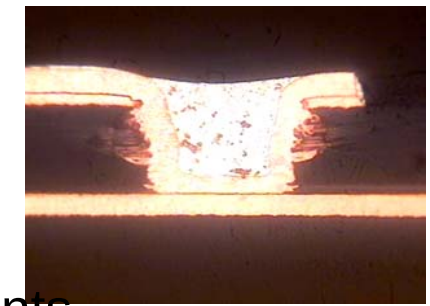


ZBC-1000™





Faradflex® 16 µm



Passes Solder Shock Tests Requirements

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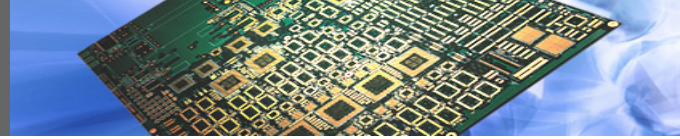
BC™ will improve power distribution



Improve EMC performance

- Reduced PCB plane resonance effects
- Reduce need for system level shielding

Enhance high frequency power distribution

- Quieter power distribution interconnects
- Increase Distributed Capacitance
- Reduced power interconnect inductance
- Reduced usage of surface mount bypass capacitors

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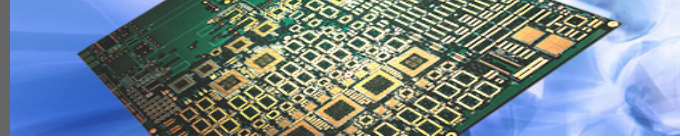

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Thank You