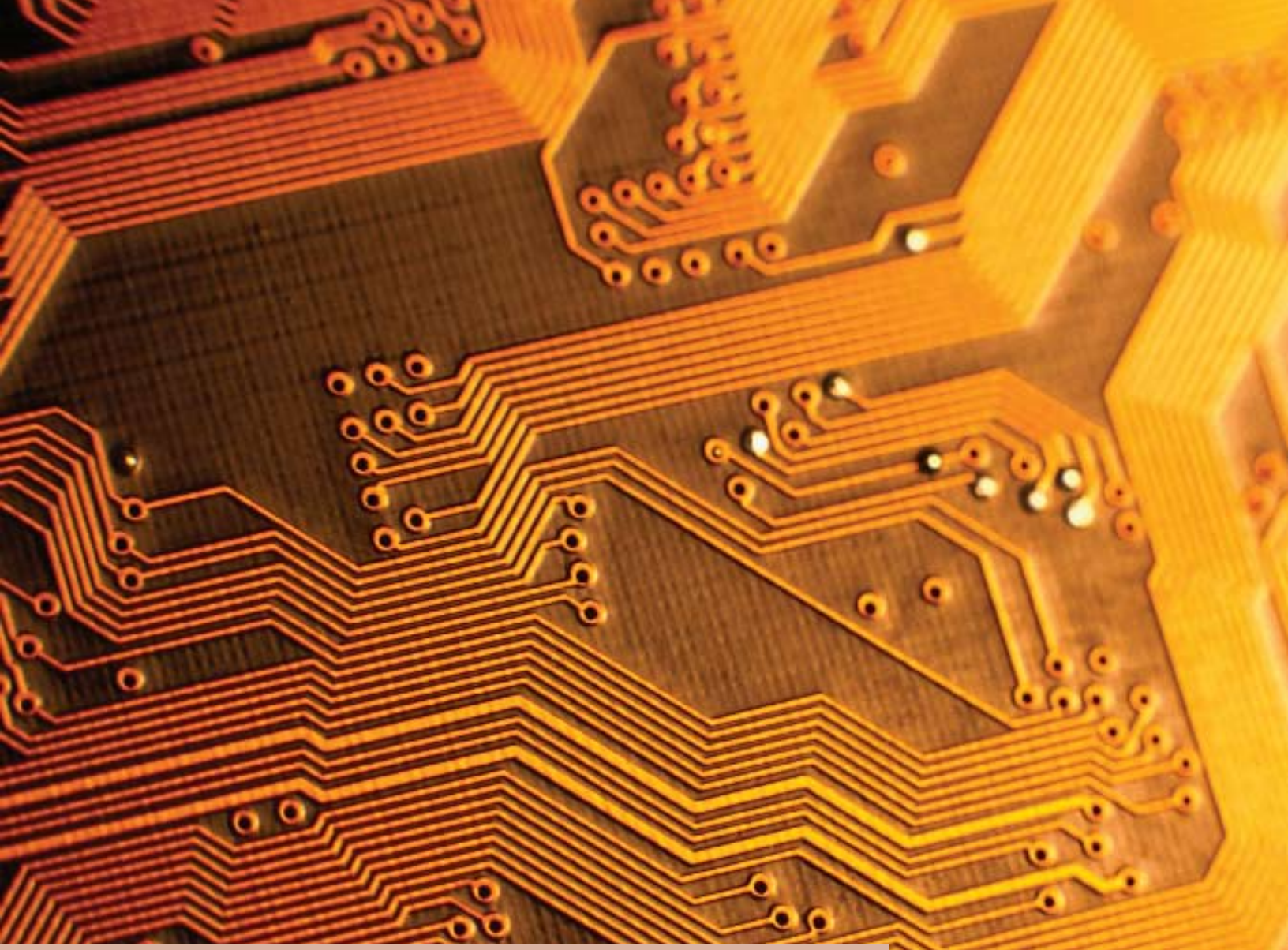


Interra™ HK 04 planar capacitor laminate

DuPont™ Interra™

EMBEDDED PASSIVES MATERIALS

DUPONT

The miracles of science™

DuPont is a science company. Our vision is to be the world's most dynamic science company, creating sustainable solutions essential to a better, safer, healthier life for people everywhere.

DuPont is a leading materials and technology supplier to the electronics industry, providing a broad and growing portfolio of innovative material solutions. One such innovation is DuPont™ Interra™ polyimide laminate. This new embedded passives substrate helps enable design engineers to push electrical boundaries to achieve better signal noise reduction and faster clock and data rates. A number of broad applications are benefiting from this innovative material solution, including multi-gigabit buses, telecom and high-reliability applications where high performance and thin circuit profiles are critical.

DuPont polyimide laminates offer the durability and reliability needed for applications in extreme environments and temperatures.

Putting our science to work

More than 35 years ago, DuPont pioneered polyimide flexible laminate technology. Polyimide flexible laminates are known for their capability to withstand high temperatures and wide thermal shock cycles, and are used extensively in military, aviation and space applications, including NASA's Mars rovers.

By leveraging decades of experience with this technology, DuPont Electronic Technologies was able to develop the Interra™ embedded passives materials product line. One of the newest members of this product line is DuPont™ Interra™ HK 04.

A thin laminate with a polyimide dielectric, Interra™ HK 04 is designed to function as a power and ground plane in printed wiring boards (PWBs). This laminate is excellent for power bus decoupling, EMI and power plane impedance reduction at high frequencies. It is ideal for use in high-end digital applications such as servers, computers, routers, switches, telecommunications equipment and medical systems where designers are looking to reduce size, improve performance and build more cost-effective electronic devices.

Simply stated, Interra™ HK 04 combines the performance of polyimides with high-yield printed circuit manufacturing to enable increasingly denser, more reliable, higher speed circuits.

Key features

- Dielectric thickness—currently available in 25 µm or 18 µm; 12 µm will be available in the future
- Capacitance density—0.8 nF/in^2 (25µm laminate)
- Excellent stability of dielectric constant and loss tangent over wide frequency and temperature ranges (1 KHz to 12 GHz; –40°C to 120°C) (Refer to Figure 1)
- >99% yield in HiPot testing
- Drop-in processing in multi-layered PWBs
- Extensive fabricator supply base throughout North America, Europe and Asia
- RoHS compliant*
- Halogen free
- Certified to UL94 V-O**
- Compatible with lead-free processing

* Per third-party laboratory testing of an Interra™ HK 04 sample.

** UL certification information for DuPont™ Interra™ HK 04 can be found at www.ul.com in the UL Certifications Directory, File E124294.

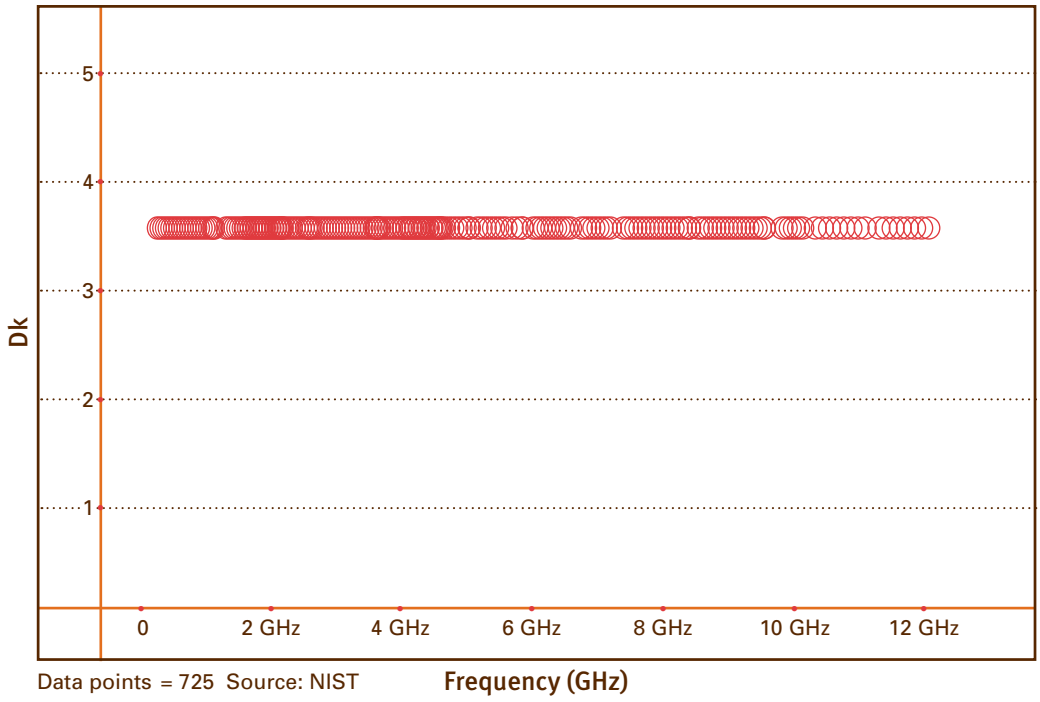


Figure 1: DuPont™ Interra™ HK 04 provides excellent stability of dielectric constant over a wide frequency range.

Uncovering the advantages of DuPont™ Interra™ HK 04 for Buried Capacitance®

Reduced power system impedance

The thinness of Interra™ HK 04 enables it to significantly reduce the impedance of the power/ground plane, while remaining capacitive up to 2 GHz. By contrast, surface mount capacitors are limited in frequency to approximately 400 MHz, beyond which they become inductive. It is important to note that a thin dielectric extends the frequency performance of the PWB power system into the GHz range. (Refer to Figure 2)

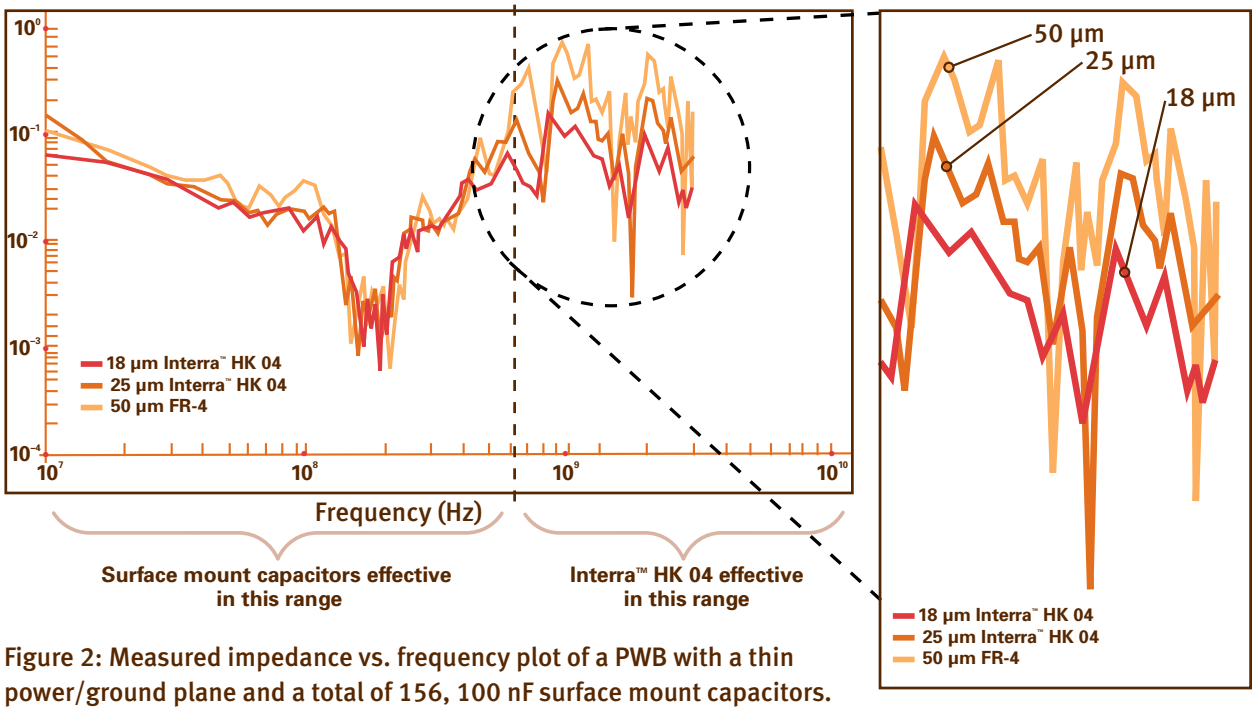


Figure 2: Measured impedance vs. frequency plot of a PWB with a thin power/ground plane and a total of 156, 100 nF surface mount capacitors.

Improved eye-openings and reduced emitted radiation

Thin Interra™ HK 04 offers a low inductance return path, which significantly lowers simultaneous switching noise (SSN) and opens an eye for multi-gigabit buses. (Refer to Figure 3) Reducing the thickness of the power plane layers also reduces the PWB edge radiation, resulting in lower total EMI of the system.

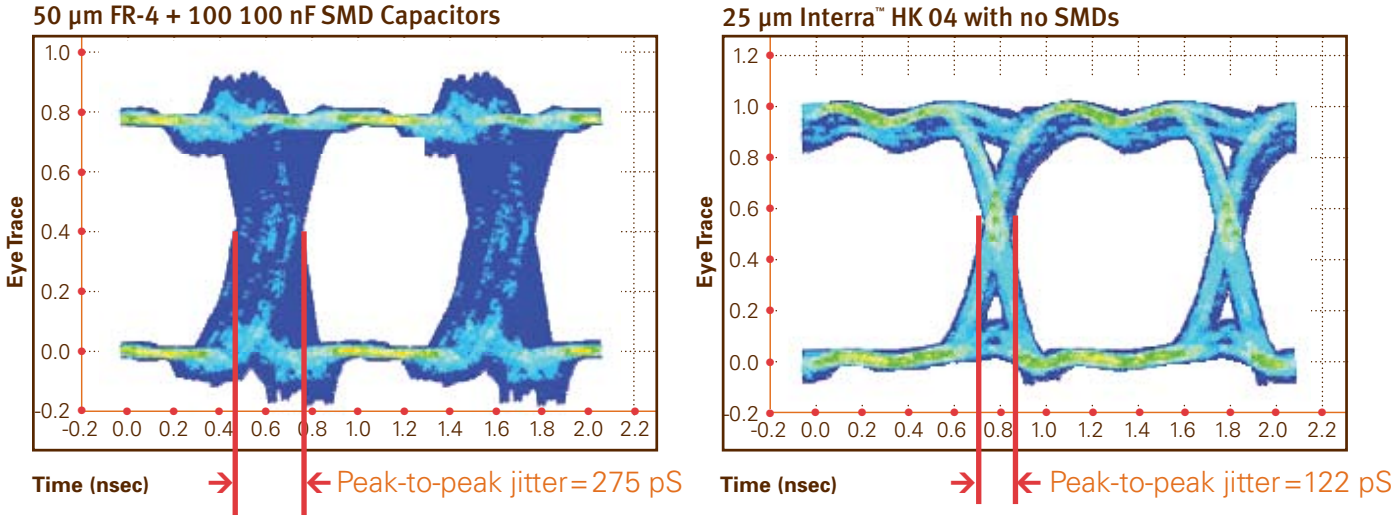


Figure 3: Comparison of the performance of two PWBs, one with 50-µm thick Buried Capacitance® and 100, 100nF surface mount capacitors, the other with only 25-µm thick DuPont™ Interra™ HK 04 as the Buried Capacitance® layer. Eye-opening simulation of a 1-Gbps 16-bit bus was used for the comparison. Note the improvement in the eye-opening for the PWB manufactured with Interra™ HK 04.

Reduced overall board thickness

Reducing the dielectric thickness enables reduction in the overall thickness of the PWB. This gives designers two distinct advantages to choose from—adding an additional power or signal layer, or increasing the thickness of the copper planes to carry more power.

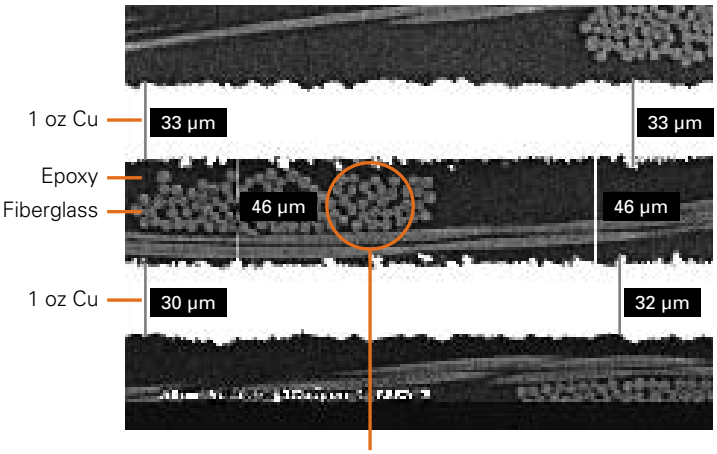
Reduced cost

Interra™ HK 04 in 25-µm or 18-µm thickness delivers charge more effectively at hundreds of MHz and can be used to replace an equivalent number of surface mount capacitors, reducing cost and saving board space.

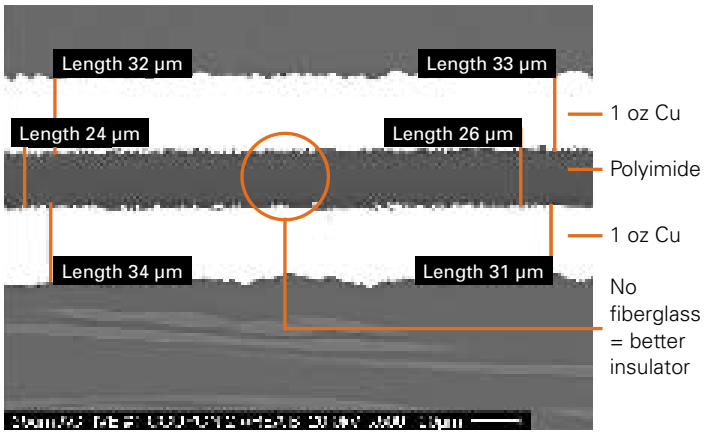
Polyimide dielectric provides superior reliability

DuPont™ Interra™ HK 04 vs. 2-mil FR-4: The HiPot advantage

The polyimide dielectric used in DuPont™ Interra™ HK 04 does not have any glass weave, which provides it with conductive anodic filament (CAF) resistance and the ability to withstand the high voltages required for high HiPot yield. Interra™ HK 04 has been tested for reliability in multi-layered PWBs and meets all requirements. (Refer to Figure 4)



Fiberglass strands can act as an ion migration path, making 2-mil FR-4, a single ply glass epoxy, prone to HiPot failure.



Interra™ HK 04: No fiberglass reinforcement—provides better insulation resistance and HiPot yield.

Figure 4: These scanning electron micrographs (SEMs) show cross-sections of an FR-4 PWB with a 50-µm Buried Capacitance® laminate and an FR-4 PWB with a 25-µm thick Interra™ HK 04 laminate.

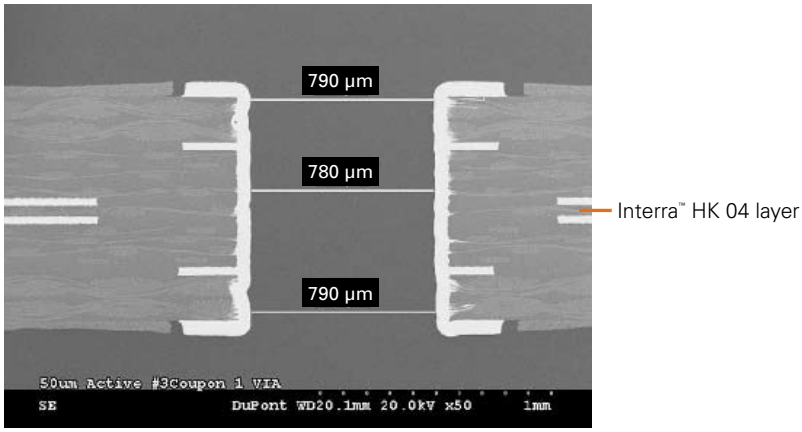


Figure 5: Cross-section of a multi-layered PWB with Interra™ HK 04, showing the plated through hole (PTH); plated using standard electroless/electroplating process.

Table I provides a summary of the tests conducted by Teradyne Inc.* on 14-layer PWBs containing four layers of Interra™ HK 04. In test after test, there were no failures reported.

Table I: Reliability testing of a 14-layer PWB with four layers of DuPont™ Interra™ HK 04.

Test	Conditions	Number of samples	Results
CAF (conductive anodic filament)	85°C/ 85% RH/96 hrs soak + 500 hrs at 100 V DC	16 coupons	0 failures
HiPot	500 V DC	5 PWBs	0 failures
IST (interconnect stress testing)	Preconditioning: 4x reflow at 215˚C max.; max. test temperature: 150˚C	12 coupons	0 failures
THB (temperature humidity bias)	85˚C/85% RH/400 hrs at 5 V DC	4 PWBs	0 failures

Easy processibility

Interra™ HK 04 is compatible with existing PWB processes—including double-sided processing. Standard PWB manufacturing lines can be used to process Interra™ with only minimal changes being required (refer to Figures 4 and 5). Due to its enhanced robustness, Interra™ HK 04 handles extremely well on the manufacturing line. It can be bent, folded and dropped without cracking, giving fabricators added confidence in defect-free processing.

With Interra™ HK 04, fabricators can expect HiPot yields of >99% during inner-layer processing, which leads to very high overall PWB processing yields.

Volume availability

To ensure volume availability, DuPont Electronic Technologies is working with a large and growing number of PWB suppliers in North America, Europe and Asia. A list of these fabricators can be obtained from your DuPont representative.

* St. Cyr, Valerie A. "Benefits and Reliability of a Thin Dielectric in a Power Supply Printed Circuit Board." 2005 IPC Works, paper SO4-3.

For more information

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