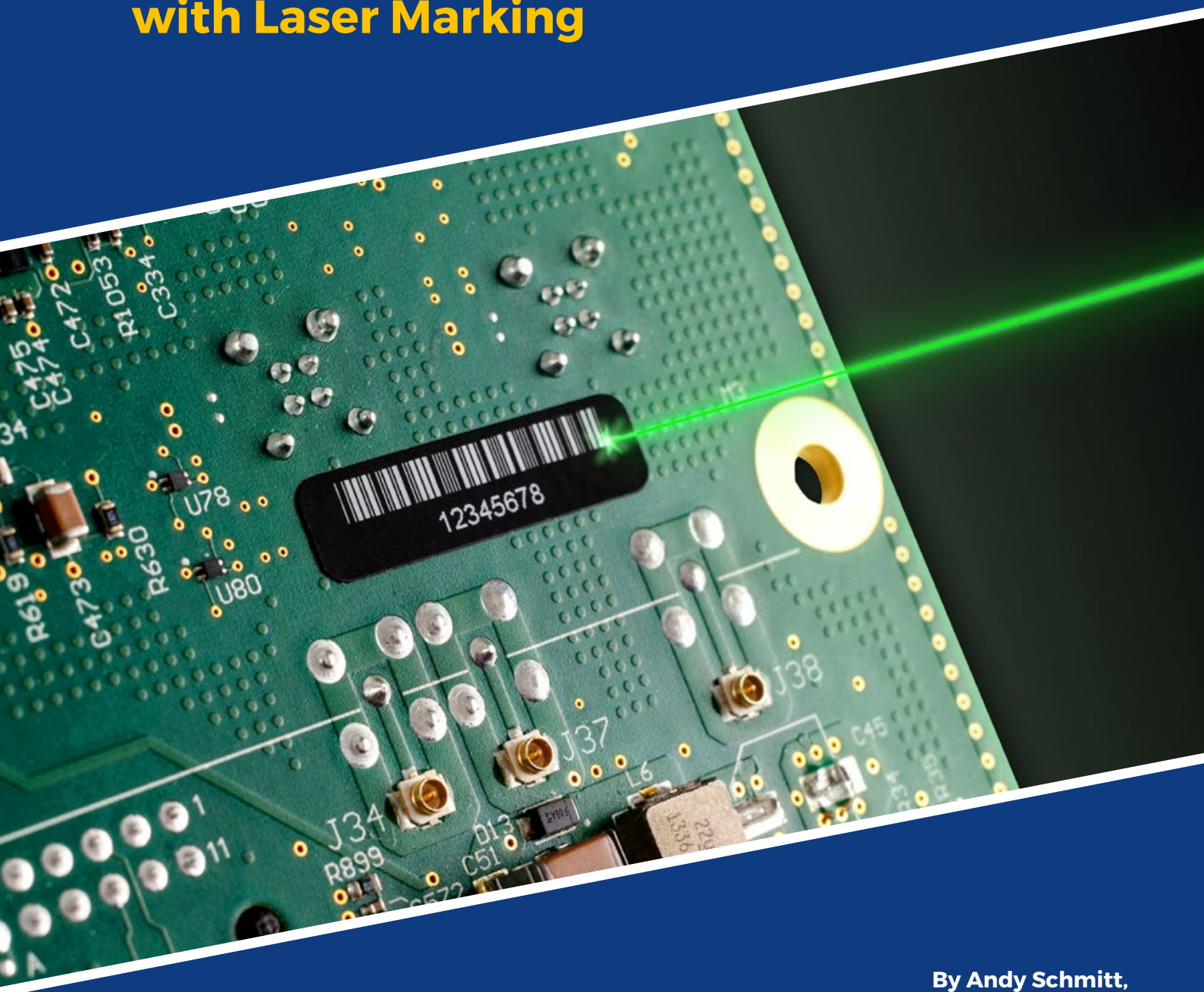
BRADY
WHEN PERFORMANCE MATTERS MOST™

Permanent Electronic Component Identification with Laser Marking



By Andy Schmitt,
Regional Product Manager, Brady Corporation

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For years, Brady's identification solutions have provided contract manufacturers and original equipment manufacturers in the electronics industry with the benefits of traceability and compliance. These advantages include:

1. Reduction in errors and reworks
2. Production cost savings
3. Reduced warranty liabilities and returns
4. Compliance with trade and substance regulations

When it comes to traceability, Brady has a long history of providing label materials that are engineered specifically for electronic components. These materials are designed for durability, consistency and compliance in high-performance environments and processing conditions, including cleaning, decontaminating and connecting each component.

Brady is pleased to offer the following new products specifically designed for printed circuit board (PCB) and component marking using laser systems:

B-420: glossy white laser engravable & cuttable polyester
B-421: black matte laser engravable & cuttable polyester
B-730: black matte laser engravable polyimide
B-731: black matte laser engravable polyimide, electrostatic dissipative
B-734: matt white laser engravable polyimide
B-735: matt white laser engravable polyimide, electrostatic dissipative

When Should I Consider Laser Marking Solutions?

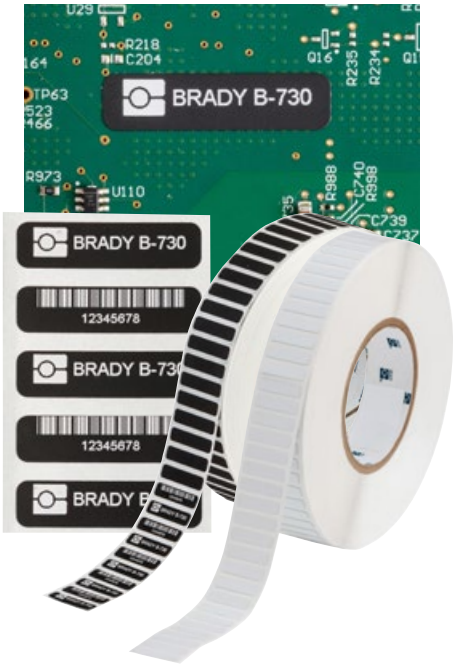
In many cases where board space is limited, smaller labels and higher print resolutions at font sizes three and below are required. There also may be additional, difficult-to-survive conditions, including high temperature reflow steps for surface-mount technology (SMT), wave soldering for through-hole assemblies and washing steps that prohibit the use of traditional thermal heat transfer (THT) print. Manufacturers may wish to more fully automate their Labelling jobs along with their pick-and-place, surface-mount technologies. In all of these cases, laser-marked PCB labels offer a complimentary solution to THT printed polyester or polyimide labels.

Brady's new Laser Markable UltraTemp Labels are the most durable PCB label in our line, offering:

- Repeated harsh aqueous cleaning resistance
- High temperature, wave soldering resistance up to 300 °C
- Custom sizes engineered-to-order
- Compatibility with most IR laser marking systems
- Optional ESD prevention layers
- Reduced rework issues related to direct laser marking board materials

Laser Marking Systems

Laser marking is the direct marking of a surface using coherent monochromatic light. Typical lasers used for this process include near IR diode lasers, Nd:YAG systems or mid-IR CO_2 continuous wave (CW) lasers. Near IR systems are often pulsed to create time-limited bursts of energy that are hard to dissipate as heat and result in sub-surface foaming, intrinsic colour change through redox reactions or through ablation (the physical removal of material through the vapor phase). For the higher wavelength CO_2 laser systems, intrinsic marking is much more difficult due to the inability to pulse the light. They are, however, typically cheaper, more powerful and can offer additional functionality in addition to marking, such as the ability to cut.



Print Technology Comparison

Brady's PCB and electronic component identification solutions have been primarily focused on using THT printing – a durable, extremely-reliable, fast and low-cost printing technology. This technology is based on transferring pigmented resins to the print-receptive surface of a label, where the resin and its adhesion to the label provide the overall printed product with abrasion, chemical and thermal resistance.

To complement our THT line of UltraTemp products, Brady developed Laser Markable Labels for the printed circuit board and electronic component assembly market. Because laser materials use subtractive printing, the printed layers can be completely cross-linked to produce the most permanent identification for a coated product. This means that the label is more chemical, abrasion and temperature resistant than typical THT labels. Because the printed information is ablated in the coating using IR lasers, the print resolution can also be extremely high and is only limited by the beam quality and focal optics of the laser system employed. ANSI "A" and "B" bar code grades are easily obtained using these materials. The resolution can reach 600-1200 dpi, which allows for small font applications at three point font and below.

Direct marking onto printed circuit boards will often cost manufacturers more money in the long run than either THT or laser marked labels. FR-4 is the most commonly used material for the fabrication of PCBs and other electrical components due its low water absorption and self-extinguishing design. However, as with other glass-reinforced epoxies, it will have very poor contrast and resolution when marked directly with a laser, leading to poor bar code grades, long scan times and no-reads. This can cause bad scans during production, identification mistakes and costly reworks. The self-extinguishing nature of the material means it's hard to ablate and these boards are typically loaded with bromine as the primary flame retardant. The generation of poisonous bromine gases through direct marking on boards becomes a large concern during production. Lastly, the gas and moisture generation from direct-marking FR4 and similar PCB materials can damage nearby ICs and electrical components, rendering the product defective.

It is important to note that equipment costs and environmental health and safety requirements will be higher than THT to integrate a laser marking system into your workflow. For full details see the below chart.

Printing Technology Comparison Guide

Attribute	THT Printing	Laser Marking	Direct Marking
Initial Equipment Costs	Low	Moderate	High
Recurring Costs	Moderate	Moderate	Low
Marking Permanence	Good	Excellent	Excellent
Print Resolution	Good	Excellent	Good
Print Speed	Excellent	Good	Poor
Contrast	Excellent	Excellent	Poor*
Barcode Grades	Excellent	Excellent	Poor*
Automation	Good	Excellent	Excellent
Air Handling	None	Recommended	Required
Easy to Re-Work	Yes	Yes	No

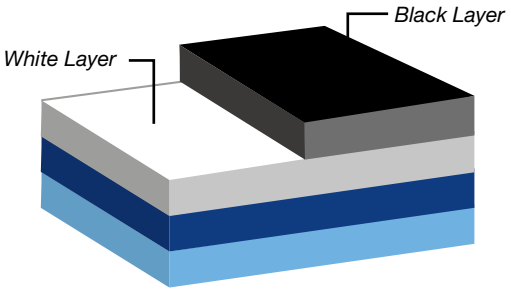
* Direct marking colour contrast defined by substrate and laser marking mechanism.

Additive vs. Subtractive Printing Techniques

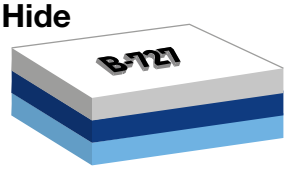
Have you ever wondered why almost all THT labels are black print on white? Or why almost all laser-engraved parts are white print on black? This is due to both light absorption and hide.

Light Absorption

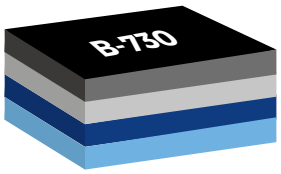
Light absorption is a material characteristic that is typically associated with a pigment's colour. Darker pigments, like carbon black, fully absorb visible and IR light and will strongly interact with IR laser marking systems. White pigments, like TiO_2, fully reflect visible and most IR light and will weakly interact with IR lasers. This is a primary reason why we see black backgrounds with laser marking products.



Hide



Additive Printing



Subtractive Printing

Hide is a print concept that defines the ability of a coating or film to mask underlying layers of colour. Black pigments, based on their strongly absorbing properties, are great at hiding and masking underlying layers. White pigments, based on reflective properties, are significantly less effective and require thicker coatings and higher densities to cover. To minimise product cost, black layers are nearly always designed to reside on top of less dark layers during printing.

For THT printing, when we add colour to the surface, it requires less pigmentation to print a dark mark on top of a white substrate. This is an additive printing technique. For laser engraving or laser marking, when we subtract colour, we ablate the black layer to reveal the white. This results in a white mark revealed during ablation on a background of black.

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