

# Printed Labels For Module Identification

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Establishing an effective and cost-efficient identification concept in electronics manufacturing is a complex proposition involving interrelated and carefully matching elements. If one of these elements is badly chosen or wrongly scaled - be it hardware, materials, or printer maintenance intervals - it will almost certainly result in a significantly higher failure rate for the labelling step, if not in the multiple subsequent reading procedures during test and/or assembly. This could be catastrophic. A look at what is needed to establish the proper marking and labelling solutions.

Ten years ago, most printed-circuit board manufacturers considered module labelling a voluntary exercise. Looking back, in the light of today's comprehensive traceability rules, this shows how radically the world of electronic manufacturing has changed through the introduction of legislation covering product liability and expanded warranty obligations. Rigid quality standards, such as ISO/EN 9001:2000, QS9000, VDA6.2, and most recently, TS16949, have greatly added to this conundrum.

All these issues have one common denominator: traceability. As a consequence, full traceability throughout the entire process chain has empowered the beneficiaries of mandatory module and board identification to establish and maintain complete process control. This helps to ensure quality and, at the same time, minimise cost. But in this realm, too, technology has advanced significantly. In the olden days, it was entirely possible to manually apply a large barcode label to a module or board, either after the placement step or cluster separation, because the label was only needed for subsequent test and mounting procedures. Today's



Figure 1 - Brady PAM 3600 Print & Apply Machine

state-of-the-art integrated process chain management commands identify components at the very beginning of the manufacturing process.

## Space considerations: Datamatrix is best

Whatever identification methodology is utilised - laser marking, inkjet printing, label application - choosing the right content and its symbology for a given identification is of utmost importance. Table 1 compares the required space for numerical identification techniques and their symbologies at various resolutions, using Datamatrix as the base. For linear coding, such as a barcode, the assumed height is 5mm. The comparison is based on a number of three dots per module with Datamatrix, or of three dots per thinnest element of a barcode. From the table it is evident that a six-digit linear barcode in 2/5 interleaved denomination needs nine times the space of a Datamatrix identification of equal information content! Even more serious is the waste of space with the traditional Code 39: its space demand compared to Datamatrix is 14-fold!

## Appropriate coding and lower data content

Growing data content and complexity mean rising demands on print quality and contrast as well. The conclusion: less is more! Unused leading zeros within long serial numbers are counterproductive! To map a manufacturing date down to the exact day by employing a simple numerical string such as "18072006" bears little efficiency: using up eight digits to denominate "18 July 2006" is certainly a possibility. But the same information could be contained in a shortened or compressed string such as 199G - just by choosing a different coding scheme. In this example, the three digits 199 stand for the 199th day of the year, which of course is the 18th of July. And the alphanumeric digit G stands for 2006, if a simple scheme: 2000=A, 2001=B, 2002=C, etc., is established.

Electing an identification compression scheme like the above will bring the era of marking printed circuit boards by inkjet printing to an end. Showing a resolution of just 100 dpi and having limited abrasion and solvent resilience, inkjet printing has almost no area left as a general identification technology. Excluding the use of RFID for the time being, there remain just two choices: laser marking and label application.

At a resolution of 500 to 600 dpi, label application now offers all the procedural options for identifying modules and boards - also at a large data content. It is true that, in recent years, laser marking has continued to gain acceptance with regard to hardware requirements and matching decoding technologies. But laser marking can't compete with labelling in terms of contrast and independence from the surface properties. A contrast of 100% black on white unambiguously

ly delivers the best readability regardless of whether matte or glossy label materials are used.

### Thermal transfer printers for all applications

What are the decisive criteria for the user to make the right selection in terms of hardware and materials for an optimal identification system based on labelling? The amount of data to be coded is certainly one of these criteria. This parameter will determine the resolution level of the thermal transfer printer to be selected, making sure that subsequent readers down the line (whether barcode or 2-D camera) will deliver optimum results, in particular high first-read rates even at a resolution below 7 mil. For this purpose, Brady offers a comprehensive product portfolio of label printers ranging from 200 to 600 dpi.

For some time now the print system of Brady's printer applicator range has also been available with a resolution of 600 dpi. Brady's PAM 3000 ensure print and positioning accuracies within +/-0.3mm. All these systems work with minimum label heights that the user should stick with: 5mm for simple models, 4mm for high quality, and 3mm for high-end systems.

### Manual labelling

For manual labelling, Brady's Precision and THT Printer Series, with or without take-up gear, offer options for the printing and reeling of labels as well as presenting them to the manual labelling process. On the other hand, pre-printed labels can be applied automatically, via component placement machines, on printed circuit boards. Hover-Davis offers a range of pre-printed label feeders that fit onto most placement machine types. They also have a print on demand version that offers 600 dpi and can be thought of as a high definition network printer that sits on the placement machine and acts as a feeder.

### Clean Liner Technology eliminates adhesive oozing

Brady has recently introduced another feature for the labelling process: the addition of the AutoApply labels to its Thermal Transfer Clean Liner Technology (THTCLT) product portfolio. The new labels feature the B-457 polyimide film as a liner, having a pressure-sensitive acrylic adhesive and a high-opacity topcoat. The liner is applied underneath the labels after they have been die-cut. The advantage is that there is no overcutting to avoid adhesive oozing, eliminating any downtime due to label misplacement or misprint. CLT labels are compatible with all applicators for THT labels.

### Not to be forgotten: expenses for materials and maintenance

Another consideration when choosing the right print system is the volume of printing per year. This determines maintenance expenses and logistics. Running length (in kilometres) or the number of labels consumed per year is a measure of the maintenance intervals required. Only expertly and correctly maintained print systems guarantee failure-free operation.

### Reflow temperature stress

In terms of the proper label material, much depends on whether the materials must endure reflow soldering or not. Label materials suitable for reflow are usually polyimide based. Non-reflow materials can be produced from polyester, paper or even polyethylene or vinyl. When selecting labels marked "Before SMD placement," one is forced to run high-temperature materials. This offers the advantage of 100% process control as the labels can be applied at the entry point of the line. They therefore serve as the process data acquisition medium for all following steps: screen printing, placement, reflow soldering, etc.

Choosing labels not suited for heavy temperature loads means applying them after reflow. These label materials are cheaper than those of high-temperature polyimide, but they diminish the concept of 100% traceability. Brady also delivers special label materials, which can dissipate electrical charges while enduring high temperature processing. Quality colour tapes ensure abrasion- and solvent-re-



Figure 2 -- Hover-Davis label feeder fits onto existing SMT placement machines and presents the labels to the pick-and-place machine as if they were just another component

	6 digits numerical	10 digits numerical	18 digits numerical
2/5-Interleaved	9	7	E
Code 128	9	6	E
Code 39	14	12	1C
Datamatrix	1	1	1

Table 1 - Comparison of space requirements for various component identification solutions (estimates)

silient printing. Printed circuit boards can therefore be cleaned after labelling.

### Label space calculation

Let's assume the following process situation: identifying modules via an 18-digit alphanumeric identification for full traceability. The anticipated annual volume to be processed is about 600,000 boards. The operation is set up for continuous 1-D and 2-D reading technology, at a minimum resolution of 8 mil. The focus is on the consumption of label material for both 1-D and 2-D coding.

The result is as follows: 2-D coding with 3 dots per module at 18 digits data content yields a 14 x 14 dot matrix, which equals a net print

area of about 4 x 4 mm. Such a coding scheme (using a standard print applicator) will easily fit a 7 x 7 mm label if using 300 dpi printing, which equals 10 mil for the smallest module. In this configuration, the existing reader is sufficient; no additional investment is necessary. All that remains is the cost of the label materials. A coding as outlined above requires 49 mm<sup>2</sup> per label; the printing of 600,000 labels per year then consumes about 30m<sup>2</sup> of label materials.

Employing 1-D coding according to CODE 128 would require a total print width (including safety zones) of almost 40mm. Printing 3 dots per thinnest bar at 4mm high would use up almost 160mm<sup>2</sup> per coding (not counting the optical print). Besides the "unyielding" square format of 1-D coded labels, material consumption is higher by a factor of 3.3 compared to 2-D coding! Also of importance is the lower colour tape consumption.

#### Cost-efficient identification solutions

It is clear that establishing an effective and cost-efficient identification concept is a complex proposition of interrelated and carefully matching elements. If one of these elements is badly chosen or wrongly scaled - be it hardware, materials, or printer maintenance intervals - it will surely result in a significantly higher failure rate for the labeling step - if not in the subsequent reading procedures during test and/or assembly.

## In-Circuit Tester Integrates Boundary Scan Platform

Göpel electronic, a worldwide leading vendor of JTAG/boundary scan solutions compliant to IEEE 1149.x, and Spea, a leader in the design, manufacturing and distribution of automatic test equipment for testing semiconductors and electronic circuit boards, have developed a boundary scan option for Spea's 3030 In-Circuit Tester



(ICT) within the framework of an OEM agreement. The solution is based on the complete integration of Göpel's recently introduced hardware architecture Scanflex, in combination with the boundary scan system software Cascon Galaxy. This announcement comes after the implementation of Göpel's boundary scan tools on the Spea 4040 Flying Probe tester. According to Göpel, test coverage can be improved by using the native ICT analogue and digital pin electronics to complement the boundary scan resources on the Unit Under Test.

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## Fully Automated X-Ray Inspection System



Comet announces the Feinfocus Cougar Pro x-ray inspection system, providing manufacturers with fully automated x-ray inspection capability. Featuring automatic loading and unloading and Automated Defect Recognition (ADR)

technology, the system fits seamlessly into SMT manufacturing lines. Fully automated x-ray inspection is becoming progressively more important, as the increasing use of BGAs and hidden solder connections in PCB assemblies requires x-ray inspection to detect abnormalities that may

be hidden from traditional optical inspection systems. According to Comet, the Cougar Pro is the only automated x-ray inspection system that provides quantitative analysis of PCB components using a modular design. Used in conjunction with traditional AOI systems, the system enhances yield by detecting defects that cannot be identified solely through AOI. It utilises a conveyor system for automatic loading and unloading of parts to be inspected. After initial automated inspection, the results can be viewed on the screen or in SPC data format. The sample can be inspected manually for further analysis or removed and reinserted into the production line.

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