CodeFacts
AIDC (Automated Identification and Data Collection) Technical & Informational Documents
Written for Everyone

Thermal Bar Code Printers

Some Detailed Information Regarding Thermal Direct and Thermal Transfer Printing Technologies

The main point of this document is to provide further detailed information regarding the use of thermal printing technologies for producing bar code labels and tags. For a more preliminary overview of bar code printing technologies, in general, please refer to our CodeFacts document on Bar Code Label Printing.

Overview

Generally speaking, direct thermal and thermal transfer printing technologies are the best overall strategies for imprinting bar code labels and tags for both batch and demand onsite printing applications. As the common name "thermal" hints, both technologies use heat to create the label image. The printers employed in both printing techniques are commonly termed "thermal" but there are a number of similarities and differences between direct thermal and thermal transfer, which should be explained first off.

Direct thermal printing technology requires the use of thermally-activated label or tag stock. Basically the same as older style fax machine printing mechanisms, the thermal print head comes in direct contact with the face of the label. The heat causes a chemical reaction to take place in the label face and a black image remains.

Thermal transfer printing utilizes a one-time-use ribbon. This ribbon is made of Mylar, a few microns in thickness. On one side of the Mylar is a black ink substance, which could be composed of predominantly wax or resin material. This coated side comes in contact with the label and, through the use of applied heat and pressure, melts and fuses the ink onto the label face.

Both printing technologies employ basically the same type of print head. It can be anywhere from about 2 to 10 inches in length and remains stationary inside the printer. These print heads are quite specialized components and can be somewhat

fragile. For explanatory purposes, a thermal print head can be thought of as a comb, where tiny resistors are analogous to the comb's teeth. These resistors, that produce heat, are electronically controlled to turn on and off very quickly. By doing so, they leave an image as the label material passes beneath the print head.

The resistors in the print head are all square in dimension. Therefore, in effect, all images being printed are as if they were created from filled-in boxes. These "building blocks" create lines and rectangles with smooth, virtually-perfect edge definition—a definite plus when printing bar codes. Text and graphics, however, have a "jagged" look with the edges of diagonal and curved lines being not very smooth. This is generally not too big a deal since we intelligent humans can read just about any text, within reason, and a high-quality bar code is our first priority.

Thermal print heads can be purchased in a number of resolutions. When referring to resolution, we typically express it in dots-per-inch (d.p.i.) or dots-per-millimetre, keeping in mind that a "dot" on a thermal printer is square. Common dots-per-inch resolutions are 152, 203, 304 and 400. The electronics of a particular thermal printer are specific, so a 304 d.p.i. print head cannot be swapped into a printer where a 203 d.p.i. one was previously used.

It is interesting to note that most thermal transfer printers can also be used in direct thermal mode. The mechanism for advancing the ribbon through the printer is simply disabled and the printer functions in direct thermal mode. However, the reverse is not true. A "direct thermal printer" does not have the internal workings to handle the dispensing and take-up of ribbon and is, therefore, only usable in direct thermal mode.

Print Resolution

The resolution of a print head greatly affects the resolution that bar code symbols can be created at. Keep in mind that the dots in a thermal printer are stationary and are of a fixed width. Before discussing bar code print resolution further, first consider the following:

Bar code symbols can be expanded or shrunk, to some degree, as long as the bar-space relationship remains consistent throughout the symbol. The width of the smallest bar in a given bar code symbol, you may recall or know, is called the "X Dimension." Therefore, if the X Dimension of a bar code symbol is doubled, so is the length of the bar code symbol. To further clarify, think of the bar code symbol as a picket fence. The length of the symbol is the distance from the beginning of the first picket to the end of the last.

There's an illustration at the conclusion of this document that might help you get through the next part. Glance at it occasionally while you read the following:

Getting back to the subject at hand, let's say that you had a printer that utilizes a 203 d.p.i. print head (the most common thermal print head resolution, by the way). Based on this resolution, it would stand to reason that the width of the dot of this printer is .004926 inches (1 divided by 203). Rounded off, the width is .005" or, using more common parlance, 5 mils. Because your building block is that size, that limits the X Dimension of your symbols printed on that printer to 5, 10, 15, etc. mils—any multiple of 5. A bar code symbol with an X Dimension of 7 mils would, therefore, be impossible to print on such a printer.

Now, let's take the lesson one step further and say that you have a label that is 1.5 inches wide and that you wish to print a UPC-A bar code with an X Dimension of 13 mils. This X Dimension happens to be the one required for printing a "100% nominal" UPC-A bar code symbol, by specification. Obviously, this is impossible, since 13 isn't divisible by five—the width of the smallest bar of our example printer. So, we have no choice but to print our UPC-A symbol with either a 10, 15 or 20 mil X Dimension. Right? Well, here's the problem:

The specifications for UPC-A state that it can be printed anywhere from 80% to 200% of nominal size. Printing the symbol with a narrow bar width of 10 mils brings the size of the symbol down to 77%—smaller than that allowed by specification. If the symbol were to be printed with a narrow bar width of 15 mils, the symbol would be longer than the 1.5" label! The only way out of this quandary is to use a thermal printer with a 152 or 304 d.p.i. print head, which will produce a UPC-A symbol with a 13.16 mil X Dimension. This is 101% of nominal and is specification-compliant. It will also fit on the 1.5" label, to boot!