HARFORD CONTROL

A Guide to 2D Codes

What is a 2D Code?

A 2D (two-dimensional) Code is a matrix barcode consisting of black and white cells or modules arranged in either a square or rectangular pattern.
The information to be encoded can include text and numeric data. It possesses fast readability and greater storage capacity compared to standard EAN barcodes.


DataMatrix

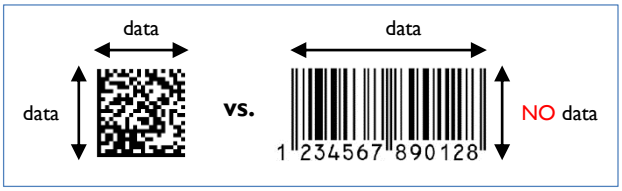
Types of 2D Codes

You may be aware that *QR* (Quick Response) Codes have become quite popular for marketing purposes or digital railway tickets, but in manufacturing ***DataMatrix*** codes have proven to be more appropriate, due to a much smaller minimum size and higher error correction level.


QR code

2D vs. 1D (EAN) Codes

Traditional, one-dimensional barcodes (e.g. EAN-8 or EAN-13) can only contain a limited amount of numbers. Due to two-dimensional data storage, DataMatrix codes can contain up to 2335 alphanumeric characters. The increased density and capacity of information enables much more versatile applications than conventional barcodes.



2D Codes offer the following features:

- **High information density** - a lot of information can be placed in a very small area, e.g. a unique identifier of a packaging component, including version control data.
- **Digital information encoding**, as opposed to the analogue encoding of data in conventional barcodes. I.e. you can store alphabetic characters as well as numbers.
- Can be **read in any orientation**, as they are read by video cameras as opposed to a scanned laser beam used for reading conventional barcodes.
- Integrated **mathematical error correction** - even if damaged and missing as much as 20% of the symbol, the overall content can still be read.
- They are **scaleable** and can be printed and read in various levels of magnification, only limited by the resolution of the available printing and imaging techniques.

Why use 2D Codes?

The purpose of 2D codes is not to replace conventional retail barcodes, but to enhance the functionality of product packaging. The addition of a 2D Code allows for:

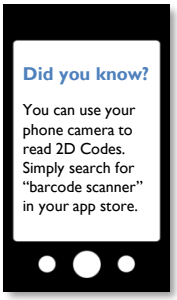
- Convenient **packaging verification** - placed within the same area on different products, the need for retail barcode scanning for verification is removed. A single 2D reader usually suffices, thus lowering the cost of a verification system.
- Automated **component matching** - where multiple components are used, e.g. tub/lid, front/back label, carton/insert.
- Increased **traceability** - tracking of parts through a process, materials usage, etc.
- **Version control** - of packaging, components, promotional labels, etc.
- Inclusion of additional customer **information**, e.g. web links.

How to use 2D Codes

2D Codes are mainly used at the packaging stage of a manufacturing operation, where the product receives its primary packaging. A 2D code is added to the label or artwork of the packaging, often within the date code box. The code contains a unique identifier of the packaging component, and can include further information, e.g. product version, pack format, language, promotional variant, link to website, etc.

The code is automatically read by an in-line camera, which decodes the DataMatrix data and verifies if the correct packaging is being used. Where a product receives numerous labels, e.g. top and base, individual 2D Codes can be used to ensure the labels match. In the case of a mismatch, production can be stopped automatically for instant rectification of the problem.

How to implement 2D Codes



Packaging

The required label/artwork changes, including all specifications for size, position and code content are supplied to the printer. The codes need to be maintained internally, to ensure that each one is unique.

Hardware

2D Code readers are available with different levels of functionality and cost. Harford Control will suggest the best option for your application. In order to stop a production line or to reject faulty packs, additional hardware or PLC links are required.

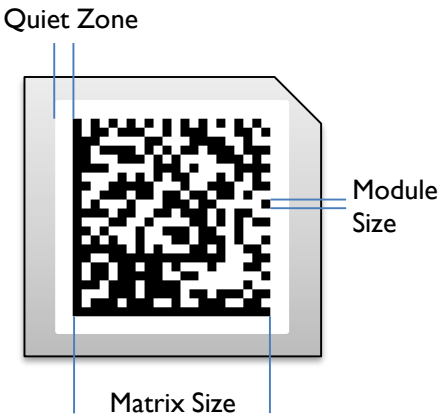
Control Solution

To fully benefit from the introduction of 2D Codes and automatic readers, a powerful control system is needed. Harford Control provides a comprehensive solution that automatically configures 2D readers, stops the line upon mismatch, stores images of the actual faulty pack and provides full traceability. Full compliance with retailer requirements (e.g. M&S) can be achieved through integrated date code printer control.

Specifications

Content

The actual content of the code is free from restrictions (unlike EAN barcodes) and is either prescribed by the customer or managed internally. Marks & Spencer, for example, use a standardised 14 digit numerical code.



Quiet zone

A quiet zone is the area that separates the code from its surroundings and does not contain any information. It should be at least one module wide, although a larger quiet zone increases the likelihood of successful location.

Code size

The size of individual modules should be at least 0.25mm (10mil) to ensure reliable reading results. The capacity depends on the matrix size, i.e. the more modules are used, the more data can be stored. If possible, a **larger code with a larger module size** is desirable and will yield significantly more reliable and flexible reading results.
M&S require a minimum code size of 7x7mm, incl. a 1mm quiet zone, to store a 14 digit code (module size 0.3mm).

Matrix size	Printed size incl. quiet zone	Alphanumeric characters
12×12	4 x 4 mm	6
16×16	5 x 5 mm	16
20×20	5.5 x 5.5 mm	31
22×22	6 x 6 mm	43
24×24	8 x 8 mm	52
32X32	10 x 10 mm	91
40X40	11 x 11 mm	169

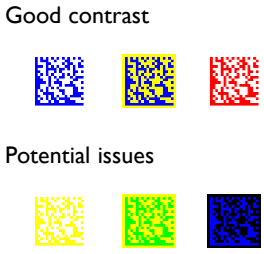
Based on module size of 0.25mm/10mil

Location

The ideal location for a 2D Code is **within the date code box**, as this usually stays in the same location, even for different packaging variants. In some cases, other positions may be necessary for scanning purposes.

Colours

The ability of the scanner to clearly discriminate between dark and light areas of the symbol, depends on the colour and reflectance of the substrate used. **Black printed on white is always the best colour combination**. Dark areas should use solid dark colours, light areas should use bright and reflective colours. In general, the colour combinations are similar to those for traditional barcode scanners. Transparent and highly reflective materials should be avoided.



Harford provides free advice and support, to help you choose the optimum size, location and colour for your specific application. We can also test your codes before final print.

For more information about the DataMatrix (ECC200) standard, see www.gs1.org.