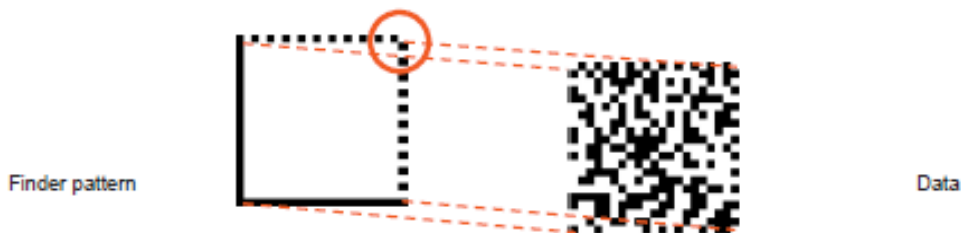# GS1 DataMatrix
Fact Sheet

GS1 DataMatrix is a compact, two-dimensional barcode which holds a large amount of data in a small space. It may be printed as a square or rectangular symbol made up of individual dots or squares. The choice of symbol form must be made based on available space on the product type, amount of data to encode, the configuration support, the printing process, trading partner requirements etc.

GS1 DataMatrix is composed of two separate parts: the finder pattern, which is used by the scanner to locate the symbol and the encoded data itself. GS1 DataMatrix always has even number of rows and columns. Therefore, it always has a light 'square' in the upper right-hand corner (highlighted in Figure 1)

Figure 1: Finder Pattern and data

Finder pattern   Data

Capacity

GS1 DataMatrix is capable of encoding variable length data. Therefore, the size of the resulting symbol varies according to the amount of data encoded.

GS1 DataMatrix (square form) can encode up to:
- 2,335 alphanumeric characters, or
- 3,116 numbers

Dimensions

The size of a GS1 DataMatrix is dependent upon the following factors:

- The amount and format (numeric or alphanumeric) of the encoded information: numbers and characters are encoded in terms of bits, represented by dark or light "dots" or "modules" of an identical size. The larger the number of bits required, the larger the symbol will be i.e., more the data included larger the symbol

- The size of the X-dimension

- The choice of form: square or rectangular

Figure 2 : GS1 DataMatrix Symbol Specification for general retail Point of Sale (POS) and not general distribution

X-dimension (mm)			Minimum symbol height	Quiet Zone	
Minimum	**Target**	**Maximum**	**For all X-dimensions**	**Left**	**Right**
0.396	0.495	0.99	Determined by the X-dimension and the data that is encoded	1X on all four sides	

Note: Figure 2 provides you the base measurements for a GS1 DataMatrix, other applications or sectors have different requirements please refer to the [GS1 General Specifications](#) **for more detailed specification requirements.**

Encoding data using GS1 Application Identifiers

To use GS1 DataMatrix you will need to use GS1 Application Identifiers (AI's). AI's can be 2,3 or 4-digit numbers, which define the meaning and the format of the data that follows. Please see Figure 3 for some of the more commonly used ones, for the full list refer to [GS1 Application Identifiers list.](#)

Figure 3 : Common GS1 Application Identifiers

AI	Data Definition	Format	*FNC1 required
01	GTIN	N2+N14	
10	Batch or lot number	N2+X..20	(FNC1)
11	Production date (YYMMDD)	N2+N6	
15	Best before date (YYMMDD)	N2+N6	
17	Expiration date (YYMMDD)	N2+N6	
21	Serial Number	N2+X..20	(FNC1)
392n	Applicable amount payable (variable measure trade items)	N4+N..15	(FNC1)
310n	Net weight (variable measure trade items)	N4+N6	

*FNC1 means Function 1 Character, see later section for explanation.

Figure 4 : Meaning of the format used in Figure 3

Format	Meaning
N	Numeric digit
X	Alphanumeric characters
N2	Fixed length of 2 numeric digits
X..20	Variable length with a maximum of 20 alphanumeric characters
N..15	Variable length with a maximum of 15 numeric digits
n	Implied decimal point position

AI(01) must be followed by 14 digits. A GTIN-13 or a GTIN-12 must therefore be preceded by meaningless Filler zero(s). An example shown in Figure 5 for GTIN-13 with a Filler Zero)

Figure 5 : GTIN-13 represented in a 14-digit format using AI(01)

Function 1 Symbol Character (FNC1)

The Function 1 or FNC1 has two separate uses in GS1 standards:

- Start character, to enable a distinction between what is a GS1 DataMatrix and DataMatrix symbol, the character is found in the first position of the DataMatrix ECC 200 version denoting that the data that follows is structured to GS1 standards.

- A separator character that separates element strings (data) that are non-predefined length when concatenated together (see section below on 'Concatenation').

The symbology identifier for GS1 DataMatrix is **]d2**. This is not encoded in the barcode but when the decoder scans the barcode this symbology identifier is generated to identify it as GS1 DataMatrix.

Concatenation

Using GS1 DataMatrix it is possible to concatenate (chain together) different element strings (data) into a single symbol (See Figure 6). When the element string is of a predefined length[1] no separator character is required. When the element string is of non-predefined length[2], it must be followed by a separator character unless it is the last element string to be encoded in the symbol.

When several element strings are concatenated and only one of them is of non-predefined length, it is recommended to position it at the end of the symbol. This optimises the size of the symbol by avoiding the use of a separator character.

[1] *Predefined - The number of characters in the AI remains constant. E.g., GTIN, SSCC*

[2] *Non-predefined – The number of characters in the AI is variable. E.g., Batch/Lot or Serial Number*

Figure 6 : GS1 DataMatrix with concatenated element strings

AI (01) - Global Trade Item Number 09312345678907
(GTIN-13 + leading '0')
AI (17) - Use By Date 31st December 2021
AI (10) - Batch/Lot Number
AI (21) - Serial Number

Note: Sample data only. Figure not to scale

(01) 0 9312345 678907
(17) 211231
(10) BL998254
(21) SN4792146874

Human readable interpretation (HRI)

The HRI of the encoded data must always be placed near the GS1 DataMatrix symbol (preferably below the symbol) and grouped together wherever physically possible. This enables manual processing of the data in the event that the symbol cannot be scanned.

Parentheses must surround the AIs in the HRI, however these are not encoded in the symbol. Always refer to the GS1 General Specifications for complete rules and recommendations on the application and use of Human Readable Interpretation.

General recommendations for symbol quality

As more use of 2D barcodes in the marketplace evolves recommendations to improve scanning and printing will present themselves. With implementations to date, some of the key findings have led to suggestions to:

- Increase symbol size (target x-dimension recommended)
- Colour contrast (black and white) is best
- Substrate of labels can impact performance – matt is preferred over glossy
- Understand the nature of surface – flat vs curved – using smaller x-dimension on curved surface is better as it will have better read rates
- Light in the surrounding areas will also affect the quality of scan

Glossary

Term	Definition
X-dimension	The specified width of the narrowest element of a barcode
Quiet Zone	A clear space which precedes the start character and follows the stop character of a linear barcode or surrounds a 2D symbol.
HRI (human readable interpretation)	Represents the same data encoded in the barcode as encoded in the barcode. Start, stop, shift and function characters, as well as the symbol check character, are not shown in the human readable interpretation.

More Information

2DB Australia webpage

General Specifications

GS1 DataMatrix Guideline

GS1 DataMatrix in Healthcare

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