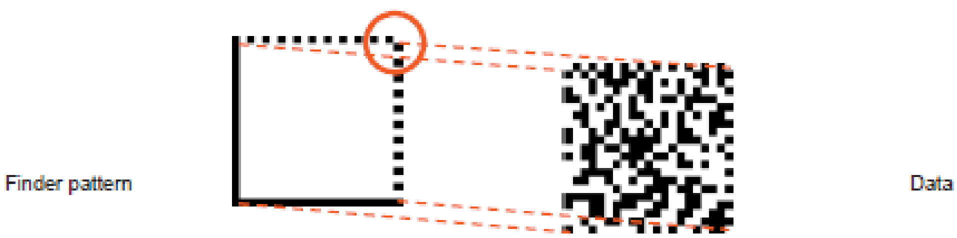
GS1 DataMatrix

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.

A GS1 DataMatrix symbol is made up of a finder pattern, which helps scanners locate and orient the symbol, and the encoded data including the GS1 Application Identifiers along with built-in error correction. 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



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

Symbol(s) specified	X-dimension mm (inches)			Minimum symbol height for given X mm (inches)			Quiet Zone	Minimum quality specification
	Minimum	Target	Maximum	For minimum X-dimension	For target X-dimension	For maximum X-dimension	Surrounding Symbol	
GS1 DataMatrix (ECC 200) (*)	0.396 (0.0150")	0.495 (0.0195")	0.990 (0.0390")	Height is determined by X-dimension and data that is encoded			1X on all four sides	1.5/12/660

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 a list of some of the more commonly used AIs, 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	
13	Packaging 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) which identifies the GTIN 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-12 with a Filler Zero)

Figure 5: GTIN-12 represented in a 14-digit format using AI(01)

(01)00068780000108

Two leading zeros to make it 14 digits

Function 1 Symbol Character (FNC1)

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

- **Start character**

  To enable a distinction between the GS1 DataMatrix and the Data Matrix symbol. In this situation FNC1 is found in the first position of the encoded data in the barcode. This tells the scanners that the data that follows is structured based on GS1 standards through the use of GS1 Application Identifiers (AIs).

- **Separator character**

  A separator character separates the data that is encoded in a barcode using GS1 Application Identifiers (AIs) that are non-predefined length when concatenated together (see section below on 'Concatenation').

  Note that FNC1 is one of the separator characters that exists in GS1 Standards.

The symbology identifier for GS1 DataMatrix is]d2.]d2 is not encoded within the barcode itself but is added by the scanner after decoding to indicate that the symbol is a GS1 DataMatrix. This allows software systems to distinguish between a plain DataMatrix (]d1) and a GS1 DataMatrix (]d2).

Concatenation

Using GS1 DataMatrix it is possible to concatenate (chain together) different pieces of data (called element strings in GS1 Standards) into one string which is encoded into a single barcode (See Figure 6).

When the piece of the data has a predefined length[1] such as Expiration date which is always 6 digits in length no separator character is required. When the piece of data is of non-predefined length[2] such as a lot number that can have a length of 1 to 20 characters, it must be followed by a separator character unless it is the last piece of data that is concatenated.

When several element strings are concatenated and only one of them is of non-predefined length, GS1 standards recommend positioning it at the end of the concatenated string. This optimizes the size of the barcode by eliminating the use of one separator character.

[1] *Predefined - The number of characters in the data that is encoded is always fixed.*

[2] *Non-predefined – The number of characters in the data that is encoded is variable.*

Figure 6: GS1 DataMatrix with concatenated information

AI (01) – GTIN 00068780000108 (GTIN-12 + leading '00')
AI (13) – Packaging Date May 29, 2025
AI (10) - Batch/Lot Number ABC123

Note: Sample data only. Figure not to scale

(01)00068780000108
(13)250529
(10)ABC123

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, the parentheses are not encoded in the barcode. Refer to the GS1 General Specifications section "4.14 Human readable interpretation (HRI) rules" for complete rules and recommendations on the application and use of Human Readable Interpretation.

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)	The text shown under or beside a barcode. It shows the same information the barcode carries, but it leaves out the extra characters the scanner needs, like start, stop, shift and function characters, as well as the symbol check character.

More Information

- GS1 Canada - Barcode Generator
- GS1 Canada - 2D Barcode Technical Details
- GS1 Canada Standards Page
- GS1 Canada - Barcode Page
- GS1 DataMatrix Guideline
- GS1 DataMatrix in Healthcare