



The Global Language of Business

2D barcode scanning test plan Executive Summary

September 2021



GS1 has commissioned global, consistent and impartial testing on barcode scanner systems to benchmark and improve their ability to meet the needs of industry. The results from the testing will inform business and technology plans for the industry, will enable guidance for transition and placement of barcodes for Suppliers and Manufacturers, and also aid Retailers and Solution Providers in defining and implementing software upgrades for scanners. The goal is to support a future where all stakeholders can leverage their choice of 2D barcode to achieve their business, customer and consumer goals with confidence in the continued efficiency of front-of-store scanning. While initial testing will be performed at the University of Memphis, Solution Providers will also be solicited to execute in-house tests and share their results to GS1 for synthesis. The initial phase of testing will occur in late 2021 through Q1/Q2 2022, with a preliminary report anticipated by April 2022.

The University of Memphis test lab

The [Automatic Identification Lab at the University of Memphis](#) is partly funded by GS1 Global Office. The lab uses commercial scanning and printing equipment that has been donated by Solution Providers. Scanning tests are performed via robotic control to provide for consistency and repeatability. University students and staff set up and conduct experiments in strict accordance with test plans developed by GS1.

Technical tools to assist the Global Migration to 2D

In addition to the technical testing summarised here, GS1 is developing additional tools and guidance in collaboration with global partners and Solution Providers. The [GS1 GitHub](#) includes open-source code for parser and translator tools, as well as GS1 Digital Link tools.

Key questions to be answered

By creating different barcode scanning benchmarks, the testing will help answer the following questions:

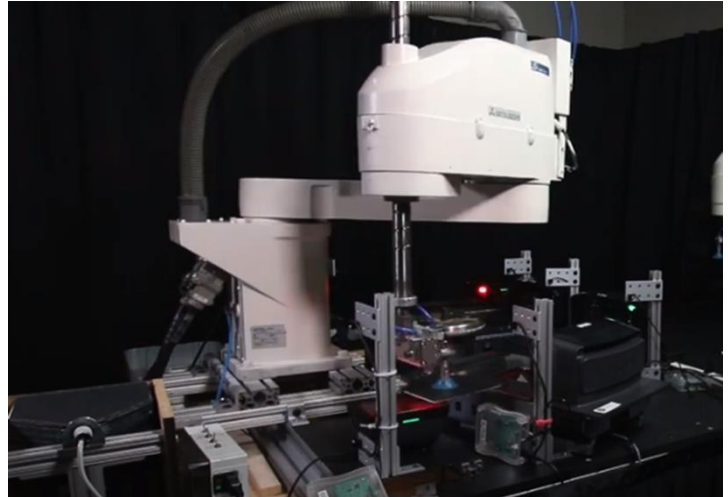
- How quickly can different barcodes be scanned with accuracy (considering different sizes of barcodes and angles of scanning)?
- How does encoded data (amount, type) impact scan speed and accuracy?
- If there are multiple barcodes on a pack (such as an EAN/UPC and a QR Code), how well do scanning systems find the right information?
- How should barcodes be placed in relation to each other for optimised scan results?
- How does the number of different barcode decoding algorithms turned on in the scanner impact performance?

[Click here to learn more about the 50 year history of GS1 barcodes and our vision for how we'll collaborate to step change the value of the barcode into the future.](#)

Barcodes that will be tested

To establish a baseline, a variety of barcodes will be tested, both by themselves, and in combination with other barcodes. In addition to testing all barcodes with only the GTIN, testing will also be done with symbols that can encode additional product data (such as expiration date, batch or lot number and serial number). The barcodes to be tested include:

- EAN/UPC
- GS1 DataBar
- GS1 DataMatrix (with GS1 element string syntax)
- Data Matrix (with GS1 Digital Link URI syntax)
- GS1 QR Codes (with GS1 element string syntax)
- QR Codes (with GS1 Digital Link URI syntax)
- Proprietary 2D barcodes (e.g., QR and Data Matrix) that do not comply with GS1 standards



University of Memphis robotic test system ensures consistency of results.

Test plan

The test plan consists of three Tiers of testing, and each test will be performed with a variety of variables changed.

- **Tier 1 baseline tests:** establish a common baseline for single symbols encoded with only a GTIN.
 - EAN/UPC, GS1 DataBar Omnidirectional barcodes: benchmarking against current capabilities
 - GS1 DataMatrix and GS1 QR Code (GS1 element string syntax with only the GTIN)
 - Data Matrix and QR Code (GS1 Digital Link URI syntax with only the GTIN)
- **Tier 2 tests:** understand how additional data in single barcodes affects scan performance and throughput.
 - GS1 DataBar Expanded Stacked (GS1 element string syntax with additional data elements – also known as “GTIN+”)
 - GS1 DataMatrix (GS1 element string syntax with additional data elements – also known as “GTIN+”)
 - Data Matrix and QR Code (GS1 Digital Link URI syntax with GTIN+)
- **Tier 3 tests:** understand how colocation of multiple barcodes affects scan performance and throughput.
 - Colocation of EAN/UPC with one additional barcode (GS1 DataMatrix, QR Code, Data Matrix, other non-GS1 2D symbols (e.g., a marketing QR Code with a URL in it, a proprietary Data Matrix, etc))
 - Colocation of multiple 2D symbols with each other (such as GS1 DataMatrix and a non-GS1 2D Data Matrix or QR Code (GS1 Digital Link URI))

As this initial phase is conducted, additional questions and concerns will be collected to consider for future phases of testing and analysis. For example, one area of analysis will be printing capabilities: evaluating different inline production technologies and considerations for printing of dynamic vs. static data, as well as variations in product materials and shape.

Test parameters

Testing will be done by varying parameters in the test setup and by changing barcode symbol characteristics. Test motion profiles will vary height, speed, angle of barcode and rotation. Additionally, barcodes will vary in the data encoded, x-dimension (size), print technology used to produce the test card, print quality (various levels of contrast), and the error correction level (relevant for QR Codes only).

[Contact](#) the GS1 Global Office programme team for questions on the test plan.