



Axicon Linear Verifier Training

Martin Fogg

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Bar codes are a machine readable way of encoding numbers, letters or symbols.



Linear bar codes use bars and spaces of different widths

They can be read with a light beam which is scanned over the code reflecting lots of light from the spaces and a little light from the bars.



The height of the bars is only important in that it gives more possible ways that the light beam can be passed over the code.



Usually bar codes have a structure which enables the scanner to know which end is the beginning of the code. In this way the number can be read correctly whether it is read from left to right or right to left



The most commonly encoded number is the GTIN (Global Trade Item Number)

This is usually seen in the form of a GTIN-13 encoded in an EAN-13 bar code



5012345678900

5012345678900

5012345678900

The first 7, 8 or 9 digits represent a company

The next 5, 4 or 3 digits identify the company's products allowing 100,000, 10,000 or 1,000 products to be identified.

The final digit is a check digit calculated from the previous 12 digits.



The company
numbers are issued
by the GS1
organisations
around the world



Bar Codes Used at Retail Checkout



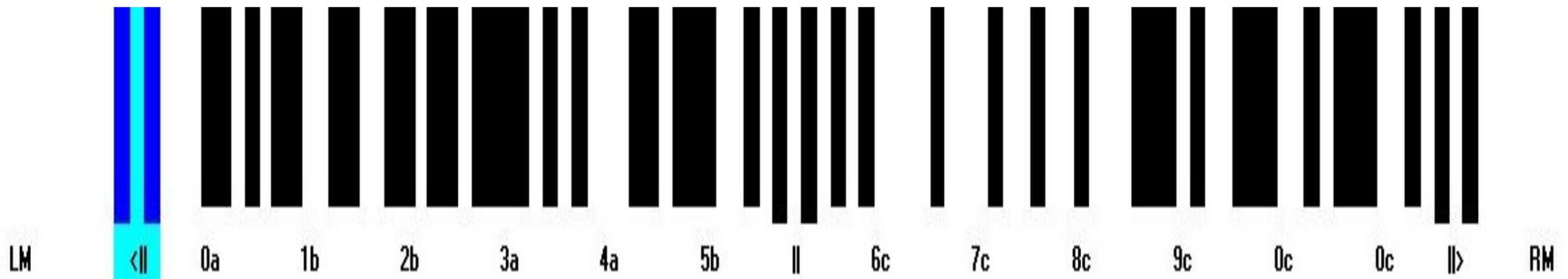
Bar Codes for Traded Units



EAN-13 bar codes are numeric only



EAN-13 structure



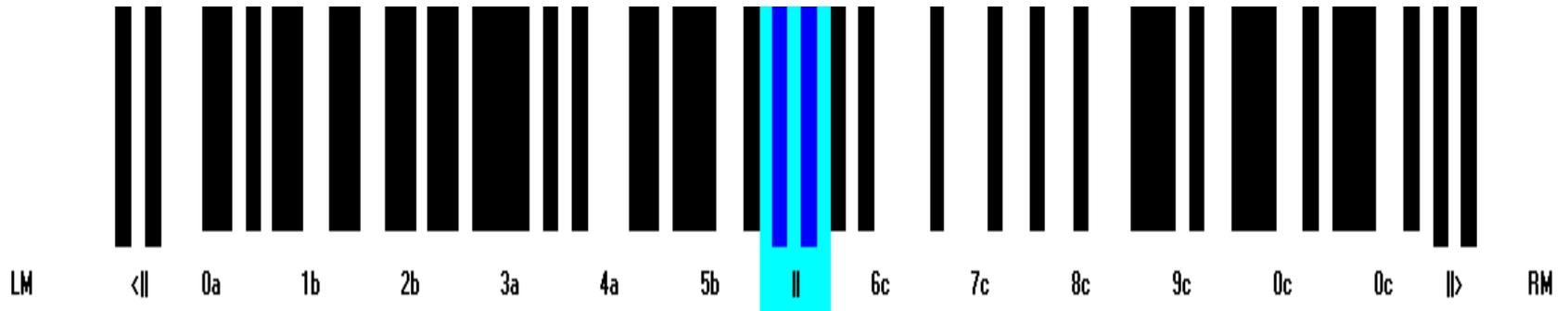
The code starts with the left hand light margin or quiet zone

Then the left guard bars

Bar Space Bar



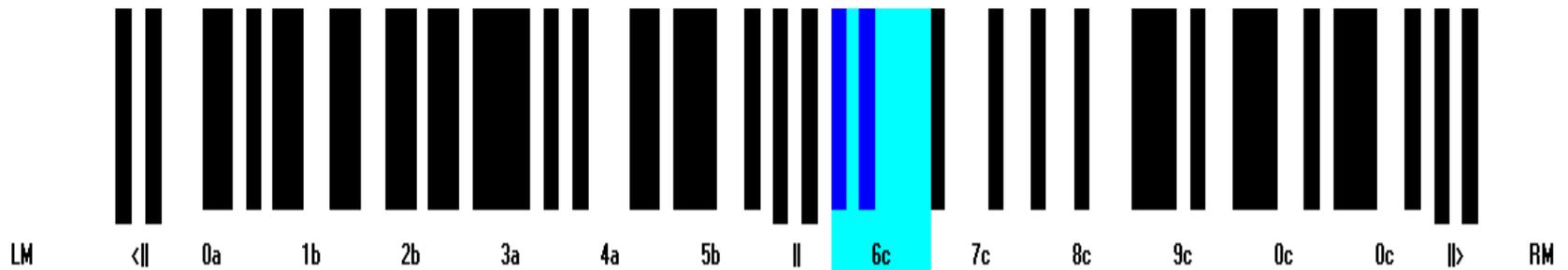
EAN-13 structure



The central guard bar pattern is
space bar space bar space



EAN-13 structure

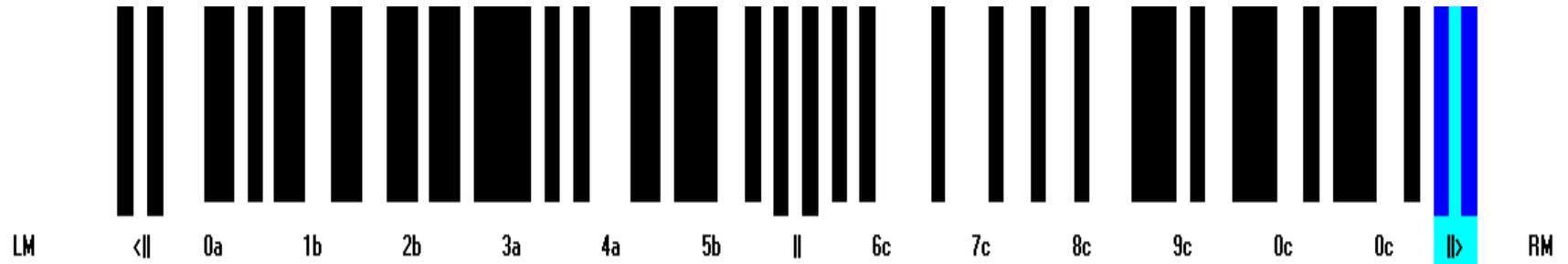


The right hand characters are
Bar Space Bar Space

There are six characters before
the right hand guard bars



EAN-13 structure



Then there are the left guard bars

Bar Space Bar

The code finishes with the right hand light margin or quiet zone



Traded unit codes can use a 14 digit GTIN

05012345678900

This must not just be a zero added in front of the consumer unit code. The preceding 0 does not make it another number

The final digit is a check digit



Traded Unit Bar Codes

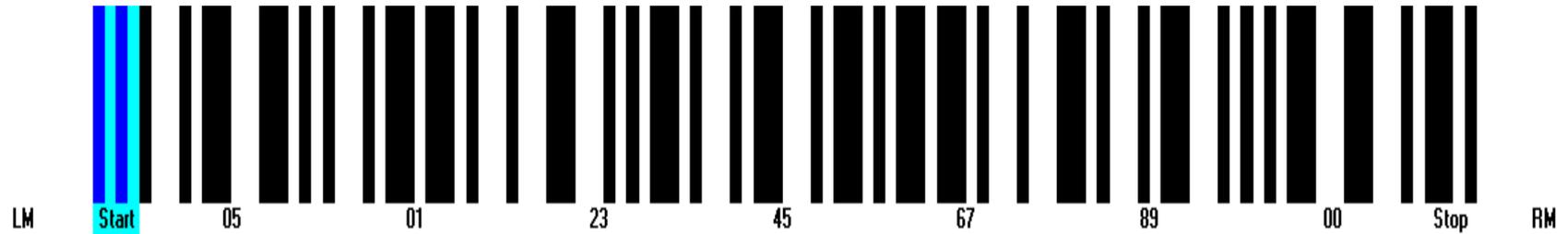
Often encoded as an ITF-14 bar code.

ITF (interleaved 2 of 5) bar codes have only two widths or bars and two widths of spaces

In each pair of characters one is encoded in the bars and the next one interleaved in the spaces. ITF-14 is numeric only



ITF-14 Structure

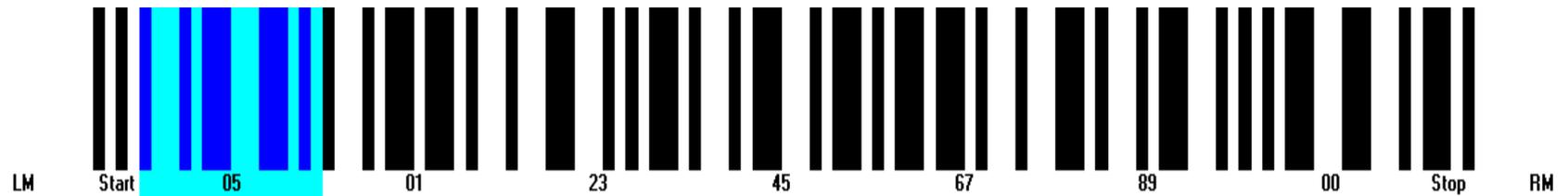


Start pattern

Narrow Bar, Narrow Space, Narrow Bar, Narrow Space



ITF-14 Structure



The 0 is encoded in bars

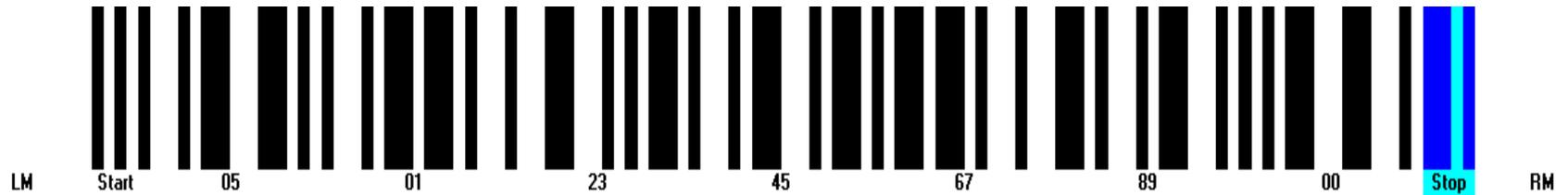
Narrow narrow wide wide narrow

The 5 is encoded in spaces

Wide narrow wide narrow narrow



ITF-14 Structure



The stop pattern is

Wide bar, narrow space, narrow bar



Code 128

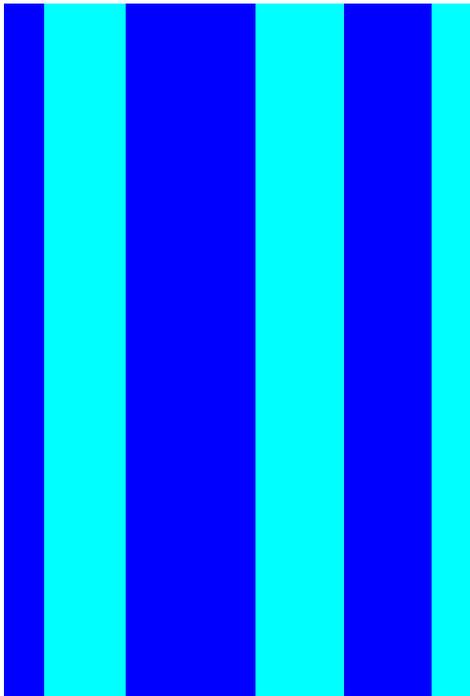
Code 128 is more complicated , with multiple widths of bars and spaces.

It can encode numbers, symbols, lower and upper case letters.

It has three character sets and can switch between them.



The 3 bars and 3 spaces shown in blue represent one character of the code



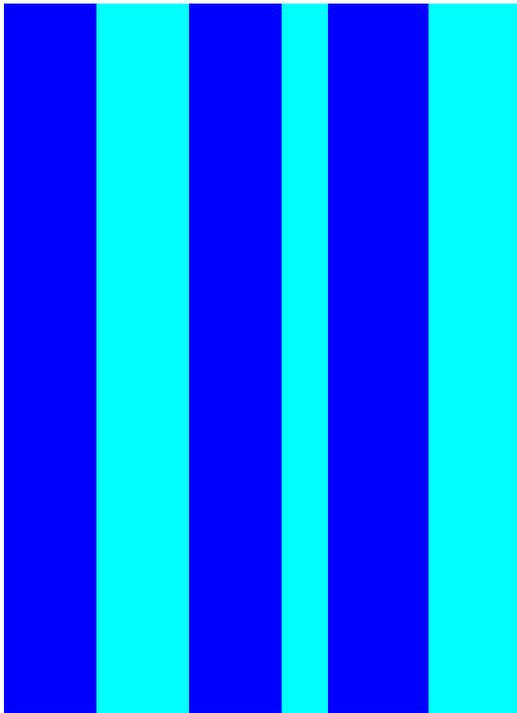
In set A they mean “1”

In set B they mean “1”

In set C they mean “17”



The 3 bars and 3 spaces shown in blue represent one character of the code



In set A they mean “!”

In set B they mean “!”

In set C they mean “01”



Subset C is numeric only

It encodes two numeric digits
per character of the code



Code 128 Structure

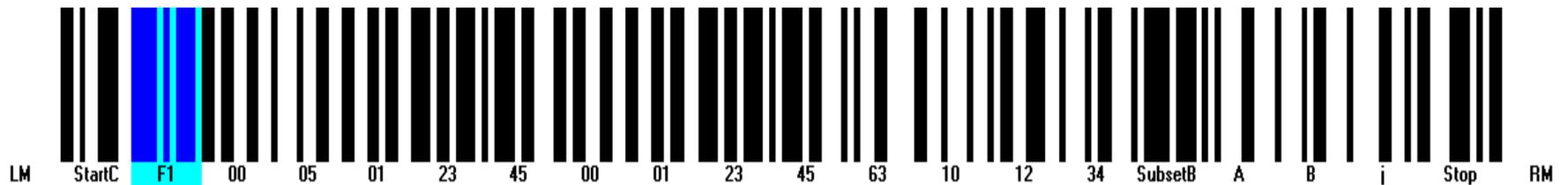


There are 3 alternative start patterns.

This is Start C



Code 128 Structure



The Function 1 character defines this code 128 as a “GS1-128”



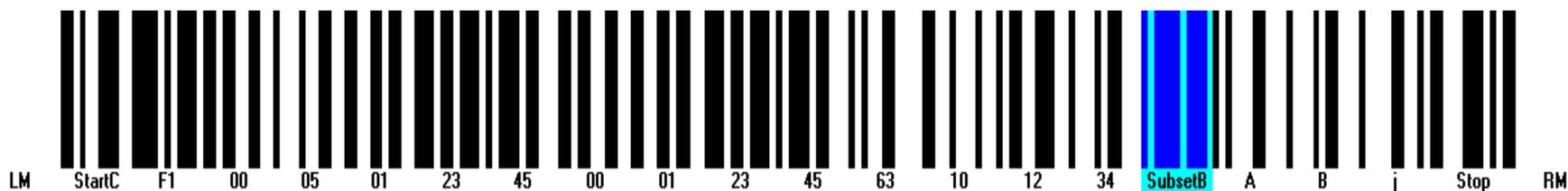
Code 128 Structure



In Subset C one character of the code (3 bars and 3 spaces) represents two decimal digits



Code 128 Structure



This character shifts the code into Subset B in order to encode letters



Code 128 Structure



In Subset B one character of the code (3 bars and 3 spaces) represents one letter, one decimal digits or one symbol



Code 128 Structure



The stop character is 13 X dimensions long
All the other characters are 11 X long



GS1-128 is a special use of code 128.

It starts with a special “Function 1” character



The data is organised into fields preceded by “application identifiers”

01 GTIN

17 Expiry Date

10 Batch Number

37 Quantity



GS1-128

In the human readable the application identifiers are placed in brackets

Brackets are not encoded in the bar code



Why do we need to verify?

To avoid arguments such as “the bar code reads on my scanner so it should scan on yours”

The verifier grades barcodes to agreed standards

Retailers can demand that their suppliers provide bar codes of a specified grade



Traditional verification

Treated the bar code as an engineering drawing with tolerances

Checked the bar growth or ink spread in the print process

Sometimes measured the print contrast to see if the colours used were acceptable



Verification to ISO/IEC 15416

The Axicon verifiers measure to this standard.

The bar codes are measured as the scanners “see” them

Scanners read the codes by shining a red light beam and detecting the light reflected back

The spaces will reflect a lot of the light

The bars will reflect very little

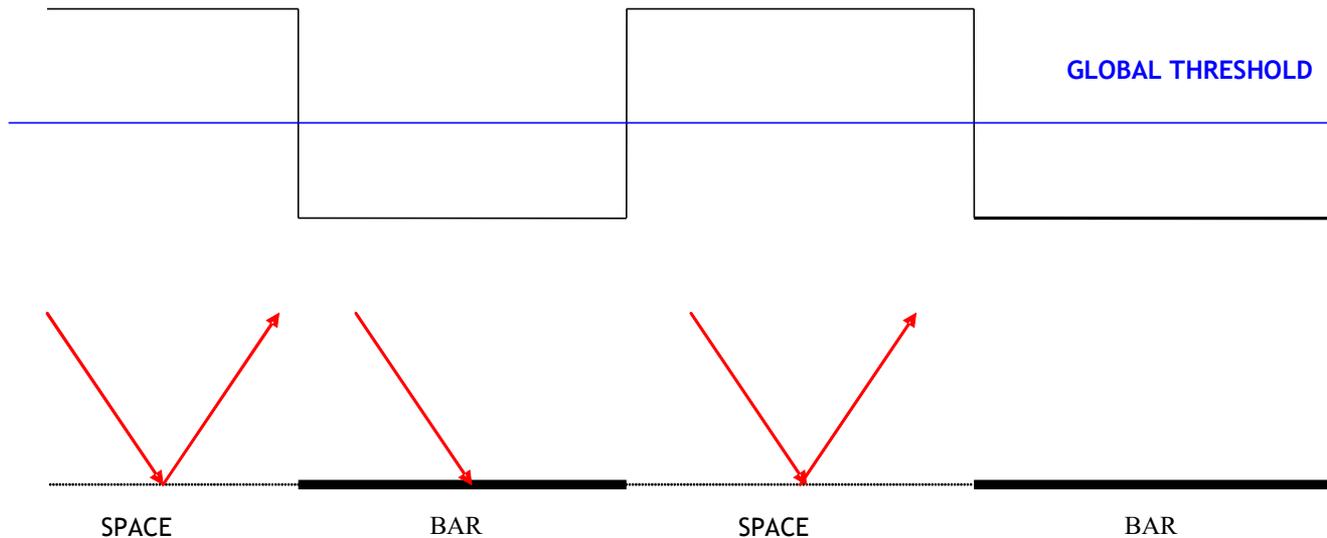


If the scanner beam is very narrow

REFLECTED LIGHT IS ALL OR NOTHING (A SQUARE WAVE)

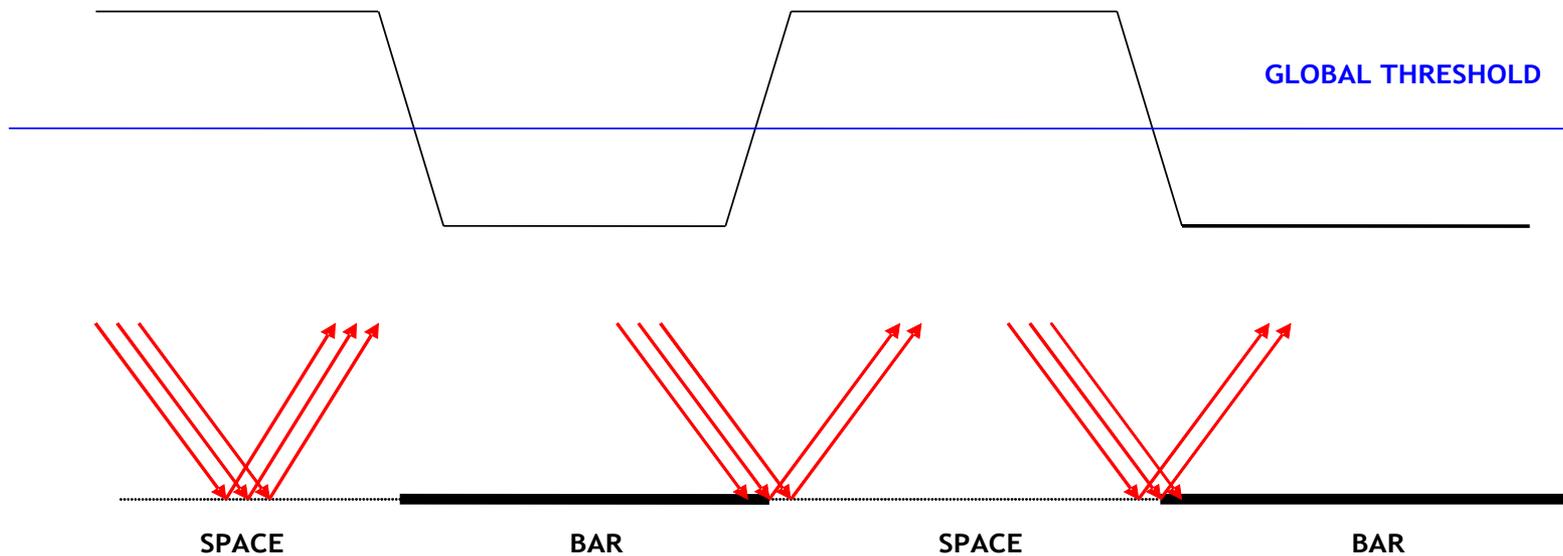
WHEN THE WAVEFORM IS ABOVE THE GLOBAL THRESHOLD THE VERIFIER SEES A SPACE

WHEN THE WAVEFORM IS BELOW THE GLOBAL THRESHOLD THE VERIFIER SEES A BAR

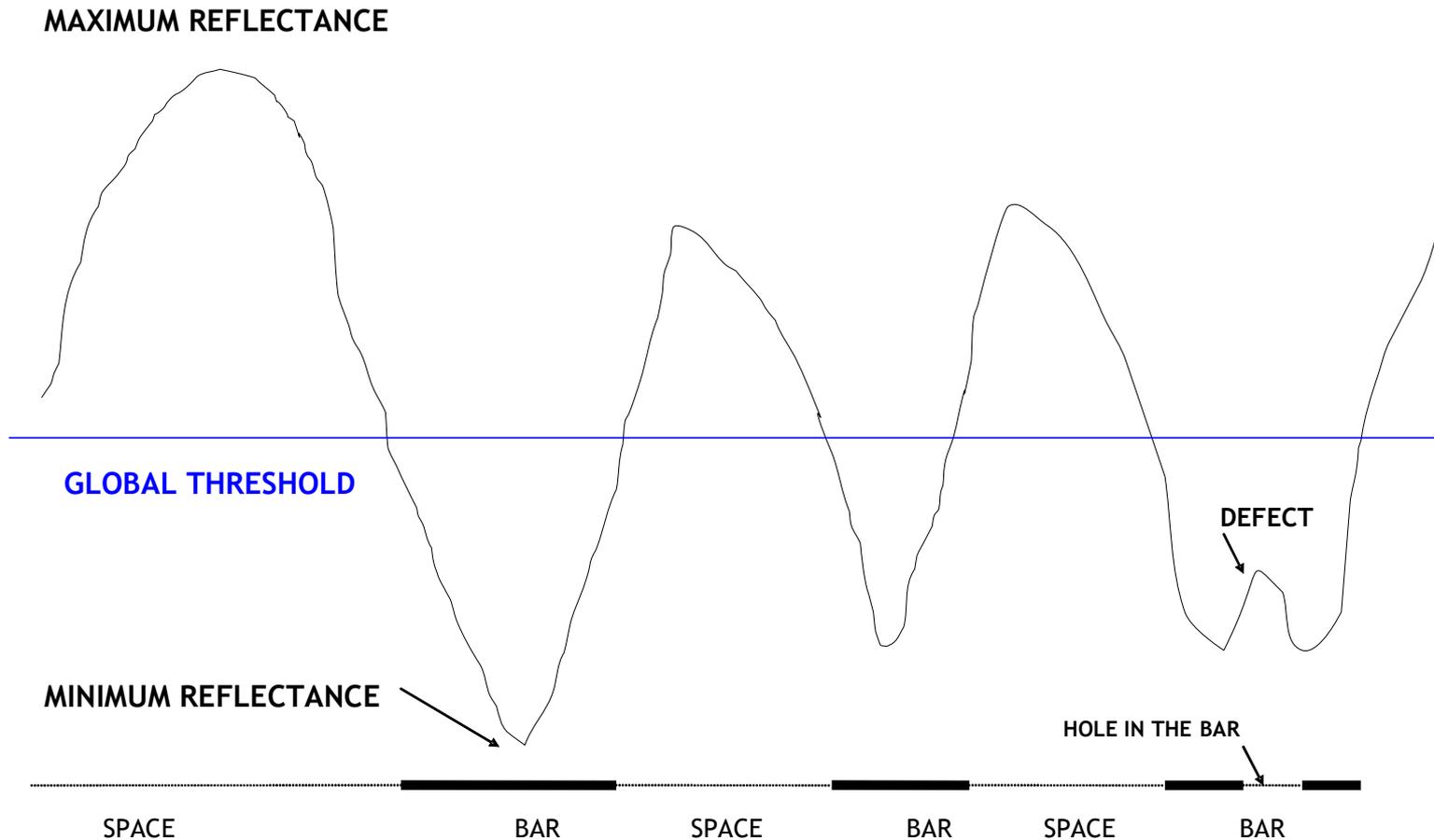


A slightly wider beam

SCAN REFLECTANCE PROFILE IS NOT A SQUARE WAVE



A more realistic scan reflectance profile



Aperture

The verification standard refers to this beam size as “aperture”

Different code X dimensions are read with different apertures

Case codes will use a large aperture. This is less prone to seeing small defects.

Small codes need a small aperture



Varying the aperture

Our linear verifiers use a CCD element like a camera but with just one row of pixels. The raw scan reflectance profile is filtered to synthesise the appropriate aperture size for the bar code

Aperture selection is automatic



Which Verifier?

The Axicon 6015 can read codes up to about 66mm wide including the light margins

The 7015 can read large case codes up to 195mm wide including light margins but it cannot make an aperture small enough to read an EAN-13 to be scanned at retail check out

The 6515 is a compromise. It can read EAN-13 and case codes up to 125mm wide including light margins



Verification Parameters

Decode - could it be decoded by the reference decode algorithm?

Symbol Contrast - the difference between R_{min} and R_{max}

Minimum Reflectance - is R_{min} less than or equal to half of R_{max} ?

Minimum Edge Contrast - minimum contrast between adjacent bars and spaces.

Modulation - the variation in contrast between the the symbol contrast and minimum edge contrast

Defects

Decodability - dimensional accuracy of the bar code



The final score

For each scan seven parameters are graded

The worst grade becomes the overall grade for that scan

If you make 10 scans at different heights the 10 overall grades are averaged



Some causes of bad grades

Decode - Poor light margins

Decodability - Excessive print gain

Symbol Contrast - Poor choice of colours

Defects - Thermal transfer printer head
element failure

Modulation - Small magnification bar code on
translucent substrate



Plug Ins

Optional features analyse the data or allow us to type in additional data and observations, for example

- GS1-128 data content checking
- Product look up
- User Data
- Use by date checking
- SISAC code data checking

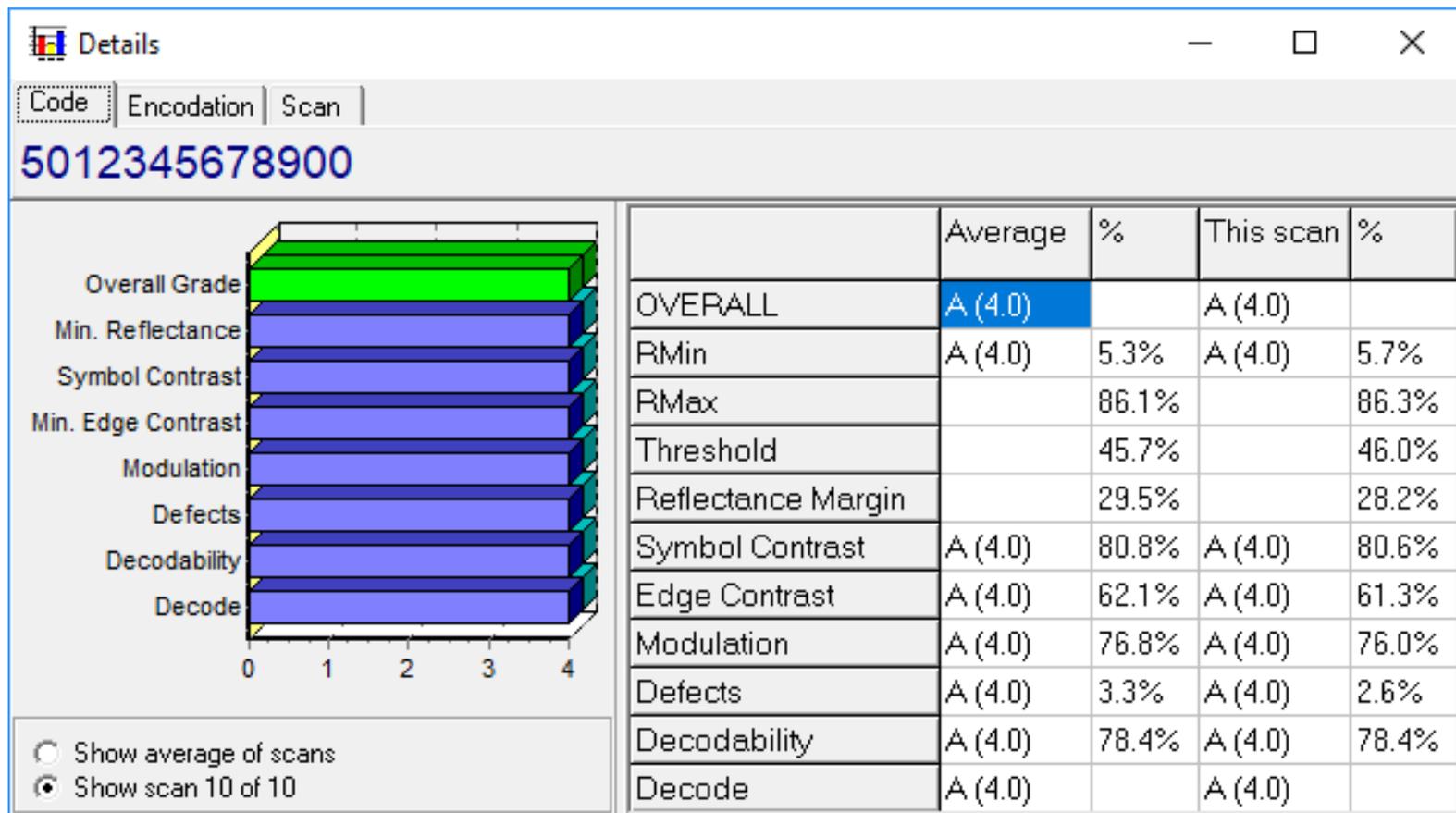


Summary Screen

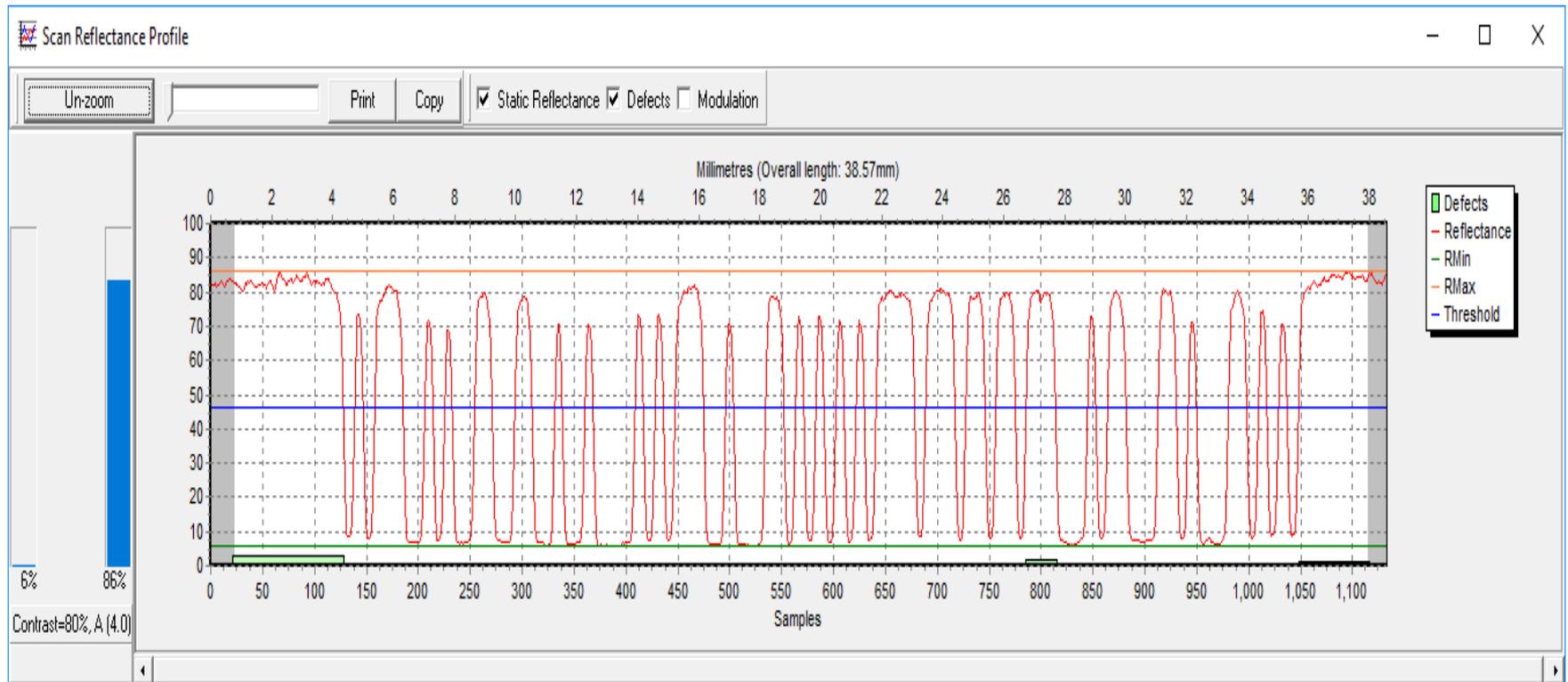
| | Average | This Scan |
|------------------------------|--|---|
| Grade (Pass=1.5) | 4.0/06/660 (A)  | A (4.0)  |
| Average Bar Gain (tolerance) | 8% ($\pm 30.5\%$)  | 8% ($\pm 30.5\%$)  |
| Magnification | 330 μm (100%)  | 329 μm (100%)  |
| Check Character | OK ('0')  | |
| Structure | 1..10  | OK  |
| Left Margin | 1..10  | OK: ≥ 13 (≥ 11)  |
| Right Margin | 1..10  | OK: ≥ 9 (≥ 7)  |
| Aperture | 150 μm (06)  | 59 bars + spaces |
| Date & Time | 12/06/2019 17:16:58 | |
| Reader Info | \$5013 (v0300): Resolution=75 μm ; Wavelength=660nm; Pixel size=34039nm | |



Details



Scan Reflectance Profile



Dimensional Analysis



Traditional Analysis

Traditional Analysis - □ ×



 Print

Pass

PCS: Avge=93% (min 64%). Scan 10=93% (min 64%)
Average Bar Gain: 8% (26 μm) Tol: ±30.5% (±100 μm)

| Char | (gain %) | Deviations (μm) |
|------|----------|----------------------------|
| < l | (7.69) | : +024 -014 +032 |
| 0a | (7.69) | : -029 +026 -035 +029 |
| 1b | (8.34) | : -026 +022 -019 +023 |
| 2b | (7.99) | : -027 +031 -031 +031 |
| 3a | (7.97) | : -027 +025 -027 +025 |
| 4a | (7.61) | : -021 +021 -024 +027 |
| 5b | (7.72) | : -029 +028 -024 +024 |
| l | (7.54) | : -027 +025 -028 +030 -025 |
| 6c | (7.35) | : +023 -024 +020 -017 |
| 7c | (6.98) | : +020 -022 +027 -027 |
| 8c | (7.44) | : +023 -023 +024 -025 |



ITF-14

| Summary | | | |
|------------------------------|---|--|--------------------------------|
| ITF-14 | <input checked="" type="checkbox"/> Lookup | | |
| 05012345678900 | | | |
| | Average | | This Scan |
| Grade (Pass=0.5) | 4.0/20/660 (A) | | A (4.0) |
| Average Bar Gain (tolerance) | 5% ($\pm 30.1\%$) | | 5% ($\pm 30.1\%$) |
| W/N Ratio, X dim | 2.5:1, 650 μm (64%) | | 2.5:1, 651 μm (64%) |
| Check Character | OK ('0') | | |
| Structure | 1..10 | | OK |
| Left Margin | 1..10 | | OK: ≥ 12 (≥ 10) |
| Right Margin | 1..10 | | OK: ≥ 12 (≥ 10) |
| Aperture | 500 μm (20) | | 77 bars + spaces |
| Date & Time | 12/06/2019 17:12:11 | | |
| Reader Info | C32D (v0206): Resolution=200 μm ; Wavelength=660nm; Pixel size=99898nm; Last c | | |



Product Lookup

| Summary | | | |
|------------------------------|---|--------------|--------------------------------|
| ITF-14 | Lookup | | |
| Sample ITF | | More Info... | |
| | Average | | This Scan |
| Grade (Pass=0.5) | 4.0/20/660 (A) | | A (4.0) |
| Average Bar Gain (tolerance) | 5% ($\pm 30.1\%$) | | 5% ($\pm 30.1\%$) |
| W/N Ratio, X dim | 2.5:1, 650 μm (64%) | | 2.5:1, 651 μm (64%) |
| Check Character | OK ('0') | | |
| Structure | 1..10 | | OK |
| Left Margin | 1..10 | | OK: ≥ 12 (≥ 10) |
| Right Margin | 1..10 | | OK: ≥ 12 (≥ 10) |
| Aperture | 500 μm (20) | | 77 bars + spaces |
| Date & Time | 12/06/2019 17:12:11 | | |
| Reader Info | C32D (v0206): Resolution=200 μm ; Wavelength=660nm; Pixel size=99898nm; Last c | | |

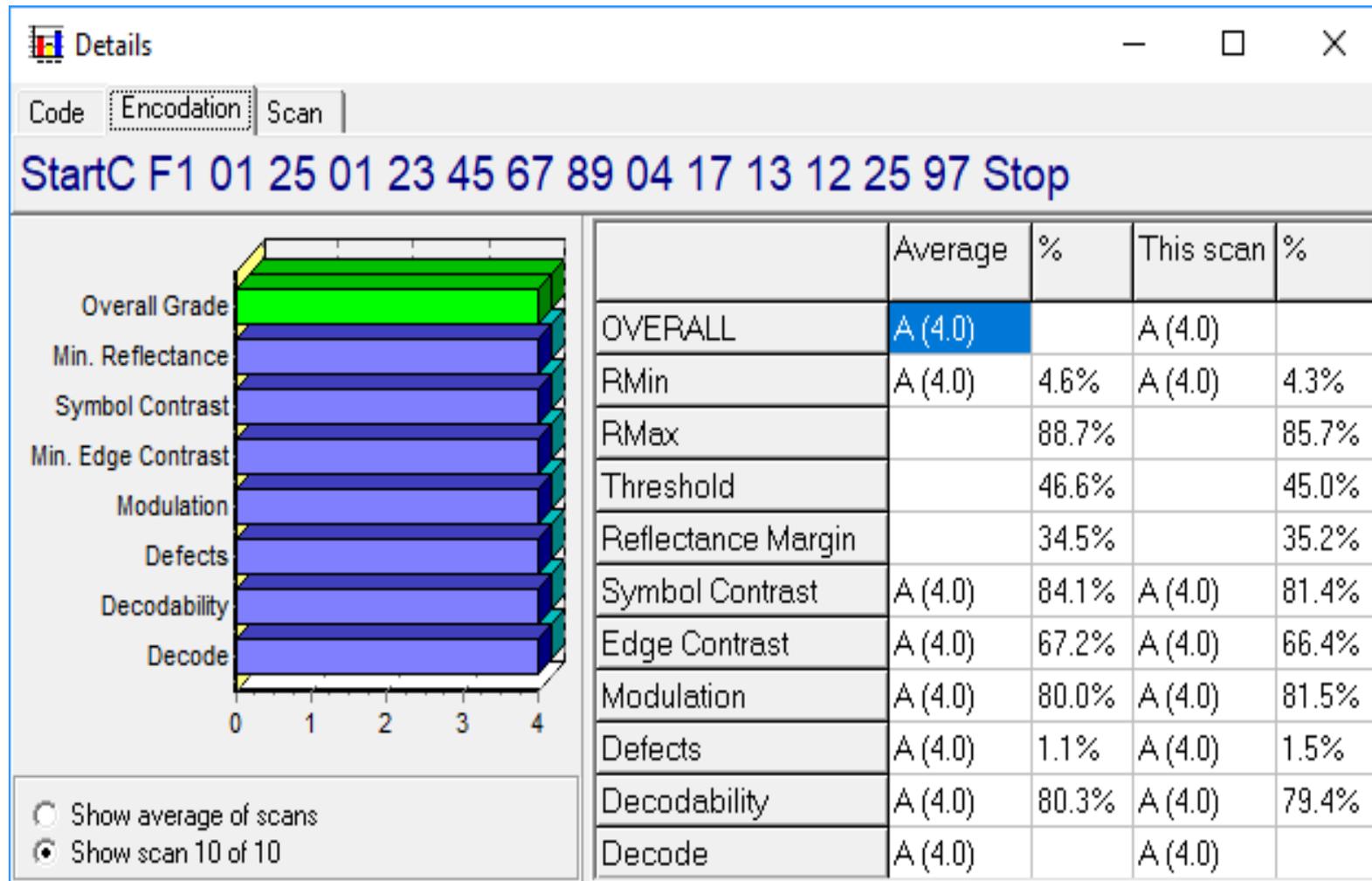


GS1-128

| Summary | | | |
|------------------------------|---|-------------------------|-----------------------------|
| GS1-128 | | X GS1-128 Content: Fail | |
| 1012501234567890417131225 | | | |
| | Average | | This Scan |
| Grade (Pass=1.5) | 4.0/10/660 (A) | | A (4.0) |
| Average Bar Gain (tolerance) | 10% ($\pm 33.0\%$) | | 10% ($\pm 33.0\%$) |
| X dimension | 497 μm (49%) | | 496 μm (49%) |
| Check Character | OK (97) | | |
| Structure | 1..10 | | OK |
| Left Margin | 1..10 | | OK: ≥ 12 (≥ 10) |
| Right Margin | 1..10 | | OK: ≥ 12 (≥ 10) |
| Aperture | 250 μm (10) | | 97 bars + spaces |
| Date & Time | 12/06/2019 17:24:53 | | |
| Reader Info | C32D (v0206): Resolution=200 μm ; Wavelength=660nm; Pixel size=99898nm; Last c | | |



GS1-128 Encodation



GS1-128 Data Content

Summary
— □ ×

 GS1-128
 GS1-128 Content: Fail

(01)25012345678904(17)131225
More Info...

| | Average | This Scan |
|------------------------------|--|---|
| Grade (Pass=1.5) | 4.0/10/660 (A) ■ | A (4.0) ■ |
| Average Bar Gain (tolerance) | 10% (±33.0%) ■ | 10% (±33.0%) ■ |
| X dimension | 497 μm (49%) ■ | 496 μm (49%) ■ |
| Check Character | OK (97) ■ | |
| Structure | 1..10 ■ | OK ■ |
| Left Margin | 1..10 ■ | OK: >=12 (>=10) ■ |
| Right Margin | 1..10 ■ | OK: >=12 (>=10) ■ |
| Aperture | 250 μm (10) ■ | 97 bars + spaces |
| Date & Time | 12/06/2019 17:24:53 | |
| Reader Info | \$C32D (v0206): Resolution=200μm; Wavelength=660nm; Pixel size=99898nm; Last c | |



GS1-128 Data Content - More Information

GS1-128/Databar Data Content

(01)25012345678904(17)131225

| | |
|--------------------|--|
| (01)25012345678904 | Global Trade Item Number (GTIN) [n2+n14] |
| (17)131225 | |

| AI | Data Content | Check Digit |
|----|----------------|-------------|
| 01 | 25012345678904 | 4 |

| Field | Value |
|------------|----------------|
| (AI Title) | 25012345678904 |

Pass

No error



