

Maximizing Bar Code Performance: A Look at Quiet Zones

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Quiet zones are clear areas around bar codes that serve to isolate it from surrounding text and graphics. Bar code symbologies typically define a minimum amount of clear space that is to serve as the quiet zone. Unfortunately, this minimum quiet zone specification is often unknowingly violated by users when they place bar codes in close proximity to text or graphics. This can prevent bar code decode software from properly locating and decoding the bar code symbol. This document summarizes the quiet zone requirements for a number of popular linear and two-dimensional symbologies.

Linear Symbology Quiet Zones

Linear symbologies encode information by varying the widths of bars and spaces. One of the more difficult aspects of decoding a linear bar code is finding it. A linear bar code normally uses a fixed start and stop pattern near the beginning and end of the bar code that is used to locate the symbol and identify its type. Often, bar codes are not printed according to specification, forcing built in margins in the decode software that allow variations in these patterns. This can allow areas of text and graphics to be mistaken for possible bar code start and stop patterns which in turn requires more processing time to dismiss them as false finds.

Quiet zones are normally fairly large compared to the width of the bar code's normal bars and spaces. Combined with the start and stop patterns of a particular symbology, they provide a more unique feature to find. By looking for a minimum quiet zone along with the adjacent start or stop pattern, false finds are reduced saving processing time.

The following table shows the minimum quiet zone requirements for a number of popular linear symbologies. The variable X mentioned in the table is referred to as the **X Dimension** and is the width of the narrowest bar or space in the symbol.

Symbology	Minimum Quiet Zone
Code 39	10X
Code 128	10X
Interleaved 2 of 5	10X or .10 inches, whichever is greater
UPC-A	9X
UPC-E	Left: 9X; Right 7X
EAN-13	Left 11X; Right 7X
EAN-8	7X
UPC/EAN Supplementals	Right: 5X
GS1 DataBar (formerly RSS)	None

Note the lack of quiet zone requirement for GS1 DataBar (formerly known as RSS). In reality, there is a 1X quiet zone as part of the fixed pattern on the left and right parts of the symbol. This lack of quiet zone with GS1 DataBar, along with the large number of finder patterns supported, typically makes them more difficult to find in a busy image. This results in additional processor cycles as compared to a symbology such as Code 39 which has a distinct finder pattern and uses a 10X quiet zone.

From the table, we can see that a minimum quiet zone of 10X will normally provide adequate quiet zone protection for the remainder of the symbologies listed above. The numerous quiet zone values for the UPC/EAN symbols are due to the size and location of the human readable characters.

To show the relative size of a quiet zone with respect to the rest of the bar code, consider the figure shown below. It shows a Code 128 encoding 12345 with a box showing the required minimum quiet zone of 10X. The quiet zone is required on both the leading and trailing edge of all linear symbologies.



Code 128 with 10X Quiet Zone

Note that no quiet zone is required above or below most linear bar codes. One exception is Interleaved 2 of 5. While the specification does not call for any quiet zone above or below the symbol, when no quiet zone can be guaranteed, **Bearer Bars** are often added to the top and

bottom of the symbol. These thick bars reduce the risk of misreads by laser based readers when the scan line falls off the top or bottom of the Interleaved 2 of 5. The figure shows an I2of5 encoding 012345 with Bearer Bars that extend across the 10X quiet zone region.



I2 of 5 with Bearer Bars

Many bar code decode packages will read substandard quiet zones because symbols are often printed that way. Omniplanar always recommends using the specified minimum quiet zone to maximize decode rates and performance for your application.

Two-Dimensional (2D) Symbology Quiet Zones

Two-Dimensional (or 2D) Symbologies require quiet zones as well. Their quiet zones are required on all 4 sides of the symbol given that data is encoded in both the height of these bar codes as well their width. The table below gives the minimum quiet zone requirements for popular 2D symbologies.

Symbology	Minimum Quiet Zone
Aztec Code	None
Data Matrix	1X
Micro QR Code	2X

QR Code	4X
PDF417	2X
Micro PDF417	1X

All of the 2D symbols shown below encode the numeric data “12345678”.

Again there is a symbology that specifies no minimum quiet zone: Aztec Code. This means that graphics touching outer perimeter cells of an Aztec Code is permissible. Aztec



Aztec Code

Code can allow this because of the distinct center finder pattern it uses, along with the format information encoded within the symbol that tells a decode algorithm exactly how big the symbol is.

This is opposed to Data Matrix, which uses a rather common “L” shaped pattern as a finder and includes no explicit size information. The sides of the Data Matrix opposite the “L” finder implement a clock track with alternating light and dark cells and indicate the end of the symbol as well as the number of modules. The figure shows a Data Matrix with an outline showing the minimum quiet zone required.



Data Matrix



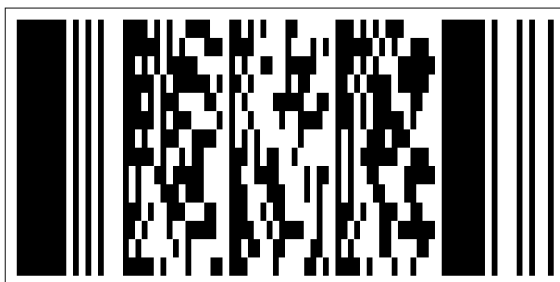
QR Code

QR Code and Micro QR Code are shown in the table with a minimum quiet zone requirement of 4X and 2X respectively. Micro QR Code is a higher density version of QR Code that may be used for smaller amounts of user data when data density is important.



Micro QR Code

Similarly, Micro PDF417 is a higher density version of PDF417. PDF417 requires a 2X quiet zone, while the more dense Micro PDF417 only requires a 1X quiet zone.



PDF417



Micro PDF417

Note that both PDF symbologies are quite a bit larger than the symbologies shown above. This is due to the fact that the PDF symbologies are stacked linear symbologies with format information included to facilitate decoding. The PDF symbologies were originally designed to allow decoding with a laser based scanning device. As a result, they are row oriented symbologies. The newer 2D codes shown above are Matrix codes that allow

significantly higher data densities. They normally require more sophisticated area based imaging devices for decoding.

Summary

This article detailed the minimum quiet zones required for a number of popular Linear and 2D symbologies. It is important to keep the clear areas around the symbols to aid the decode software that must extract the user information that the bar codes encode. The quiet zone minimums are often inadvertently violated by users resulting in bar codes that appear to be perfect, yet do not decode reliably.