The Best Guide to Choosing the Right Digital Signage Size

This article is based on InfoComm’s DISCAS training developed to help Audio Visual (AV) experts design the optimal size display solutions taking into consideration the science behind the human visual system, deep understanding of the display technology and applications.

The DISCAS (ANSI/INFOCOMM V202.01:2016 Display Image Size for 2D Content in Audiovisual Systems) standard was developed over many years by leading academic and industry experts. It was put through extensive testing with relevant stakeholders to ensure the theory truly meets the practical application requirements of AV experts. The fact that it has been vetted through public review and by a third-party accrediting body should give the user additional confidence. In addition, InfoComm has developed a calculator so that you don't have to make all of the calculations manually. You can find it at www.infocomm.org/discascalc.

We thank the InfoComm team for sharing these with the PID community.

What was the need for a standard?

Determining the right screen size for the signage application is a crucial part of the design process. Deciding on the optimal screen size and position was challenging even for the most experienced AV designers and system integrators. While rules of thumb have been widely circulated across the industry professionals, there was no framework that could guarantee a repeatable process to promote compliance with requirements and deliver optimum viewing experience.

Professional digital signage solutions are intricate systems with many inputs that affect the design, cost and ultimately the project ROI and success. Every installation is different and has specific needs with respect to usability and viewability and must work with the additional environment’s constraints. But until the DISCAS standard, there was no scientific methodology to determine the right signage size.

To address this major pain point of the commercial signage community, InfoComm has worked with the leading AV and human factor experts to design a standard for optimal display size when displaying content that helps viewers make decisions (like a menu at a restaurant). DISCAS standard provides a set of guidelines allowing you to scientifically tailor your solution to meet the application needs.

Read on to identify the optimum image size, text height, farthest and closest possible viewers and more.

The objective of DISCAS is to provide guidance to design an AV system that will allow the viewer to see and clearly make out what they are meant to on the display. If you use the calculator, all you have to do is plug in the variables that you already know to find the values of the variables you don’t know. The standard can be used for all resolutions and will still be applicable as resolutions increase.
The viewing categories

The DISCAS standard may be applied to two viewing needs: Basic Decision Making (BDM) and Analytical Decision Making (ADM).

- **Basic Decision Making (BDM)**

In BDM, the viewer needs to be able to make basic decisions based on the display. They must be able to retain information shown, but they don’t need to make out the tiny details to do so. Unsurprisingly, this is a far more common category. Applications like classrooms, boardrooms, information displays, and product illustrations fall into this grouping. In order for the displayed image to do its job, the relationship between the size of the content and the size of the display must be correct. The standard refers to this content as 'percent element height'. The definition is below.

- **Analytical Decision Making (ADM)**

ADM installations are necessary when it is essential for viewers to be able to see minute details to make the correct decisions. This means they are usually standing up and inspecting screens close-up. Such applications are far more specialized and cover security, medical imagery, technical drawings, and electrical schematics utilization.

Before you can determine the size, let us introduce some terms, which are included in the standard.

The key factors

Like any recipe there are some key ingredients; let us get you familiar with them. While the formulas used are different for each category (BDM and ADM), the basic factors are the same:

- **Image height (IH)**— the measured height of the displayed image.
- **Vertical Image resolution (IR)**—the number of pixels that comprise the image on the screen in each dimension. For example, for a Full HD panel with a resolution of 1,920 x 1,080, IR would be 1,080.
- **Size of the image content**— the active image area displaying the user’s content.
- **Closest (CV) and farthest (FV) viewing distances**—the horizontal distance between the display image and viewer.
- **Relative horizontal and vertical viewing locations.**
- **Acuity Factor**—relates to our ability to discern objects in the image. For BDM it is 200 and for ADM it is 3,438. These are the constants.
- **Image Offset (IO)**—the difference between the height from the floor to the bottom of the image and the viewing height.
- **Vertical Viewing Factor (VF)**—the sum of the Image Height and the Image Offset.
- **Element Height (EH)**—it is the height of the element to be displayed, you can think of it as the font size.
- **Percent element height (%EH)**—the height of an element in relation to the overall image height.

Simply stated, percent element height (%EH) refers to the percentage of the display that an
element—a single letter, for example—occupies. In practice that would mean an element that takes up 540 pixels on a 1,080p display has a %EH of 50%.

![Diagram showing the calculation of Percent Element Height (%EH)](image)

\[
\text{Percent Element Height (\%EH)} = \frac{\text{Element Height (EH)}}{\text{Image Height (IH)}}
\]

This is a very important consideration for Basic Decision Making set-ups, particularly to ensure viewers far from the screen can interpret the information on a display. By working out a minimum %EH, practitioners can be confident the all viewers can make out any text or symbols they need to see.

While the standard’s formula will give you your exact minimum %EH, there are some general guidelines for practical %EH in different situations:

- 2% EH—usually sufficient for conference rooms where detailed content is disseminated over an extended period of time.
- 3% EH—this is the most common setting, usually employed where the viewers have additional clues for the information.
- 4% EH—used when there are no clues for the viewer and they don’t see the content for very long.

Generally, 3%EH is the recommended set up, but working out the exact dimension for your own display and environment is always going to produce the best results.
Now, let us put it into action.

**DISCAS standard: key steps to determine the image size**

We will approach to answer each for both BDM and ADM.

(Remember, there is a calculator that will do the math for you: [www.infocomm.org/discascalc](http://www.infocomm.org/discascalc))

**First, determine minimum image height and resolution**

Let’s go through the formulas, to work out the minimums for each specification.

To determine the optimum image height it is influenced by the farthest viewer. The further away a user is from the screen the harder it would be to recognize the contents of the screen.

- **BDM minimum image height**

  \[IH = \frac{FV}{(200 \times %EH)}\]

  Where IH is the minimum image height for the space, FV is the farthest viewer distance, and %EH is the element height. The 200 refers to the acuity factor for BDM.

- **ADM minimum image height**

  Resolution is used as a variable for Analytical Decision Making.
\[ IH = \frac{(IR \times FV)}{3,438} \]

Where \( IH \) is the minimum image height, \( IR \) is the vertical image resolution, and \( FV \) is the farthest viewer distance. The 3,438 refers to the acuity factor constant for ADM.

**Second, determine the viewability of display content**

A key factor in determining the viewer experience is the viewing angle. By defining this we can work out the areas in a room where a viewer can be located and still assimilate the necessary information.

A good viewing angle must be no more than 60 degrees from the perpendicular edge of the opposite side of the screen. (DISCAS specifies that no viewing position should exceed 60 degrees of any part of the displayed image.)

From here we can work out the closest and farthest viewing positions for BDM and ADM.

- **BDM closest viewer**

First, we calculate the vertical viewing factor using the following equation:

\[ VF = IH + IO \]

\( VF \) is the vertical viewing factor, \( IH \) is the image height, and \( IO \) is the image offset.
Image offset is the difference between the height from the floor to the bottom of the image against the viewing height. The calculation is expressed as a positive number if the bottom of the image is above the viewing height and a negative number if the bottom of the image is below the viewing height.

Then the following equation gives us the closest viewer:

\[ CV = VF \times 1.732 \]

Where \( CV \) is the closest viewer distance, and \( VF \) is the vertical viewing factor.

To calculate the horizontal closest viewer distance (this determines how wide the closest viewer area extends) you use the following:

*Horizontal \( CV = 6 \times VF - IW \)*

Where \( CV \) is the closest viewer distance, \( VF \) is the vertical viewing factor, and \( IW \) is the image width.

Closest viewer calculations for BDM, image height based on 16:9 (1.78:1) aspect ratio.
Viewing parameters for BDM, No Scale, Image height based on 16:9 (1.78:1) aspect ratio.

- **BDM Farthest Viewer**

  \[
  FV = IH \times \%EH \times 200 \text{ (BDM acuity factor)}
  \]

  Where FV is the farthest viewer distance, IH is the image height, and \%EH is the percent element height. The 200 refers to the visual acuity factor for BDM.

- **ADM closest viewer**

  Due to the specialized nature of ADM and the fact viewers are meant to get very close to the screen, the standard does not call for the closest viewer distance to be calculated.

- **ADM farthest viewer**

  \[
  FV = (IH / IR) \times 3,438
  \]

  Where FV is the farthest viewer distance, IR is the vertical image resolution, and IH is the image height. The 3,438 refers to the visual acuity factor for ADM.
Viewing parameters for ADM, no scale, image height based on 16:9 (1.78:1) aspect ratio.

- **Using the display for both ADM and BDM**

DISCAS recommends calculating the Farthest Viewer (FV), Image Size and Viewing distance to meet ADM recommendation and Element Height (%EH) and Closest Viewer (CV) to meet BDM recommendation.

Want to test your understanding of this knowledge? Read on.

**An illustration of the DISCAS in action**

For the next two scenarios, we’ll use the room detailed here.
Scenario 1: Basic Decision Making

Signage purpose: used for PowerPoint presentations and text documents, thus it falls into the BDM category.

Additional data: The viewers are seated with a standard 48” eye level with the display sitting 48” from the floor. The farthest viewer would be at 215” from the display. The %EH has been stipulated to be 3%.

With this information, can you determine the minimum image height and the closet viewer distance?

- **BDM image height**

  \[
  IH = \frac{215}{(200 \times 0.03)}
  \]

  \[
  IH = 35.83
  \]

- **BDM closest viewer distance**

  \[
  VF = 35.83 + IO
  \]
\[ CV = VF \times 1.732 \]

Putting that together, we know we need a display that’s at least 35.83 inches tall. For a 16:9 ratio that would call for a 73” diagonal. We would also know the closest viewer would have to be 62” away.

Recommendation use: indoor display 98” UHD, 75” UHD.

**Scenario 2: Analytic Decision Making**

Signage purpose: used for analyzing and viewing technical diagrams.

Additional data: In this scenario, the client wants a 1,080 display, while the farthest viewer will be 215” away from the screen. The viewers are seated with a standard 48” eye level with the display sitting 48” from the floor. The farthest viewer would be at 215” from the display. The %EH has been stipulated to be 3%.

From here, can you work out the minimum image height needed for this purpose?

- **ADM image height**

\[ IH = \frac{(1,080 \times 215)}{3,438} \]

\[ IH = 67.54" \]

The image height in this case would have to be at least 67.54” tall. On a 16:9 display that comes out at a 138” diagonal—far larger than in the BDM scenario.

Recommendation—use video wall with 46” ENB 3x3 format.

This goes to show how different requirements will dictate the need for a different signage solution.

We hope this helps you design better signage solutions and continue to deliver customer happiness in all your projects!

**Recap of key terms**

The following terms have been taken from the standard. Copies of the standard can be downloaded for free if you are an InfoComm member at [www.infocomm.org/standards](http://www.infocomm.org/standards).

**%Element Height:** The height of an element in relation to the overall Image Height. The BDM %Element Height factor represents the ratio of element height to screen height expressed as a percentage (for example, 1% represents an element height of 1 unit relative to 100 units screen height). The Standard provides a range of percentages; users of the Standard should vary this percentage according to the content.

**Acuity Factor:** A constant derived from the Visual Acuity standards formulas. The Acuity Factor for Analytical Decision Making and Basic Decision Making are different constants, as the formulas to
calculate each are different. The Acuity Factor for Basic Decision Making is 200. The Acuity Factor
Analytical Decision Making is 3,438.

**Closest Viewer Distance:** The horizontal distance between the display image and viewer.

**Conforming Viewing Area:** The area bounded by the closest and farthest viewer calculations in
conformance for viewing the specified content.

**Display Image:** The active image area displaying the user’s content.

**Element:** This term is used in relation to Basic Decision Making. It refers to a group of pixels
conveying an item of information (for example, a character at a given font size). Users of this
Standard shall ensure that the display has sufficient resolution to render an element at its smallest
prescribed size.

**Farthest Viewer Distance:** Viewer positioned at the farthest distance from the screen as defined by
the viewing area.

**Horizontal Viewing Area:** The area bounded by a line drawn 60 degrees from the perpendicular of
each edge of the image to determine Closest Viewer.

**Image Aspect Ratio:** The ratio found by dividing the image width by the image height.

**Image Height:** The measured height of the displayed image.

**Image Offset:** The difference between the height from the floor to the bottom of the image against
the Viewing Height. The calculation is expressed as a positive number if the bottom of the image is
above the Viewing Height and a negative number if the bottom of the image is below the Viewing
Height.

**Image Width:** The measured width of the displayed image.

**Vertical Viewing Factor:** A value derived from the sum of the Image Height and the Image Offset.
The Vertical Viewing Factor shall be undefined if the calculation results in a factor that is less than 50
percent of the Image Height.

**Viewer:** An observer with normal/corrected vision, or normal visual acuity of 20/20 as defined in The

**Viewing Area Plan:** Plan view drawing of the viewing environment.

**Viewing Distance:** The measured distance between the viewer and the displayed image.

**Viewing Height:** The distance from the floor to the eye of the viewer. This is generally defined as
nominally 1,200 mm (48 inches) for a seated viewer and 1,500 mm (60 inches) for a standing viewer.

**Viewing Ratio:** The ratio found by dividing the Viewing Distance by the Image Height.
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Credits

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