CVT v1.2 Errata E2
Published 07/18/21

This errata contains all SCRs published through 07/18/21.

The following SCRs are included in CVT_v1.2_E2:

- Reduced blank v3 timing support to facilitate Adaptive-Sync operation and guarantee attainment of target refresh rate
- Updated Reduced blank v3 timing support to facilitate Adaptive-Sync operation and guarantee attainment of target refresh rate

VESA STANDARDS CHANGE REQUEST FORM

To be Filled in by Submitter (Refer to VESA Document VP235H, Section 5)

TITLE:	Reduced blank v3 timing support to facilitate Adaptive-Sync operation and guarantee attainment of target refresh rate
AFFECTED DOCUMENT:	Coordinated Video Timing (CVT) specification 1.2
REVISION CATEGORY:	Refer to VP235H Appendix A; will be subject to Task Group review
SUBMITTED TO:	DisplayID Task Group
SPONSOR:	Syed Athar Hussain, AMD

SCR REVISION HISTORY	
(DATE)	**(CHANGE)**
11/18/2020	Initial Draft, rev1
1/13/2021	Draft 2, updated based on group feedback
1/18/2021	Draft 3, addressed comment on v3 horizontal blank pixel count clarification and allowed flexibility of custom values beyond fixed 80 and fixed 160 pixels with a range of 80 to 200 pixels and divisible by 8.
2/22/2021	Draft 4, Address task group comments
03/02/2021	Draft 5: Addressing further comments from the task group. Changes highlighted with yellow background.
03/10/2021	Draft 6: Addressing Post GMR Comment #3704 (editorial)

(add more rows as needed)

To be Filled in by VESA Office:

VESA SCR NUMBER:	(To be assigned by VESA office)
SCR ENTRY DATE:	11/18/2020

To be Filled in by Task Group or VESA Office

SCR ADOPTED, REJECTED, or otherwise DISPOSITIONED for other action	SCR is (adopted) or (rejected) or (Dispositioned for other action) If rejected, explain reason for acceptation or rejection If dispositioned, explain action or plan for action (such as including in future draft specification revision, or re-visiting at future date, or other)
DATE SCR ADOPTED or REJECTED or DISPOSITIONED	ADOPTED 03/22/2021

Summary of the Proposed Change(s)

The SCR adds reduced blank version 3 to VESA Coordinated Video Timing (CVT) specification to facilitate Adaptive-Sync operation and guarantee attainment of target refresh rate. All VESA AdaptiveSync certified sink and source shall support CVT reduced blank version 3 timing.

IPR (Intellectual Property Rights) declaration, if any

None

Benefits as a Result of the Changes

The new timing standard guarantees Adaptive-Sync refresh rate attainment and ensures lower overall PPM error when targeting an Adaptive-Sync refresh rate.

Assessment of the Impact

SW/FW update on source and sinks side.

Analysis of the Device Hardware Implication

No hardware impact is expected.

Analysis of the Device Software Implications

SW and FW may need to be updated to support the new CVT timing rules.

Analysis of the Compliance Test & Interop Implications

Requires as part of the VESA AdaptiveSync logo testing

New Referenced Documents Resulting from Change

None

Attachments

None

Proposed Document Change(s) or Addition(s)

Editorial Note: Only those texts and tables with changes are shown below.

3.4.3 Reduced Blanking Timing Version 2

The following sections describe new rules mandated by the reduced blanking timing v2. ~~New reduced blank DMT timings shall use the reduced blanking timing v2 rules.~~

1. **Pixel Clock Selection**
   Reduced Blanking Version 2 shall support a resolution of 0.001MHz to produce more accurate refresh rate result required in some application.

   The target refresh rate is comprised of a nominal refresh rate and optionally a 1000/1001 multiplier factor for video optimized rates (i.e. for 59.94Hz, it has 60Hz nominal refresh rate and a 1000/1001 factor).

   The following lists the steps taken to calculate the pixel clock for a given target refresh rate and active H/V resolution; further details are in Section 5.4.

   a) First the nominal refresh rate is used to calculate the horizontal and vertical blank parameters,
   b) then calculate horizontal and vertical blank parameter along with required H/V active with the target refresh rate (including 1000/1001 factor if required) is used to calculate the pixel clock.
   c) The result value is then rounded down to nearest 0.001 pixel clock

   Using the nominal value in step (a) guarantees that the only difference in timing between a video optimized timing vs. a non-video optimized timing for a given refresh rate is in pixel clock (i.e. all other vertical and horizontal parameters are same). The result from step (c) will often cause the actual refresh rate to be lower than the target refresh rate by a very small amount.

2. **Vertical Refresh Rate**
   The standard refresh rate for Reduced Blanking v2 timing is 60Hz however other progressive refresh may be used depending on the application. Higher precision of the pixel clock step allows video optimized refresh rates (i.e. 60*1000/1001Hz, 30*1000/1001Hz) to be supported with the new version. A factor of 1000/1001 is applied to the nominal refresh rate if the video optimized target refresh rate is required.

3. **Horizontal Counts**
   The counts for Horizontal Active pixels have a precision of 1. Unlike Standard Blanking and Reduced Blanking v1, Reduced Blanking v2 timings do not require the Horizontal Active pixels to be divisible by eight.

   Margins shall not be included in Reduced Blanking v2 timings
   (i.e. LEFT_MARGIN=RIGHT_MARGIN=TOP_MARGIN=BOT_MARGIN=0)

   ~~As per rules of the Reduced Blanking v2 timings, Horizontal Timings may have a precision of 1 pixel. This allows timing for resolutions like 1366x768 to be defined with the new standard. No longer is the Horizontal Timing, including the Horizontal Active pixels, Horizontal Total pixels, Sync Pulse duration and "Front Porch" and "Back Porch" times required to be divisible by eight.~~

4. **Horizontal Blanking Time**
   For Reduced Blanking v2 timings, the Horizontal Blanking time ~~will in all cases are~~ is fixed to 80 pixels ~~count~~.

5. **Horizontal Sync Pulse Duration and Position**
   The Horizontal Sync Pulse duration ~~will~~ ~~in all cases be~~ is fixed to 32 pixels. ~~count~~ ~~in duration, with the position set so that~~ The trailing edge of the Horizontal Sync Pulse is located in the center of the Horizontal Blanking period. Since the Horizontal Blanking time is fixed to 80 pixels, ~~This implies that for a fixed blank of 80 pixels count clocks,~~ the Horizontal Back Porch is (80/2) = 40 pixels ~~count~~ and the Horizontal Front Porch is (80-40-32) = 8 pixels ~~count~~.

6. **Vertical Blanking Time**
   The Vertical Blanking shall be the first multiple of integer Horizontal Lines that results in a vertical blanking period that exceeds ~~the minimum requirement of~~ 460 microseconds.

7. **Vertical Sync Pulse Duration and Position**
   Vertical Sync Pulse is fixed at 8 lines indicating timing generated based on Reduced Blanking v2 timing rules and aspect ratio information is to be derived based on Vertical and Horizontal Active Timing. This will allow any new timing with non-standard aspect ratio to be supported without any update to the specification. The Vertical Back Porch shall in all cases be fixed to 6 lines. The Vertical Front Porch shall be the remainder of the Vertical Blanking Time.

3.4.4 Reduced Blanking Timing Version 3

The following items ~~sections~~ describe new rules mandated by the reduced blanking timing v3, only differences from v2 are listed below. ~~New reduced blank DMT timings if any shall use the reduced blanking timing v3 rules with default parameters.~~ With Reduced Blanking v3, only progressive video timings are supported. Devices shall not use Reduced Blanking v3 to generate interlaced video timings. Reduced Blanking v3 is intended to work in conjunction with Adaptive-Sync operation (or other similar variable refresh rate methodology).

1. **Pixel Clock Selection**

   The following lists the steps taken to calculate the pixel clock for a given target refresh rate and active H/V resolution; further details are in Section 5.4.

   a) First the target refresh rate is increased by +350 ppm and the adjusted target refresh rate is used to calculate the horizontal and vertical blank parameters,
   b) then calculate horizontal and vertical blank parameter along with required H/V active with the adjusted target refresh rate is used to calculate the pixel clock.
   c) The result value is then rounded up to nearest 0.001 pixel clock step

   The result from step (c) will often cause the actual refresh rate to be higher than the target refresh rate by a very small amount.

2. **Vertical Refresh Rate**
   The target refresh rate shall be an integer. The +350 ppm increase described under "Pixel Clock Selection" guarantees that both the target vertical refresh rate (e.g., 60) and a video optimized refresh rate variant (e.g., 59.94) can always be achieved with Adaptive-Sync vertical blank line addition or dithering. This is why a factor of 1000/1001 is not optionally applied to the target refresh rate for Reduced Blanking v3 as it is with Reduced Blanking v2.

   The tolerance of the pixel clock of the transmitted timing shall be ±300 ppm. As a result of the pixel clock tolerance, the transmitted refresh rate of a Reduced Blanking v3 timing will be between [target refresh rate + 50ppm] and [target refresh rate + 650 ppm]. Adaptive-Sync

operation (or another variable refresh rate technology) is used to match the average transmitted refresh rate to the desired video refresh rate by injecting additional video blanking lines to maintain the desired rate. The desired video refresh rate may be the target rate (e.g., 60 Hz), a video optimized variant of the target rate (e.g., 59.94 Hz), or a different rate that matches the rendered content (e.g., 48 Hz) as long as it is within the display's supported Adaptive-Sync range.

3. **Horizontal Counts**
   Same rule as the Reduced Blanking v2 timings.

4. **Horizontal Blanking Time**

   For Reduced Blanking v3 timings, Horizontal Blank shall have a value from 80 to 200 that is also divisible by 8. Note, despite the added flexibility of Horizontal Blank vs earlier Reduced Blanking version, the default Horizontal Blank value is 80 pixels to ensure minimum bandwidth requirement for the timings.

5. **Horizontal Sync Pulse Duration and Position**
   For Reduced Blanking v3 timings, Horizontal Sync Pulse duration shall be fixed to 32 pixels. Horizontal Front Porch shall be fixed to 8 pixels and remaining horizontal blank pixels are applied to Horizontal Back Porch.

6. **Vertical Blanking Time**
   Same rule as the Reduced Blanking v2 timings.

7. **Vertical Sync Pulse Duration and Position**
   Same rule as the Reduced Blanking v2 timings.

3.6 Sync Polarities and Durations

Table 3-2: Vertical Sync Duration (Standard and Reduced Blanking v1 timings)

Vertical Sync Width V_SYNC_RND	Aspect Ratio
3 or less	Reserved (Used by existing DMT and GTF timings)
4	4:3
5	16:9
6	16:10
7	Special Case: 5:4 (1280x1024) 15:9 (1280x768)
8	~~Reduced Blank Timing v2 and v3 Aspect Ratio based on Horizontal and Vertical Active Timing~~ Reserved (Used by Reduced Blank Timing v2 and v3)
9	Reserved
10	Non-standard Aspect Ratio

Note: Non-standard Aspect Ratio refers to an aspect ratio other than 4:3, 16:9, 16:10, 5:4, or 15:9 ~~not defined within this document as being standard and can~~ that may be used for manufacturer-specific timings.

The Vertical Sync Width (V_SYNC_RND) of Reduced Blanking v2 and v3 timings shall be 8 regardless of the aspect ratio. For these timings the aspect ratio can be inferred from the Horizontal Active and Vertical Active timing parameters.

5.1 Explanation of Terms

The following details the Expressions and Terms used in the following equations:

Table 5-1: Expression Terms & Operators

TERM / OPERATOR	DESCRIPTION
+	Addition
-	Subtraction
*	Multiplication
/	Division
ROUNDDOWN(*value*, 0)	Returns *value* rounded down to the nearest integer
ROUNDUP(*value*, 0)	Returns *value* rounded up to the nearest integer
IF(*logic_test*, *value_if_true*, *value_if_false*)	If-then statement that returns *value_if_true* when the *logic_test* expression evaluates to true, and returns *value_if_false* when the *logic_test* expression evaluates to false.

5.1 Computation of Common Parameters

Initially both Standard "CRT" style and Reduced Blanking CVT timings have common computational steps that must be done first. This section details those steps.

1. Find the refresh rate required (Hz):
   V_FIELD_RATE_RQD = IF(INT_RQD?="y", IP_FREQ_RQD * 2, IP_FREQ_RQD)

   V_FIELD_RATE_RQD = V_FIELD_RATE_RQD*(1 + V_FIELD_RATE_PPM_ADJ/1000000)

   The **V_FIELD_RATE_PPM_ADJ** value is "0" when using Standard Blanking CVT timings, however for Reduced Blanking CVT timings refer to Table 5-4.

2. In order to give the correct results, the number of horizontal pixels requested is first processed to ensure that it is divisible by the character size, by rounding it to the nearest character cell boundary:

   CELL_GRAN_RND = IF ((RED_BLANK_RQD?="N") Or (RED_BLANK_RQD?="Y" AND (RD_BLANK_VER=1), 8, 1)
   H_PIXELS_RND = ROUNDDOWN(H_PIXELS / CELL_GRAN_RND,0) * CELL_GRAN_RND

3. Determine the width of the left and right borders:
   LEFT_MARGIN = IF(MARGINS_RQD?="Y", (ROUNDDOWN(((H_PIXELS_RND * MARGIN_PER / 100) /CELL_GRAN_RND), 0)) * CELL_GRAN_RND, 0)
   RIGHT_MARGIN = IF(MARGINS_RQD?="Y", (ROUNDDOWN(((H_PIXELS_RND * MARGIN_PER / 100) /CELL_GRAN_RND), 0)) * CELL_GRAN_RND, 0)

4. The total number of active pixels is equal to the rounded horizontal pixels and the margins:
   TOTAL_ACTIVE_PIXELS = H_PIXELS_RND + LEFT_MARGIN + RIGHT_MARGIN

5. If interlace is requested, the number of vertical lines assumed by the calculation must be halved, as the computation calculates the number of vertical lines per field. In either case, the number of lines is rounded down to the nearest integer.
   V_LINES_RND = IF(INT_RQD?="y", ROUNDDOWN(V_LINES / 2, 0), ROUNDDOWN(V_LINES, 0))

6. Determine the top and bottom margins:
   TOP_MARGIN = IF(MARGINS_RQD?="Y", ROUNDDOWN(((MARGIN_PER / 100) * V_LINES_RND), 0), 0)
   BOT_MARGIN = IF(MARGINS_RQD?="Y", ROUNDDOWN(((MARGIN_PER / 100) * V_LINES_RND), 0), 0)
7. If interlaced is required, then set variable INTERLACE = 0.5:
   INTERLACE = IF(INT_RQD?="Y", 0.5, 0)

Once the above calculations have been done, the next steps change depending upon whether Standard "CRT" style or Reduced Blanking style timing is required. For Standard "CRT" style timing, the steps detailed in Section 5.3 are performed next. If Reduced Blanking timing is required, then the steps detailed in Section 5.4 are performed.

Once the relevant set of calculations have been completed, then it is possible to derive all timing parameters.

5.3 Computation of Reduced Blanking Timing Parameters

First perform the Common Parameter Calculations as described in Section 4 and then the following steps. Table 5-4 lists the parameter values for Reduced Blank v1, v2, and v3 that are to be used in these formulas:

8. Estimate the Horizontal Period (kHz):
   H_PERIOD_EST = ((1000000 / (V_FIELD_RATE_RQD)) - RB_MIN_V_BLANK) / (V_LINES_RND + TOP_MARGIN + BOT_MARGIN)
9. Determine the idealized number of lines in the vertical blanking interval:
   VBI_LINES = ROUNDDOWN(RB_MIN_V_BLANK / H_PERIOD_EST, 0) + 1
10. Check Vertical Blanking is Sufficient and determine the actual number of lines in the vertical blanking interval:
    RB_MIN_VBI = RB_V_FPORCH+V_SYNC_RND+MIN_V_BPORCH
    ACT_VBI_LINES = IF(VBI_LINES < RB_MIN_VBI, RB_MIN_VBI, VBI_LINES)
11. Find total number of vertical lines:
    TOTAL_V_LINES = ACT_VBI_LINES + V_LINES_RND + TOP_MARGIN + BOT_MARGIN + INTERLACE
12. Find total number of pixel clocks per line:
    TOTAL_PIXELS = RB_H_BLANK + TOTAL_ACTIVE_PIXELS
13. Calculate Pixel Clock Frequency to nearest CLOCK_STEP MHz:

For Reduced Blank Version 1 and 2:

ACT_PIXEL_FREQ = CLOCK_STEP * ROUNDDOWN((V_FIELD_RATE_RQD * TOTAL_V_LINES * TOTAL_PIXELS / 1000000* REFRESH_MULTIPLIER) / CLOCK_STEP,0)

For Reduced Blank Version 3:

ACT_PIXEL_FREQ = CLOCK_STEP * ROUNDUP((V_FIELD_RATE_RQD * TOTAL_V_LINES * TOTAL_PIXELS / 1000000* REFRESH_MULTIPLIER) / CLOCK_STEP,0)

14. Find actual Horizontal Frequency (kHz):
    ACT_H_FREQ = 1000 * ACT_PIXEL_FREQ / TOTAL_PIXELS
15. Find Actual Field Rate (Hz):
    ACT_FIELD_RATE = 1000*ACT_H_FREQ / TOTAL_V_LINES

16. Find actual Vertical Refresh Rate (Hz):
    ACT_FRAME_RATE = IF(INT_RQD? = "y", ACT_FIELD_RATE / 2, ACT_FIELD_RATE)

Table 5-4: Delta between Reduced Blank Timing v1, v2 and v3

Constant	Description	Reduced Blanking v1	Reduced Blanking v2	Reduced Blanking v3
CLOCK_STEP	Pixel clock resolution (MHz)	0.25	0.001	0.001
MIN_V_BPORCH	Minimum vertical back porch (lines)	~~Min~~Fixed ~~6~~7	Fixed 6	Fixed 6
CELL_GRAN_RND	Character cell width (pixels)	8	1	8
RB_H_BLANK	Specifies the fixed number of pixels ~~count~~ in the Horizontal Blanking period for Reduced Blanking timings. Measured as the number of pixels from the last active pixel of one line to the first active pixel of the next line.	Fixed 160	Fixed 80	Value from 80-200 that is divisible by 8
RB_H_SYNC	Horizontal sync period for Reduced Blanking timings, expressed as the number of pixels.	Fixed 32	Fixed 32	Fixed 32
RB_MIN_V_BLANK	Specifies the minimum vertical blanking period (in µs) for Reduced Blanking timings. Measured as the number of lines from the last line of active video to the first line of active video. A custom timing may be generated with a blank duration higher than the minimum specified.	Min 460	Min 460	Min 460
RB_V_FPORCH	Reduced Blanking vertical front porch (lines)	Fixed 3	Min 1	Min 1
V_SYNC_RND	Vertical sync width (lines)	Variable See Table 3-2	Fixed 8	Fixed 8
REFRESH_MULTIPLIER	Refresh rate multiplier factor, for reduced blanking v2 timing the factor is set to 1000/1001 if video optimized refresh rate is required, in all other cases the factor is set to 1.	1	1 or 1000/1001	1
V_FIELD_RATE_PPM_ADJ	Additional ppm offset adjustment to be added to requested refresh rate	0	0	+350 ppm
ACT_PIXEL_FREQ	Final pixel frequency	Computed with Round-Down method	Computed with Round-Down method	Computed with Round- Up method

VESA STANDARDS CHANGE REQUEST FORM

To be Filled in by Submitter (Refer to VESA Document VP235H, Section 5)

TITLE:	Reduced blank v3 timing support to facilitate Adaptive-Sync operation and guarantee attainment of target refresh rate
AFFECTED DOCUMENT:	Coordinated Video Timing (CVT) specification 1.2
REVISION CATEGORY:	Refer to VP235H Appendix A; will be subject to Task Group review
SUBMITTED TO:	DisplayID Task Group
SPONSOR:	Syed Athar Hussain, AMD

SCR REVISION HISTORY	
(DATE)	**(CHANGE)**
11/18/2020	Initial Draft, rev1
1/13/2021	Draft 2, updated based on group feedback
1/18/2021	Draft 3, addressed comment on v3 horizontal blank pixel count clarification and allowed flexibility of custom values beyond fixed 80 and fixed 160 pixels with a range of 80 to 200 pixels and divisible by 8.
2/22/2021	Draft 4, Address task group comments
03/02/2021	Draft 5: Addressing further comments from the task group. Changes highlighted with yellow background.
03/10/2021	Draft 6: Addressing Post GMR Comment #3704 (editorial)
04/21/2021	Draft 7: Added early V SYNC option based on task group discussion

(add more rows as needed)

To be Filled in by VESA Office:

VESA SCR NUMBER:	(To be assigned by VESA office)
SCR ENTRY DATE:	05/05/2021

To be Filled in by Task Group or VESA Office

SCR ADOPTED, REJECTED, or otherwise DISPOSITIONED for other action	SCR is (adopted) or (rejected) or (Dispositioned for other action) If rejected, explain reason for acceptation or rejection If dispositioned, explain action or plan for action (such as including in future draft specification revision, or re-visiting at future date, or other)
DATE SCR ADOPTED or REJECTED or DISPOSITIONED	ADOPTED 05/17/2021

Summary of the Proposed Change(s)

The SCR adds reduced blank version 3 to VESA Coordinated Video Timing (CVT) specification to facilitate Adaptive-Sync operation and guarantee attainment of target refresh rate. All VESA AdaptiveSync certified sink and source shall support CVT reduced blank version 3 timing.

IPR (Intellectual Property Rights) declaration, if any

None

Benefits as a Result of the Changes

The new timing standard guarantees Adaptive-Sync refresh rate attainment and ensures lower overall PPM error when targeting an Adaptive-Sync refresh rate.

Assessment of the Impact

SW/FW update on source and sinks side.

Analysis of the Device Hardware Implication

No hardware impact is expected.

Analysis of the Device Software Implications

SW and FW may need to be updated to support the new CVT timing rules.

Analysis of the Compliance Test & Interop Implications

Requires as part of the VESA AdaptiveSync logo testing

New Referenced Documents Resulting from Change

None

Attachments

None

Proposed Document Change(s) or Addition(s)

Editorial Note: Only those texts and tables with changes are shown below.

3.4.3 Reduced Blanking Timing Version 2

The following sections describe new rules mandated by the reduced blanking timing v2. ~~New reduced blank DMT timings shall use the reduced blanking timing v2 rules.~~

1. **Pixel Clock Selection**
   Reduced Blanking Version 2 shall support a resolution of 0.001MHz to produce more accurate refresh rate result required in some application.

   The target refresh rate is comprised of a nominal refresh rate and optionally a 1000/1001 multiplier factor for video optimized rates (i.e. for 59.94Hz, it has 60Hz nominal refresh rate and a 1000/1001 factor).

   The following lists the steps taken to calculate the pixel clock for a given target refresh rate and active H/V resolution; further details are in Section 5.4.

   a) First the nominal refresh rate is used to calculate the horizontal and vertical blank parameters,
   b) then calculate horizontal and vertical blank parameter along with required H/V active with the target refresh rate (including 1000/1001 factor if required) is used to calculate the pixel clock.
   c) The result value is then rounded down to nearest 0.001 pixel clock

   Using the nominal value in step (a) guarantees that the only difference in timing between a video optimized timing vs. a non-video optimized timing for a given refresh rate is in pixel clock (i.e. all other vertical and horizontal parameters are same). The result from step (c) will often cause the actual refresh rate to be lower than the target refresh rate by a very small amount.

2. **Vertical Refresh Rate**
   The standard refresh rate for Reduced Blanking v2 timing is 60Hz however other progressive refresh may be used depending on the application. Higher precision of the pixel clock step allows video optimized refresh rates (i.e. 60*1000/1001Hz, 30*1000/1001Hz) to be supported with the new version. A factor of 1000/1001 is applied to the nominal refresh rate if the video optimized target refresh rate is required.

3. **Horizontal Counts**
   The counts for Horizontal Active pixels have a precision of 1. Unlike Standard Blanking and Reduced Blanking v1, Reduced Blanking v2 timings do not require the Horizontal Active pixels to be divisible by eight.

   Margins shall not be included in Reduced Blanking v2 timings
   (i.e. LEFT_MARGIN=RIGHT_MARGIN=TOP_MARGIN=BOT_MARGIN=0)

   ~~As per rules of the Reduced Blanking v2 timings, Horizontal Timings may have a precision of 1 pixel. This allows timing for resolutions like 1366x768 to be defined with the new standard. No longer is the Horizontal Timing, including the Horizontal Active pixels, Horizontal Total pixels, Sync Pulse duration and "Front Porch" and "Back Porch" times required to be divisible by eight.~~

4. **Horizontal Blanking Time**
   For Reduced Blanking v2 timings, the Horizontal Blanking time ~~will in all cases are~~ is fixed to 80 pixels ~~count~~.

5. **Horizontal Sync Pulse Duration and Position**
   The Horizontal Sync Pulse duration ~~will~~ ~~in all cases be~~ is fixed to 32 pixels. ~~count~~ ~~in duration, with the position set so that~~ The trailing edge of the Horizontal Sync Pulse is located in the center of the Horizontal Blanking period. Since the Horizontal Blanking time is fixed to 80 pixels, ~~This implies that for a fixed blank of 80 pixels count clocks,~~ the Horizontal Back Porch is (80/2) = 40 pixels ~~count~~ and the Horizontal Front Porch is (80-40-32) = 8 pixels ~~count~~.

6. **Vertical Blanking Time**
   The Vertical Blanking shall be the first multiple of integer Horizontal Lines that results in a vertical blanking period that exceeds ~~the minimum requirement of~~ 460 microseconds.

7. **Vertical Sync Pulse Duration and Position**
   Vertical Sync Pulse is fixed at 8 lines indicating timing generated based on Reduced Blanking v2 timing rules and aspect ratio information is to be derived based on Vertical and Horizontal Active Timing. This will allow any new timing with non-standard aspect ratio to be supported without any update to the specification. The Vertical Back Porch shall in all cases be fixed to 6 lines. The Vertical Front Porch shall be the remainder of the Vertical Blanking Time.

3.4.4 Reduced Blanking Timing Version 3

The following items ~~sections~~ describe new rules mandated by the reduced blanking timing v3, only differences from v2 are listed below. ~~New reduced blank DMT timings if any shall use the reduced blanking timing v3 rules with default parameters.~~ With Reduced Blanking v3, only progressive video timings are supported. Devices shall not use Reduced Blanking v3 to generate interlaced video timings. Reduced Blanking v3 is intended to work in conjunction with Adaptive-Sync operation (or other similar variable refresh rate methodology).

1. **Pixel Clock Selection**

   The following lists the steps taken to calculate the pixel clock for a given target refresh rate and active H/V resolution; further details are in Section 5.4.

   a) First the target refresh rate is increased by +350 ppm and the adjusted target refresh rate is used to calculate the horizontal and vertical blank parameters,
   b) then calculate horizontal and vertical blank parameter along with required H/V active with the adjusted target refresh rate is used to calculate the pixel clock.
   c) The result value is then rounded up to nearest 0.001 pixel clock step

   The result from step (c) will often cause the actual refresh rate to be higher than the target refresh rate by a very small amount.

2. **Vertical Refresh Rate**
   The target refresh rate shall be an integer. The +350 ppm increase described under "Pixel Clock Selection" guarantees that both the target vertical refresh rate (e.g., 60) and a video optimized refresh rate variant (e.g., 59.94) can always be achieved with Adaptive-Sync vertical blank line addition or dithering. This is why a factor of 1000/1001 is not optionally applied to the target refresh rate for Reduced Blanking v3 as it is with Reduced Blanking v2.

   The tolerance of the pixel clock of the transmitted timing shall be ±300 ppm. As a result of the pixel clock tolerance, the transmitted refresh rate of a Reduced Blanking v3 timing will be between [target refresh rate + 50ppm] and [target refresh rate + 650 ppm]. Adaptive-Sync

operation (or another variable refresh rate technology) is used to match the average transmitted refresh rate to the desired video refresh rate by injecting additional video blanking lines to maintain the desired rate. The desired video refresh rate may be the target rate (e.g., 60 Hz), a video optimized variant of the target rate (e.g., 59.94 Hz), or a different rate that matches the rendered content (e.g., 48 Hz) as long as it is within the display's supported Adaptive-Sync range.

3. **Horizontal Counts**
   Same rule as the Reduced Blanking v2 timings.

4. **Horizontal Blanking Time**

   For Reduced Blanking v3 timings, Horizontal Blank shall have a value from 80 to 200 that is also divisible by 8. Note, despite the added flexibility of Horizontal Blank vs earlier Reduced Blanking version, the default Horizontal Blank value is 80 pixels to ensure minimum bandwidth requirement for the timings.

5. **Horizontal Sync Pulse Duration and Position**
   For Reduced Blanking v3 timings, Horizontal Sync Pulse duration shall be fixed to 32 pixels. Horizontal Front Porch shall be fixed to 8 pixels and remaining horizontal blank pixels are applied to Horizontal Back Porch.

6. **Vertical Blanking Time**
   Same rule as the Reduced Blanking v2 timings.

7. **Vertical Sync Pulse Duration and Position**
   Same rule as the Reduced Blanking v2 timings.

3.6 Sync Polarities and Durations

Table 3-2: Vertical Sync Duration (Standard and Reduced Blanking v1 timings)

Vertical Sync Width V_SYNC_RND	Aspect Ratio
3 or less	Reserved (Used by existing DMT and GTF timings)
4	4:3
5	16:9
6	16:10
7	Special Case: 5:4 (1280x1024) 15:9 (1280x768)
8	~~Reduced Blank Timing v2 and v3 Aspect Ratio based on Horizontal and Vertical Active Timing~~ Reserved (Used by Reduced Blank Timing v2 and v3)
9	Reserved
10	Non-standard Aspect Ratio

Note: Non-standard Aspect Ratio refers to an aspect ratio other than 4:3, 16:9, 16:10, 5:4, or 15:9 ~~not defined within this document as being standard and can~~ that may be used for manufacturer-specific timings.

The Vertical Sync Width (V_SYNC_RND) of Reduced Blanking v2 and v3 timings shall be 8 regardless of the aspect ratio. For these timings the aspect ratio can be inferred from the Horizontal Active and Vertical Active timing parameters.

5.1 Explanation of Terms

The following details the Expressions and Terms used in the following equations:

Table 5-1: Expression Terms & Operators

TERM / OPERATOR	DESCRIPTION
+	Addition
-	Subtraction
*	Multiplication
/	Division
ROUNDDOWN(*value*, 0)	Returns *value* rounded down to the nearest integer
ROUNDUP(*value*, 0)	Returns *value* rounded up to the nearest integer
IF(*logic_test*, *value_if_true*, *value_if_false*)	If-then statement that returns *value_if_true* when the *logic_test* expression evaluates to true, and returns *value_if_false* when the *logic_test* expression evaluates to false.

5.1 Computation of Common Parameters

Initially both Standard "CRT" style and Reduced Blanking CVT timings have common computational steps that must be done first. This section details those steps.

1. Find the refresh rate required (Hz):
   V_FIELD_RATE_RQD = IF(INT_RQD?="y", IP_FREQ_RQD * 2, IP_FREQ_RQD)

   V_FIELD_RATE_RQD = V_FIELD_RATE_RQD*(1 + V_FIELD_RATE_PPM_ADJ/1000000)

   The **V_FIELD_RATE_PPM_ADJ** value is "0" when using Standard Blanking CVT timings, however for Reduced Blanking CVT timings refer to Table 5-4.

2. In order to give the correct results, the number of horizontal pixels requested is first processed to ensure that it is divisible by the character size, by rounding it to the nearest character cell boundary:

   CELL_GRAN_RND = IF ((RED_BLANK_RQD?="N") Or (RED_BLANK_RQD?="Y" AND (RD_BLANK_VER=1), 8, 1)
   H_PIXELS_RND = ROUNDDOWN(H_PIXELS / CELL_GRAN_RND,0) * CELL_GRAN_RND

3. Determine the width of the left and right borders:
   LEFT_MARGIN = IF(MARGINS_RQD?="Y", (ROUNDDOWN(((H_PIXELS_RND * MARGIN_PER / 100) /CELL_GRAN_RND), 0)) * CELL_GRAN_RND, 0)
   RIGHT_MARGIN = IF(MARGINS_RQD?="Y", (ROUNDDOWN(((H_PIXELS_RND * MARGIN_PER / 100) /CELL_GRAN_RND), 0)) * CELL_GRAN_RND, 0)

4. The total number of active pixels is equal to the rounded horizontal pixels and the margins:
   TOTAL_ACTIVE_PIXELS = H_PIXELS_RND + LEFT_MARGIN + RIGHT_MARGIN

5. If interlace is requested, the number of vertical lines assumed by the calculation must be halved, as the computation calculates the number of vertical lines per field. In either case, the number of lines is rounded down to the nearest integer.
   V_LINES_RND = IF(INT_RQD?="y", ROUNDDOWN(V_LINES / 2, 0), ROUNDDOWN(V_LINES, 0))

6. Determine the top and bottom margins:
   TOP_MARGIN = IF(MARGINS_RQD?="Y", ROUNDDOWN(((MARGIN_PER / 100) * V_LINES_RND), 0), 0)
   BOT_MARGIN = IF(MARGINS_RQD?="Y", ROUNDDOWN(((MARGIN_PER / 100) * V_LINES_RND), 0), 0)
7. If interlaced is required, then set variable INTERLACE = 0.5:
   INTERLACE = IF(INT_RQD?="Y", 0.5, 0)

Once the above calculations have been done, the next steps change depending upon whether Standard "CRT" style or Reduced Blanking style timing is required. For Standard "CRT" style timing, the steps detailed in Section 5.3 are performed next. If Reduced Blanking timing is required, then the steps detailed in Section 5.4 are performed.

Once the relevant set of calculations have been completed, then it is possible to derive all timing parameters.

5.3 Computation of Reduced Blanking Timing Parameters

First perform the Common Parameter Calculations as described in Section 4 and then the following steps. Table 5-4 lists the parameter values for Reduced Blank v1, v2, and v3 that are to be used in these formulas:

8. Estimate the Horizontal Period (kHz):
   H_PERIOD_EST = ((1000000 / (V_FIELD_RATE_RQD)) - RB_MIN_V_BLANK) / (V_LINES_RND + TOP_MARGIN + BOT_MARGIN)
9. Determine the idealized number of lines in the vertical blanking interval:
   VBI_LINES = ROUNDDOWN(RB_MIN_V_BLANK / H_PERIOD_EST, 0) + 1
10. Check Vertical Blanking is Sufficient and determine the actual number of lines in the vertical blanking interval:

    A new option is added when generating Reduced Blank v3 (RB v3) timing only to provide more time between VSYNC pulse and active frame start. The option is set by EARLY_VSYNC_RQD? = "y" and it extends MIN_V_BPORCH from fixed 6 lines for RB v3 to half the VBI_LINES.

    MIN_V_BPORCH = IF(EARLY_VSYNC_RQD? = "y", ROUNDDOWN(**VBI_LINES** / 2, 0), MIN_V_BPORCH)

    RB_MIN_VBI = RB_V_FPORCH+V_SYNC_RND+MIN_V_BPORCH
    ACT_VBI_LINES = IF(VBI_LINES < RB_MIN_VBI, RB_MIN_VBI, VBI_LINES)
11. Find total number of vertical lines:
    TOTAL_V_LINES = ACT_VBI_LINES + V_LINES_RND + TOP_MARGIN + BOT_MARGIN + INTERLACE
12. Find total number of pixel clocks per line:
    TOTAL_PIXELS = RB_H_BLANK + TOTAL_ACTIVE_PIXELS
13. Calculate Pixel Clock Frequency to nearest CLOCK_STEP MHz:

For Reduced Blank Version 1 and 2:

ACT_PIXEL_FREQ = CLOCK_STEP * ROUNDDOWN((V_FIELD_RATE_RQD * TOTAL_V_LINES * TOTAL_PIXELS / 1000000* REFRESH_MULTIPLIER) / CLOCK_STEP,0)

For Reduced Blank Version 3:

ACT_PIXEL_FREQ = CLOCK_STEP * ROUNDUP((V_FIELD_RATE_RQD * TOTAL_V_LINES * TOTAL_PIXELS / 1000000* REFRESH_MULTIPLIER) / CLOCK_STEP,0)

14. Find actual Horizontal Frequency (kHz):
    ACT_H_FREQ = 1000 * ACT_PIXEL_FREQ / TOTAL_PIXELS
15. Find Actual Field Rate (Hz):
    ACT_FIELD_RATE = 1000*ACT_H_FREQ / TOTAL_V_LINES
16. Find actual Vertical Refresh Rate (Hz):
    ACT_FRAME_RATE = IF(INT_RQD? = "y", ACT_FIELD_RATE / 2, ACT_FIELD_RATE)

Table 5-4: Delta between Reduced Blank Timing v1, v2 and v3

Constant	Description	Reduced Blanking v1	Reduced Blanking v2	Reduced Blanking v3
CLOCK_STEP	Pixel clock resolution (MHz)	0.25	0.001	0.001
MIN_V_BPORCH	Minimum vertical back porch (lines)	~~Min~~Fixed ~~6~~7	Fixed 6	Fixed 6
CELL_GRAN_RND	Character cell width (pixels)	8	1	8
RB_H_BLANK	Specifies the fixed number of pixels ~~count~~ in the Horizontal Blanking period for Reduced Blanking timings. Measured as the number of pixels from the last active pixel of one line to the first active pixel of the next line.	Fixed 160	Fixed 80	Value from 80-200 that is divisible by 8
RB_H_SYNC	Horizontal sync period for Reduced Blanking timings, expressed as the number of pixels.	Fixed 32	Fixed 32	Fixed 32
RB_MIN_V_BLANK	Specifies the minimum vertical blanking period (in µs) for Reduced Blanking timings. Measured as the number of lines from the last line of active video to the first line of active video. A custom timing may be generated with a blank duration higher than the minimum specified.	Min 460	Min 460	Min 460
RB_V_FPORCH	Reduced Blanking vertical front porch (lines)	Fixed 3	Min 1	Min 1
V_SYNC_RND	Vertical sync width (lines)	Variable See Table 3-2	Fixed 8	Fixed 8
REFRESH_MULTIPLIER	Refresh rate multiplier factor, for reduced blanking v2 timing the factor is set to 1000/1001 if video optimized refresh rate is required, in all other cases the factor is set to 1.	1	1 or 1000/1001	1
V_FIELD_RATE_PPM_ADJ	Additional ppm offset adjustment to be added to requested refresh rate	0	0	+350 ppm

ACT_PIXEL_FREQ	Final pixel frequency	Computed with Round-Down method	Computed with Round-Down method	Computed with Round- Up method