Digiteq Automotive

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EDID Format Guideline

How to make a display profile for ScreenLinq or FrameGrabber 4

Version 1.0

Classification: Public
Author: Matěj Bartík (MAB)
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Contents

List of Figures

List of Tables

List of Code Listings

Changes

Version	Date	Change description	Changed by	Approved by
0.1	08.04.24	Initial revision.	MAB	MAB
0.8.1	12.06.24	Alpha revision.	MAB	MAB
0.8.2	12.07.24	Beta revision.	MAB	MAB
1.0	08.04.25	Released to the public.	MAB	MAB

1 Introduction

The VESA E-EDID Standard Release A2 (EDID 1.4)[1] format has been chosen because of:

- tt is a proven standard introduced by VESA more than 30 years ago,
- even modern displays utilizing the same principles,
- satisfies most of our requirements.

An E-EDID data structure is often provided (implemented) by a (computer) display to enable display identification; therefore, it allows a GPU driver to automatically detect and configure necessary timing parameters of a video stream suitable for the attached display.

1.1 Cathod Ray Tube (CRT) technology

The history of the EDID standard began in 1994, when most displays were based on CRT technology. Due to the principles used in CRT technology, EDID was designed to contain the information needed for their operations.

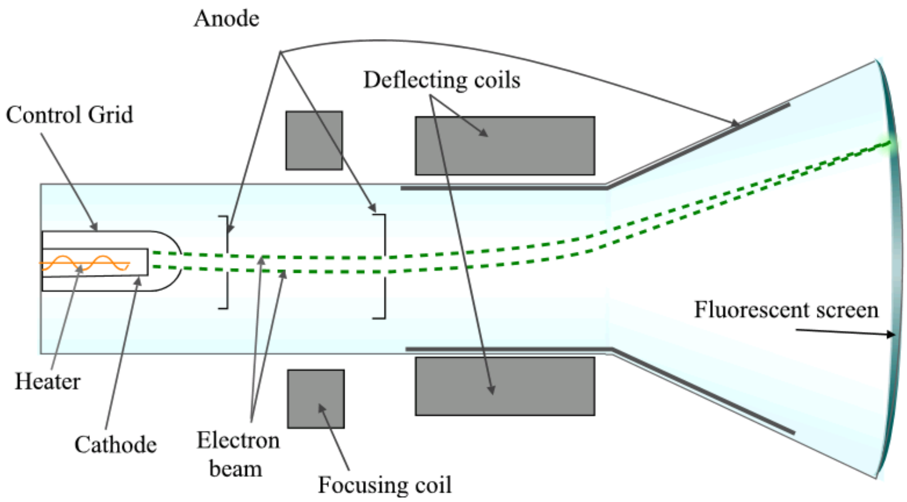

Figure 1: Example of a CRT display fundamental components.

The CRT display (see Fig. 1) uses an electron gun to generate a beam of electrons. When an electron impacts a phosphor-coated display surface, the energy will be converted into visible light (matching the color of the phosphorus). The number of electron guns equals the number of individual colors (3 are needed to generate an RGB image). Coils generate an electromagnetic field to deviate the trajectory of the electron stream, affecting the resulting point of impact.

[1] https://glenwing.github.io/docs/VESA-EEDID-A2.pdf

Due to this fact, some amount of time is required to move the (horizontal) position from the end of a pixel line to the beginning (and similarly for vertical position as well). The time required for such transition is called **Blanking** (see Fig. 2).

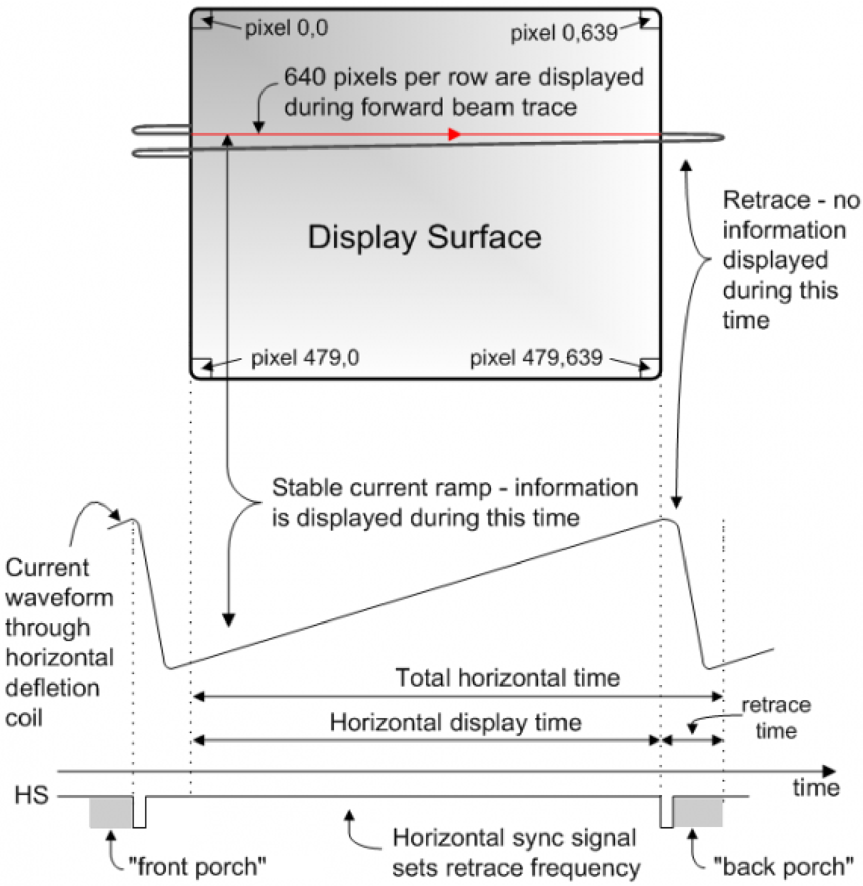

Figure 2: Visualization of video timing parameters and (analog) blanking signal for a display with VGA resolution.

1.2 Active and blanking areas – video timing parameters

To project a video stream on a display, generating a stream with the video timing parameters matching the allowed timing parameter ranges of such a display is necessary. Otherwise, the display is not guaranteed to operate properly.

A display's pixels are organized in a 2-dimensional grid; each pixel has horizontal and vertical coordinates. The pixels visible to a user are part of an **active area**. The pixels transmitted during a blanking period(s) are called **blanking area** (see Fig. 3).

Although blanking is not necessary for modern display, the blanking area is used for transferring auxiliary data such as audio channels.

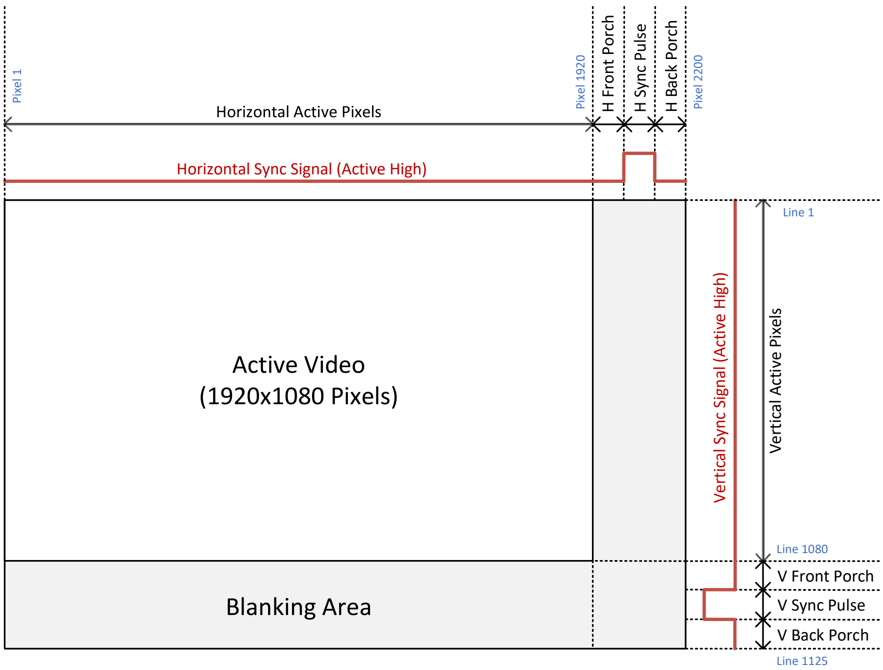

Figure 3: Visualization of video timing parameters - Full HD (1080p) resolution as defined by CEA-861 standard.

2 Information required for a display profile

To create a display profile, the following information are required (see Table 1):

1. Part number of an in-car display.
2. Video timing parameters of the used display/screen/LCD panel.
3. Any other known details such as manuals, datasheets, car platform, hardware revision, or software version (see Fig. 4).

If the timing parameters are unknown, measuring the video signal with FrameGrabber 4 on a working setup is possible. The working setup requires a matching head unit (ICAS3, HCP3, for example) and the in-car display.

Table 1: Parameters required for creating a display profile

Video Timing Parameter	Parameter Value	Unit
Pixel Clock		Hz
Framerate		Hz (FPS)
H Active		Pixels
H Total		Pixels
H Blanking		Pixels
H Front Porch		Pixels
H Back Porch		Pixels
H Sync Pulse		Pixels
H Sync Polarity[1]		Logical Level
V Active		Lines
V Total		Lines
V Blanking		Lines
V Front Porch		Lines
V Back Porch		Lines
V Sync Pulse		Lines
V Sync Polarity[1]		Logical Level
Display Parameter	**Parameter Value**	**Example/Unit**
Part number (see Fig. 4)		XXX.XXX.XXX[.X]
Screen size (active area) – X axis		Millimeters
Screen size (active area) – Y axis		Millimeters
Hardware revision		3-digit code
Software revision		4-digit code
Car platform		MEB; MQB

1. Only two values are possible: Active-Low or Active-High logic levels.

In case some of the video timing parameters are unknown, they still can be calculated from other parameters by following these equations:

$$H_{Blanking} = H_{Front\ Porch} + H_{Back\ Porch} + H_{Sync\ Pulse}$$
$$H_{Total} = H_{Active} + H_{Blanking}$$
$$V_{Blanking} = V_{Front\ Porch} + V_{Back\ Porch} + V_{Sync\ Pulse}$$
$$V_{Total} = V_{Active} + V_{Blanking}$$
$$Pixel\ Clock = H_{Total} \times V_{Total} \times Framerate$$

For the example of the Full HD resolution (see Fig. 3), the equations can be solved in the following way:

$$H_{Blanking} = 88 + 148 + 44 = 280\ [Pixels]$$
$$H_{Total} = 1920 + 280 = 2200\ [Pixels]$$
$$V_{Blanking} = 4 + 36 + 5 = 45\ [Lines]$$
$$V_{Total} = 1080 + 45 = 1125\ [Lines]$$
$$Pixel\ Clock = 2200 \times 1125 \times 60 = 148,500,000\ [Hz]$$

Figure 4: An example of a sticker (of an in-car display) with depicted part number (5E3.920.770), software version (M230), and hardware version (E03).

!

TIP

Usually, a ratio (16:9, for example) of screen dimensions in millimeters is approximately the same as respective dimensions in pixels/lines (individual pixels do not have to have perfectly squared dimensions).

!

TIP

In some cases, a screen of an in-car display could be physically rotated. In such case, screen size parameters (see Table 5) reflects the dimensions from a user perspective and *Detailed Timing Descriptor* dimensions (see Fig.6) will respect the screen properties (X and Y dimensions will be swapped).

3 Creating a display profile

A process of creating a display profile uses properties/parameters described by the E-EDID format (version 1.4) and is tool independent. However, *DeltaCast E-EDID editor* is used for a demonstration.

3.1 General/Video Input/Feature tab

This tab (see Fig. 5) has multiple fields which needs to be filled, organized in a sub-tabs:

1. Vendor & Product ID (see Tab. 2)
2. Display Transfer Characteristic (Gamma should be set to 2.20)
3. Video Input Definition (see Tab. 4)
4. Screen Size (see Tab. 5)
5. Feature Support (see Tab. 6)

3.2 Color/Established Timings I & II tab

Currently, no in-car display has been using/supporting such features.

3.3 Standard Timings tab

Currently, no in-car display has been using/supporting such features.

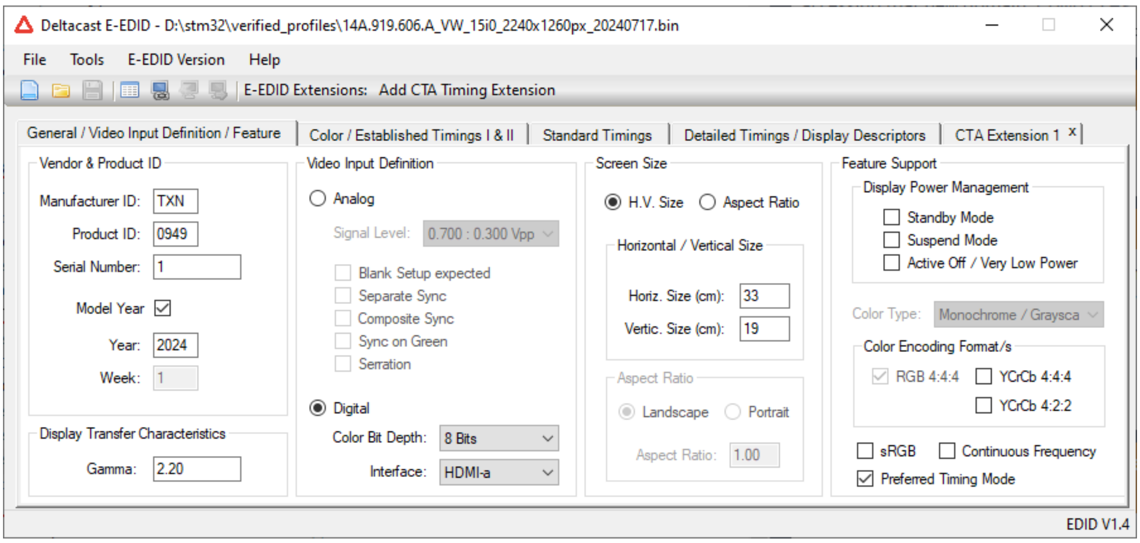

Figure 5: DeltaCast E-EDID editor – General/Video Input/Feature tab.

Table 2: Vendor & Product ID sub tab.

Field	Description
Manufacturer ID	The value (see Tab. 3) depends on a serialiser used in a ScreenLinq device.
Product ID	Depends on the actual serialiser IC (see Tab. 3).
Serial Number	A condensed UNIX timestamp indicating the creation time of the display profile.
Model year	Have the option activated to fill only the year when an in-car display was manufactured.
Year	Year when the in-car display was manufactured (or introduced to a market).

Table 3: Used interfaces and VESA Manufacturer & Product IDs for serialisers

Interface (Out)	Interface (In)	Manufacturer	ID	Serializer	Product ID
GMSL2	DisplayPort	Analog (Maxim)	MXM	MAX96851	1921
GMSL2	DisplayPort	Analog (Maxim)	MXM	MAX96853	1921
GMSL3	DisplayPort	Analog (Maxim)	MXM	MAX96851	1921
GMSL3	DisplayPort	Analog (Maxim)	MXM	MAX96853	1921
FPD-Link III	HDMI	Texas Instruments	TXN	DS90UB949A	0949
FPD-Link III	HDMI	Texas Instruments	TXN	DS90UH949A	0949
FPD-Link III	HDMI	Texas Instruments	TXN	DS90UB949	0949
FPD-Link III	HDMI	Texas Instruments	TXN	DS90UH949	0949
FPD-Link III	HDMI	Texas Instruments	TXN	DS90UB929	0929
FPD-Link III	HDMI	Texas Instruments	TXN	DS90UH929	0929
FPD-Link III	DisplayPort	Texas Instruments	TXN	DS90UB943	0943
FPD-Link III	DisplayPort	Texas Instruments	TXN	DS90UH943	0943

Table 4: Video Input Definition sub tab

Field	Description
Color Bit Depth	Set it accordingly to the display features. The most of in-car displays supports only 8 bits per color.
Interface	Set the video input interface accordingly to the used serialiser (see Tab. 3).

Table 5: Screen Size sub tab.

Field	Description
H.V. Size	An option *H.V. Size* should be selected instead of *Aspect Ratio*. Physical dimensions are used in DQ systems to calculate a (diagonal) screen size (in inches) of an in-car display. In case of a *vertically* oriented screen, it's height should be greater it's width (respect the orientation).
Horiz. Size	Horizontal dimension (width) of visible screen area in centimeters.
Vertic. Size	Vertical dimension (height) of visible screen area in centimeters.

Table 6: Feature Support sub tab.

Field	Description
Standby Mode	Should be off as interrupting a video stream might not be feasible for most of in-car displays.
Suspend Mode	Should be off as interrupting a video stream might not be feasible for most of in-car displays.
Active Off / Very Low Power	Should be off as interrupting a video stream might not be feasible for most of in-car displays.
Color Encoding Format/s	Should match screen capabilities. Currently, no screen (of an in-car display) has been known to support other format than the **RGB 4:4:4**.
sRGB	Should be off or matching screen capabilities. Currently, no screen (of an in-car display) has been known to support such feature.
Continuous Frequency	Should be off or matching screen capabilities. Currently, no screen (of an in-car display) has been known to support such feature.
Preferred Timing Mode	Should be enabled to allow use of *Detailed Timings* (see Section 3.4)

3.4 Detailed Timings / Display Descriptors

The base 128 bytes of EDID data structure includes up to four *display timing descriptor or display/monitor descriptors*. The meaning and function are described in this section. The recommended order of such blocks is following:

1. Detailed Timing Descriptor
2. (Optional) Detailed Timing Descriptor
3. Display Descriptor – Product Name
4. Display Descriptor – Data String

In case the second *Detailed Timing Descriptor* is not used, remaining descriptors (*Product Name* & *Data String* will move up).

3.4.1 Block 1 – Detailed Timing Descriptor

This block contains video timing parameters of an (in-car) display. Use a collected information (see Tab. 1) and fill them into the form (see Fig 6). Only some information/parameters (see Tab. 7) are described here in detail, as majority of them have been already described in Section 1 and Section 2.

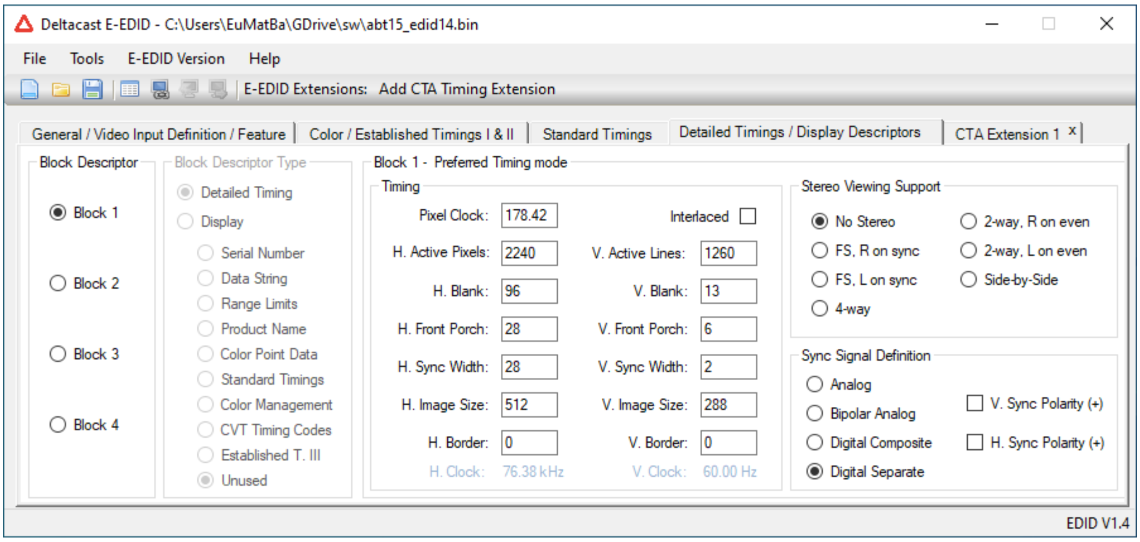

Figure 6: DeltaCast E-EDID editor – Detailed Timings (Block 1) tab.

3.4.2 Block 2 – (Optional) Detailed Timing Descriptor

This *Timing Descriptor* shall be used in case the FrameGrabber 4 card cannot accurately generate a pixel clock (or any other video timing parameter). In such a case, use the *Block 2* to create an alternative set of video timing parameters specifically for the FrameGrabber 4.

Table 7: Detailed Timing Descriptor tab.

Field	Description
Pixel Clock	The resolution of the field is 10 kHz; thus, the calculated frequency should be rounded up.
H. Border	This video timing parameter is often unused and should be set to 0.
V. Border	This video timing parameter is often unused and should be set to 0.
Stereo Viewing Support	Set to *No stereo* unless the screen supports/requires such feature to be enabled.
Sync Signal Definition	Set to *Digital Separate* unless the screen supports/requires such feature to be changed to another value.

Because the FPS (refresh rate) and pixel clock are not bound (can be set independently) by FrameGrabber 4, the desired FPS value should be reverse-calculated from the video timing parameters stored in the *Block 1*.

3.4.3 Block 2/3 – Display Descriptor – Product Name

This block indicates the *Product Name* of a display. In our case, this 13-character long field should be equal to a standardized *Volkswagen Group Part Number* of an in-car display (see Fig. 4) in the format **XXX.XXX.XXX[.X]**, where the last segment denotes a revision/variant of an in-car display (when it is known/specified).

3.4.4 Block 3/4 – Display Descriptor – Data String

This block indicates the *Data String* of a display. In our case, this 13-character long field contains a text with the following format **HaaaSbbbbPcc** where:

- **H** – Denotes hardware revision,
- **aaa** – Hardware revision (3-character long code) of an in-car display (see Fig. 4),
- **S** – Denotes software version,
- **bbbb** – Software version (4-character long code) of an in-car display (see Fig. 4),
- **P** – Denotes profile version,
- **cc** – Display profile version (increments with every version).

3.5 CTA Extensions

The *CTA Extensions* store additional information that doesn't have a dedicated field in the base EDID format. Such extensions are optional; however, some ScreenLinq or FrameGrabber 4 features might not be available. A display profile should use *CTA Extensions* version 3 to support *Vendor Specific* blocks.

3.5.1 (Digiteq Automotive) Vendor Specific block(s)

Such blocks are designed to store general information, while the E-EDID format (see Fig. 7) does not specify their interpretation. Each block starts with a 24-bit IEEE Company ID (CID)[2], which Digiteq Automotive currently has not assigned. Due to this fact, the used *CID* will be 0. Keep in mind that byte numbering starts with 1 instead of 0, according to the VESA standard. The maximum payload size is 30 bytes. All Digiteq Automotive's blocks start with a common header (see Tab. 8).

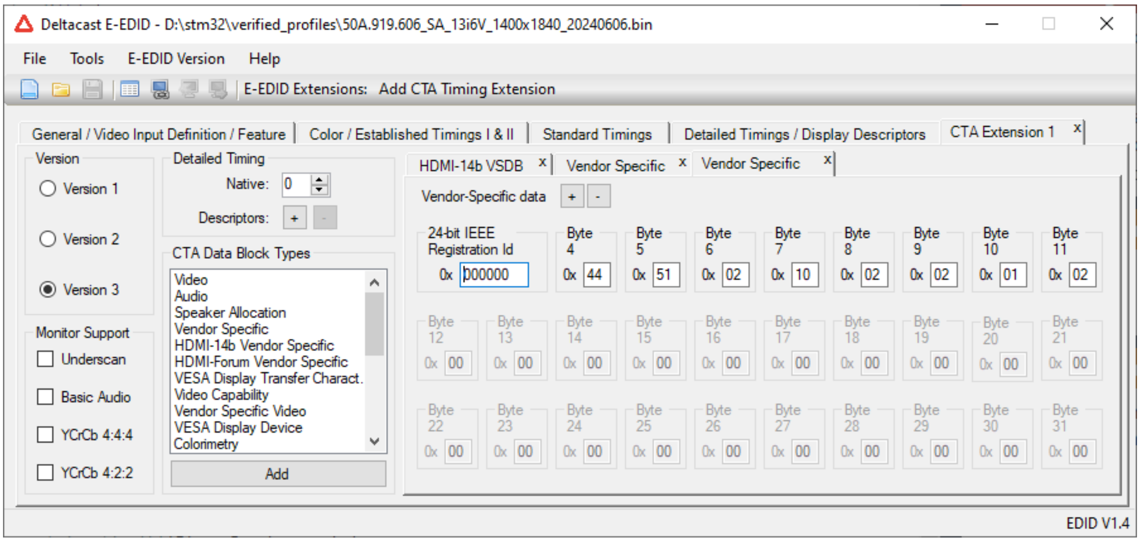

Figure 7: DeltaCast E-EDID editor – Vendor Specific Block tab.

[2] https://standards.ieee.org/products-programs/regauth/cid/

Table 8: (Digiteq Automotive) Vendor Specific block – common header.

Byte(s)	Description
1-3	IEEE Company ID (CID)
4	Character **D** in ASCII
5	Character **Q** in ASCII
6	Payload type: 0. Invalid 1. CAN Simulation 2. Video Interface Additional Parameters
7	Version of the specification (this document) used, encoded as: • Bits 7:4 – Major version • Bits 3:0 – Minor version

3.5.2 CAN Simulation block

The description of *CAN Simulation* block is in Table 9.

Table 9: (Digiteq Automotive) Vendor Specific block – CAN simulation body.

Byte(s)	Description
8	Simulation enabled. Each bit position specifies active CAN interfaces (CAN1 is the bit 0).
9-10	16-bit Simulation ID in little-endian format: 0. No simulation 1. MIB-CAN 2. AB-CAN
11-12	16-bit ISO TP enumerator in little-endian format: 0. None (blank) 1. ABT/CID 2. *CDD* 3. i.ID/FID 4. HUD 5. PID 6. *PPE CID* 7. *PPE FID* 8. *FPK* *Gray-colored types are reserved for future use.*
13	Display multiplicatior coeficient X-axis
14	Display multiplicatior coeficient Y-axis
15	Reserved for future use.
16	Specification of the screen's and touchscreen's orientation (rotation): • Bits 6 – Touchscreen digitizer mirrored (horizontally) • Bits 5:4 – Relative touchscreen digitizer's orientation (clockwise rotation in **value** $\times 90°$) • Bits 2 – Screen mirrored (horizontally) • Bits 1:0 – Relative screen's orientation (clockwise rotation in **value** $\times 90°$)
17:31	(Optional) CAN simulation's signals definition area.

CAN simulation's signals definition area

It's defined as a byte array where the first byte is a CAN signal ID and following byte(s) define a default value of the CAN signal in little endian format. Specification of these signals are supposed to be defined in a user manual of each (supported) device. The signals' specification contains following items: signal ID, message name, signal name, signal length and signal default value. If an unknown signal ID occurs, all remaining bytes will be ignored.

Table 10: (Digiteq Automotive) Vendor Specific block – CAN simulation body.

Message	Signal	ID	Length	Default value
Dimmung_01	DI_KL_58xd	0x01	1	0xFD
Dimmung_01	DI_KL_58xs	0x02	1	0x64
Dimmung_01	DI_Display_Nachtdesign	0x03	1	0x00
Dimmung_01	DI_KL_58xt	0x04	1	0x64
RLS_02	LS_Helligkeit_FW	0x05	2	0xFD; 0x03
RLS_02	RLS_Vorfeldhelligkeit_Boost	0x06	1	0x0F
Reserved	N/A	0x64	0	N/A

3.5.3 Video Interface Additional Parameters block

The description of the *Video Interface Additional Parameters* block is in Table 11. The payload size depends on the *Output interface*; therefore, additional bytes might be specified.

Table 11: (Digiteq Automotive) Vendor Specific block – Video Interface Additional Parameters body.

Byte(s)	Description
8	Output interface 0. Native LVDS (OpenLDI) 1. FPD-Link II 2. FPD-Link III (see Tab. 12) 3. FPD-Link IV 4. GMSL 1 5. GMSL 2 (see Tab. 13) 6. GMSL 3 (see Tab. 13) 7. GMSL 4 8. Embedded DisplayPort
9	Number of processed pixels per (pixel) clock.
10	Color mapping: 0. unspecified or not applicable 1. VESA 2. JEIDA

Table 12: Additional bytes for the FPD-Link III output interface.

Byte(s)	Description
11	*Link Count* 0. Automatic 1. Force Single-Link 2. Force Dual-Link

Table 13: Additional bytes for the GMSL 2 and GMSL 3 output interface.

Byte(s)	Description
11	Link-Rate [Gbps], nominal speeds are 3/6/12.
12	FEC Enabled 0/1
13	Stream ID – allowed range is 1–4 (other values are invalid)
14	Output 0. Unspecified 1. Out A 2. Out B 3. Out A & B

3.5.4 HDMI-14b VSDB block

In case the required pixel clock exceeds 165 MHz and an HDMI interface is used, it will be necessary to add a *HDMI-14b VSDB* block (see Fig. 8). If the pixel clock is below 165 MHz, this block is optional. This block indicates to a GPU driver that an HDMI sink is attached instead of a legacy DVI sink. The limit of the DVI is 165 MHz. Therefore, *Max. TMDS clock* field should be specified in the following way:

$$\text{Max. TMDS Clock} = \left\lceil \frac{\text{Pixel Clock}}{5} \right\rceil$$

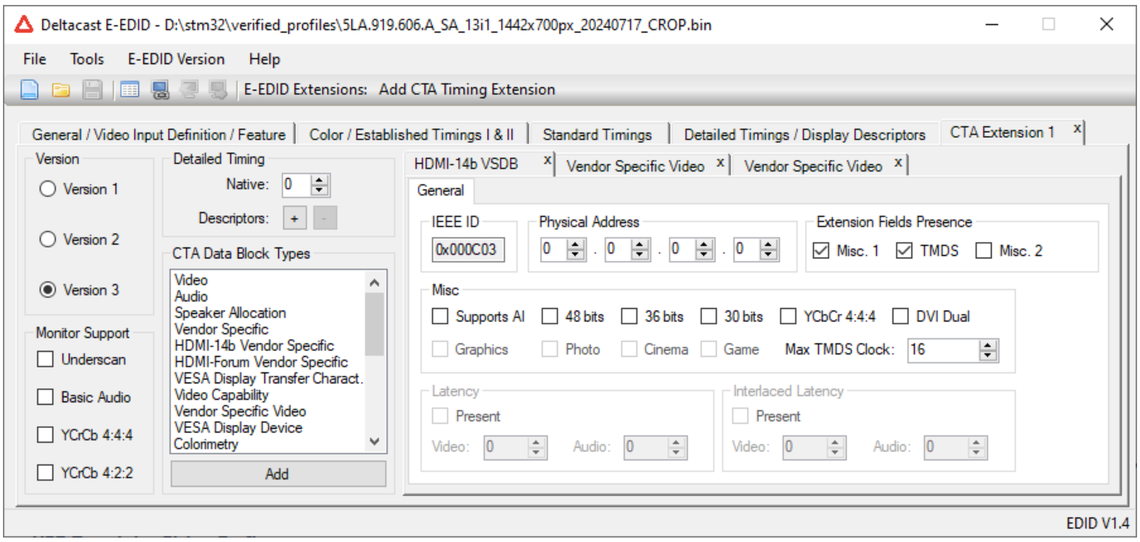

Figure 8: DeltaCast E-EDID editor – HDMI-14b VSDB block tab.

4 Example of a display profile

```
0x00,0xFF,0xFF,0xFF,0xFF,0xFF,0xFF,0x00,0x53,0x0E,0x49,0x09,0x01,0x00,0x00,0x00,
0xFF,0x22,0x01,0x04,0xA2,0x21,0x13,0x78,0x02,0xEC,0x18,0xA3,0x54,0x46,0x98,0x25,
0x0F,0x48,0x4C,0x00,0x00,0x00,0x01,0x01,0x01,0x01,0x01,0x01,0x01,0x01,0x01,0x01,
0x01,0x01,0x01,0x01,0x01,0x01,0xB2,0x45,0xC0,0x60,0x80,0xEC,0x0D,0x40,0x1C,0x1C,
0x62,0x00,0x4C,0xBB,0x10,0x00,0x00,0x18,0x00,0x00,0x00,0xFC,0x00,0x31,0x34,0x41,
0x2E,0x39,0x31,0x39,0x2E,0x36,0x30,0x36,0x0A,0x20,0x00,0x00,0x00,0xFE,0x00,0x48,
0x30,0x33,0x30,0x53,0x41,0x30,0x33,0x30,0x50,0x30,0x32,0x0A,0x00,0x00,0x00,0x10,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x01,0x5E,
0x02,0x03,0x2B,0x00,0x67,0x03,0x0C,0x00,0x00,0x00,0x00,0x24,0xF1,0x01,0x00,0x00,
0x00,0x44,0x51,0x01,0x10,0x01,0x01,0x00,0x01,0x00,0x03,0x02,0x00,0x00,0xEC,0x01,
0x00,0x00,0x00,0x44,0x51,0x02,0x10,0x02,0x02,0x01,0x02,0x00,0x00,0x00,0x00,0x00,
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0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0xFB
```

Listing 1: Example of a display profile – VW ABT 15" (14A.919.606).