Intel® HD Graphics – Display Configuration Tool (DisCon)

User Guide

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Contents

1 Introduction

The Display configuration tool is a rewrite of the BMP tool in the organization with additional features and functionality which is used to modify the binary file table. The new tool is written in python language version-3.7 and its inbuilt libraries such as Tkinter, mainly used for the UI part and JSON file is used as script file instead of the .bsf file present in the current tool. The new tool performs all the functionalities performed by the BMP tool with added features and functionalities, and modifies the binary data based upon the response given by the user on the user interface. The binary table contains information about the configuration of the underlying hardware on which the display firmware / driver runs on. This tool allows modification of the configuration present in the binary table when the underlying hardware configuration changes. Thus decoupling the driver/firmware from the underlying hardware.

1.1 Purpose

Motivation to develop the new tool over the old one is because of the

- Old fashioned design
- Difficult to maintain
- Lack of features
- Not so friendly User Interface

The new tool has enhanced features such as

- Block sequence checks
- Range checks
- Clearly viewable help texts and tooltips
- Better User Interface
- Better maintainability
- Updating UI Dynamically.

1.2 Audience

The target audiences of this document are Intel customers that want to configure the VBT for GOP Driver to their specification.

2 Managing DisCon Work

This section will describe how to prepare the DisCon work session and discuss the basic instructions for modifying the GOP. More in-depth features of DisCon will be discussed in further chapter.

The tool is developed using python 3.7 language and inbuilt libraries are used and mainly the Tkinter library is used for the user interface enhancement.

The Display Configuration tool modifies the binary file which has values according to the specification of a particular hardware platform.

The tool needs two inputs, the binary file and a script file which has the default data fields, binary value ranges as per specifications.

The UI displays the default configuration present in the input binary file, as per the blueprint JSON file(script file). Now user can change the values in the binary table by selecting appropriate fields and values from the UI according to the HW configuration, which will be used by the GFX Driver/ Firmware for enabling different display components.

2.1 JSON(Java Script Object Notation)

- JSON stands for JavaScript Object Notation
- JSON is a lightweight format for storing and transporting data
- JSON is often used when data is sent from a server to a web page
- JSON is "self-describing" and easy to understand

2.1.1 JSON Example

This example defines an employees object: an array of 3 employee records (objects):

```
{
	"employees":
	[
		{"firstName":"John", "lastName":"Doe"},
		{"firstName":"Anna", "lastName":"Smith"},
		{"firstName":"Peter", "lastName":"Jones"}
	]
}
```

2.1.2 JSON Syntax Rules

- Data is in name/value pairs
  - JSON data is written as name/value pairs, just like JavaScript object properties.
  - A name/value pair consists of a field name (in double quotes), followed by a colon, followed by a value
  - Example : "firstName":"John"
- Data is separated by commas
- Curly braces hold objects
  - JSON objects are written inside curly braces.
  - Just like in JavaScript, objects can contain multiple name/value pairs
  - Example: {"firstName":"John", "lastName":"Doe"}
- Square brackets hold arrays
- JSON arrays are written inside square brackets called lists.
  - Just like in JavaScript, an array can contain objects
  - Example: "employees":[
    {"firstName":"John", "lastName":"Doe"},
    {"firstName":"Anna", "lastName":"Smith"},
    {"firstName":"Peter", "lastName":"Jones"}
    ]
  - In the example above, the object "employees" is an array. It contains three objects(Dictionaries) . Each object is a record of a person (with a first name and a last name).

2.1.3 JSON used in Tool

Inside a single list

```
[
    // First object or dictionary which is for data block and contains the information of data.
    {
     "Type": "DataBlock",
     "block": {
        "info": [
           {
         // Multiple nested lists and dictionaries are present for data information.
         }
        ]
```

```
    },
  // Second object or dictionary which is for Page block and contains the
  information of widgets and UI.
    {
       "Type": "PageBlock",
      "block": {
        "info": [
           {
         // Multiple nested lists and dictionaries are present for page information.
          }
        ]
    }
]
```

- Data Blocks contain the information of Block Size, Block ID, number of bits and bytes required for a block and each field that will be mapped to the widgets, and information regarding the offsets.
- Page Blocks contain the information of all the pages and widgets in the corresponding pages that has to be created and widget information as to which datafield the widget is mapped to in the datablock.

2.2 Using DisCon

1. Download the latest version of GOP files that you want to use. Save the files to a convenient directory on your hard drive.
2. Notice that there are several types of files
   a. .json JSON files
   b. .bin for GOP

Note: There is no .vbt file type.

Vbt.bin – Binary file

Vbt.json – JSON file

3. Start the DisCon. Select File, Open, and point to the directory where the video BIOS files are located. From the Files of Type selection, select All Files *.* if no JSON or Binary files are seen.
4. Select the Vbt.bin file and Select Vbt.json file and hit ok button.

File will load to the DisCon tool. Appropriate changes can now be made.

5. After changes have been made, save the file by selecting File, then Save or SaveAs to make sure the changes take effect.

2.3 Save JSON/ Apply Saved JSON

Changes that have been made to by the OEM can be saved via a Saved JSON File (.sjf). The saved JSON file is a JSON file that contains all of the current settings, not just the changes that have been made.

Note: The OEM may want to modify the saved JSON file so that the file will contain only the changes that were made by the user. This way the saved JSON file will not overwrite future default settings changes accidentally.

How to Create a Saved JSON File:

1. Open a Vbt.bin file for modification.
2. Make all desired settings changes using the DisCon tool.
3. Select File from the main menu, then we can see Save Changed and Save All.
4. Save Changed creates a sjf file for changed values.
5. Save All creates a sjf file for all the present values on the tool.
6. Create an .sjf file and save this file in a convenient location on your hard disk drive.
7. Edit the .sjf file as necessary using Notepad or WordPad.
8. Save the final Vbt.bin file and close the DisCon application.

How to Use a Saved Settings File:

1. Open a Vbt.bin file for modification.
2. Select File from the main menu, then Apply sjf.
3. Select the .sjf that contains all of the changes that you want to use.
4. Click Open. All of the settings will be applied.
5. Save the final Vbt.bin file and close the DisCon application.

Note: To Apply the SJF, it is recommended to have the same version of SJF file.

2.4 Command Line Support

1. To launch the tool using command line use:
   DisCon.exe -j <input JSON file> -b <input BINARY file>
2. To apply SJF and create a output binary file use:
   DisCon.exe -j <inputJSONfile> -b <inputBINfile> -s <sjfJSONfile> -o <outputBINfile> -a <SaveAllSjffile>

Where,

- -b : BINARY File
- -j : JSON File
- -s : SJF File(Saved Json File)
- -o : OUTPUT BINARY File
- -a : SJF File(All the fields)

2.5 Opening multiple VBT's

DisCon can be used to open only one VBT using one instance of Discon by design. But if there is a need to open multiple VBTs parallelly, following can be done:

1. Open the first VBT using DisCon. (Do not close DisCon!)
2. Run DisCon.exe again
3. Open the second VBT.

3 DisCon Modifications

The Display configuration tool is a tool used to view/ modify the configuration table used by the display driver for different hardware platforms. The tool is written based on an already existing tool in the organization. The new tool is written in python language version-3.7 with inbuilt libraries and JSON format file is used as script file instead of the bsf file which is used in the existing tool. The new tool performs all the functionalities performed by the current tool with added features and modifies the binary data based upon the response given by the user on the user interface.

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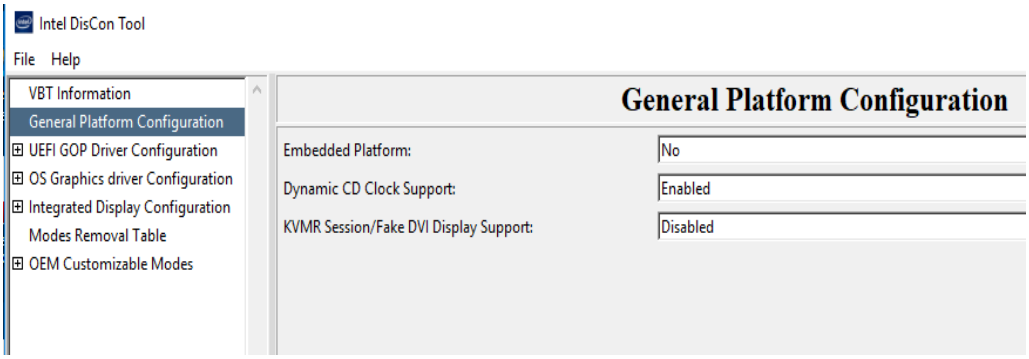
3.1 VBT Version

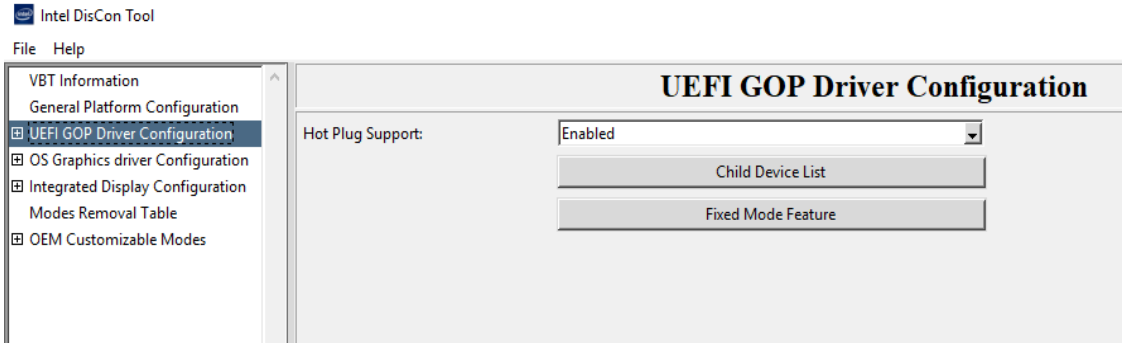
- VBT Version: User can click on this option in DisCon to get platform name and current VBT version.
- PLATFORM: platform name is Tigerlake
- Supported LFP type: Specifies if its eDP ,MIPI or both.

3.2 General Platform Configuration



- Embedded Platform: This feature allows a selectable option to determine whether the platform is embedded design or not.
- Dynamic CD clock Support: Enabling this feature configures optimal CD Clock frequency at run time
- KVMR Session/Fake DVI Display Support: When enabled, GOP and Gfx driver will keep a display pipe enable even if no displays are attached. When no displays are attached, GOP or Gfx driver will check VBT settings for EFP1/2/3/4 for DVI support. If any EFP setting supports DVI display type, GOP/driver will enable that port. If none of the EFP settings support DVI display type, GOP/driver will enable DVI on port-B by default.

3.3 UEFI GOP Driver Configuration

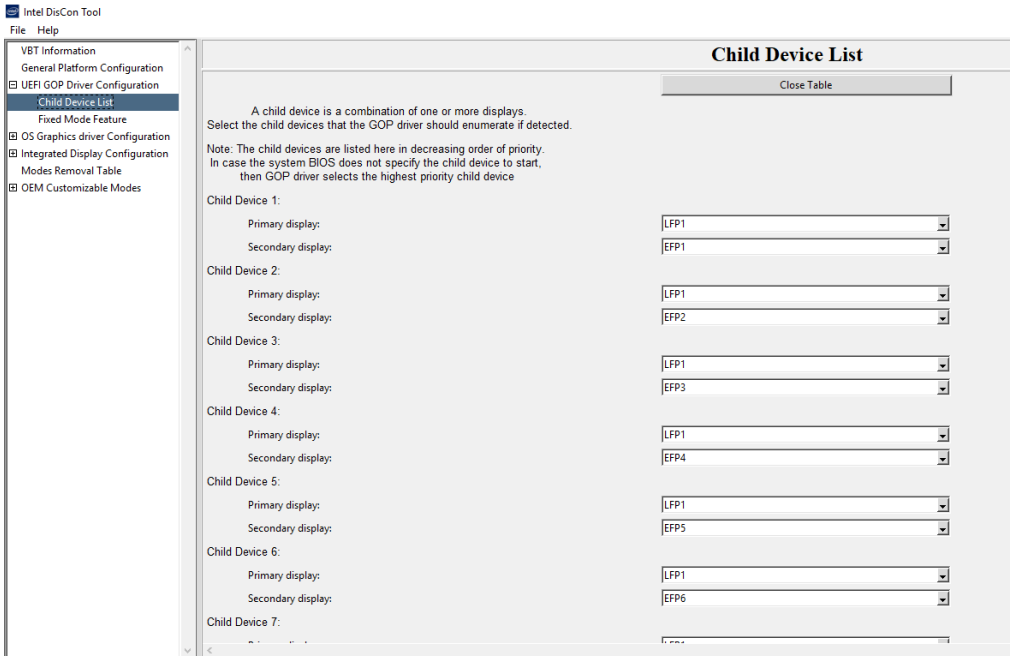


- Hot Plug Support: This feature is to enable/disable Hot Plug Support for EFP displays in GOP driver.

UEFI GOP Driver Configuration: This option in VBT will have 2 features

1. Child Device Configuration
2. Fixed Mode Feature

Child Device List:



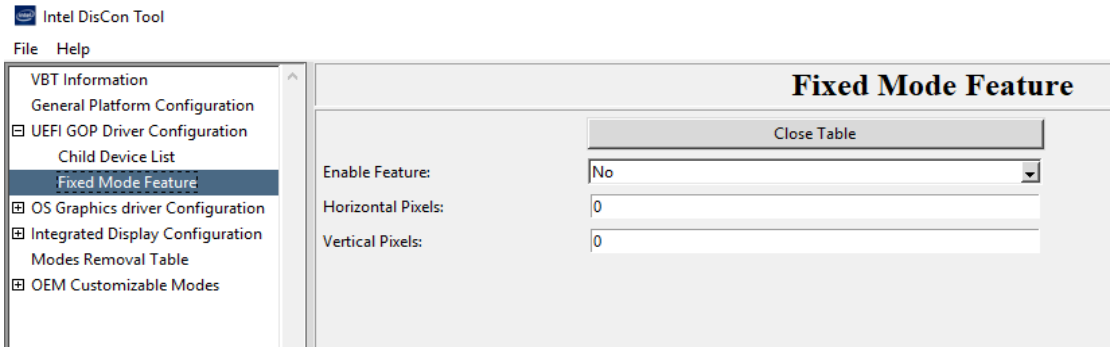
A child device is a combination of one or more displays. Select the child devices that the GOP driver should enumerate if detected.

There are 16 child devices each having a primary and secondary display.

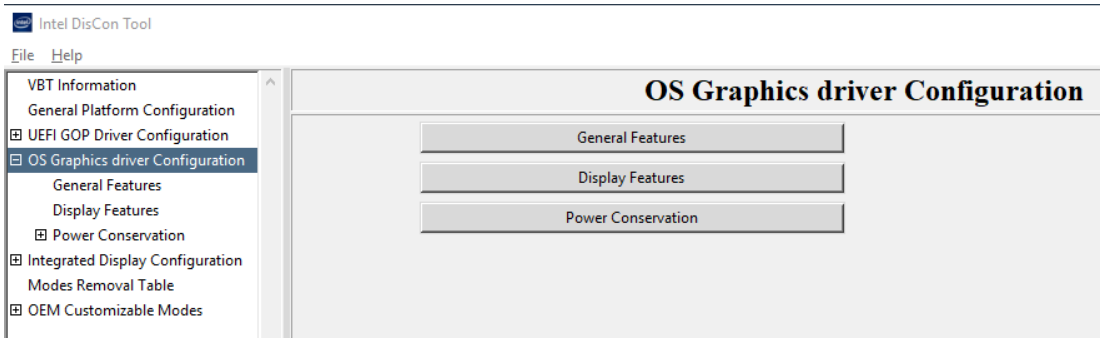
Note: The child devices are listed here in decreasing order of priority. In case the system BIOS does not specify the child device to start, then GOP driver selects the highest priority child device

Fixed Mode Feature

- Enable Feature: Fixed Mode Feature allows user to fix a mode during POST such that only that particular mode will be always set.
- Horizontal Pixels: This value specifies the horizontal pixels of the mode.
- Vertical Pixels: This value specifies the vertical pixels of the mode.



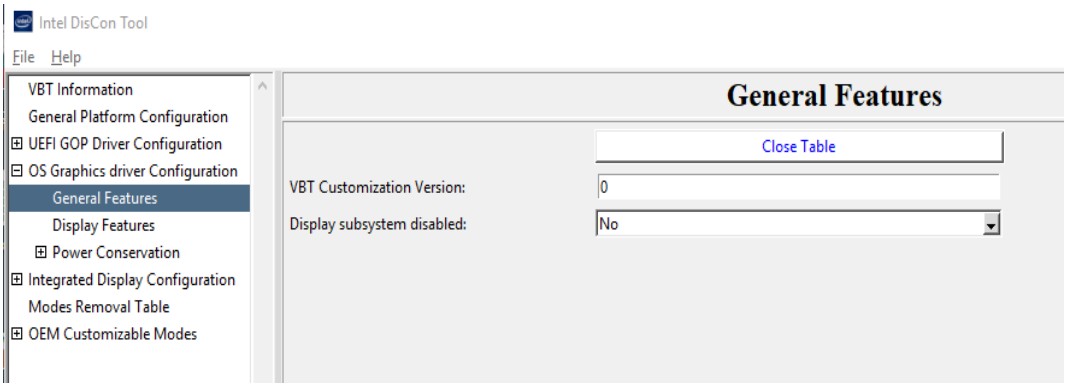
3.4 OS Graphics driver Configuration



OS Graphics driver Configuration: This option in VBT will have 3 features

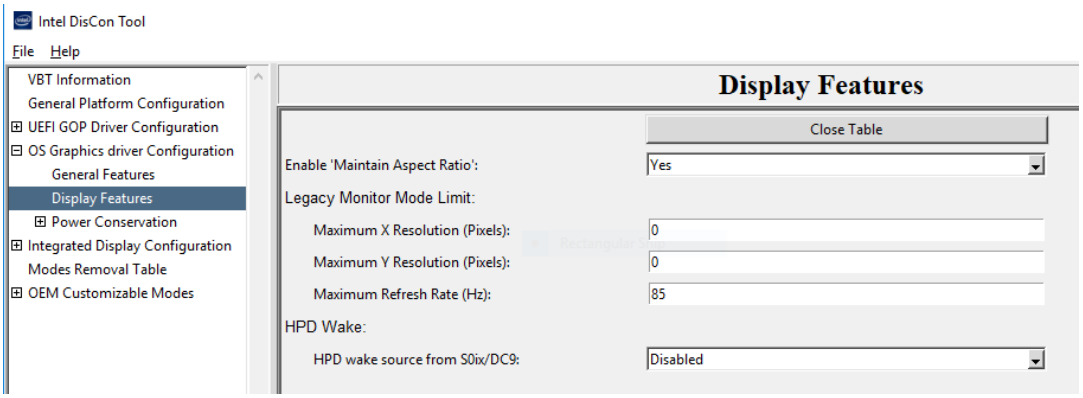
1. General Features
2. Display Features
3. Power Conservation

General Features:



- VBT Customization Version: This feature allows the OEM to have a customized VBT version number.
- Display subsystem disabled: This option allows windows driver to be aware that display subsystem is not needed. Driver could choose not to activate any display hardware if this bit is set. However this is only valid if there's no LFP on system or no force projectable connector.

Display Features:



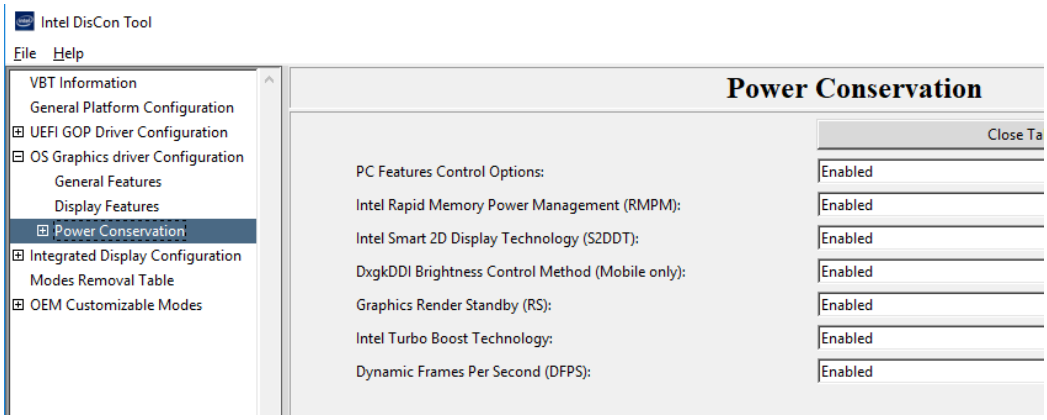
- Enable 'Maintain Aspect Ratio': This feature allows the OEM to enable or disable the 'Maintain Aspect Ratio' feature. When the option is set to Yes, the feature will be enabled and CUI will show for end user selection 'Maintain Aspect Ratio'. When the option is set to No,the complete 'Maintain Aspect Ratio' feature will be disabled.

- Legacy Monitor Mode Limit :
- Maximum X and Y Resolution(Pixels): This feature allows the limiting of selectable display modes when a legacy monitor is detected. The maximum resolution is specified by a maximum number of vertical and horizontal active pixels.
- Maximum Refresh Rate(Hz): This feature allows the limiting of selectable display modes when a legacy monitor is detected. The maximum refresh rate is specified in Hz.

Note: A legacy monitor is defined as a monitor with no DDC available.

HPD Wake**:** This feature enables HPD events like Hotplug/unplug as a wake up source from S0ix/DC9 in supported platforms. Based on the bit configuration, h/w and f/w routes the HPD interrupt to the OS/driver. The behavior (whether to wake the system from S0ix/DC9 or not)is controlled by display driver.

Power Conservation:



- PC Features Control Options**:** This feature determines the validity of the following PC Features Control Options.

- Intel Rapid Memory Power Management (RMPM)**:** This feature determines whether Intel Rapid Memory Power Management (RMPM) is to be enabled.

- Intel Smart 2D Display Technology (S2DDT)**:** This feature determines whether Intel Smart 2D Display Technology (S2DDT) is to be enabled.

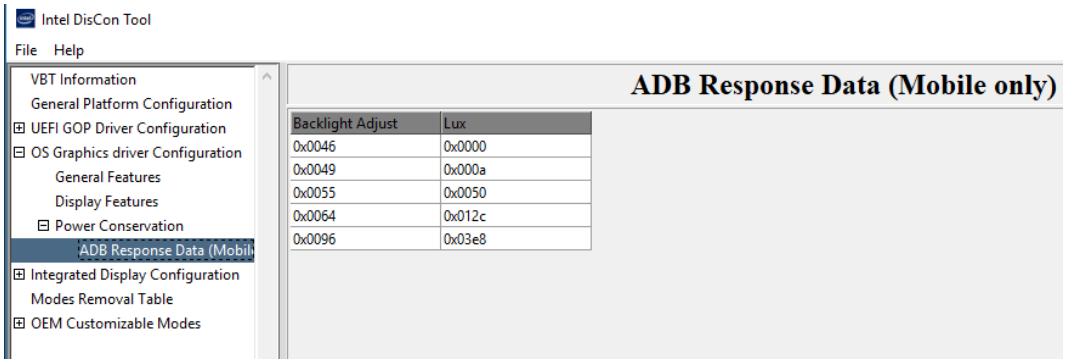
- DxgkDDI Brightness Control Method (Mobile only)**:** This option determines whether the Vista, Win7, and future version DxgkDDI LFP Brightness Control method is to be enabled.

- Graphics Render Standby (RS)**:** This feature determines whether Graphics Render Standby (RS)is to be enabled.

- Intel Turbo Boost Technology**:** This feature determines whether Intel Turbo Boost Technology is to be enabled.

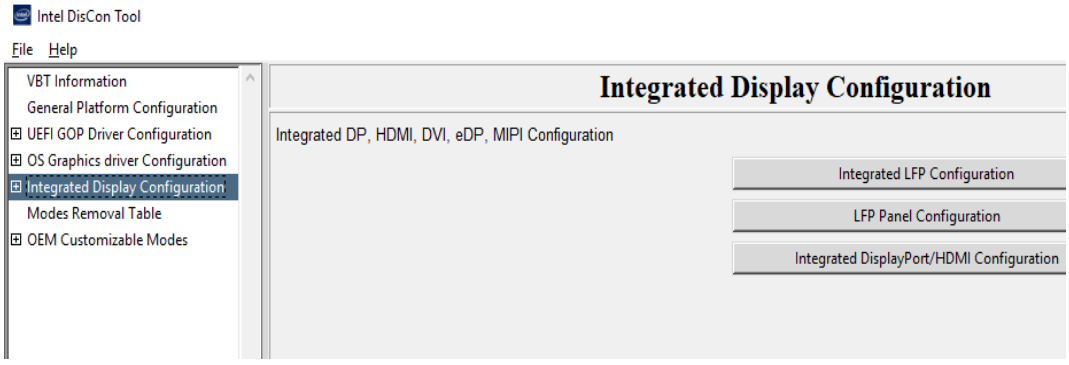
- Dynamic Frames Per Second (DFPS):** This feature determines whether Dynamic Frames Per Second is to be enabled.

ADB Response Data:



This feature defines values used to calibrate the Intel Automatic Display Brightness policy's response to account for specific hardware implementation details such as sensor placement and optics. Up to five points can be specified, where each point indicates a given ambient light illuminance to display luminance mapping specified as (<%BacklightAdjust>, <Lux>). Points should be listed in monotonically increasing order by ambient light illuminance (lux). A minimum of two points are required (min and max).

3.5 Integrated Display Configuration

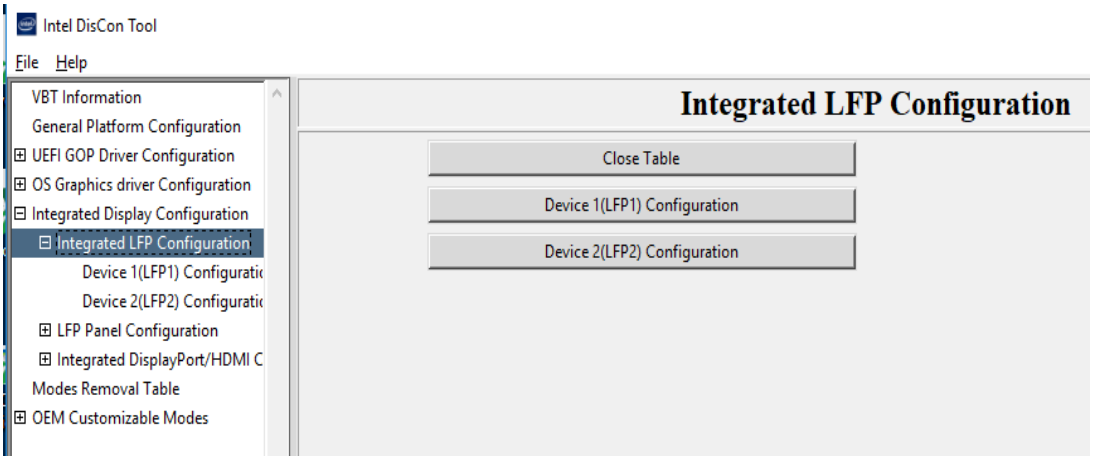


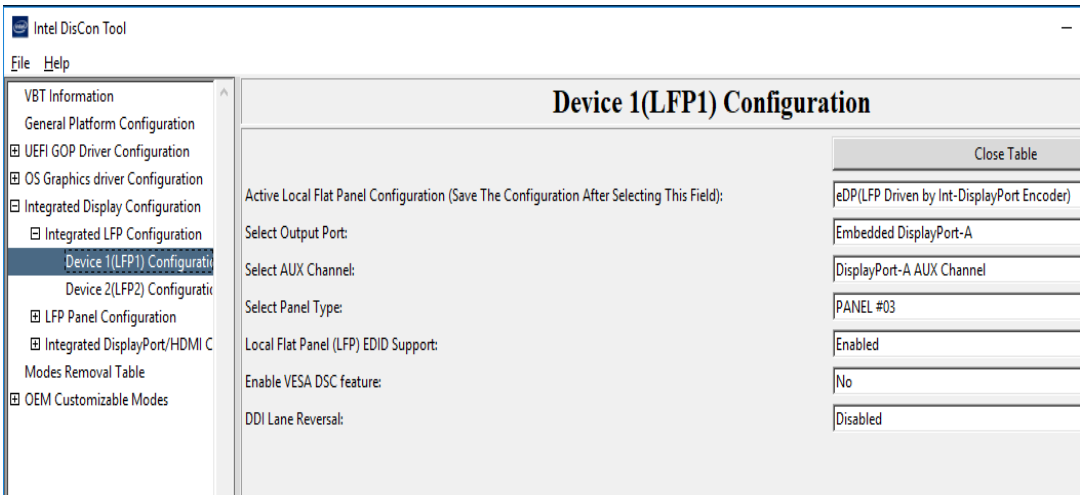
Integrated Display Configuration: This option in VBT will have 3 features

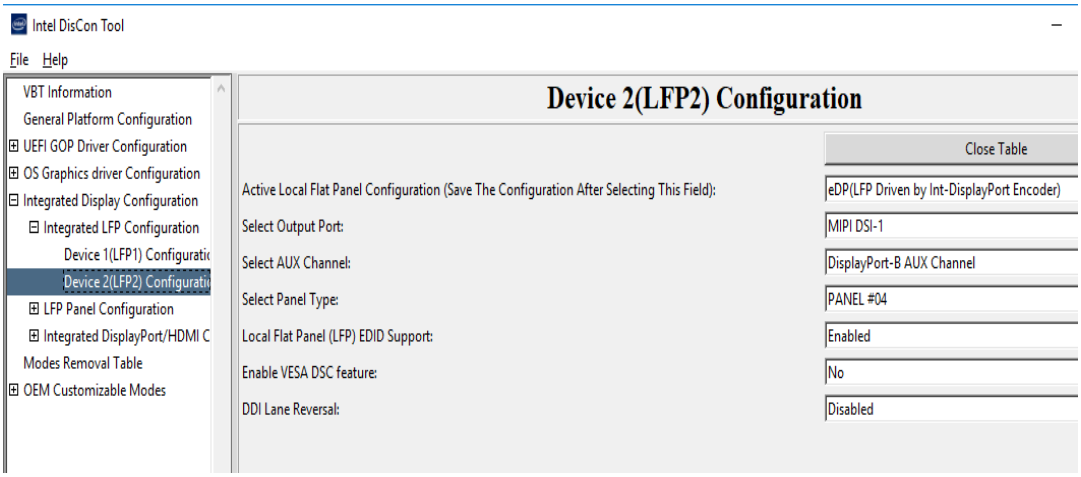
1. Integrated LFP Configuration
2. LFP Panel Configuration
3. Integrated DisplayPort/HDMI Configuration with External Connectors

Integrated LFP Configuration:

Device 1 (LFP1) and Device 2 (LFP2) –







- Active Local Flat Panel Configuration (Save The Configuration After Selecting This Field): This feature is for configuring LFP type.

- Select Output Port**:** This feature, when enabled, will activate support for an eDP Driver also uses the same data for enabling eDP on the selected port.
  Note: Do not enable any other digital ports on the same Port as eDP..

- Select AUX Channel**:** This feature specifies the AUX Channel for embedded-DisplayPort. This field is valid only if integrated eDP is selected for Device Type.

- Select Panel Type**:** Select the Local Flat Panel (LFP) which display driver will enable. If panel type is selected as 0xFF, Graphics Software will populate panel index by comparing actual PNP ID Data from panel to that of PNP ID Data for each panel in VBT. The panel index for which PNP ID Data matches with actual connected panel PNP ID Data is used by driver for all further references. EDID Read is assumed to be enabled if panel index is selected as 0xFF.

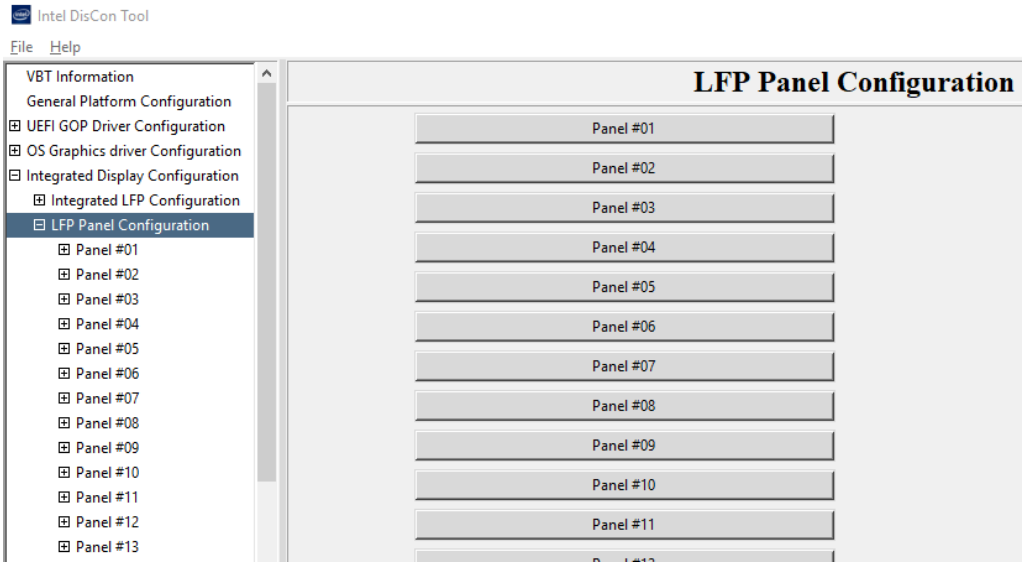
- Local Flat Panel (LFP) EDID Support: This feature, when enabled, will activate support for a LFP with an EDID. The GOP and driver will load the EDID and use its data to set appropriate timing on current panel. If disabled, there will be no attempt to read an EDID and other methods will be used to set panel timing.

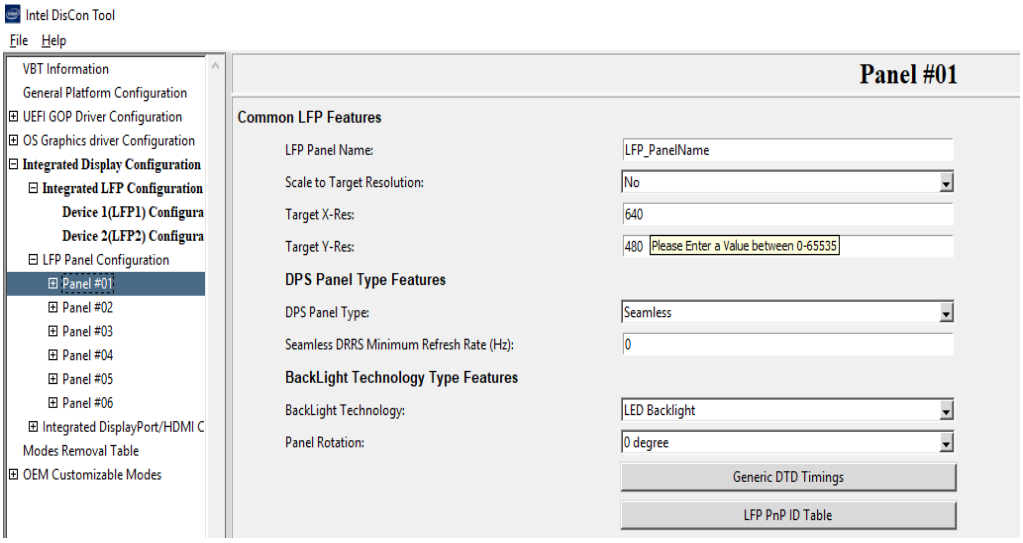
- Enable VESA DSC feature**:** This feature when set to yes, will enable VESA DSC compression feature for LFP display.For eDP displays, the field is not used and feature is controlled through panel DPCDs For MIPI displays, the fields is used to enable the feature.Note: When enabled, DSC parameters must be configured properly in the DSC parameters page in VBT.

- DDI Lane Reversal**:** This feature, when enabled, will set lane reversal bit for Selected Port.

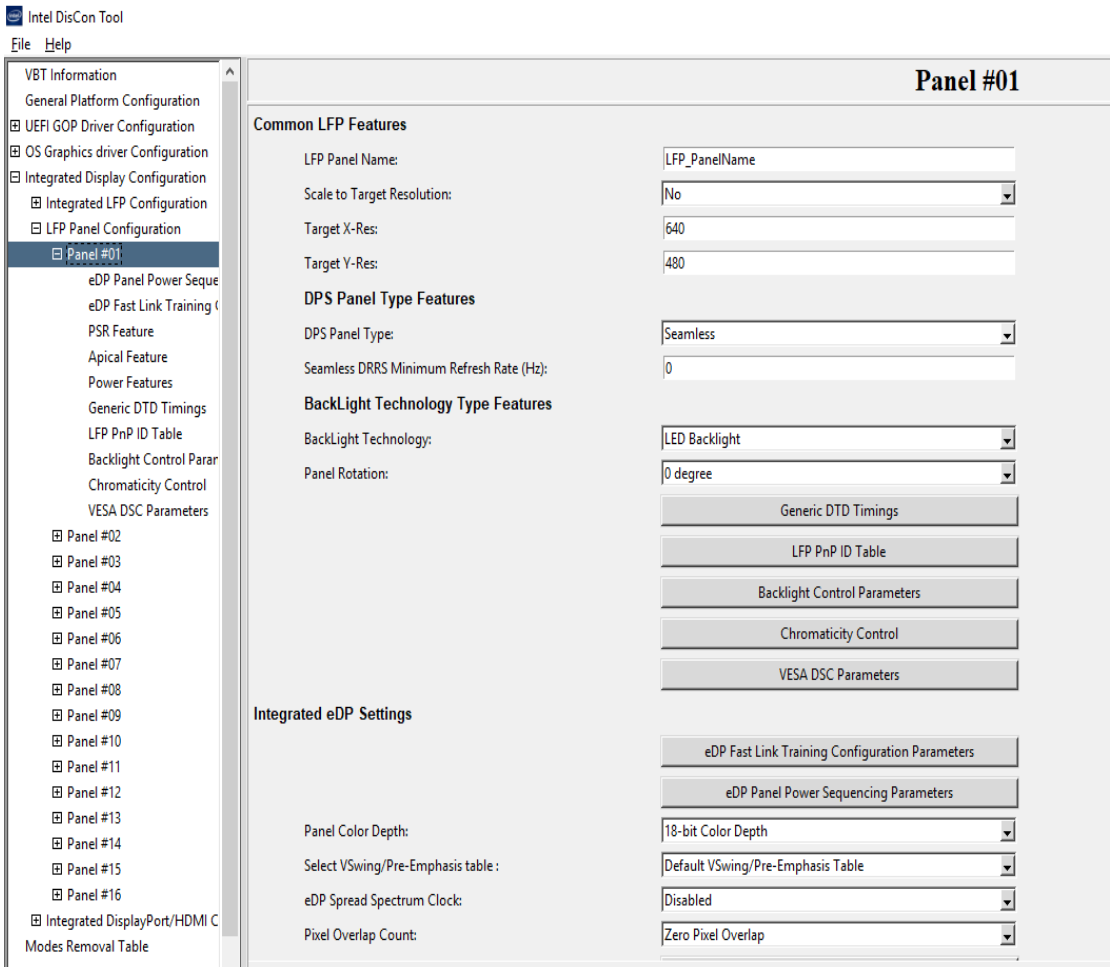
LFP Panel Configuration: This option in VBT will have 16 panels shown for edp and 6 panels for shown when mipi is selected.

Based on EDP and MIPI selection the corresponding pages and widgets are displayed.





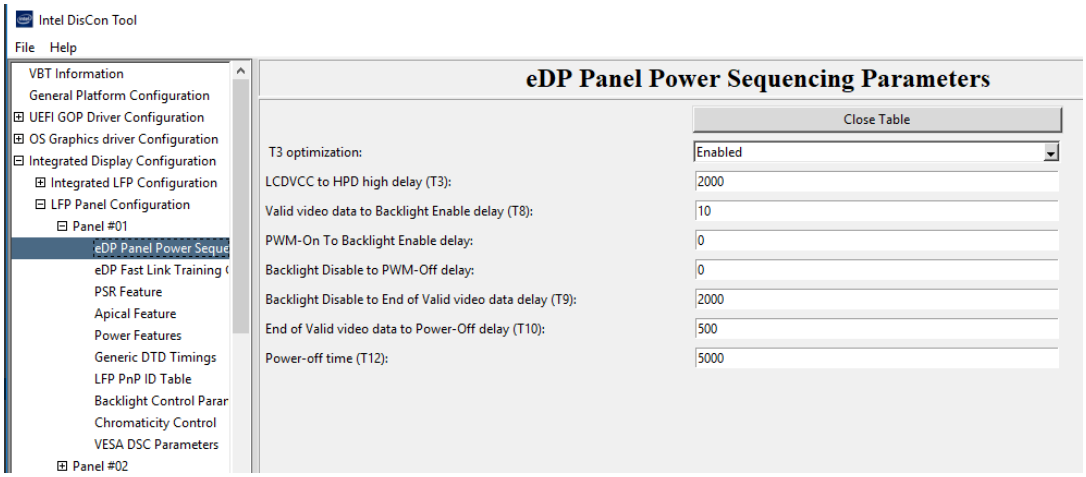
- There are 16 panels which have similar fields and perform the same functions for its respective panel.
- Below Panel number 1 fields and fields in its nested pages are explained. Refer the same for all the panels.
- When the MIPI option is selected then there are only 6 panels and relevant pages and widgets only displayed.



- LFP panel name: This feature defines the panel name, used by the driver only. Panel name can be only of maximum 13 characters and rest of the characterswill be truncated.
- Scale to Target Resolution: Selecting this feature will make the graphics driver to enable Scaling feature by taking the Horizontal and Vertical resolution from Target X-Res and Target Y-Res fields.

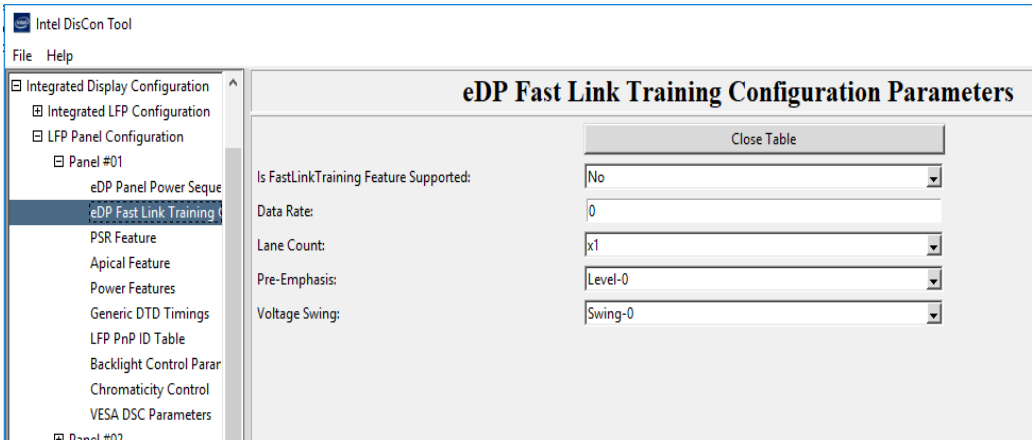
- Target X and Y -Res : This value specifies the Target X and Target Y Resolution for this panel.
- DPS Panel Type: This feature allows OEM to select the DPS Panel Type.
- Seamless DRRS Minimum Refresh Rate: Using this field the minimum Refresh Rate to be used for Seamless DRRS feature can be entered in Hertz.
- BackLight Technology: This feature allows OEM to select the Backlight Technology.
- Panel Rotation: This feature specifies the Panel Rotation of the LFP panel used.
- Panel Color Depth: This feature specifies the color depth of eDP panel used.
- Select VSwing/Pre-Emphasis table: This feature selects the VSwing Pre-Emphasis setting table to be used.
- eDP Spread Spectrum Clock: This feature will allow users to disable/enable Spread Spectrum Clock for eDP.
- Pixel Overlap Count: Select the number of Pixels to be overlapped per half of Scanline while using Edp Multi-SST(MSO) feature.

eDP Panel Power Sequencing –



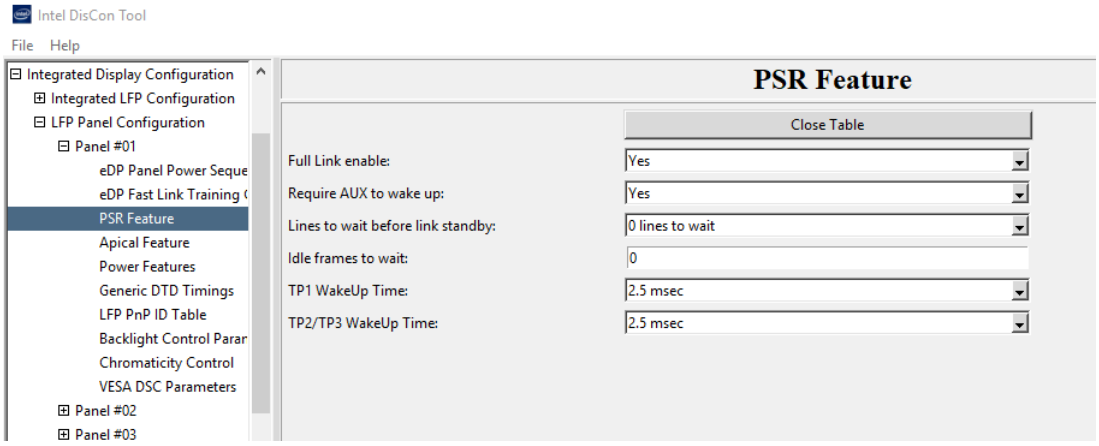
- T3 optimization: This feature enables or disables T3 optimization.
- LCDVCC to HPD high delay (T3): Using this field the delay from LCDVCC to HPD high can be specified in 100uS.
- Valid video data to Backlight Enable delay (T8): Using this field the delay from Start of Valid video data from Source to Backlight Enable can be specified in 100uS.
- PWM-On To Backlight Enable delay: Using this field the delay from PWM-On to Backlight Enable can be specified in 100uS.
- Backlight Disable to PWM-Off delay: Using this field delay from Backlight Disable to PWM-Off can be specified in 100uS.
- Backlight Disable to End of Valid video data delay (T9): Using this field the delay from Backlight Disable to End of Valid video data can be specified in 100uS.
- End of Valid video data to Power-Off delay (T10): Using this field delay from End of Valid video data from Source to Power-Off can be specified in 100uS.
- Power-off time (T12): Using this field Power-off time can be specified in 100uS.

eDP Fast Link Training Configuration Parameters -



- Is FastLinkTraining Feature Supported: This feature allows for the selection of the Fast Link Training feature is to be enabled or disabled.
- Data Rate: This field specifies Data Rate to be used for Fast Link Training in unit of 200KHz for the embedded DP link.
- Lane Count: This feature allows for the selection of the Lane Count (Port Width) for the embedded DP link.
- Pre-Emphasis: This feature allows for the selection of the Pre-emphasis value for the embedded DP link.
- Voltage Swing: This feature allows for the selection of the Voltage Swing value for the embedded DP link.

PSR feature –

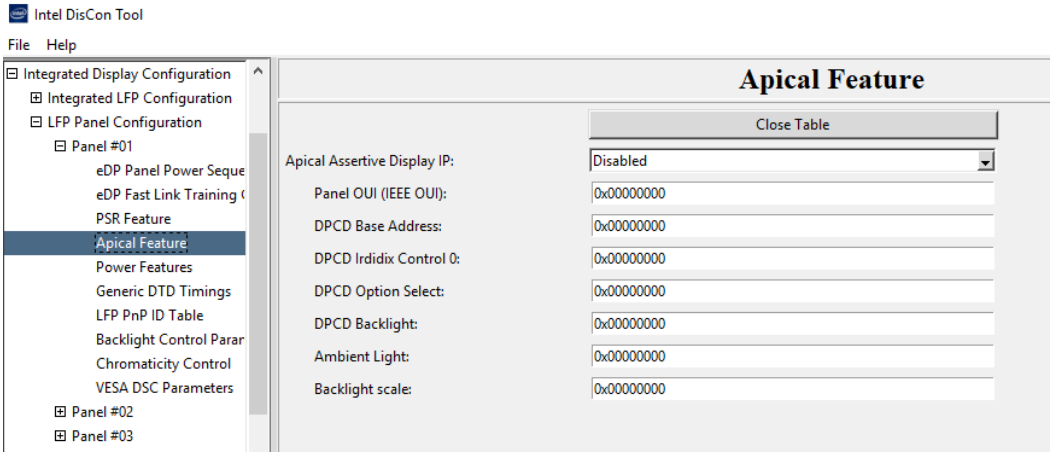


- Full Link enable: When panel is in PSR mode and 'Full Link Enable' is set to Yes, Link is kept in standby state.
- Require AUX to wake up: When panel is exiting PSR mode and 'Require AUX to wake up' is set to Yes, the AUX channel handshake(link training is required) will be used.
- Lines to wait before link standby: This field determines Lines to wait before link standby.
- Idle frames to wait: Idle frames to wait for PSR enable.Allowed

values 0-15. Default value is 0.

- TP1 WakeUp Time: This field selects the link training TP1(Training Pattern1) time during PSR exit(wake up).
- TP2/TP3 WakeUp Time: This field selects the link training TP2(Training Pattern2) or TP3(Training Pattern3) time during PSR exit(wake up).

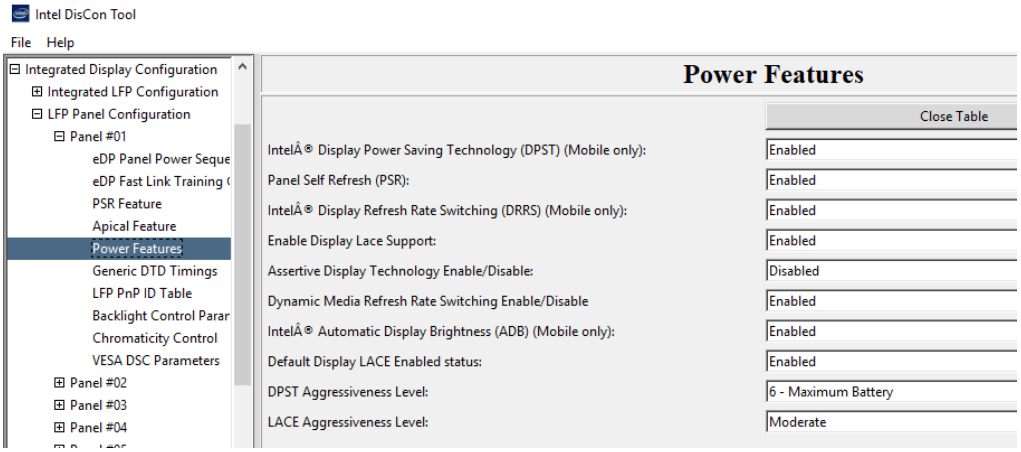
Apical Feature –



- Apical Assertive Display IP: This field enables/disables the Apical Assertive Display IP for this panel.
- Panel OUI (IEEE OUI): This field specifies the Apical IP specific Panel OUI field.
- DPCD Base Address: This field specifies the Apical IP specific DPCD base address field.
- DPCD Irdidix Control 0: This field specifies the Apical IP specific DPCD Irdidix control 0 field.
- DPCD Option Select: This field specifies the Apical IP specific DPCD option select field.
- DPCD Backlight: This field specifies the Apical IP specific backlight value.
- Ambient Light: This field specifies the Apical IP specific Ambient light value.

- Backlight scale: This field specifies the Apical IP specific backlight scale field.

Power Features –

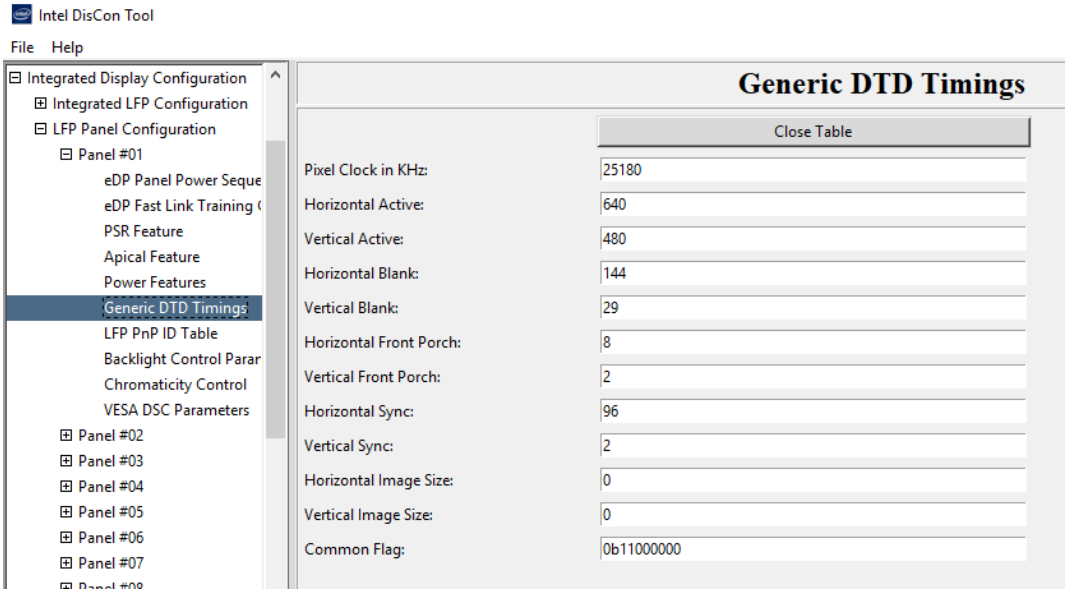


- Intel® Display Power Saving Technology (DPST) (Mobile only): This feature determines whether the Intel® Display Power Savings Technology (DPST) is enabled or disabled.
- Panel Self Refresh (PSR): This feature determines whether Panel Self Refresh (PSR) feature is to be enabled.
- Intel® Display Refresh Rate Switching (DRRS) (Mobile only): This feature determines whether Intel® Display Refresh Rate Switching (DRRS) is to be enabled.
- Enable Display Lace Support: This feature, when enabled, will set Display Lace Support otherwise, the functionality will be disabled.
- Assertive Display Technology Enable/Disable: This feature determines whether Assertive display technology is to be enabled.
- Dynamic Media Refresh Rate Switching Enable/Disable: This feature determines whether Dynamic media refresh rate switching is to be enabled.
- Intel® Automatic Display Brightness (ADB) (Mobile only): This feature determines whether Intel® Automatic Display Brightness is to be enabled.
- Default Display LACE Enabled status: This feature, when enabled,

will set Default Display LACE Enabled status otherwise, the functionality will be disabled.

- DPST Aggressiveness Level: This feature allows for the selection of DPST Aggressiveness level for this Panel Type.
- LACE Aggressiveness Level: This feature allows for the selection of LACE Aggressiveness level for this Panel Type.

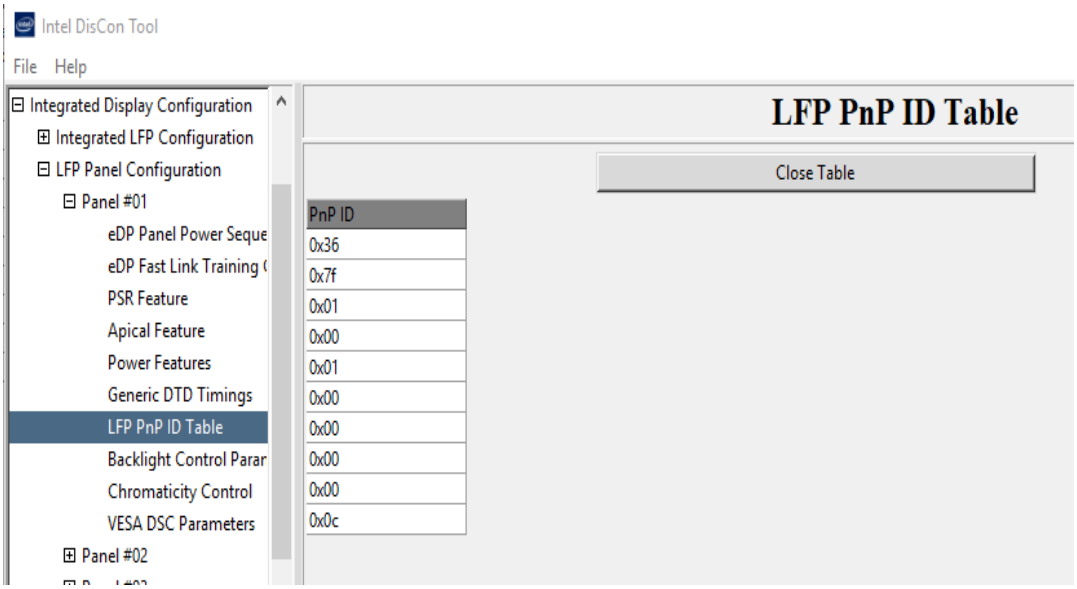
Generic DTD Timings –



- Pixel Clock in KHz: Pixel Clock (in KHz) Range from 0.001 to 4294967.295 MP/s.
- Horizontal Active: Horizontal Active Image Pixels Number of Pixels ranges from 1 to 65,536.
- Vertical Active: Vertical Active Image Pixels Number of Pixels ranges from 1 to 65,536.
- Horizontal Blank: Horizontal Blank Pixels Number of Pixels ranges from 1 to 65,536.
- Vertical Blank: Vertical Blank Pixels Number of Pixels ranges from 1 to 65,536.
- Horizontal Front Porch: Horizontal Front Porch Number of Pixels ranges from 1 to 65,536.

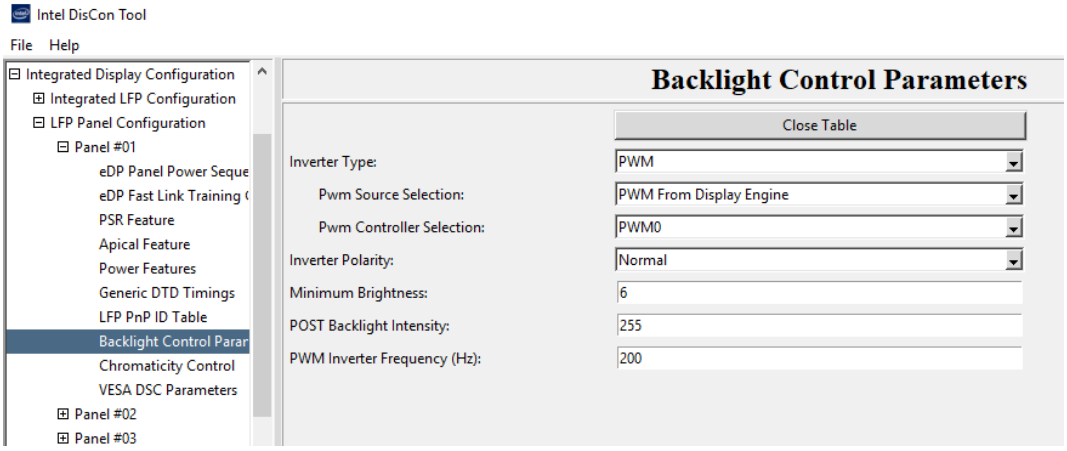
- Vertical Front Porch: Vertical Front Porch Number of Pixels ranges from 1 to 65,536.
- Horizontal Sync: Horizontal Sync Width Number of Pixels ranges from 1 to 65,536.
- Vertical Sync: Vertical Sync Width Number of Pixels ranges from 1 to 65,536.
- Horizontal Image Size: Horizontal Addressable Video Image Size in mm represented by 16bits. Image size multiplier 1.00 mm precision.
- Vertical Image Size: Vertical Addressable Video Image Size in mm represented by 16bits. Image size multiplier 1.00 mm precision.
- Common Flag: Common DTD Flags

LFP PnP ID Table –



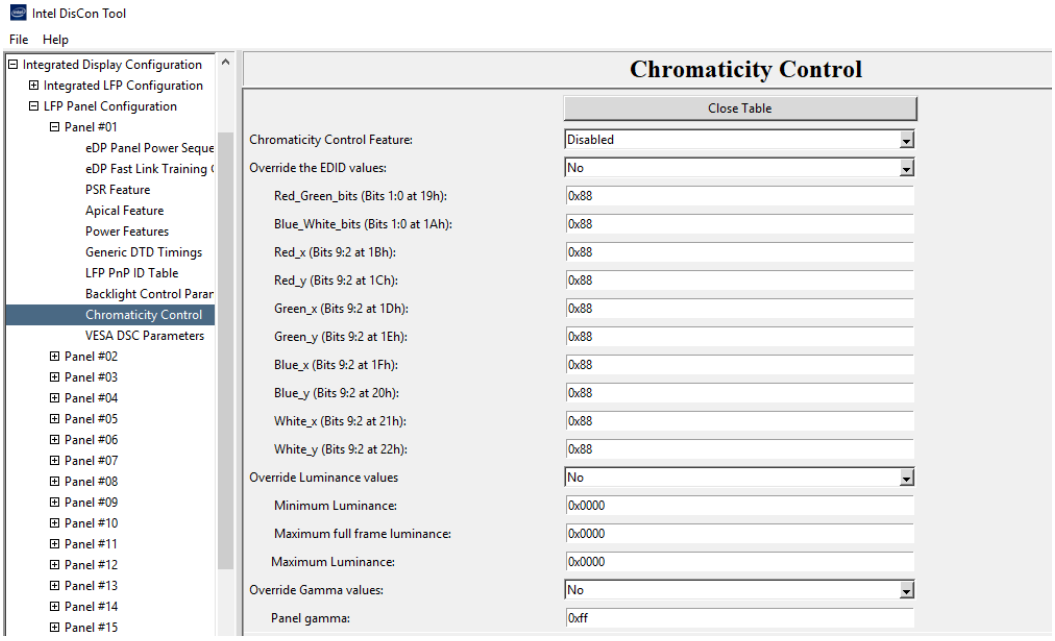
This feature allows the 10 bytes of EDID Vendor/Product ID starting at offset 08h to be used as a PnP ID.

Backlight Control Parameters –



- Inverter Type: This feature allows for the selection of the Backlight Inverter type that is to be used to control the backlight brightness of the LFP.
- Pwm Source Selection: This field allows to select the Source of the PWM to be used for the selected Local Flat Panel.
- Pwm Controller Selection: This field allows to select the PWM Controller to be used for the selected Local Flat Panel.
- Inverter Polarity: This feature allows the backlight inverter polarity to be specified.
- Minimum Brightness: This feature allows defining the absolute minimum backlight brightness setting.
- POST Backlight Intensity: This feature is used to set default brightness value at POST.
- PWM Inverter Frequency (Hz): This feature allows for the definition of the frequency needed for PWM Inverter.

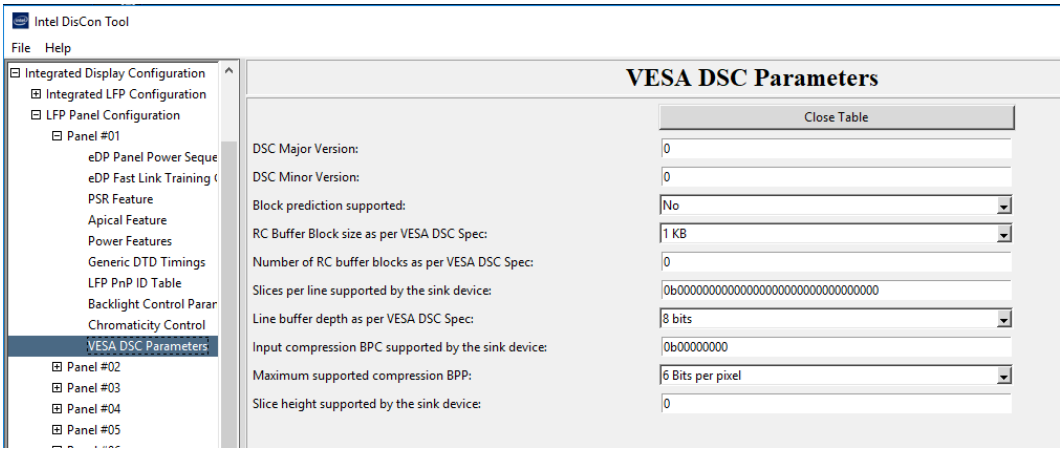
Chromaticity Control -



- Chromaticity Control Feature: This bit enables Chromaticity feature. If this bit is enabled, EDID values for chromaticity will be used, else feature is disabled.
- Override the EDID values: This option when enabled along with Chromaticity feature will override EDID values through following VBT data.
- Red Green bits (Bits 1:0 at 19h): Lower order bytes (bits 1 and 0) of Red, Green Coordinates represented as Rx1 Rx0 Ry1 Ry0 Gx1 Gx0 Gy1 Gy0.
- Blue_White_bits (Bits 1:0 at 1Ah): Lower order bytes (bits 1 and 0) of Blue, White Coordinates represented as Bx1 Bx0 By1 By0 Wx1 Wx0 Wy1 Wy0
- Red x (Bits 9:2 at 1Bh) and Red y (Bits 9:2 at 1Ch): Bits 9:2 of red color x and y coordinates.
- Green x (Bits 9:2 at 1Dh) and Green y (Bits 9:2 at 1Eh): Bits 9:2 of Green color x and y coordinates.
- Blue x (Bits 9:2 at 1Fh) and Blue y (Bits 9:2 at 20h): Bits 9:2 of Blue color x and y coordinates.

- White_x (Bits 9:2 at 21h) and White_y (Bits 9:2 at 22h): Bits 9:2 of White color x and y coordinates.
- Override Luminance values: This option when enabled along with Chromaticity feature will override luminance values following VBT values.
- Minimum Luminance and Maximum full frame luminance: Minimum and Maximum Full frame luminance value. 2 byte value, encoded in IEEE 754 half-precision binary floating point format.
- Override Gamma values: This option when enabled along with Chromaticity feature will override gamma values through following VBT data.
- Panel gamma: Value shall define the gamma range.

VESA DSC Parameters -

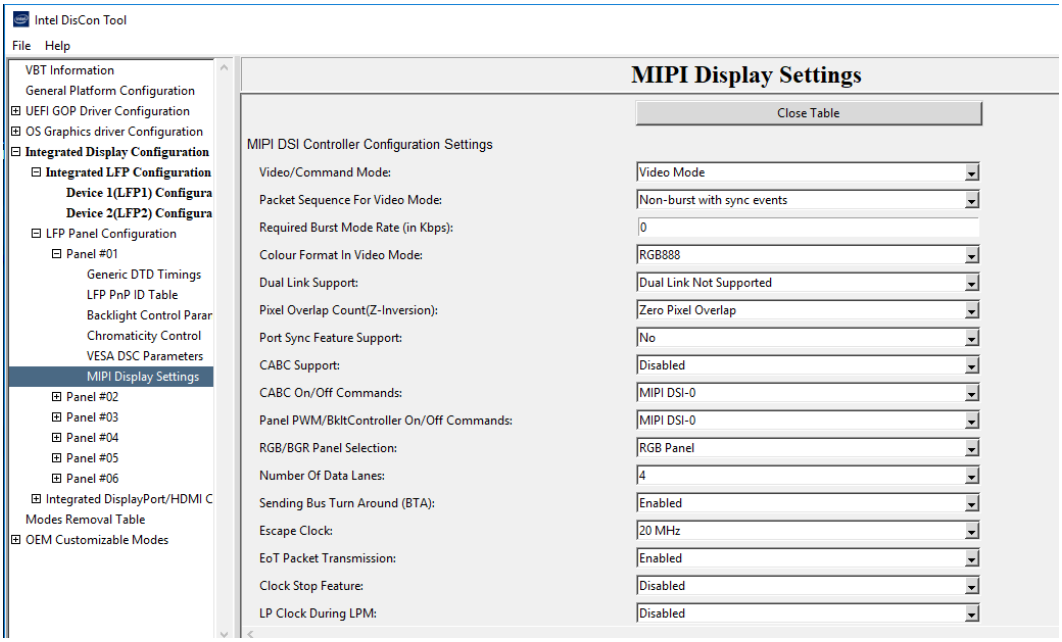


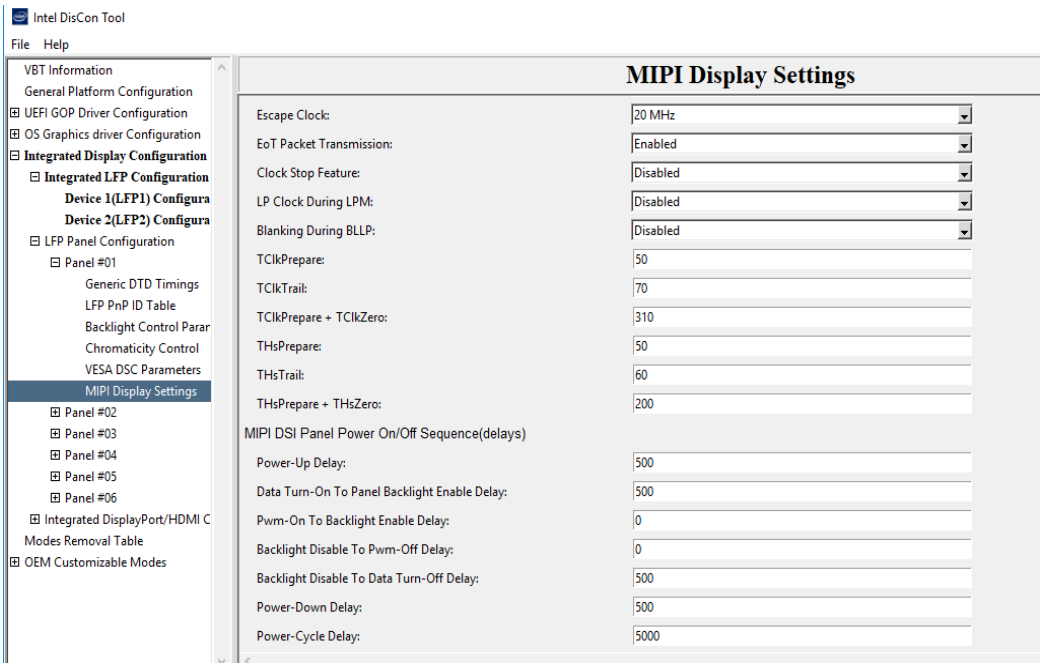
- DSC Major Version and DSC Minor Version: VESA DSC Major and Minor revision field.
- Block prediction supported: Sink supports block prediction as per the VESA DSC Spec.
- RC Buffer Block size as per VESA DSC Spec: RC buffer block size for a single RC buffer as defined by the VESA DSC spec.
- Number of RC buffer blocks as per VESA DSC Spec: This field defines the number of RC buffers as per VESA DSC spec.

- Slices per line supported by the sink device: This field defines the slices per line supported by the sink device.
- Line buffer depth as per VESA DSC Spec: Line buffer depth in bits as per VESA DSC spec.
- Input compression BPC supported by the sink device: This field defines the compression input bpc supported by the sink device.
- Maximum supported compression BPP: As of today, we are supporting 6/8/10/12 BPP for compression output.
- Slice height supported by the sink device: Slice height supported by the sink device for DSC slice. Note: Slice height must divide the picture height uniformly.

MIPI Display Settings –

- Appears only when the MIPI is selected for LFP.
- When Mipi is selected for both LFPs there are only 6 pages appearing under panels and in total there are 6 panels.





- Video/Command Mode: This feature helps in selecting Video/Command Mode.
- Packet Sequence For Video Mode: This feature helps in selecting packet sequence for Video Mode.
- Required Burst Mode Rate (in Kbps): This feature allows to enter Required Burst Mode Rate in Kilo bits per sec. This should be greater than Non-Burst Mode Rate.
- Colour Format In Video Mode: This feature helps in selecting supported colour format in Video Mode.
- Dual Link Support: This feature allows to select type of dual link.
- Pixel Overlap Count(Z-Inversion): Select the number of Pixels to be overlapped per half of Scanline while using MIPI Dual Link Front-Back video mode.
- Port Sync Feature Support: This field reports if Dual Port Sync Feature can be supported by the Mipi Dsi panel.
- CABC Support: This feature helps in selecting CABC_Support.
- CABC On/Off Commands: Select the MIPI Port for sending CABC On/Off Commands in case of Dual link MIPI panels. This field is

ignored in single link MIPI case.

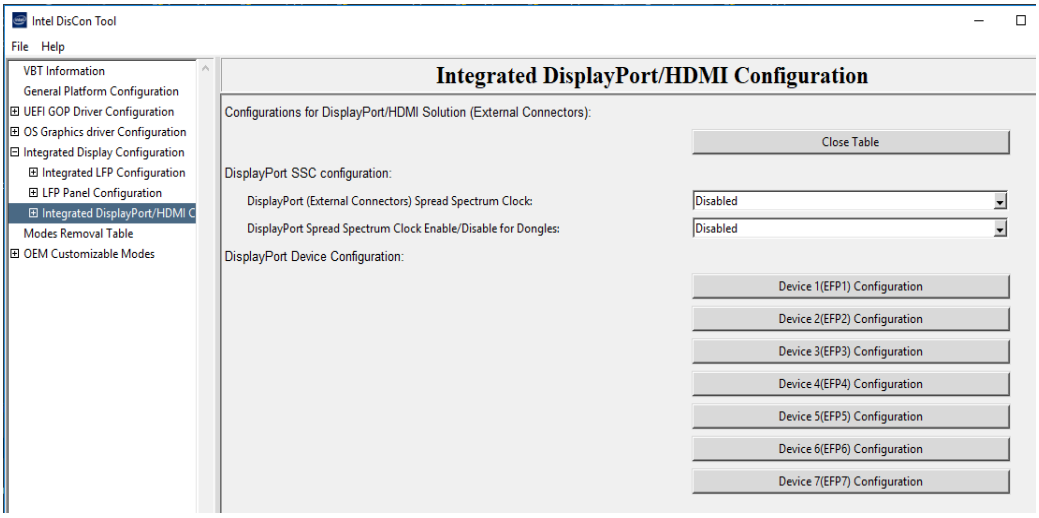
- Panel PWM/BkltController On/Off Commands: Select the MIPI Port for sending Panel PWM/BkltController On/Off Commands in case of Dual link MIPI panels. This field is ignored in single link MIPI case
- RGB/BGR Panel Selection: Select if the panel is RGB or BGR
- Number Of Data Lanes: This feature allows to select number of data lanes going to use for MIPI DSI.
- Sending Bus Turn Around (BTA): Enable or Disable sending Bus Turn Around to the Peripheral.
- Escape Clock: This feature helps to select frequency of Escape Clk.
- EoT Packet Transmission: This feature helps to either enable or disable EoT packet Transmission.
- Clock Stop Feature: To enable or disable clock stopping feature during BLLP timing in a MIPI DPI (video) mode.
- LP Clock During LPM: In continuous clock mode (Clock Stop Feature disabled), Clock lane will always be in HS mode. If this feature is enabled, Clock lane also goes to LP state once per frame during the mandated data lane LPM in MIPI DSI DPI (video) mode.
- Blanking During BLLP: This feature helps to send Blanking packets during BLLP regions in a MIPI DSI DPI (video) mode.
- TClkPrepare: This feature allows to enter TClkPrepare in ns.
- TClkTrail: This feature allows to enter TClkTrail in ns.
- TClkPrepare + TClkZero: This feature allows to enter TClkPrepare + TClkZero in ns.
- THsPrepare: This feature allows to enter THsPrepare in ns.
- THsTrail: This feature allows to enter THsTrail in ns.
- THsPrepare + THsZero: This feature allows to enter THsPrepare + THsZero in ns.
- Power-Up Delay: Delay to be given after panel power up in 100uS.
- Data Turn-On To Panel Backlight Enable Delay: Delay to be given

after MIPI DATA TURN ON and before backlight enabling in 100uS.

- Pwm-On To Backlight Enable Delay: Delay to be given after PWM-On and before Backlight Enable in 100uS.
- Backlight Disable To Pwm-Off Delay: Delay to be given after Backlight Disable and before Pwm-Off in 100uS.
- Backlight Disable To Data Turn-Off Delay: Delay to be given after Backlight Disable and before MIPI DATA TURN OFF in 100uS.
- Power-Down Delay: Delay to be given before panel power down in 100uS.
- Power-Cycle Delay: Delay to be given before panel power up and after panel power down in 100uS.

Integrated DisplayPort/HDMI Configuration –

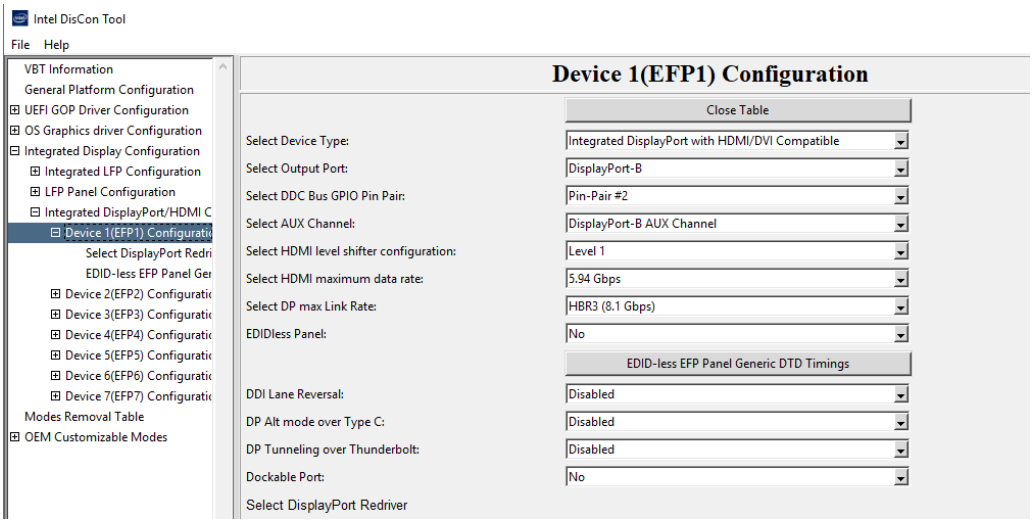
- There are 7 EFPs which are similar with same fields and each field performs the same functionality for its respective EFP.
- Below, fields in Device 1 configuration and its nested pages are explained. Refer the same for all the 7EFP's



- DisplayPort (External Connectors) Spread Spectrum Clock: This feature allow OEMs to enable/disable SSC for external DisplayPort.

- DisplayPort Spread Spectrum Clock Enable/Disable for Dongles: This feature is to enable or disable DisplayPort Dongle Spread Spectrum Clock when dongle are used and the attached DisplayPort panel should support SSC.

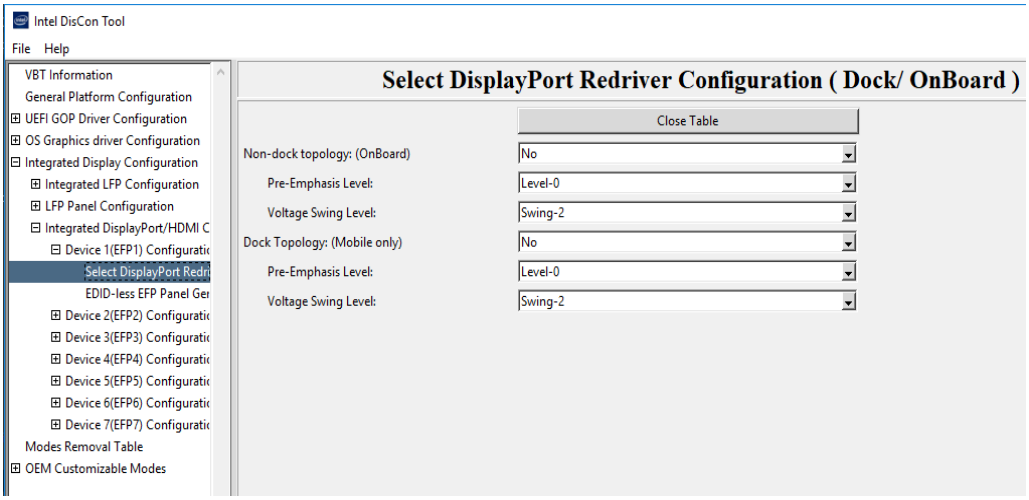
Device 1 (EFP1) Configuration–



- Select Device Type: This feature specifies the Device Type for this add-in device.
- Select Output Port: This feature specifies which DVO port the device is configured.
- Select DDC Bus GPIO Pin Pair: This feature specifies the GPIO pin pair used as DDC bus by this device.
- Select AUX Channel: This feature specifies the AUX Channel for int-DisplayPort.
- Select HDMI level shifter configuration: This feature specifies the Level shifter configuration for HDMI.
- Select HDMI maximum data rate: This feature limits the maximum data rate per lane for HDMI.
- Select DP max Link Rate: This feature limits the maximum link rate for DP Port.
- EDIDless Panel: If the Attached panel is EDIDless select Yes and the supplied DTD takes priority.

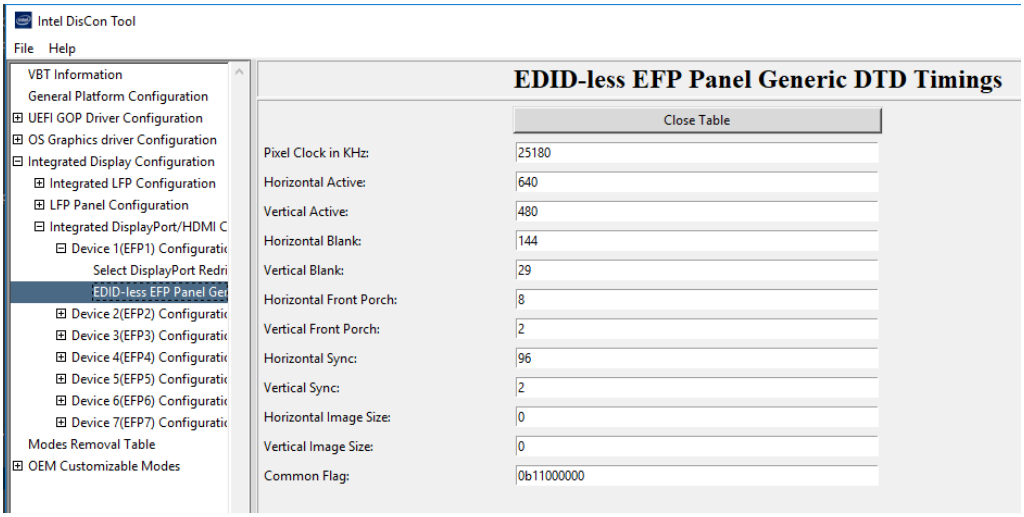
- DDI Lane Reversal: This feature, when enabled, will set lane reversal bit for selected Port.
- DP Alt mode over Type C: This option Enables/Disables DP alternate mode over type C ports.
- DP Tunneling over Thunderbolt: This option Enables/Disables DP tunneling over Thunderbolt for selected Port.
- Dockable Port: This feature will describe if this Port is Dockable or Not.

Select DisplayPort Redriver Configuration (Dock/ OnBoard)–



- Non-dock topology (OnBoard): This feature will describe if Non-Dock Topology/OnBoard Redriver DP Link is present or Not.
- Pre-Emphasis Level: This feature allows for the selection of Pre-emphasis level for the OnBoard redriver DP link.
- Voltage Swing Level: This feature allows for the selection of voltage swing level for the OnBoard redriver DP link.
- Dock Topology (Mobile only): This feature will describe if Dock Topology/Dock Redriver DP Link is present or not.
- Pre-Emphasis Level: This feature allows for the selection of Pre-emphasis level for the Dock redriver DP link.
- Voltage Swing Level: This feature allows for the selection of voltage swing level for the Dock redriver DP link.

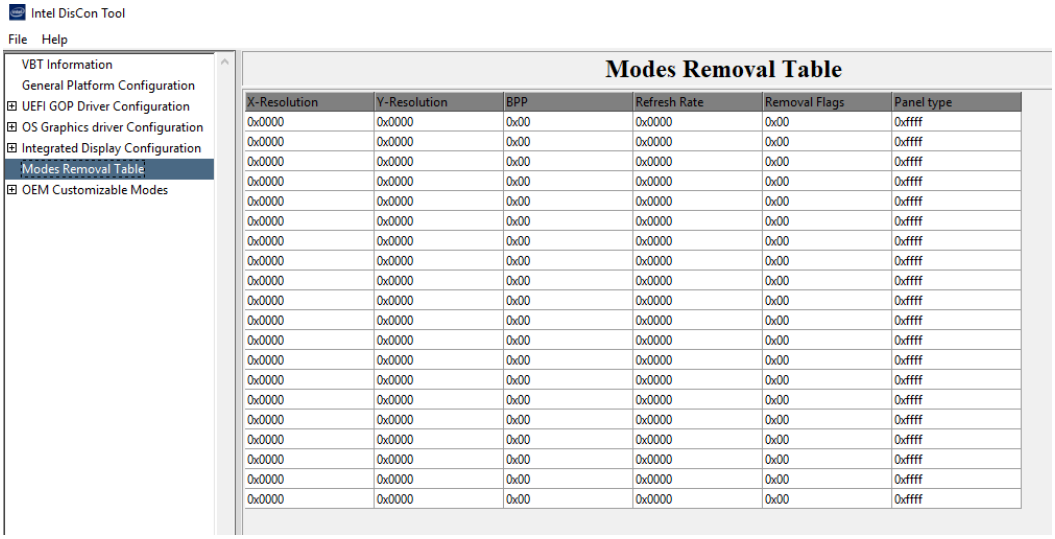
EDID-less EFP Panel Generic DTD Timings –



- Pixel Clock in KHz: Pixel Clock (in KHz) Range from 0.001 to 4294967.295 MP/s.
- Horizontal Active: Horizontal Active Image Pixels Number of Pixels ranges from 1 to 65,536.
- Vertical Active: Vertical Active Image Lines Number of lines ranges from 1 to 65,536.
- Horizontal Blank: Horizontal Blank Pixels Number of Pixels ranges from 1 to 65,536.
- Vertical Blank: Vertical Blank lines Number of lines ranges from 1 to 65,536.
- Horizontal Front Porch: Horizontal Front Porch Number of Pixels ranges from 1 to 65,536.
- Vertical Front Porch: Vertical Front Porch Number of lines ranges from 1 to 65,536.
- Horizontal Sync: Horizontal Sync Width Number of Pixels ranges from 1 to 65,536.
- Vertical Sync: Vertical Sync Width Number of lines ranges from 1 to 65,536.
- Horizontal Image Size: Horizontal Addressable Video Image Size in mm represented by 16bits. Image size multiplier 1.00 mm precision.

- Vertical Image Size: Vertical Addressable Video Image Size in mm represented by 16bits. Image size multiplier 1.00 mm precision.
- Common Flag: Common DTD Flags.

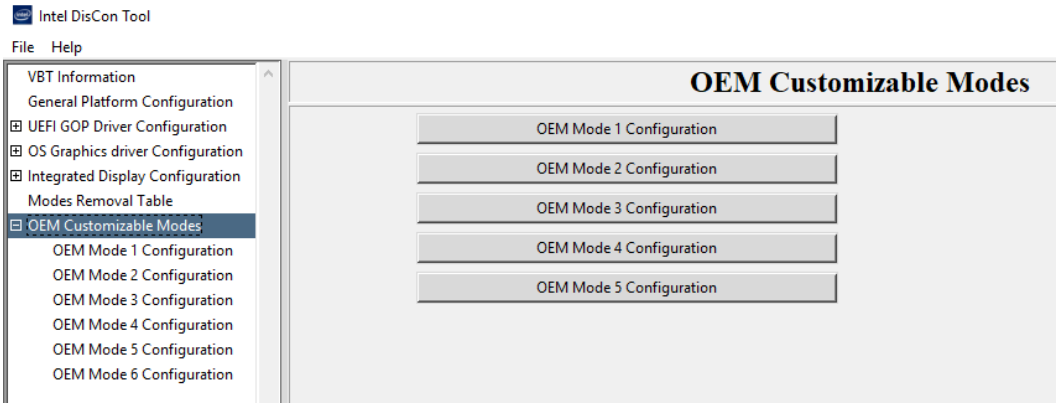
3.6 Modes Removal Table



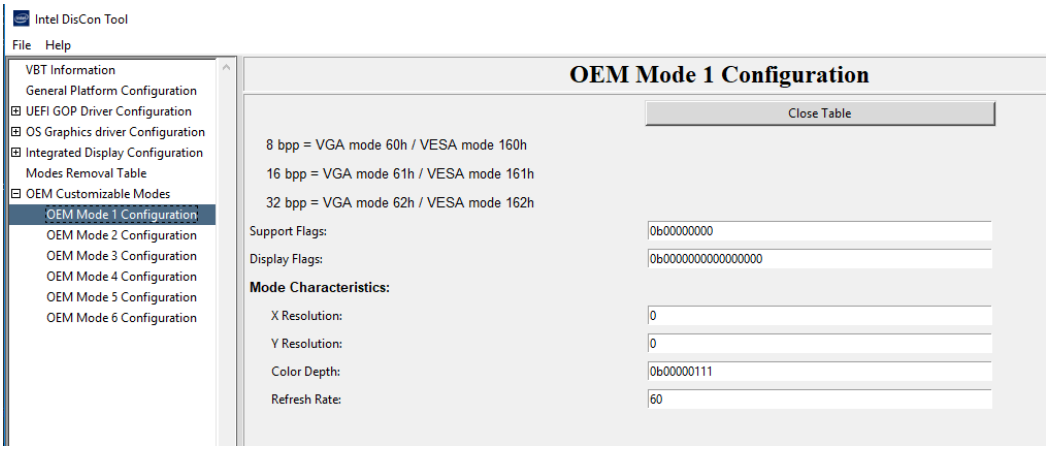
- This feature allows removing support for selected modes resolutions.

3.7 OEM Customizable Modes

- There are 6 OEM Mode Configuration which are similar.
- Below, OEM Mode Configuration 1 is taken and all the fields are explained. Refer the same for all the ther 5 OEM Mode Configurations.



OEM Mode 1 Configuration –



- Support Flags: Support flags: (0 = Disabled, 1 = Enabled).
- Display Flags: Display Flags: (0 = Disabled, 1 = Enabled).
- X Resolution: X Resolution in pixels (decimal).
- Y Resolution: Y Resolution in pixels (decimal).
- Color Depth: Color Depth, bits can be set simultaneously (binary).
- Refresh Rate: Refresh rate for OEM customizable mode (decimal).