HDMXpress

Printable Application Help

Tektronix

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Contacting Tektronix

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■ In North America, call 1-800-833-9200.

■ Worldwide, visit *www.tektronix.com* to find contacts in your area.

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Welcome

HDMXpress is a HDMI signal generation software that runs on the Master AWG. HDMXpress supports the generation of HDMI 2.0 patterns that can be used to perform electrical, protocol and margin tests.

The TekExpress HDM application acts as a controller that controls, and communicates with the HDMXpress application running on the Master AWG. The TekExpress HDM application is also used to synchronize and load patterns generated using HDMXpress.

The HDMXpress software is designed to work with the following Tektronix arbitrary waveform generators:

- AWG70002A series arbitrary waveform generator (firmware V3.0 and above).

- AWG7122C series arbitrary waveform generators (V4.6.0.7).

The software can be run in the following way.

From the Start menu, click **All Programs** > **HDMXpress**. You can also double-click the HDMXpress shortcut on the desktop.

Introduction

Conventions

The online help uses the following conventions:

- When steps require a sequence of selections using the software interface, the ">" delimiter marks each transition between a menu and an option. For example, **File > Save**.

- DUT refers to the Device Under Test.

- The terms "waveform" and "signal" are used interchangeably.

- The term AWG refers to a Tektronix Arbitrary Waveform Generator.

Feedback

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HDMXpress Printable Application Help

Getting started

Minimum system requirements

The minimum requirements of the HDMXpress application are listed in the following table:

Table 1: Minimum system requirements

Supported OS	Windows 7 Professional
Minimum Requirements	2 GB free disk space .Net 4.0 Matlab® Compiler Runtime version 7.14

Prerequisites TekVisa is required to communicate with the AWG70002A / AWG7122C signal generators (or other test instruments), over a LAN. If TekVisa is not already installed in your system, you can download the software from www.tektronix.com.

Installation

An installation wizard installs HDMXpress. If you have not installed MATLAB Runtime and .NET 4.0, the installer will detect and install it.

You can uninstall in either of these two ways:

- From **Start > All Programs > Tektronix HDMXpress > Uninstall HDMXpress**.
- From Add/Remove programs in **Control panel**.

Activate the license

NOTE. The HDM-DSM option has to be enabled on an oscilloscope connected to the AWG in which the HDMXpress is installed.

Activate the license using the option installation wizard on the oscilloscope. Follow these steps to activate the HDMXpress license:

1. From the oscilloscope menu bar, click **Utilities** > **Option Installation**.

   The **TekScope Option Installation** wizard opens.
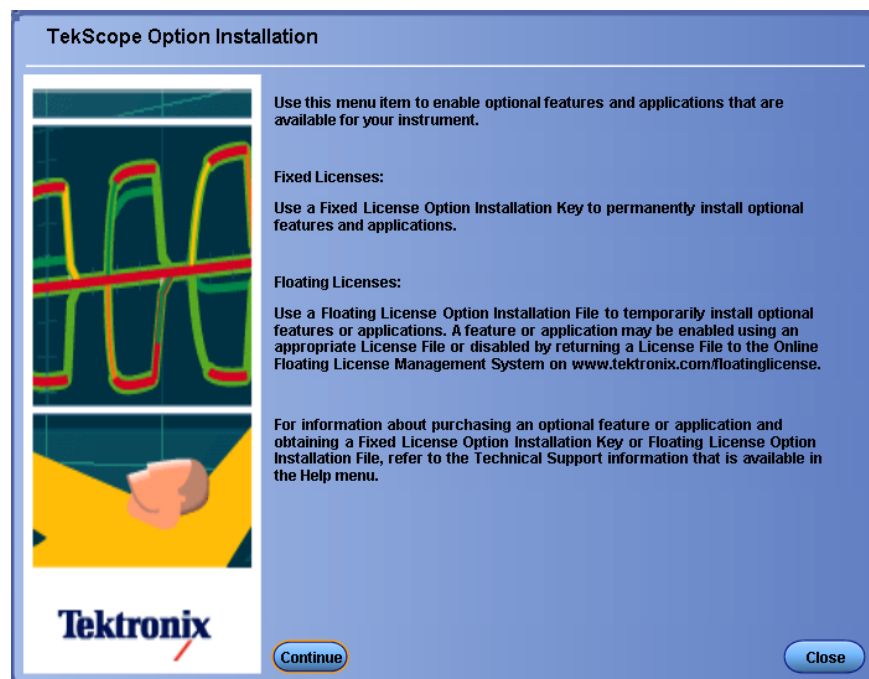
2. Instructions for using the Options Installation window to activate licenses for installed applications is provided in the oscilloscope online help. Press the **F1** key on the oscilloscope keyboard to open the Option Installation help topic. Follow the directions in the topic to activate the license.

View version and license information

To view version information

Click **Help** > **About HDMXpress**.
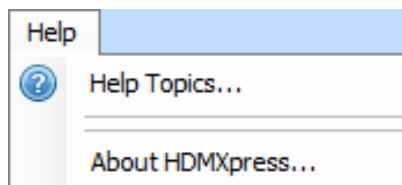
Option Information

From the oscilloscope Help menu, select **About TekScope**.

The Options section in the dialog box displays a list of installed options, including HDMXpress (option HDM-DSM).

NOTE. Option HDM-DSM must be installed on the oscilloscope. The oscilloscope is connected to the AWG (where HDMXpress is installed) through LAN network.

Additional Information

For HDMXpress to be activated on the AWG, the AWG with the HDMXpress software installed must be connected via the network to an oscilloscope with option HDM-DSM installed.

Specify the IP address of the oscilloscope in the **HDMXpress** > **Instrument Control**, in the **Scope** group box to ensure that the HDMXpress installed on the AWG is connected to the oscilloscope with the option HDM-DSM enabled.
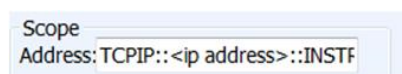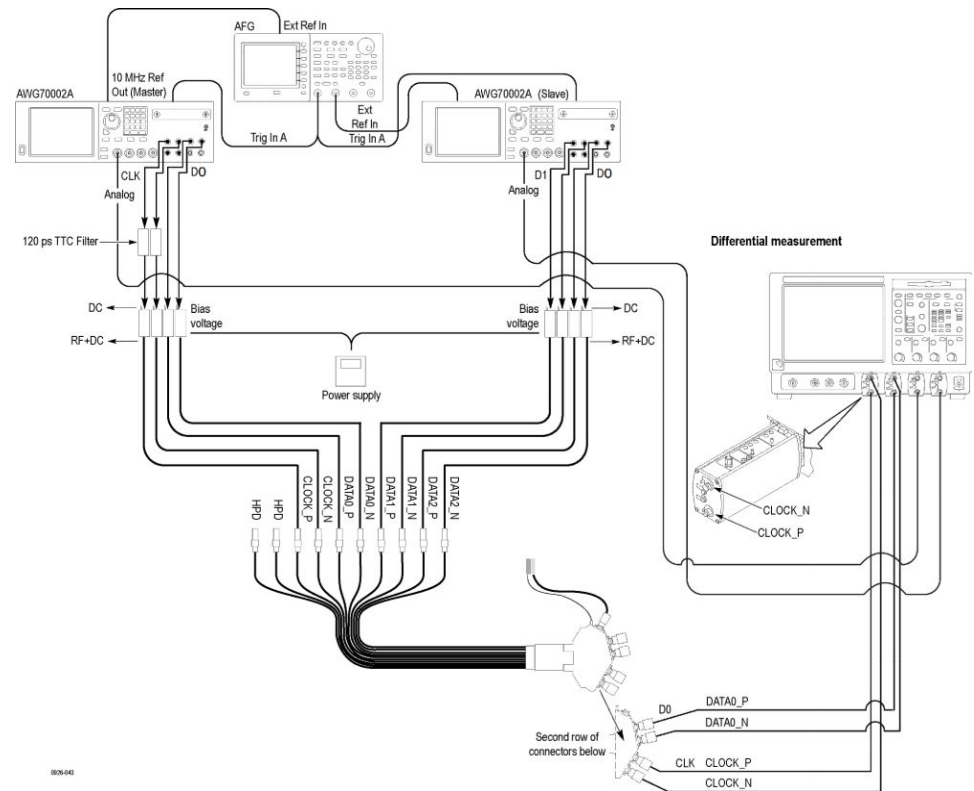
Connection setups

NOTE. Signal connections from an AWG to an oscilloscope is not required for protocol tests as physical parameters calibration is not performed for protocol tests.

However for HDMXpress to run, the AWG (were the HDMXpress software is installed) must be connected to an oscilloscope on the network were option HDM-DSM enabled.

For the electrical tests, connect the instruments as per the below table.

Test number and characteristic tested	Setup diagram
Test ID HF2-1: Sink TMDS Electrical - 6G - Min/Max Differential Swing Tolerance	*Setup for Test ID HF2-1: Sink TMDS Electrical - 6G - Min/Max Differential Swing Tolerance, Max connections for AWG70002A*
Test ID HF2-1: Sink TMDS Electrical - 6G - Min/Max Differential Swing Tolerance	*Setup for Test ID HF2-1: Sink TMDS Electrical - 6G - Min/Max Differential Swing Tolerance, Min and Nominal connections for AWG70002A*
Test ID HF2-3: Sink TMDS Electrical - 6G - Jitter Tolerance	*Setup for Test ID HF2-3: Sink TMDS Electrical - 6G - Jitter Tolerance for AWG70002A*
Test ID HF2-2: Sink TMDS Electrical - 6G - Intra-Pair Skew	*Setup for Test ID HF2-2: Sink TMDS Electrical - 6G - Intra-Pair Skew for AWG70002A*
Test ID HF2-1: Sink TMDS Electrical - 6G - Min/Max Differential Swing Tolerance	*Setup for Test ID HF2-1: Sink TMDS Electrical - 6G - Min/Max Differential Swing Tolerance, Max/Min/Nominal connections for AWG7122C*
Test ID HF2-3: Sink TMDS Electrical - 6G - Jitter Tolerance	*Setup for Test ID HF2-3: Sink TMDS Electrical - 6G - Jitter Tolerance for AWG7122C*
Test ID HF2-2: Sink TMDS Electrical - 6G - Intra-Pair Skew	*Setup for Test ID HF2-2: Sink TMDS Electrical - 6G - Intra-Pair Skew for AWG7122C*

Sink TMDS Electrical - 6G - Min / Max Differential Swing Tolerance, Max connections for AWG70002A

Sink TMDS Electrical - 6G - Min / Max Differential Swing Tolerance, Min and Nominal connections for AWG70002A
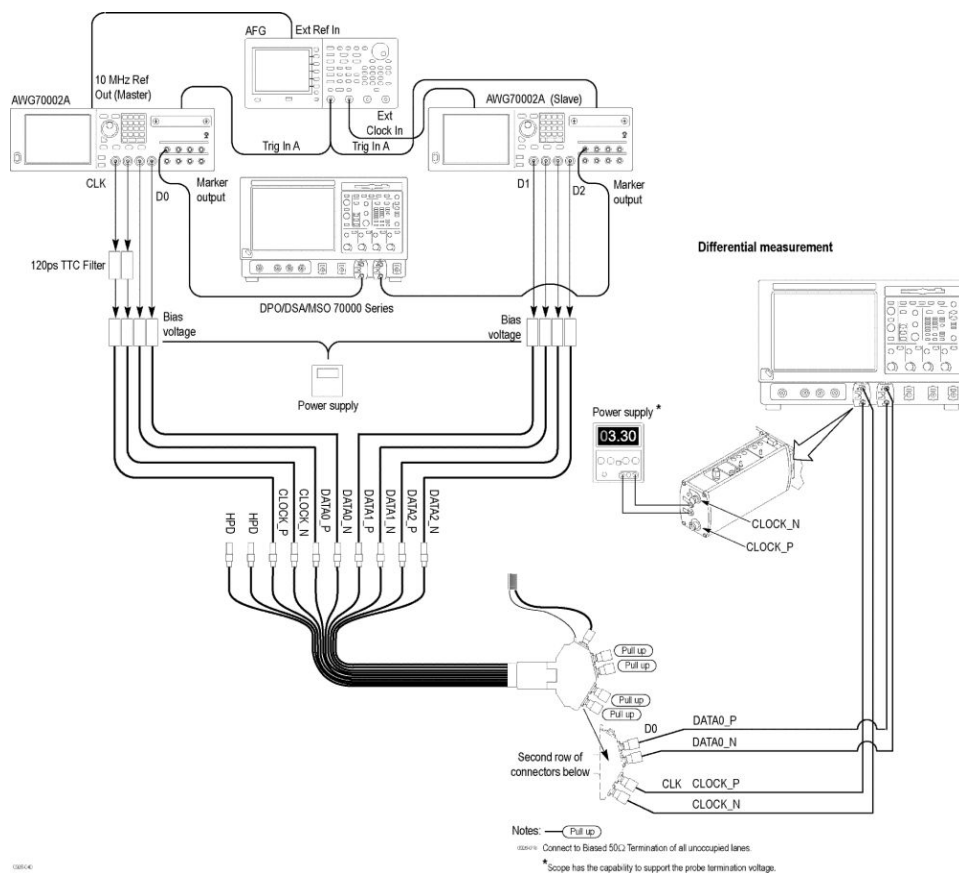
Sink TMDS Electrical - 6G - Jitter Tolerance for AWG70002A
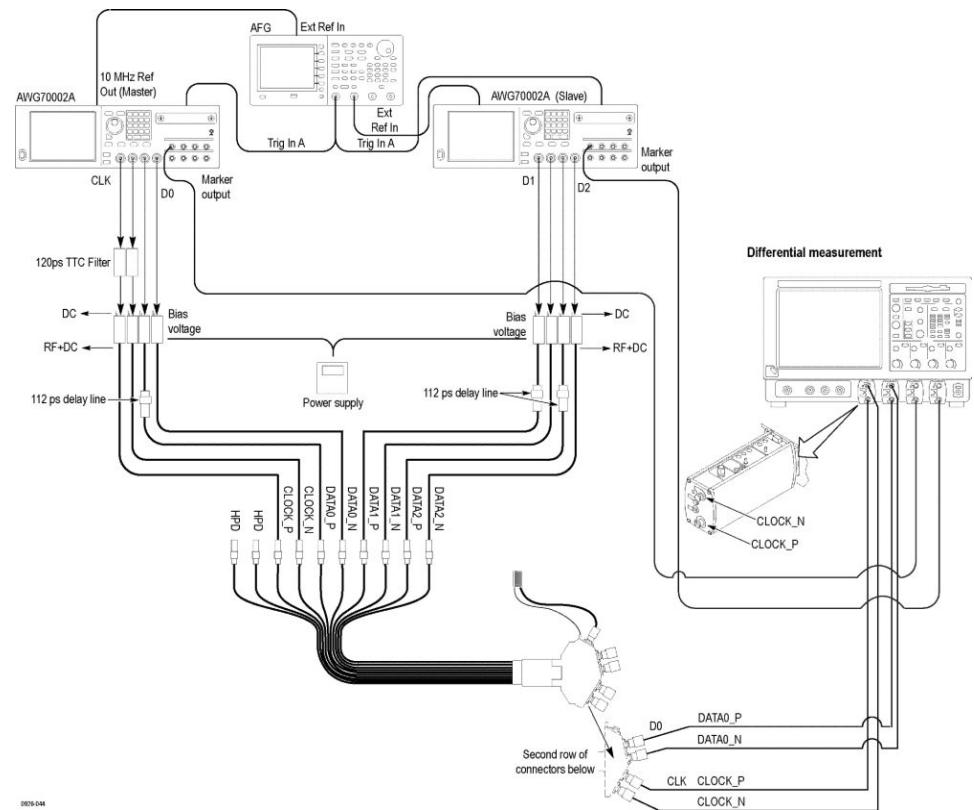
Sink TMDS Electrical - 6G - Intra-Pair Skew for AWG70002A
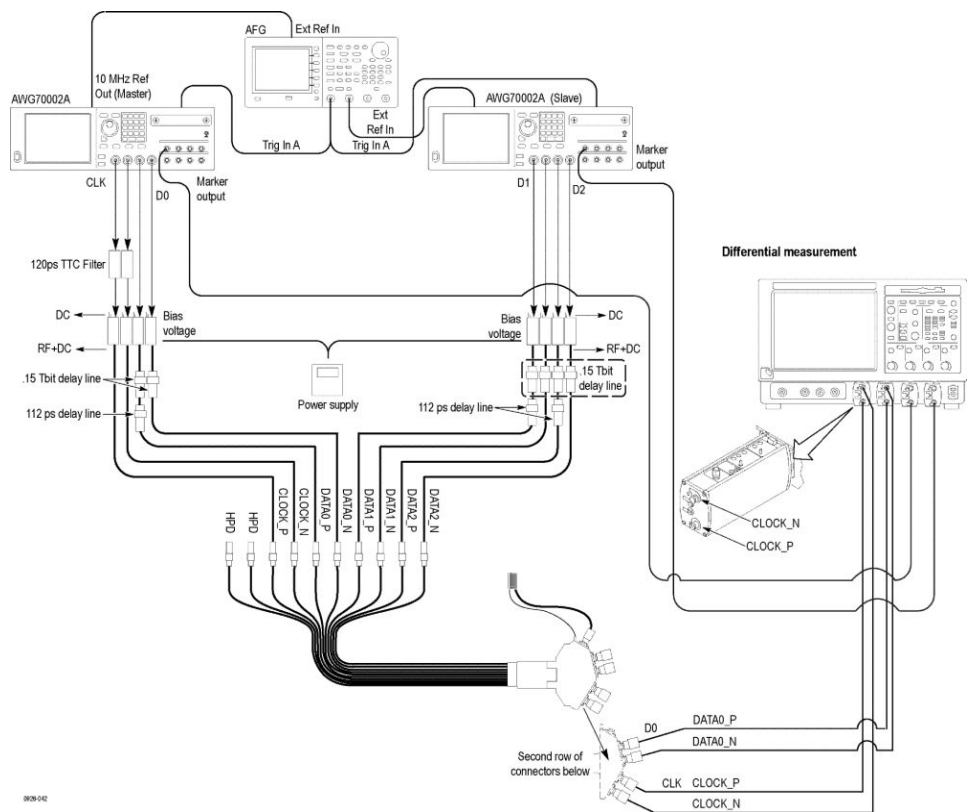
Sink TMDS Electrical - 6G - Min / Max Differential Swing Tolerance, Max / Min / Nominal connections for AWG7122C

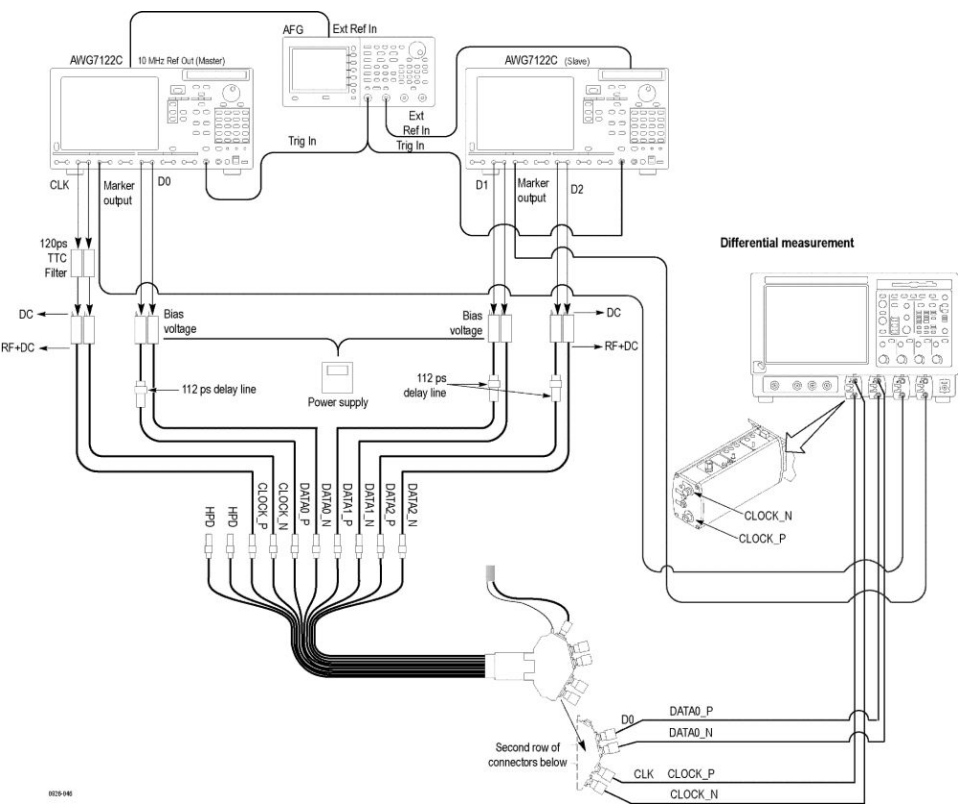**Sink TMDS Electrical - 6G - Jitter Tolerance for AWG7122C**

　　　　　　　　　　　　　　　　　　　　　HDMXpress Printable Application Help

Sink TMDS Electrical - 6G - Intra-Pair Skew for AWG7122C

HDMXpress Printable Application Help
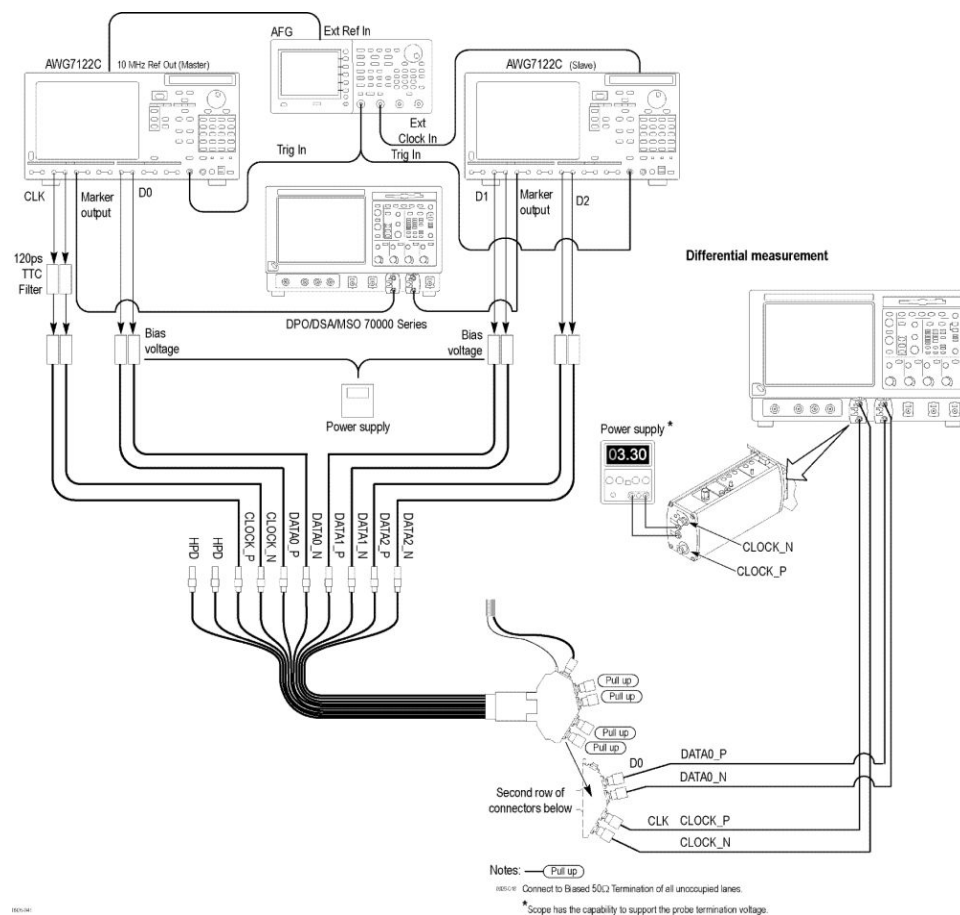
Operating basics

Overview of the software

HDMXpress is a HDMI signal generation software that runs on the Master AWG. HDMXpress supports the generation of HDMI 2.0 patterns used to perform electrical, protocol and margin tests.

The TekExpress HDM application, running on an oscilloscope acts as the controller that controls, and communicates with the HDMXpress application running on the AWG. The TekExpress HDM application is also used to synchronize and load patterns generated in HDMXpress.

The patterns created by the HDMXpress application will be used by the TekExpress HDM application when performing tests.

Key Features   HDMXpress has the following key features:

- Supports all the VIC (Video Identification Code) specified in the CEA861-F specification

- 24, 30, 36, and 48 bit color depths are supported

- Color sub sampling like RGB, YCBCR 4-4-4, YCBCR 4-2-0, and YCBCR 4-2-2

- All 3D frame types and 3D structures like FP, SSH, and TB are supported

- Color Bar, Chess board, Special image, Aspect ratio test image, Custom images (image of user choice) are all supported

- Ability to sync the patterns created in the HDMXpress to the TekExpress HDM solution

- Supports Closed loop calibration and has the ability to create patterns for margin testing

Starting the software

From the Start menu, click **All Programs > HDMXpress**. You can also double-click the **HDMXpress** shortcut on the desktop.

Exiting the software

Select **File > Exit** to exit the application. If you have not saved patterns, you are prompted to do so. This option is always enabled.

File name extensions

The application uses the following file name extensions:

Table 2: File name extensions

File name extension	Description
.csv	Ascii file containing Comma Separated Values. This file format may be read by any ascii text editor (such as Microsoft Notepad) or may be imported into spreadsheets such as Microsoft Excel.
.wfm	Binary file containing an AWG waveform record in a recallable. proprietary format.
.flt	Files containing the inverse filter co-efficient.
.png	Files containing the schematics and images.
.sxs	XML (Extensible Markup Language) file containing setup information that can be saved and recalled whenever necessary for creating a pattern.

Menus and toolbars

Menu bar The HDMXpress menu has the following items:

File
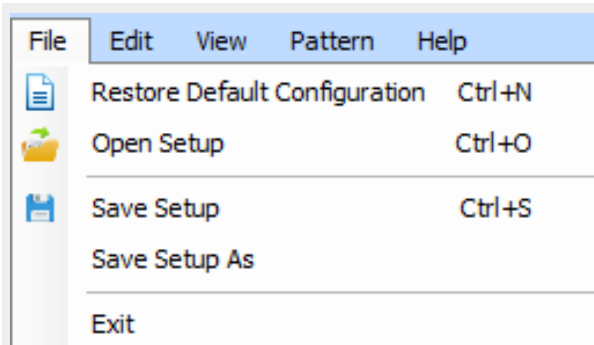
Use the File menu to:

- **Restore Default Configuration**: Restore the default configuration.
- **Open Setup**: Open a saved setup file.
- **Save Setup**: Save the setup file in the .sxs format in a folder in your C drive.
- **Save Setup As**: Save the setup under another name in the .sxs format.
- **Exit**: Exit the application.

Edit
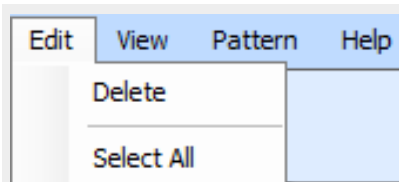
Use the Edit menu to:

- **Delete**: Deletes the selected configurations.
- **Select All**: Selects all the configurations.

View

Use the View menu to:

- **Standard Toolbar**: View or hide the toolbar. If the toolbar is hidden before closing the application, it remains hidden when the application is opened again.
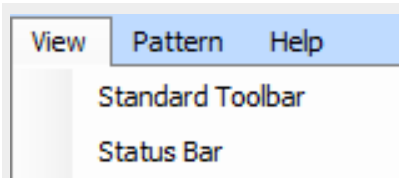
- **Status Bar**: View or hide the status bar. If the status bar is hidden before closing the application, it remains hidden when the application is opened again.

Pattern
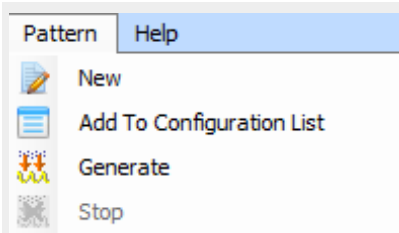
Use the Pattern menu to:

- **New**: Creates a new pattern file based on current settings.

- **Add to Configuration List**: Adds a pattern to the configuration list.

- **Generate**: Generates the new pattern. The pattern will be created in both the AWG's (Master and Slave).

- **Stop**: Stop generating the pattern.

Help
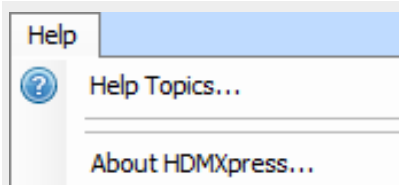
Use the Help menu to:

- **Help Topics**: Open the online help.

- **About HDMXpress**: Display information about the application, such as the version number.

Standard toolbar   Select **View > Standard** toolbar to hide or show the toolbar. The toolbar is displayed by default. The Standard toolbar uses icons that provide a quick access to many frequently used functions.
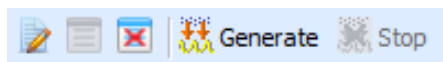

The Standard toolbar has the following options:

- **New Configuration**: Creates a new pattern based on the current settings.
- **Add To Configuration List** : The configured pattern is added to the Configuration list.
- **Delete Configuration**: Deletes the selected configuration from the Configuration list.
- **Generate**: Generates the configured pattern. The pattern will be created in both the AWG's (Master and Slave).
- **Stop**: Stops generating the pattern.

Status bar   Select **View > Status Bar** to hide or show the status bar. The status bar displays the AWG name on which the HDMXpress is installed. The status bar is displayed by default.

Configuration list   Configuration list displays a list of all the patterns. By default it is displayed and opens in the leftmost area of the display window.

After you configure the pattern in the **Configuration - New** window, select **Add To List**. The configured pattern data will be saved and displayed in the **Configuration List** window. The Configuration list displays the Label, Test ID, VIC, Frame Type, 3D Structure, HDMI Version, Color Depth, Color Mode, and Image Type of the pattern data.

NOTE. You can configure any number of patterns and add them to the configuration list.

After you select a pattern to generate, you must compile it to create the data. Once you generate a pattern (using **Generate** from the toolbar), a pattern is created.

To save a configured pattern that is available in the list, select the pattern and select **File > Save Setup As**. The configured pattern is saved as a (.sxs) file in the specified location.

*NOTE. If you close the application without saving the configured pattern, the pattern data is lost. You can compile the pattern again from the setup, if you have saved the setup using **File > Save Setup** or **Save Setup As**.*

You can select multiple contiguous and non-contiguous patterns using the **Shift** and **Ctrl** keys, respectively. Selecting multiple configured patterns and selecting the **Delete** option deletes all the selected patterns. Selecting multiple configured patterns and selecting the **Generate** option generates all the pattens for the selected pattern configurations.

Generating a pattern

Protocol test

Configure the settings

In the **Configuration - New** group:

1. Enter the label name for the pattern in the **Label** text box.
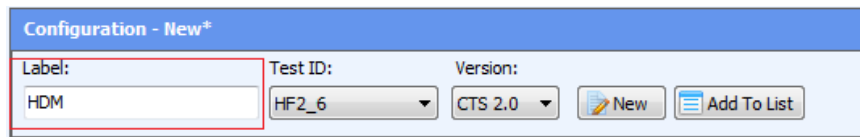
Labeling helps to identify or group one or more patterns in the TekExpress HDM application, as shown in the below TekExpress HDM application figure.
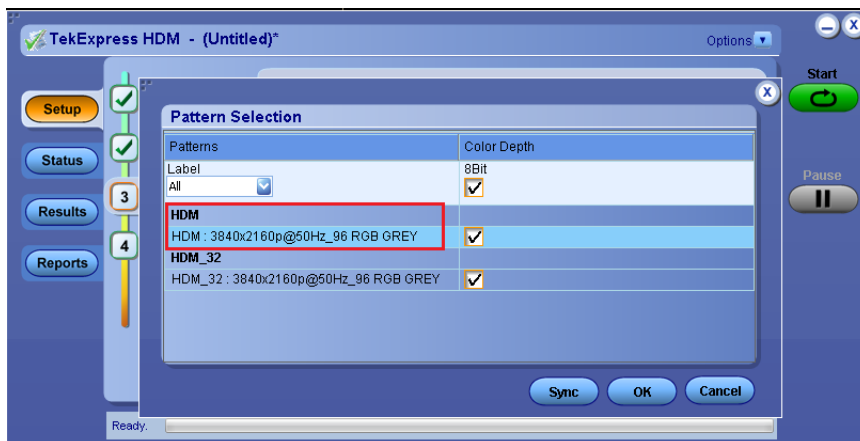
2. Select the Test ID for the pattern to be created.

NOTE.

- *Based on the selected Test ID, the application displays the fields that are configurable for that test.*

- *The patterns created for the specific Test ID will only appear in the TekExpress HDM application for the corresponding tests.*

3. Configure the HDMI patterns to be created.

In the **Base Configuration** group,

4. Configure the **VIC**, **Frame Type**, **Color Depth**, **Color Mode**, and **Image Type** from the respective fields. You can view the image, in the Image Type group.

Save the configuration

Once the pattern is configured, it should be saved.

To save the configured pattern, follow the steps.

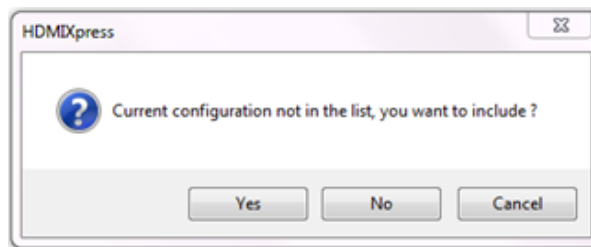1. Click **Save Setup** from the **File** menu, to save the current configuration of HDMXpress.
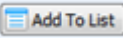
    The setup files can be recalled later by selecting **Open Setup** in the **File** menu.

2. Click **New** to create a new pattern settings using either of these methods:

    ▪   **Pattern** menu click **New** [New icon] icon, or

    ▪   **Toolbar** menu click **New Configuration** [icon] icon.

    A popup prompts you to include the Current Configuration to the list.

    ▪   Click **Yes**, to add the current configuration to the Configuration List in the left side. Automatically the Configuration Panel parameters will set to the default pattern settings.

    ▪   Click **No**, to discard the settings. This also sets the default pattern settings.

    ▪   Click **Cancel**, to close the popup window. There will be no effect on the Configuration panel settings.

3. Click **Add to List** to add the current configuration to the Configuration List.

    ▪   You can click the **Add To List** [Add To List icon] icon either from Configuration tab, or

    ▪   Click the **Add To Config List** [icon] icon from the toolbar menu

Create a pattern   To create a pattern, follow the steps.

1. Select one or more pattern from the Configuration List.

2. Click **Generate** icon, either from the

   ■ **Tool bar**, or

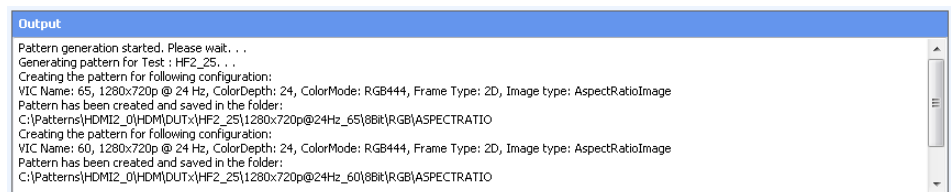   ■ **Pattern**, menu

     The pattern will be created automatically on Master AWG and Slave AWG.

     All the generated patterns will be created automatically. View the saved location of the generated patterns in the **Output** window.

NOTE. *Generated pattern files will be saved as **Setup1.awgx/Setup1.awg** on Master AWG and **Setup2.awgx/Setup2.awg** on Slave AWG.*

Electrical Test

Configure the settings   To configure the settings, follow the steps.

1. Enter the name to be given to the pattern in the **Label** text box

2. Select the test for which the pattern is created from the **Test ID** drop-down box.

NOTE.

   ■ *Based on the selected Test ID, the application displays the fields that are configurable for the test.*

   ■ *The patterns created for the specific Test ID will only appear in the TekExpress application for the corresponding tests.*

---

3. Configure the HDMI patterns to be created.

   In the **Base Configuration** group,

4. Configure the **VIC** , **Frame Type**, **Color Depth**, **Color Mode**, and **Image Type** from the respective fields.

   You can view the image, in the **Image Type** group.

In the **Test Configuration** group, when the **Compliance** mode is selected, you can only specify the **Frequency Profile** and select the **Percentage Deviation of Result** for Auto Calibration. The **Clock Jitter**, **Data Jitter, Voltage Swing** and **Cable Emulator** fields are not-editable in Compliance mode, and default values are used.

When the **User Defined** mode is selected, you can modify the default values for **Clock Jitter**, **Data Jitter**, and **Voltage Swing** parameters. You can also specify the **Frequency Profile**, browse to select the **Cable Emulator** and select the **Percentage Deviation of Result** for calibration.

NOTE. *In the **Frequency Profile** field*

- *If FP1 is selected, the pattern for the frequency profile1 (500 KHz, 10 MHz) is generated.*

- *If FP2 is selected, the pattern for the frequency profile2 (1 MHz, 7 MHz) is generated.*

- *If Both are selected, both frequency profiles 1 and 2 will be generated and saved.*

Save the configuration Once the pattern is configured, it should be saved.

To save the configured pattern, follow the steps.

1. Click **Save Setup** from the **File** menu, to save the current configuration of HDMXpress.
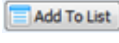
   The setup files can be recalled later by selecting **Open Setup** in the **File** menu.

2. Click **New** to create a new pattern settings using wither of these methods:

   ▪ **Pattern** menu click **New** [New] icon, or

   ▪ **Toolbar** menu click **New Configuration** [icon] icon
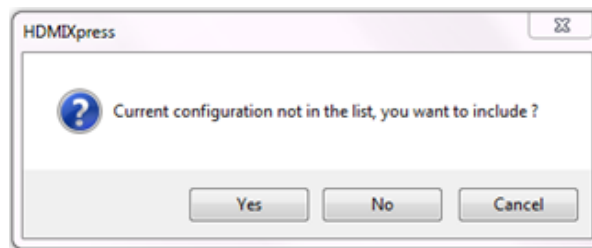
A popup prompts you to include the Current Configuration to the list.

   ▪ Click **Yes**, to add the current configuration to the Configuration List in the left side. The Configuration Panel parameters will set to the default pattern settings.

   ▪ Click **No**, to discard the settings. This also sets the configuration parameters to default settings.

   ▪ Click **Cancel**, to close the popup window. There will be no effect on the Configuration panel settings.

3. Click **Add to List** to add the current configuration to the Configuration List.

   ▪ You can click the **Add To List** [Add To List] icon either from Configuration tab, or

   ▪ Click the **Add To Config List** [icon] icon from the toolbar menu

Create the pattern   The auto calibration module generates the required pattern and then performs the required measurement using DPOJET. The application automatically configures DPOJET for performing these measurements. The auto calibration module performs the closed loop calibration based on the measured values, and creates the pattern within the specified accuracy. Once the signal is created, the setup file is saved in the location defined for HDMXpress setup files.

Once a pattern is loaded onto the AWG, the auto calibration module manages the DPOJET measurements. Auto calibration estimates final reacquired input for specific output and sends feedback to the impairments algorithm to generate the signal. Once the signal is created, the setup file is saved in the location defined for HDMXpress setup files.

Once the pattern is generated, the Output window is updated with the path of the saved pattern file.

```
Output
Pattern generation started. Please wait. . .
Generating pattern for Test : HF2_25. . .
Creating the pattern for following configuration:
VIC Name: 65, 1280x720p @ 24 Hz, ColorDepth: 24, ColorMode: RGB444, Frame Type: 2D, Image type: AspectRatioImage
Pattern has been created and saved in the folder:
C:\Patterns\HDMI2_0\HDM\DUTx\HF2_25\1280x720p@24Hz_65\8Bit\RGB\ASPECTRATIO
Creating the pattern for following configuration:
VIC Name: 60, 1280x720p @ 24 Hz, ColorDepth: 24, ColorMode: RGB444, Frame Type: 2D, Image type: AspectRatioImage
Pattern has been created and saved in the folder:
C:\Patterns\HDMI2_0\HDM\DUTx\HF2_25\1280x720p@24Hz_60\8Bit\RGB\ASPECTRATIO
```

Instrument control setting

HDMXpress works with the following arbitrary waveform generators.

- AWG70002A
- AWG7122C

HDMXpress creates patterns on both the Master and the Slave AWG.

Clock and Data0 patterns are created on the Master AWG. Data1 and Data2 patterns are created on the Slave AWG.

Configure the Slave AWG and Oscilloscpe IP address.

Run pattern generated using HDMXpress in TekExpress HDM application

To run the pattern generated using HDMXpress in TekExpress HDM application, follow the below steps:
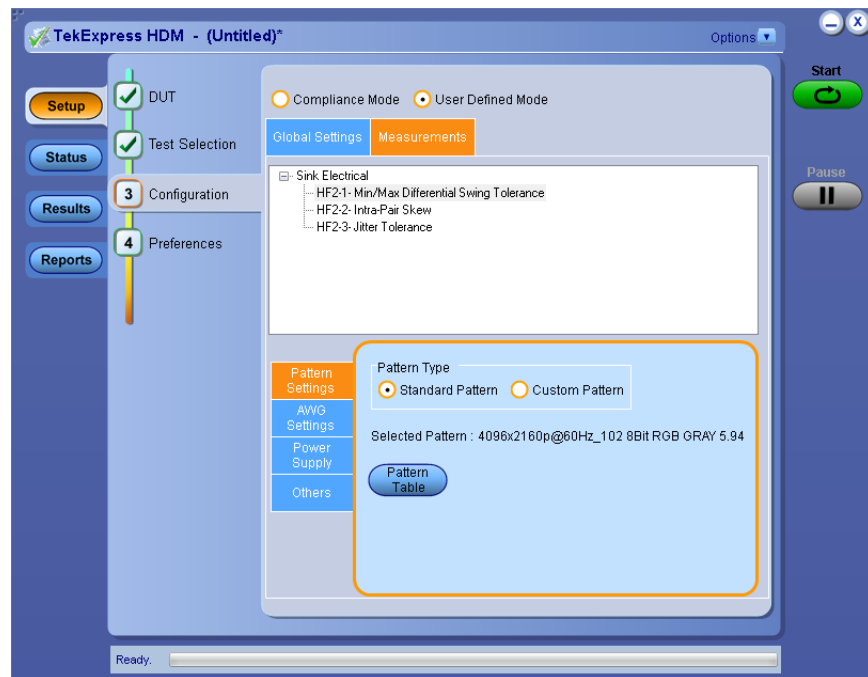
1. Go to **Setup** panel, and select the **Test Selection** tab.

2. Select the test.
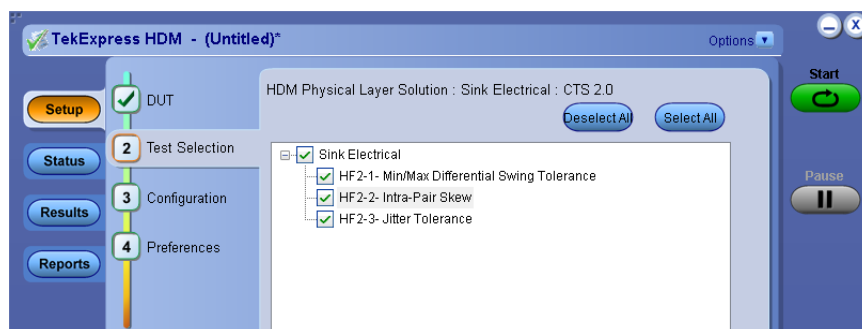
3. Click **Configuration** panel > **Global Settings** tab to define the Master and Slave IP address.
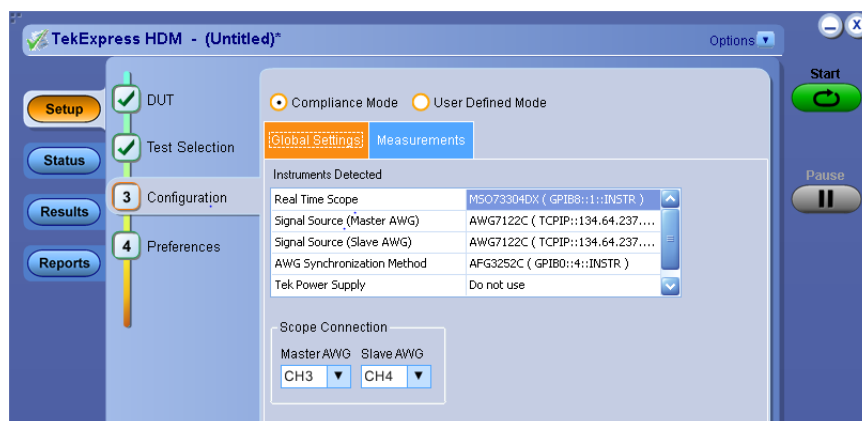
4. Click the **Measurements** tab.

5. Select the **Pattern Settings**, and then in the **Pattern Type** group, select **Custom Pattern**.

NOTE. If Standard Pattern is selected, you will see a list of patterns supplied as part of AWG Pattern installer.

6. Click the **Pattern Table** button, which displays the **Pattern Selection** pop-up window.
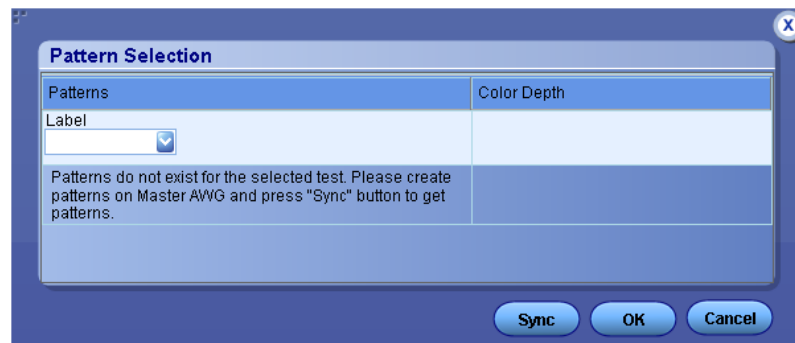
7. Click **Sync**. HDMXpress will display the patterns created for this particular test in the Patterns Selection table. All the labels will be updated in the patterns drop-down. Label is the label entered in the HDMXpress when creating the pattern.

8. Select a label in the **Label** drop-down. You will then see all the patterns that are created under the same label in the HDMXpress.

---

*NOTE. If **All** is selected, you can view all the created labels and the patterns.*

---

9. Select a waveform from the list.

10. Click **OK**.

11. Click the **Start** button to perform the test.

Algorithms

HF-2-1 Sink Min Max measurement

Application calibrates the pattern for Min Voltage Swing and Max Voltage Swing. The below algorithm is used for Min and Max Voltage Swing calibration.

Voltage Swing calibration algorithm

1. VmeasuredAmplitude = 0

2. Vdiff = (VmeasuredAmplitude - Required Amplitude)

3. Calculate

    a. awgGain = AWG Gain = Vamplitude (AWG7K)

    b. awgGain = Vamplitude /2.0 (AWG7K)

4. While (Vdiff > allowed devation)

    a. Set the awgGain

    b. Measure the amplitude on the oscilloscope(VmeasuredAmplitude)

    c. Vdiff = (Required Amplitude - VmeasuredAmplitude)

    d. awgGain = awgGain + awgGain * (Vdiff / VmeasuredAmplitude)

NOTE. *Max Voltage swing pattern on AWG70K is generated on the Marker channel. You need to perform the skew calibration manually.*

HF-2-2 Sink Intra Pair Skew measurement

Application calibrates the Voltage Swing as per the specification.

Voltage Swing calibration algorithm

1. VmeasuredAmplitude = 0

2. Vdiff = (VmeasuredAmplitude - Required Amplitude as per specification)

3. Calculate

    a. awgGain = AWG Gain = Vamplitude (AWG7K)

    b. awgGain = Vamplitude /2.0 (AWG7K)

4. While (Vdiff > allowed devation)

    a. Set the awgGain

    b. Measure the amplitude on the oscilloscope(VmeasuredAmplitude)

    c. Vdiff = (Required Amplitude - VmeasuredAmplitude)

    d. awgGain = awgGain + awgGain * (Vdiff / VmeasuredAmplitude)

NOTE. *You have to perform the skew calibration manually.*

HF-2-3 Sink Jitter Tolerance measurement

Application calibrates Jitter and Amplitude parameters.

Voltage Swing calibration algorithm

1. VmeasuredAmplitude = 0

2. Vdiff = (VmeasuredAmplitude - Required Amplitude)

3. Calculate

    a. awgGain = AWG Gain = Vamplitude (AWG7K)

    b. Measure the amplitude on the oscilloscope(VmeasuredAmplitude)

    c. Vdiff = (Required Amplitude - VmeasuredAmplitude)

    d. awgGain = awgGain + awgGain * (Vdiff / VmeasuredAmplitude)

Jitter parameter

Application calibrates C_Jitter and D_Jitter parameters to the required value

1. CJMagnitude = CJMagnitudeRequired ; DJMagnitude = DJMagnitudeRequired

2. Insert CJMagnitude and DJMagnitude and generate the pattern.

3. Measure the CJMagnitudeMeasured and DJMagnitudeMeasured and find the result variation. If the result variation is within the specified range then stop.

4. Below step is required for jitter components which does not meet the required criteria)

    ■ If it is first time then

        a. Proportionately increase/decrease the input jitter values

5. Go back to step *b*

Reference

Shortcut keys

Table 3: Shortcut keys

Menu/Menu item	Shortcut key
File	Alt+F
File > Open Setup	Ctrl+O
File > Save Setup	Ctrl+S
View	Alt+V
Pattern	Alt+P
Help	Alt+H

Default values

Table 4: Default values and selection

Item	Option	Default value/selection
Configuration - New group		
Label	Test name defined by you	HDM
Version	HDMI specification version	CTS 2.0
Test ID	Define the compliance tests as mentioned in the CTS	HF2_6
Base Configuration group: Includes all the Protocol configuration		
VIC Code	Video identification code, represents resolution of the video format	96 : 3840x2160p @ 50Hz
Frame Type	Video dimension	2D
Color Depth	Image pixel intensity	24
Color Mode	Pixel encoding format	RGB444
Image Type	Kind of image used for pattern generation	Gray Scale
Test Configuration group		
Compliance	Sets default values for electrical configurations as defined by the CTS specification	Selected by default
User Defined	You can specify the values for electrical configurations.	NA

Item	Option	Default value/selection
Clock Jitter	Amount of the jitter to be inserted on the clock signal in terms of Unit Interval	0.30 UI
Data Jitter	Amount of jitter to be inserted on the data signal in terms of Unit Interval	0.60 UI
Voltage Swing	Output signal amplitude	800 mV
Frequency Profile		Both
Cable Emulator	Filter file used for applying the cable effect	NA
Auto Calibration Calibrates the signal in terms of Unit Interval		
Percentage Deviation Of Result	Percentage of variation in the calibrated values acceptable	5.0 %
Instrument Control: Tab for providing AWG and scope addresses		
Address	Instrument TCP-IP or GPIB address required for communication	
Clock	AWG channels to output the lanes	Ch 1: Analog
Data0		Ch 2: Analog
Data1		Ch 1: Analog
Data2		Ch 2: Analog

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