

TekExpress®
HEAC (HDMI Ethernet Audio Return Channel)
Automated Solution
Quick Start User Manual



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For product information, sales, service, and technical support:

- In North America, call 1-800-833-9200.
- Worldwide, visit www.tektronix.com to find contacts in your area.

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Tektronix warrants that this product will be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If any such product proves defective during this warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product. Parts, modules and replacement products used by Tektronix for warranty work may be new or reconditioned to like new performance. All replaced parts, modules and products become the property of Tektronix.

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General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it.

To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

While using this product, you may need to access other parts of a larger system. Read the safety sections of the other component manuals for warnings and cautions related to operating the system.

To Avoid Fire or Personal Injury

Use proper power cord. Use only the power cord specified for this product and certified for the country of use.

Use proper voltage setting. Before applying power, ensure that the line selector is in the proper position for the source being used.

Connect and disconnect properly. Do not connect or disconnect probes or test leads while they are connected to a voltage source.

Ground the product. This product is indirectly grounded through the grounding conductor of the mainframe power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

Observe all terminal ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

The inputs are not rated for connection to mains or Category II, III, or IV circuits.

Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

Power disconnect. The power cord disconnects the product from the power source. Do not block the power cord; it must remain accessible to the user at all times.

Do not operate without covers. Do not operate this product with covers or panels removed.

Do not operate with suspected failures. If you suspect that there is damage to this product, have it inspected by qualified service personnel.

Avoid exposed circuitry. Do not touch exposed connections and components when power is present.

Use proper AC adapter. Use only the AC adapter specified for this product.

Do not operate in wet/damp conditions.

Do not operate in an explosive atmosphere.

Keep product surfaces clean and dry.

Terms in This Manual

These terms may appear in this manual:



WARNING. Warning statements identify conditions or practices that could result in injury or loss of life.



CAUTION. Caution statements identify conditions or practices that could result in damage to this product or other property.

Symbols and Terms on the Product

These terms may appear on the product:

- DANGER indicates an injury hazard immediately accessible as you read the marking.
- WARNING indicates an injury hazard not immediately accessible as you read the marking.
- CAUTION indicates a hazard to property including the product.

The following symbol(s) may appear on the product:



Compliance Information

This section lists the environmental standards with which the instrument complies.

Environmental Considerations

This section provides information about the environmental impact of the product.

Product End-of-Life Handling

Observe the following guidelines when recycling an instrument or component:

Equipment Recycling. Production of this equipment required the extraction and use of natural resources. The equipment may contain substances that could be harmful to the environment or human health if improperly handled at the product's end of life. In order to avoid release of such substances into the environment and to reduce the use of natural resources, we encourage you to recycle this product in an appropriate system that will ensure that most of the materials are reused or recycled appropriately.



This symbol indicates that this product complies with the applicable European Union requirements according to Directives 2002/96/EC and 2006/66/EC on waste electrical and electronic equipment (WEEE) and batteries. For information about recycling options, check the Support/Service section of the Tektronix Web site (www.tektronix.com).

Restriction of Hazardous Substances

This product has been classified as Monitoring and Control equipment, and is outside the scope of the 2002/95/EC RoHS Directive.

Preface

TekExpress is the Tektronix Compliance Test Automation Framework, developed to support current and future test automation needs of customers. Developed using National Instruments' TestStand, TekExpress leverages on the capabilities of the Microsoft .NET framework. TekExpress HEAC provides a test and compliance solution that address the needs of the of HDMI 1.4 and CTS 1.4 standards.

Key Features

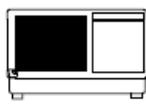
The application provides the following features:

- Reliable testing
 - Conformance to HDMI 1.4 (HEAC) standards and test specifications CTS 1.4 ensures reliable results
 - Accurate Transmitter (Tx) and Receiver (Rx) testing and violation testing ensures reliable tests
 - Sophisticated measurement techniques eliminate errors in jitter measurements
 - Closed loop measurements eliminate non-linearities of test setup enables precise testing
 - Significantly reduced test times for Sink and Audio tests
 - Optimal setups ensure accurate results
- Fast testing
 - Remote control of signal sources automates Source and Sink tests and reduces test times
 - One-button selection of multiple tests ensures faster testing
 - Automatic mask fit, measurements, and Pass/Fail notification delivers quick results
 - Test margins and statistical information aid analysis to help find answers quickly
 - One-button CSV-format summary and MHT report saves time
- Complete testing
 - Wide range of tests for Source and Sink devices enables complete validation
 - Complete compliance solution with a test fixture and signal sources

Documentation

This manual describes the basic installation and operation of the TekExpress application. For more detailed information, see the online help. The following information is available for this product:

Table i: Related documentation

TekExpress HEAC Online Help, English	076-0191-xx	
TekExpress HEAC User Manual, English (PDF)	077-0388-xx	 (Documents folder)
TekExpress HEAC Quick Start User Manual, English (PDF)	077-0389-xx	
		 

Software Upgrades

Periodic software upgrades may become available. To check for upgrades:

- Go to the Tektronix Web site (www.tektronix.com/software).
- Enter the product name (TekExpress HEAC).

Install the Software

The TekExpress application must be installed on a computer or on a Tektronix oscilloscope.

Before Installation

Read the Readme .txt file provided with the product software.

Prerequisites

The product software installer automatically installs all the necessary software and components needed to run the TekExpress HEAC solution. The following are the prerequisites:

- Microsoft .NET Framework
- National Instruments TestStand Runtime Engine
- OpenChoice TekVISA
- DK2 DESKey Driver
- TekExpress Framework

Installation

1. Close all applications.
2. Download HEACwebinstaller_<version>.EXE.
3. Double-click the executable to extract the files. After extraction, the HEAC installer launches and the software is installed in C:\Program Files\Tektronix\TekExpress\TekExpress HEAC.
4. Download the executables: HEAC_AudioRX_Patterns_AWG5K.EXE and HEAC_AudioRX_Patterns_AWG7K.EXE.
5. Double-click the executables to extract the files. The audio patterns are extracted to C:\HEAC Patterns.

Required Test Equipment

Each test suite requires specific equipment setups. Click **Show Schematic** within the select pane to see how to connect the device under test and test equipment to your oscilloscope.

The following Tektronix test fixtures are required, depending on the tests that you will be running:

- TF-HEAC-TPA-KIT consisting of:
 - TF-HEAC-TPA-MAIN
 - TF-HEAC-TPA-AP
 - TF-HEAC-TPA-CP
 - TF-HEAC-TDR-AR (2 numbers)
 - TF-HEAC-TDR-CR (2 numbers)
- TF-HDMI-TPA-CE (EDID board) consisting of:
 - EDID fixture PCBA
 - EEPROM with HDMI 1.4 software
 - Ribbon cable
- TF-HDMID-TPA-KIT (required for HEAC testing of Type D devices) consisting of:
 - Plug assembly
 - Receptacle cable assembly (2 numbers)

The following arbitrary waveform generators are required for running common mode receiver tests:

- Tektronix AWG5000 Series or AWG5000B Series
- Tektronix AWG7000 Series or AWG7000B Series

Start the Software

To start the software, do one of the following:

- From the Start menu, select **Start > Programs > Tektronix > TekExpress > TekExpress HEAC**.

- Double-click  on the desktop.

Close the Software

To close the software, do one of the following:

- Select **File > Exit**.

- Click .

Use the TekExpress Software

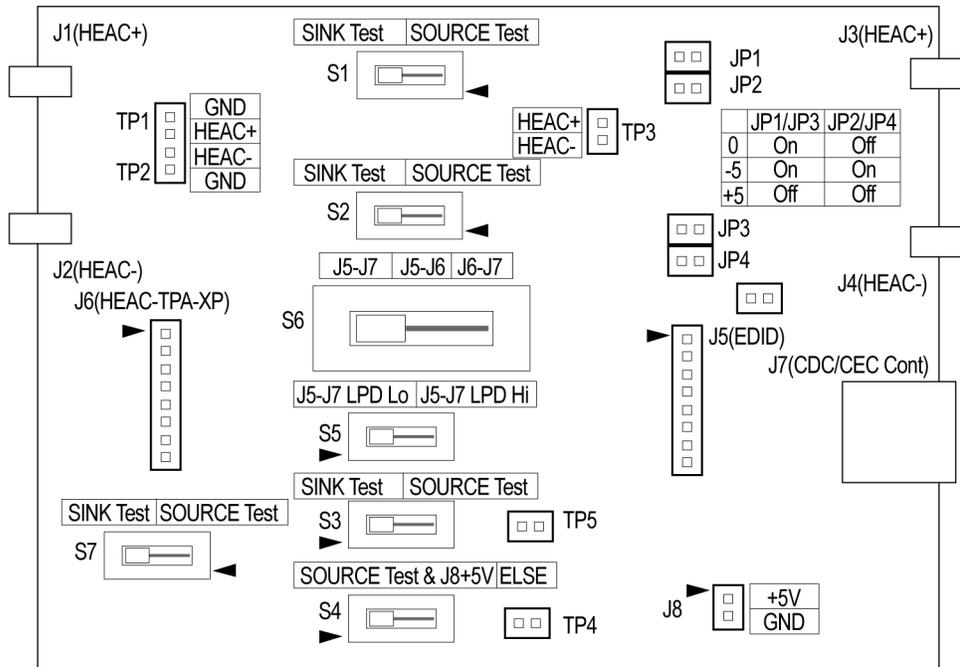
Process Flow

Follow steps 1 through 11 to select and run a test to check for compliance. Details for each of these actions are given on the following pages.

1. Set up the switches on the HEAC-TPA-MAIN fixture.
2. Set up the jumpers on the HEAC-TPA-MAIN fixture.
3. Select a device.
4. Select the test suite and choose the version.
5. Select the test.
6. Configure the test parameters.
7. View and select connected instruments.
8. Run the test.
9. View the progress of acquisition.
10. View the progress of analysis.
11. View and print the generated report.

Set Up the Switches on the HEAC-TPA-MAIN Fixture

The following diagram shows the fixture configuration switches on the HEAC-TPA-MAIN fixture.



The following table shows the settings to configure on the HEAC-TPA-MAIN fixture.

Table 1: HEAC-TPA-MAIN switch setup

Test ID	Description	DUT	+5 V from	S1	S2	S3	S4	S7
5-1	Differential Mode Operating DC	Source	J6, J8	Right	Right	Right	Left	Right
		Sink	J8	Left	Left	Left	Right	Left
5-2 to 5-5	Differential Mode Transmitter	Source	J6	Right	Right	Right	Right	Right
		Sink	J8	Left	Left	Left	Right	Left
5-6 to 5-10	Common Mode Transmitter	Sink	J8	Left	Left	Left	Right	Left
5-11 to 5-15	Single Mode Transmitter	Sink	J8	Left	Left	Left	Right	Left
5-16	Differential Mode Receiver	Source	J6	Right	Right	Right	Right	Right
		Sink	J8	Left	Left	Left	Right	Left
5-17	Common Mode Receiver	Source	J6	Right	Right	Right	Right	Right

Table 1: HEAC-TPA-MAIN switch setup (cont.)

Test ID	Description	DUT	+5 V from	S1	S2	S3	S4	S7
5-18	Single Mode Receiver	Source	J6, J8	Right	Right	Right	Left	Right
5-19	Common Mode Operating DC	Source	J6, J8	Right	Right	Right	Left	Right
5-20	Single Mode Operating DC	Source	J6, J8	Right	Right	Right	Left	Right

Set Up the Jumpers on the HEAC-TPA-MAIN Fixture

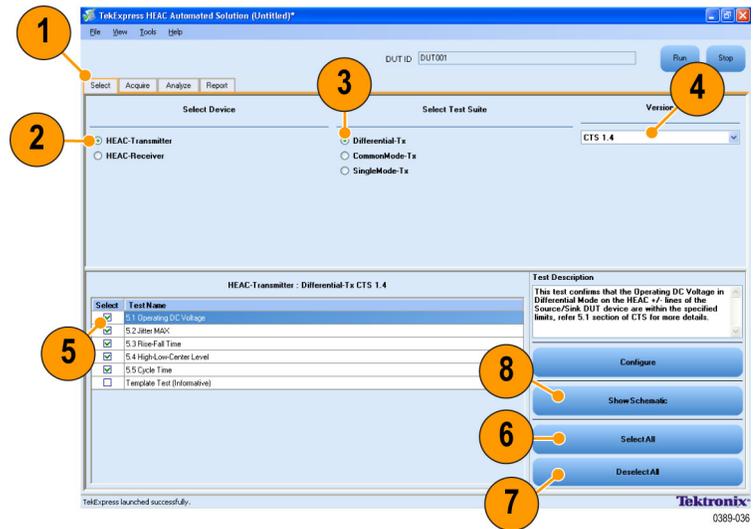
The following table shows the jumper settings to configure on the HEAC-TPA-MAIN fixture.

Table 2: HEAC-TPA-MAIN jumper setup

Test ID	Description	Termination	Signal Source output impedance	JP1	JP2	JP3	JP4
5-1 to 5-5	Differential Mode Transmitter	50 Ω	-	ON	OFF	ON	OFF
5-6 to 5-10	Common Mode Transmitter	50 Ω	-	ON	OFF	ON	OFF
5-11 to 5-15	Single Mode Transmitter	55 Ω	-	OFF	OFF	OFF	OFF
5-16	Differential Mode Receiver	-	110 Ω	OFF	OFF	OFF	OFF
			100 Ω	ON	OFF	ON	OFF
			90 Ω	ON	ON	ON	ON
5-17 to 5-19	Common Mode Receiver	-	50 Ω	ON	OFF	ON	OFF
5-18 to 5-20	Single Mode Receiver	-	55 Ω	OFF	OFF	OFF	OFF

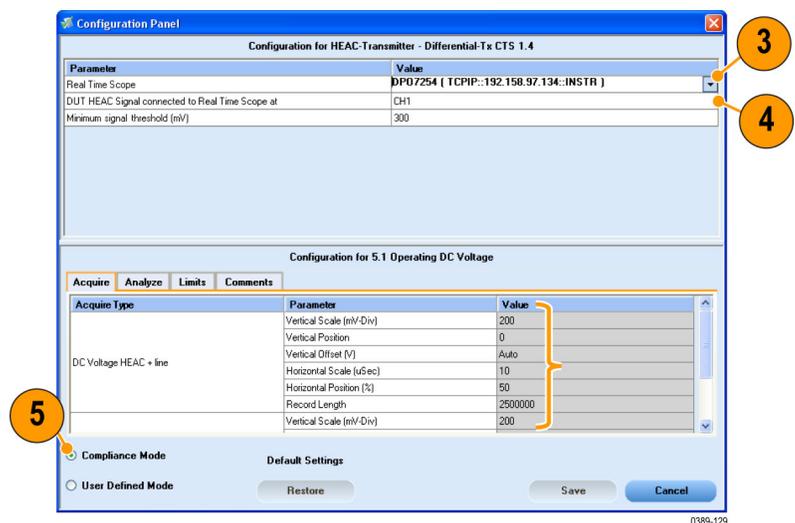
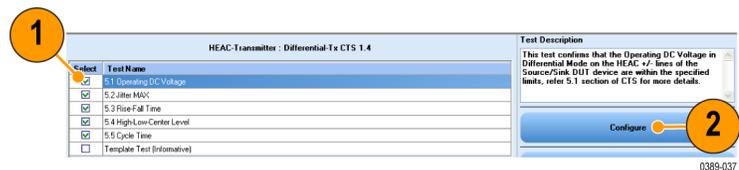
Select a Device, Test Suite, and Test

1. Click the **Select** tab.
2. Select a Device type.
3. Select the Test Suite.
4. Choose the version of the selected test suite from the **Version** drop-down list.
5. Select the test to run. You can select multiple tests from the list.
6. Click **Select All** to select all the tests in the list.
7. Click **Deselect All** to disable the tests.
8. Click **Show Schematic** to see the schematic diagram of the test setup.

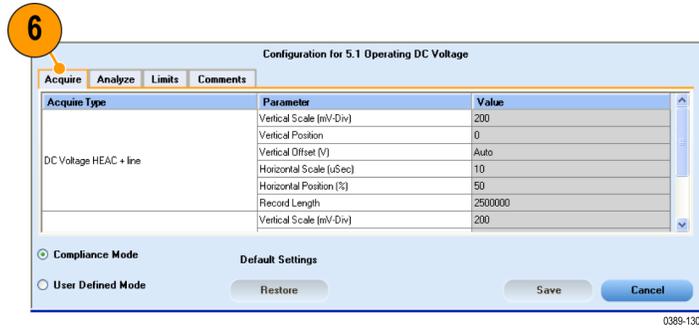


Configure the Test Parameters

1. Click the test name to configure.
2. Click **Configure**.
3. If multiple instruments are connected, choose the correct instrument from the drop-down list in the parameter-value list.
4. Verify schematic-related parameters such as DUT HEAC Signal connected to Real Time Scope at and others. You can also change other parameters such as Minimum signal threshold.
5. The Compliance Mode is selected by default. You can generally use the default settings in Compliance Mode.

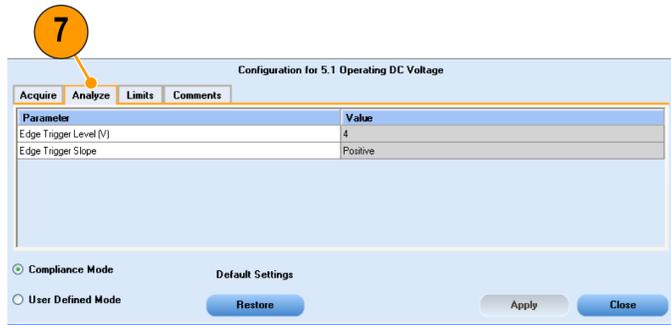


- Click the **Acquire** tab to view parameters related to acquisition.



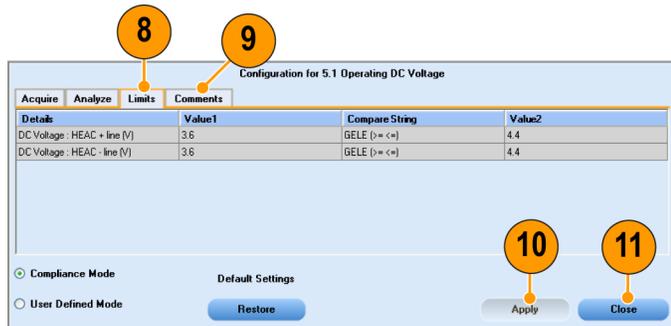
0389-130

- Click the **Analyze** tab to view the test analysis parameters.



0389-040

- Click the **Limits** tab to view the measurement limits.
See the online help for various test limit comparisons.
- Click the **Comments** tab to enter test-specific comments.



0389-041

- Click **Apply**.

- Click **Close**.

NOTE. Use the File menu to save the session.

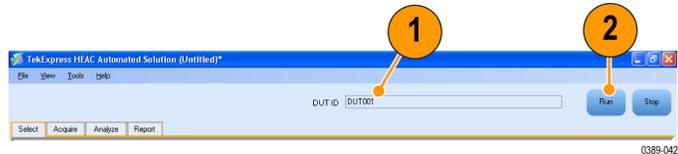
Connect and Configure the Equipment

The equipment connection is given in detail in the Application Examples section of this document. (See page 10, *Application Examples*.)

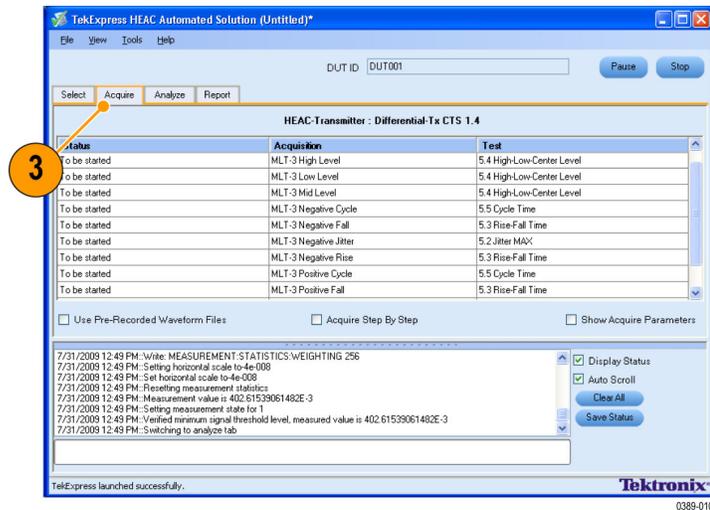
You can click **Show Schematic** to display a diagram of the test setup for each of the test suites.

Run the Test

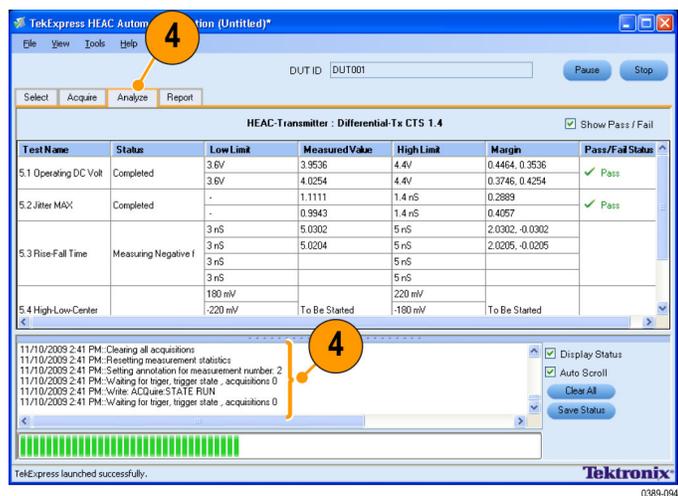
1. Enter the ID of the Device to be tested in the **DUT ID** field.
2. Click **Run** to run the test.



3. Click the **Acquire** tab to view the waveform acquisition details for the tests in the currently selected test suite.



4. Click the **Analyze** tab when the tests are running to view the status and progress of the tests. The application checks to see if the device has passed the test. The Status Messages window time stamps all runtime messages and displays them.



Interpret the Test Result

When the test completes, the report summary appears. Check the report to see if the device passed the test.

1. The report displays the DUT ID, the date and time the test was run, and execution time.
2. Test information like the Device Type, Version, Execution Time, Compliance Mode (Yes or No), and Overall Test Result (Pass or Fail), MAC Address (in case of Receiver tests) are shown.
3. Instrument information like the models, serial numbers, and firmware/software versions are shown.
4. A table displays the Test Name, Measurement Details, Limit1 and Limit2, CRC Status, CRC Details, Test Result, Compliance Mode, Analysis Time, and Comments.

Test Name	Measurement Details	Low Limit	Measured value	High Limit	Margin	Units	Test Result
5.1 Operating DC Voltage	DC Voltage - HEAC + line	>= 3.6	3.9536	<= 4.4	0.4464, 0.3536	V	Pass
	DC Voltage - HEAC - line	>= 3.6	4.0254	<= 4.4	0.3746, 0.4254		Pass
5.2 Jitter MAX	Jitter MAX Positive Pulses	-	1.1111	< 1.4	0.2889	nSec	Pass
	Jitter MAX Negative Pulses	-	0.9943	< 1.4	0.4057		Pass

Generate, Save, and Print a Report

After you have successfully run one or more test(s), a report summary is generated in MHT format.

To save the report summary in the desired location, select **File > Save Report As**.

To preview the report before printing, select **File > Print Preview Report**. Select **File > Print Report**.

Application Examples

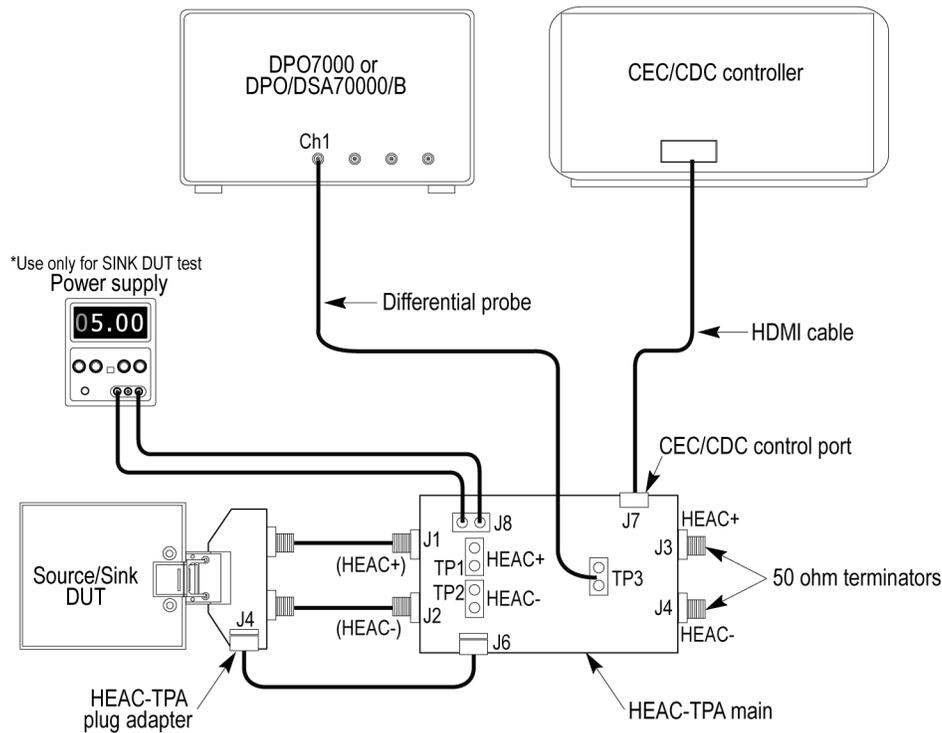
Differential Mode Transmitter Tests

Required equipment	Model supported
Real-time oscilloscope	Tektronix DPO7000 Series, DPO70000 Series, DPO70000B Series, DSA70000 Series, DSA70000B Series, and MSO70000 Series Digital and Mixed Signal Oscilloscopes
Probe	Tektronix P6247, P6248, P6330, or P7330 for a DPO70000 Series, DPO70000B Series, DSA70000 Series, DPO70000B, and MSO70000 Series Digital and Mixed Signal Oscilloscope Tektronix P6330, TDP1000, TDP1500,, or TDP3500 for a Tektronix DPO7000 Series Digital Oscilloscope
Test fixture	TF-HEAC-TPA-P (A/C) or TF-HEAC-TPA-KIT, TF-HDMID-TPA-KIT
50 Ω SMA Terminators	Any terminator that meets the following requirements: <ul style="list-style-type: none"> ■ 50 Ω impedance \pm 1% or better ■ Connects directly to the SMA female connector
DUT	An HEAC sink or source device
SMA Cables	Tektronix part number 174-1428-00 (1.5 meter) Tektronix part number 174-1341-00 (1 meter)
HDMI Cable	HDMI cable with HEAC capability

This tests the DUT for compliance with differential mode transmitter tests.

1. Connect the DUT to the equipment as shown.

NOTE. This equipment setup diagram and connections are the same for all differential transmitter tests except the Operating DC Voltage test.



- Connect the CEC or CDC Controller to the CEC/CDC Control Port on the HEAC-TPA main board.
- Connect the HEAC-TPA plug board to the HEAC connector on the Source/Sink DUT.
- Connect the 50 Ω SMA terminators to the HEAC-TPA main board.
- Connect a differential probe to the HEAC \pm differential signal probe point on the HEAC-TPA main board.
- If you are testing a Sink DUT, set the HEAC-TPA main board to enable the Sink DUT test. Set switch S7 position to the left (Off position) on the HEAC-TPA adapter.
If you are testing a Source DUT, set the HEAC-TPA main board to enable the Source DUT test. Activate +4 V bias using the +5 V power from the Source DUT. Set switch S7 to the right (On position) on the HEAC-TPA main fixture.
- Activate the HEC transmission on the HEAC Source/Sink DUT using CEC/CDC controller.

2. Select **HEAC-Transmitter** as the device type.

By default, the Differential-Tx is selected as the Test Suite.

The default version CTS 1.4.

All the differential mode transmitter tests, except the Template test, are selected by default.

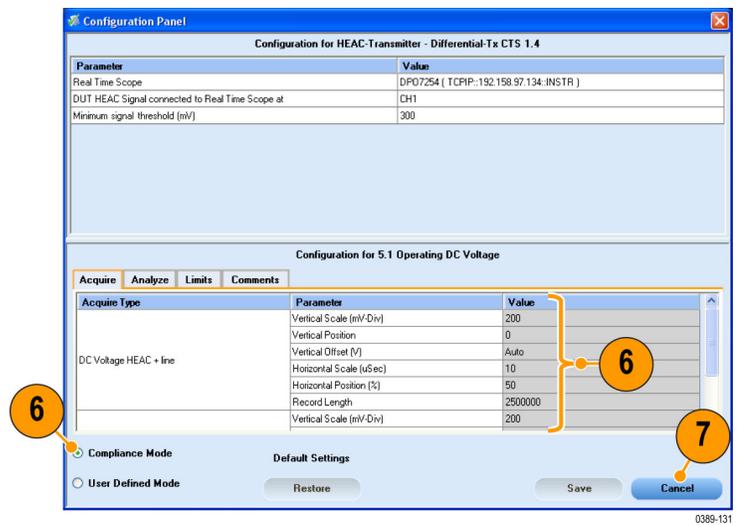
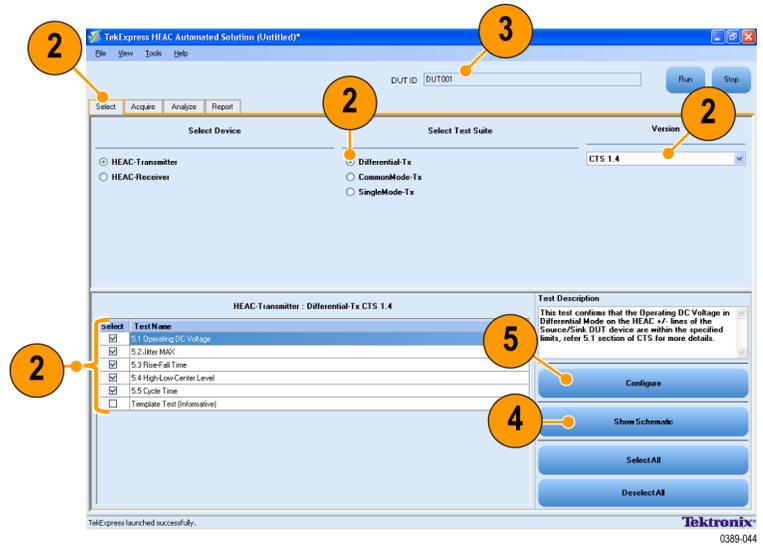
NOTE. *The Template test is an informative test and not a part of the CTS 1.4.*

3. Enter the DUT identification in the **DUT ID** field.
4. Click **Show Schematic** to display a diagram of the test setup and confirm that your test setup is correct.
5. Click **Configure** to open the Configuration panel.
6. Use the default values in the Compliance Mode to run the tests for compliance with the standards.

NOTE. *To change acquisition parameter values, click **User Defined Mode**. A message appears prompting you that if you make changes to a test, the test may no longer be compliant. Click **OK** to proceed with the User Defined Mode.*

7. Click **Close**.

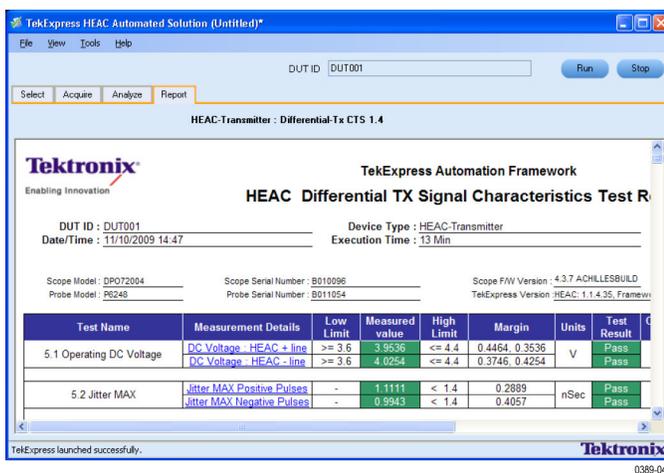
8. Click **Run** in the Select panel.



9. Click the **Analyze** tab to view test analysis results.
10. The application displays the status of the tests in the Status Messages window. Click **Save Status** to save the status messages.



11. When the tests complete, the application shows a report in the Report panel.

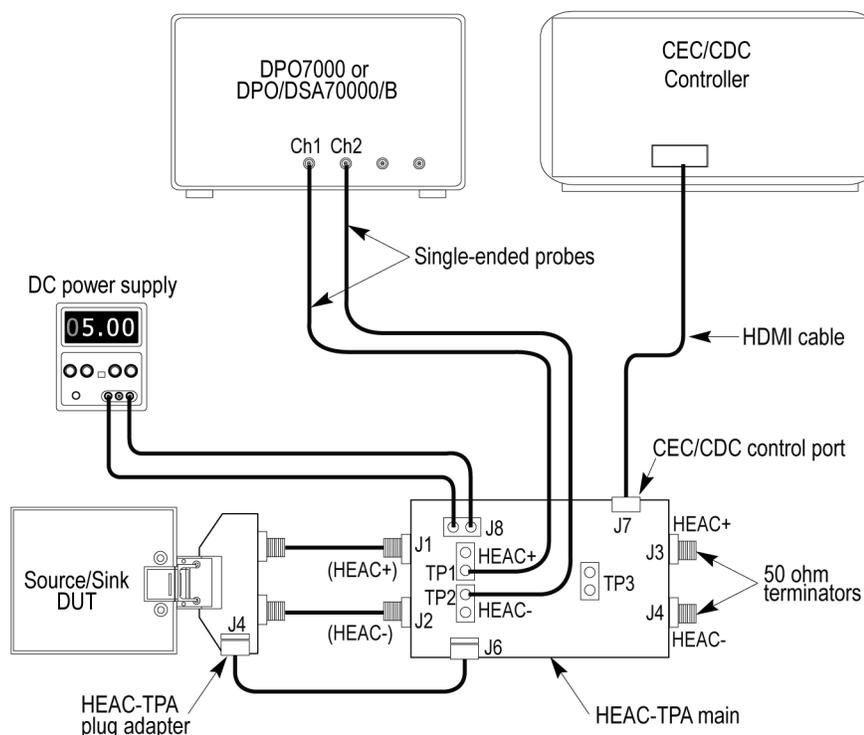


Differential Mode Operating DC Voltage Test (Transmitter)

Required equipment	Model supported
Real-time oscilloscope	Tektronix DPO7000 Series, DPO70000 Series, DPO70000B Series, DSA70000 Series, DSA70000B Series, and MSO70000 Series Digital and Mixed Signal Oscilloscopes
Probe	Tektronix P6247, P6248, P6330, or P7330 for a DPO70000 Series, DPO70000B Series, DSA70000 Series, DPO70000B, and MSO70000 Series Digital and Mixed Signal Oscilloscope Tektronix P6330, TDP1000, TDP1500, or TDP3500 for a Tektronix DPO7000 Series Digital Oscilloscope
Test fixture	TF-HEAC-TPA-P (A/C) or TF-HEAC-TPA-KIT, TF-HDMID-TPA-KIT
50 Ω SMA Terminators	Any terminator that meets the following requirements: <ul style="list-style-type: none"> ■ 50 Ω impedance \pm 1% or better ■ Connects directly to the SMA female connector
DUT	An HEAC sink or source device
SMA Cables	Tektronix part number 174-1428-00 (1.5 meter) Tektronix part number 174-1341-00 (1 meter)
HDMI Cable	HDMI cable with HEAC capability

This tests the DUT for compliance with differential mode operating DC voltage (Transmitter) tests.

1. Connect the equipment as shown.



NOTE. Use two probes for DC voltage measurement. Use the differential mode configuration for other measurements.

- Connect the CEC or CDC Controller to the CEC/CDC Control Port of the HEAC-TPA main board.
- Connect the HEAC-TPA plug board to the HEAC connector of the Source/Sink DUT.
- Connect the 50 Ω SMA terminators to the HEAC-TPA main board.
- Connect the first single-ended probe from Ch1 of the digital oscilloscope to the HEAC+ probe point on the HEAC-TPA main board, and the second single-ended probe from Ch2 to the HEAC- probe point.
- If you are testing a Sink DUT, set the HEAC-TPA main board to enable the Sink DUT test. Set switch S7 to the left (Off position) on the HEAC-TPA main fixture.
If you are testing a Source DUT, set the HEAC-TPA main board to enable the Source DUT test, and use +5 V power from the DC Power Supply. Set switch S7 to the right (On position) and the switch S4 is set to the left (Off position) on the HEAC-TPA main fixture.

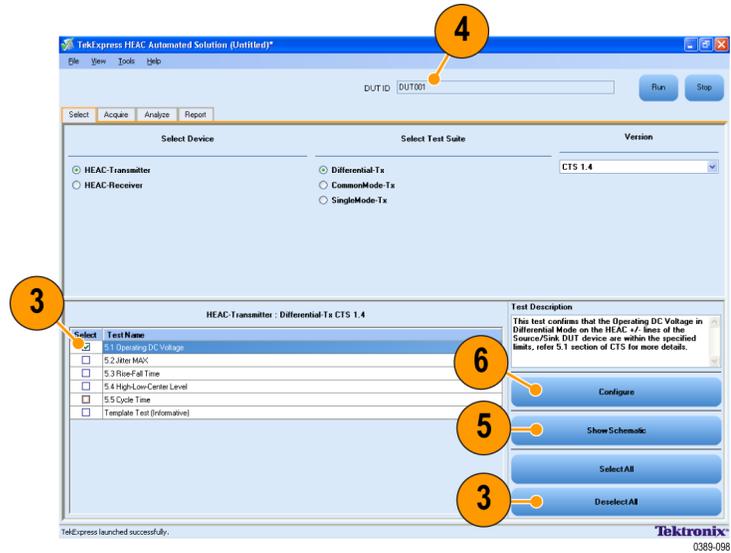
NOTE. Do not use +5 V power from the Source DUT.

- Connect and configure the DC Power Supply to supply +5 V to the HEAC-TPA main board.
- Power on the Source/Sink DUT.
- Activate the HEC transmission capability for the HEAC Source/Sink DUT using the CEC/CDC controller.

2. Select **HEAC-Transmitter** as the device type.

By default, Differential-Tx is selected as the Test Suite.

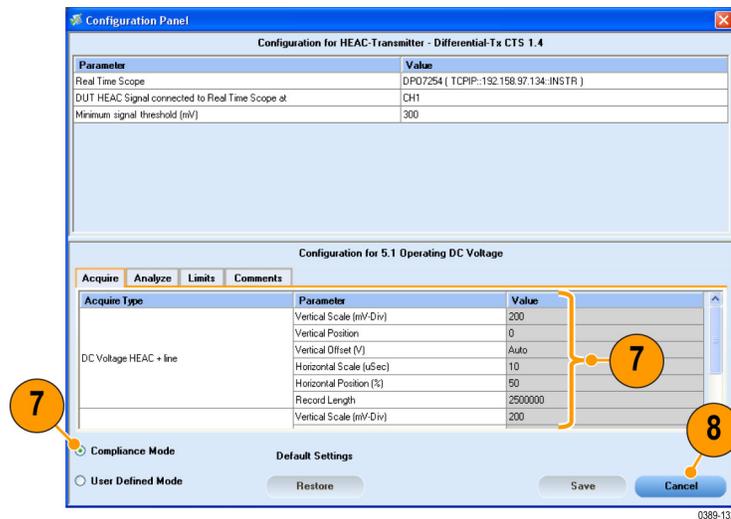
The default version CTS 1.4.



3. Click **Deselect All** and select only the Operating DC Voltage test.
4. Enter the DUT identification in the **DUT ID** field.
5. Click **Show Schematic** to display a diagram of the test setup and confirm that your test setup is correct.
6. Click **Configure** to open the Configuration panel.
7. Use the default values in the Compliance Mode to run the tests for compliance with the standards.

NOTE. To change acquisition parameter values, click **User Defined Mode**. A message appears prompting you that If you make changes to a test, the test may no longer be compliant. Click **OK** to proceed with the User Defined Mode.

8. Click **Close**.

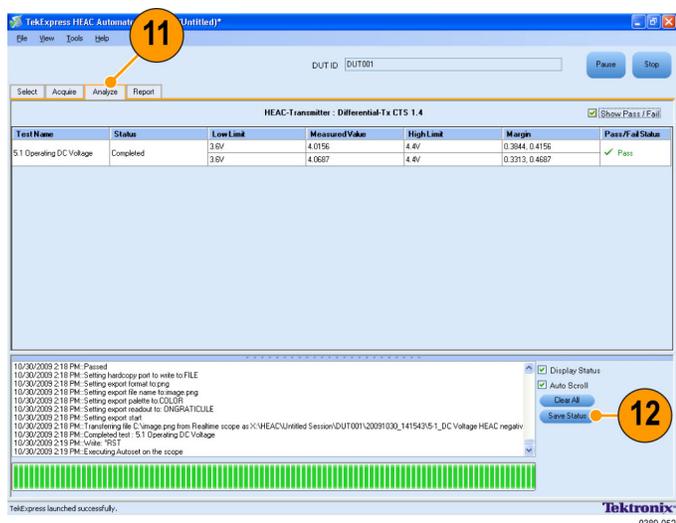


- Click **Run** in the Select panel.
The application switches to the Acquire tab.

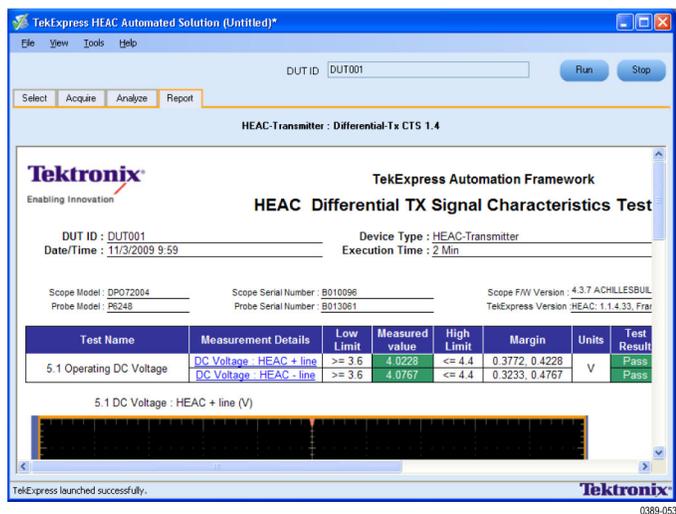


- Follow the on-screen prompts and the schematics to change the setup. Click **OK** to continue.

- Click the **Analyze** tab to view test analysis results.
- The application displays the status of the tests in the Status Messages window. Click **Save Status** to save the status messages.



- When the tests complete, the application shows a report in the Report panel.

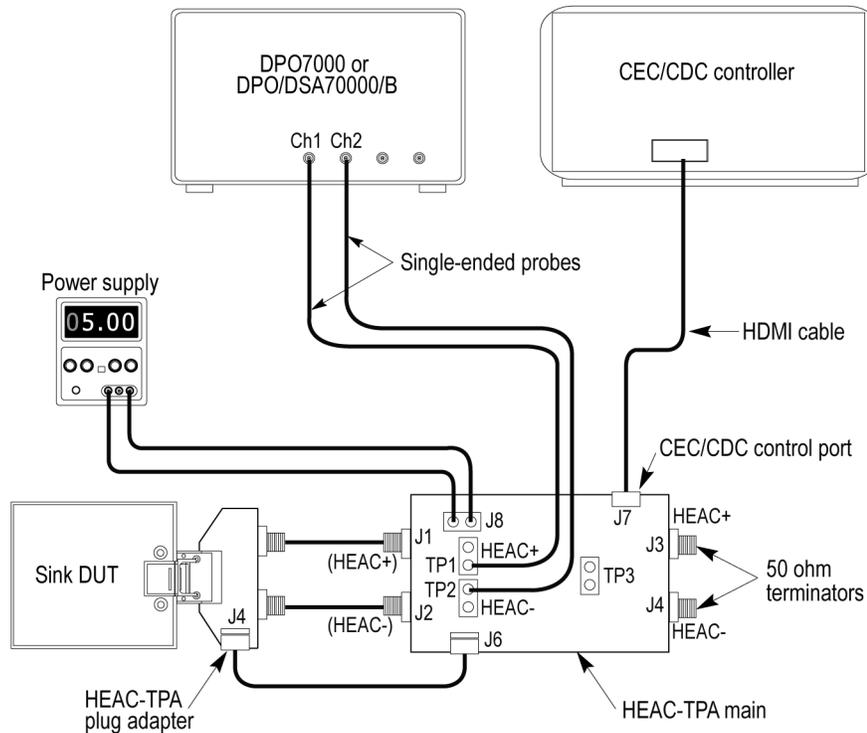


Common Mode Transmitter Tests

Required equipment	Model supported
Real-time oscilloscope	Tektronix DPO7000 Series, DPO70000 Series, DPO70000B Series, DSA70000 Series, DSA70000B Series, and MSO70000 Series Digital and Mixed Signal Oscilloscopes
Probe	<p>Tektronix P6243 or P6245 for Tektronix DPO70000 Series, DPO70000B Series, DSA70000 Series, and DSA70000B Series, and MSO7000 Series Digital and Mixed Oscilloscopes</p> <p>Tektronix P6243, P6245, or TAP1500 for Tektronix DPO7000 Series Digital Oscilloscopes</p> <p>NOTE. You can also use two differential probes in single-ended mode.</p>
Test fixture	TF-HEAC-TPA-P (A/C) or TF-HEAC-TPA-KIT, TF-HDMID-TPA-KIT
50 Ω SMA Terminators	<p>Any terminator that meets the following requirements:</p> <ul style="list-style-type: none"> ■ 50 Ω impedance \pm 1% or better ■ Connects directly to the SMA female connector
DUT	An HEAC sink device
SMA Cables	<p>Tektronix part number 174-1428-00 (1.5 meter)</p> <p>Tektronix part number 174-1341-00 (1 meter)</p>
HDMI Cable	HDMI cable with HEAC capability

This tests the DUT for compliance with common mode (Transmitter) tests.

1. Connect the equipment as shown.



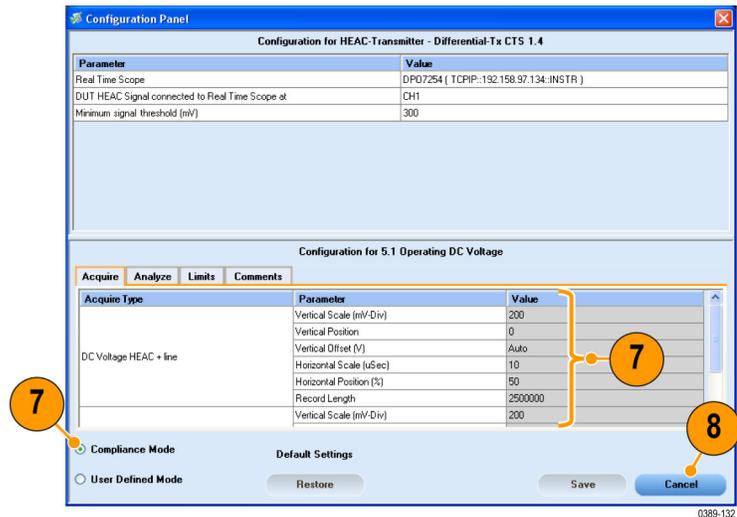
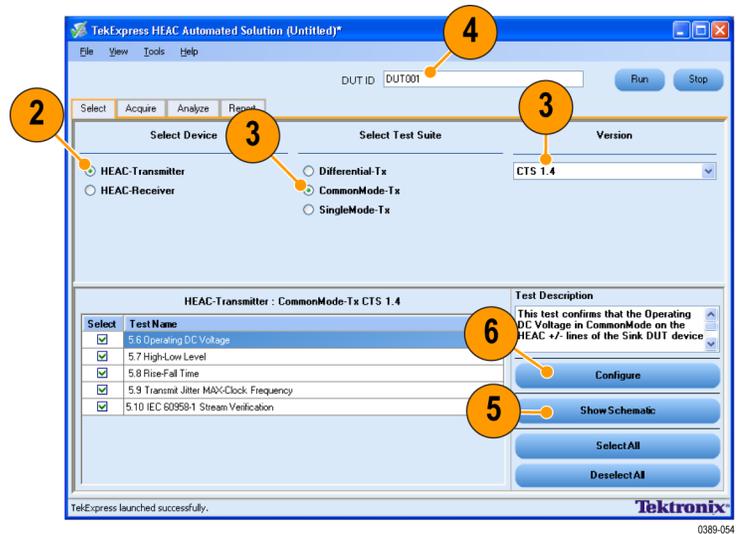
- Connect the CEC or CDC Controller to the CEC/CDC Control Port of the HEAC-TPA main board.
- Connect the HEAC-TPA plug board to the HEAC connector of the Sink DUT.
- Connect the 50 Ω terminators to the HEAC-TPA main /board.
- Connect the first single-ended probe from Ch1 of the digital oscilloscope to the HEAC+ probe point on the HEAC-TPA main board, and the second single-ended probe from Ch2 to the HEAC- probe point.
- Set the HEAC-TPA main board to enable the Sink DUT test.
- Connect and configure DC Power Supply to drive +5 V to the HEAC-TPA main board.
- Power on the Sink DUT.
- Activate the ARC (Common mode) transmission on the HEAC Sink DUT using the CEC/CDC controller.

2. Select **HEAC-Transmitter** as the device type.
3. Select **CommonMode-Tx**.
The default version CTS 1.4.
All the common mode transmitter tests are selected by default.
4. Enter the DUT identification in the **DUT ID** field.
5. Click **Show Schematic** to display a diagram of the test setup and confirm that your test setup is correct.
6. Click **Configure** to open the Configuration panel.
7. Use the default values in the Compliance Mode to run the tests for compliance with the standards.

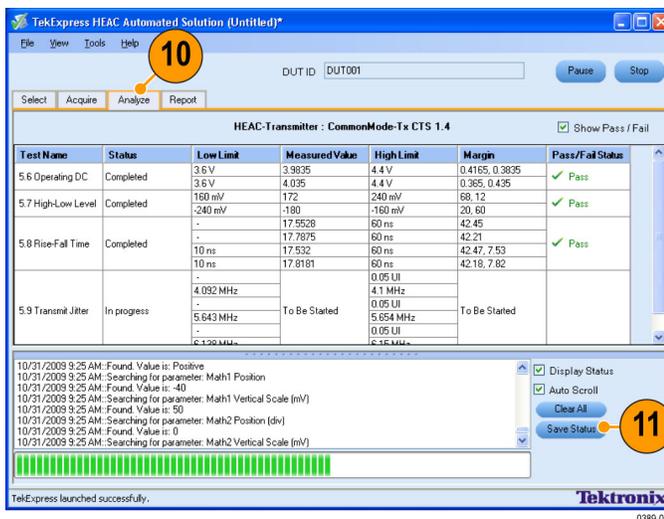
NOTE. To change acquisition parameter values, click **User Defined Mode**. A message appears prompting you that If you make changes to a test, the test may no longer be compliant. Click **OK** to proceed with the User Defined Mode.

8. Click **Close**.

9. Click **Run** in the Select panel.
The application switches to the Acquire tab.



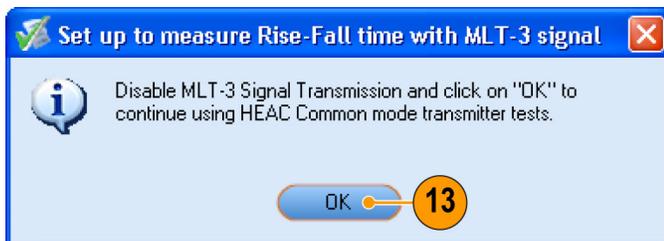
10. Click the **Analyze** tab to view test analysis results.
11. The application displays the status of the tests in the Status Messages window. Click **Save Status** to save the status messages.



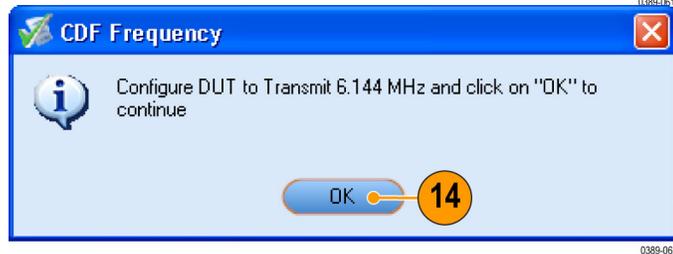
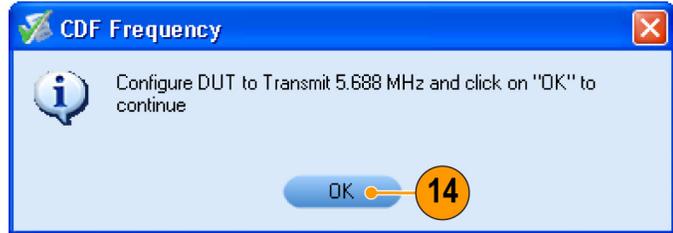
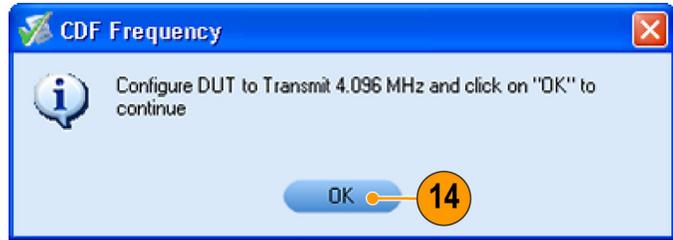
12. Follow the on-screen prompts. For the Rise-Fall Time test, configure the DUT to transmit an MLT-3 signal and click **OK**.



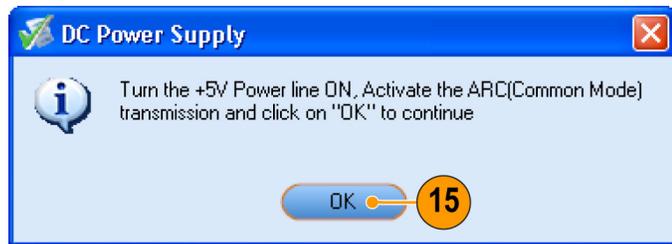
13. When prompted, configure the DUT to disable the MLT-3 signal and click **OK**.



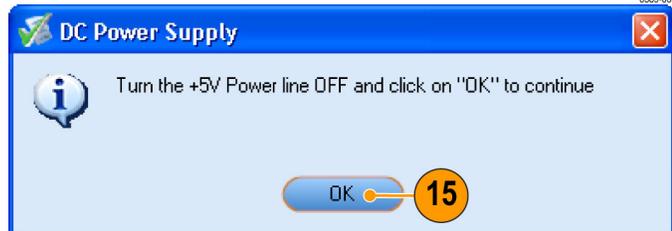
14. The Transmit Jitter MAX test is run at three frequencies. The application prompts you to configure the DUT for each of these frequencies: 4.096 MHz, 5.688 MHz, and 6.144 MHz. If your device supports the frequency, configure the DUT, and click **OK**.



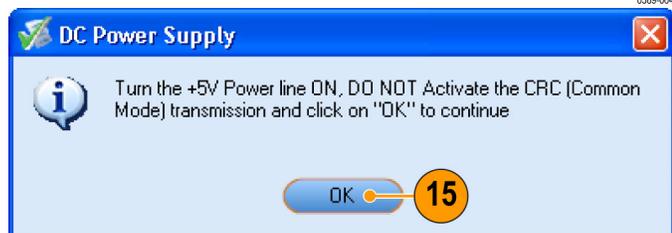
15. The IEC Stream Verification test is run under three conditions: With +5 V power turned on and ARC activated, With +5 V power turned off, and With +5 V power turned on and ARC not activated. Follow the prompts and click **OK**.



0389-063

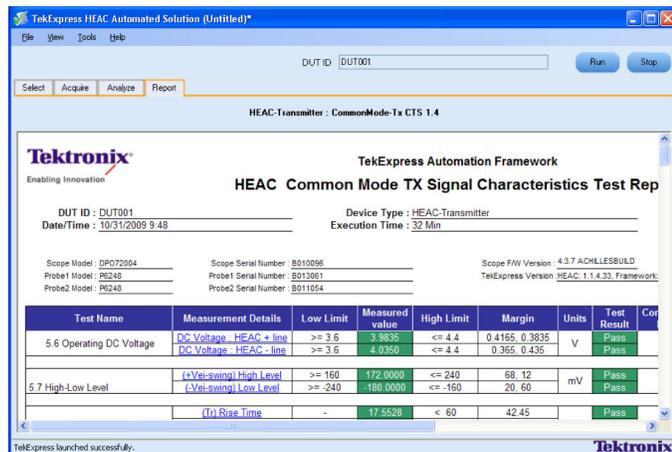


0389-064



0389-065

16. When the tests complete, the application shows a report in the Report panel.



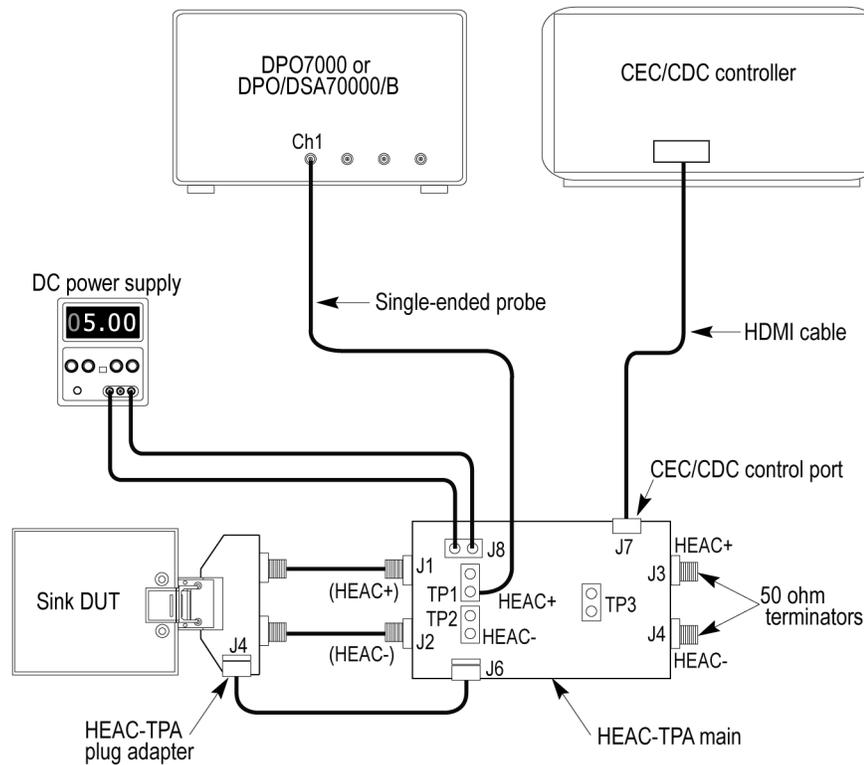
0389-066

Single Mode Transmitter Tests

Required equipment	Model supported
Real-time oscilloscope	Tektronix DPO7000 Series, DPO70000 Series, DPO70000B Series, DSA70000 Series, DSA70000B Series, and MSO70000 Series Digital and Mixed Signal Oscilloscopes
Probe	<p>Tektronix P6243 or P6245 for Tektronix DPO70000 Series, DPO70000B Series, DSA70000 Series, and DSA70000B Series, and MSO7000 Series Digital and Mixed Oscilloscopes</p> <p>Tektronix P6243, P6245, or TAP1500 for Tektronix DPO7000 Series Digital Oscilloscopes</p> <p>NOTE. You can also use two differential probes in single-ended mode.</p>
Test fixture	TF-HEAC-TPA-P (A/C) or TF-HEAC-TPA-KIT, TF-HDMID-TPA-KIT
50 Ω SMA Terminators	<p>Any terminator that meets the following requirements:</p> <ul style="list-style-type: none"> ■ 50 Ω impedance \pm 1% or better ■ Connects directly to the SMA female connector
DUT	An HEAC sink device
SMA Cables	<p>Tektronix part number 174-1428-00 (1.5 meter)</p> <p>Tektronix part number 174-1341-00 (1 meter)</p>
HDMI Cable	HDMI cable with HEAC capability

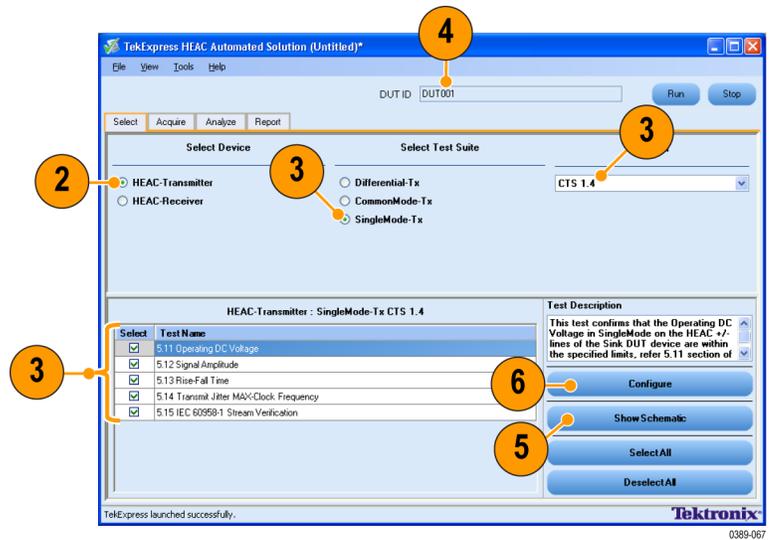
This tests the DUT for compliance with single mode (Transmitter) tests.

1. Connect the equipment as shown.



- Connect the CEC or CDC Controller to the CEC/CDC Control Port on the HEAC-TPA main board.
- Connect the HEAC-TPA plug board to the HEAC connector on the Sink DUT.
- Connect the 50 Ω SMA terminators to the HEAC-TPA main board.
- Set the Impedance Conversion Circuit on the HEAC-TPA main board to **55 Ω** .
- Connect a single-ended probe from Ch1 of the digital oscilloscope to the HEAC+ probe point on the HEAC-TPA main board.
- Set the HEAC-TPA main board to enable the Sink DUT test.
- Connect and set the DC Power Supply to supply +5 V to the HEAC-TPA main board. Set switch S7 to the left (Off position) on the HEAC-TPA main fixture.
- Power on the Sink DUT.
- Activate the ARC (Single mode) transmission on the HEAC Sink DUT using the CEC/CDC controller.

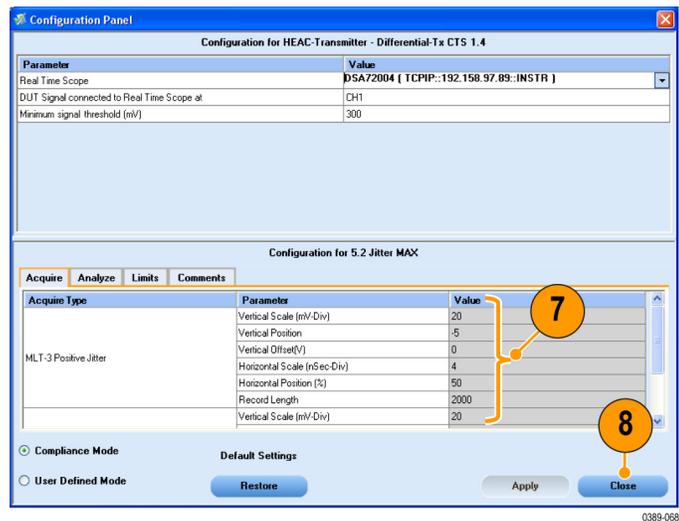
2. Select **HEAC-Transmitter** as the device type.
3. Select **SingleMode-Tx**.
The default version CTS 1.4.
All the single mode transmitter tests are selected by default.
4. Enter the DUT identification in the **DUT ID** field.
5. Click **Show Schematic** to display a diagram of the test setup and confirm that your test setup is correct.



6. Click **Configure** to open the Configuration panel.
7. Use the default values in the Compliance Mode to run the tests for compliance with the standards.

NOTE. To change acquisition parameter values, click **User Defined Mode**. A message appears prompting you that If you make changes to a test, the test may no longer be compliant. Click **OK** to proceed with the User Defined Mode.

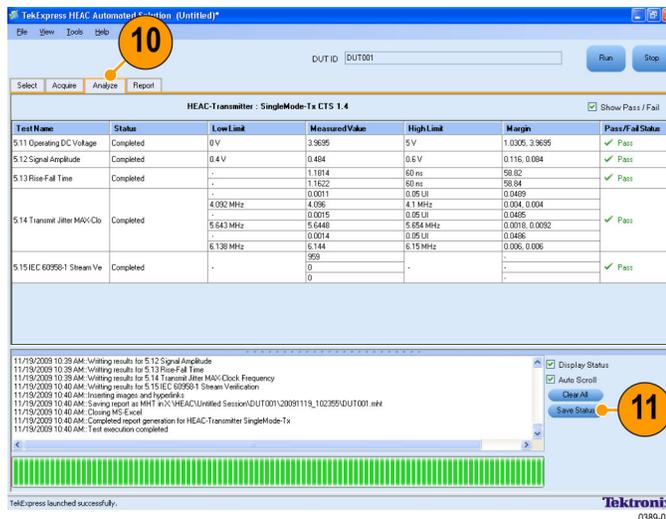
8. Click **Close**.



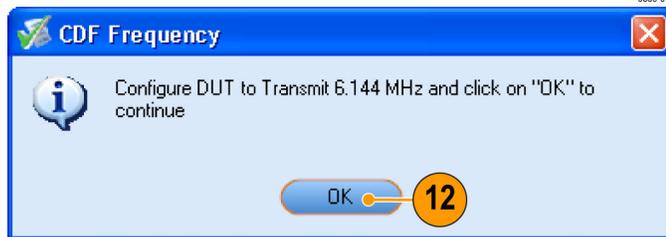
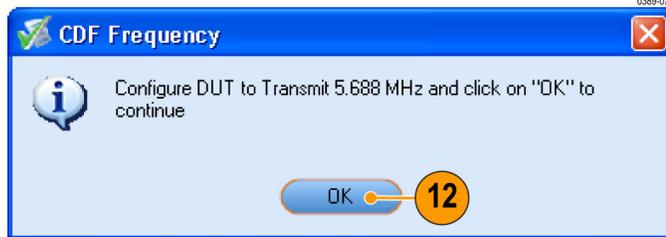
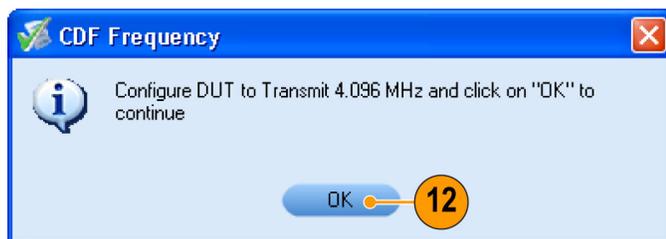
9. Click **Run** in the Select tab.
The application switches to the Acquire tab.



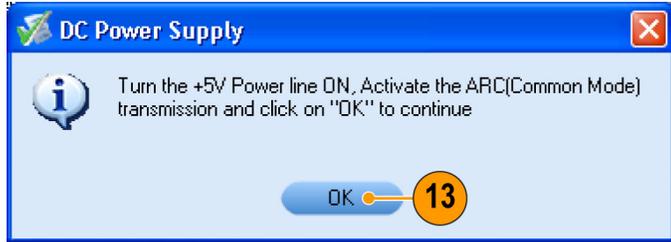
- 10. Click the **Analyze** tab to view test analysis results.
- 11. The application displays the status of the tests in the Status Messages window. Click **Save Status** to save the status messages.



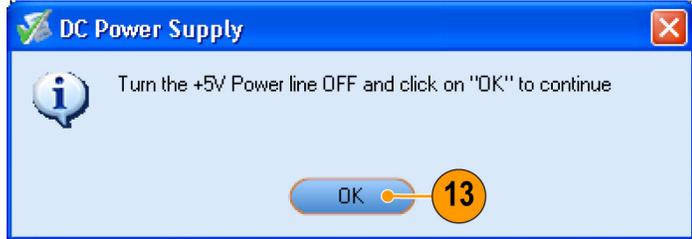
- 12. The Transmit Jitter MAX test is run at three frequencies. The application prompts you to configure the DUT for each of these frequencies: 4.096 MHz, 5.688 MHz, and 6.144 MHz. If your device supports the frequency, configure the DUT, and click **OK**.



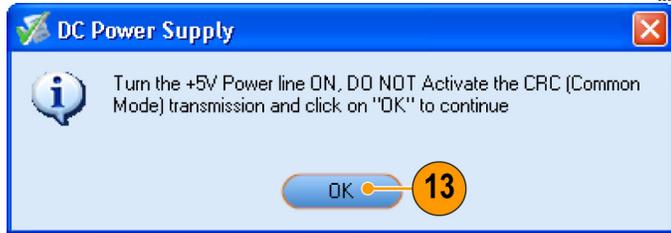
13. The IEC Stream Verification test is run under three conditions: with +5 V power turned on and ARC activated, with +5 V power turned off, and with +5 V power turned on and ARC not activated. Follow the prompts and click **OK**.



0389-074

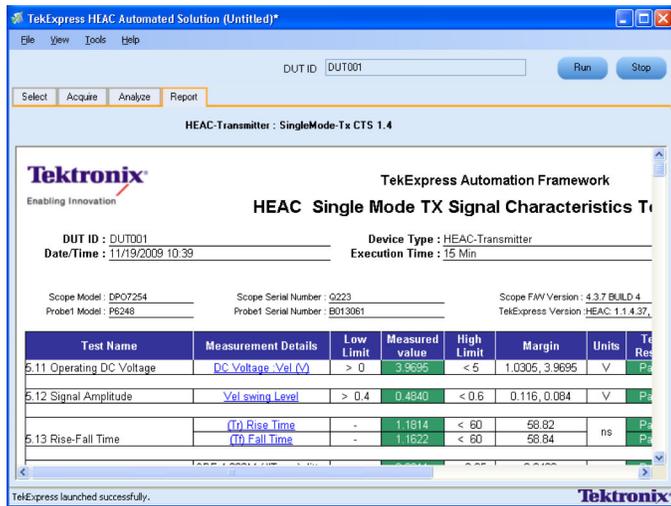


0389-075



0389-076

14. When the tests complete, the application shows a report in the Report panel.



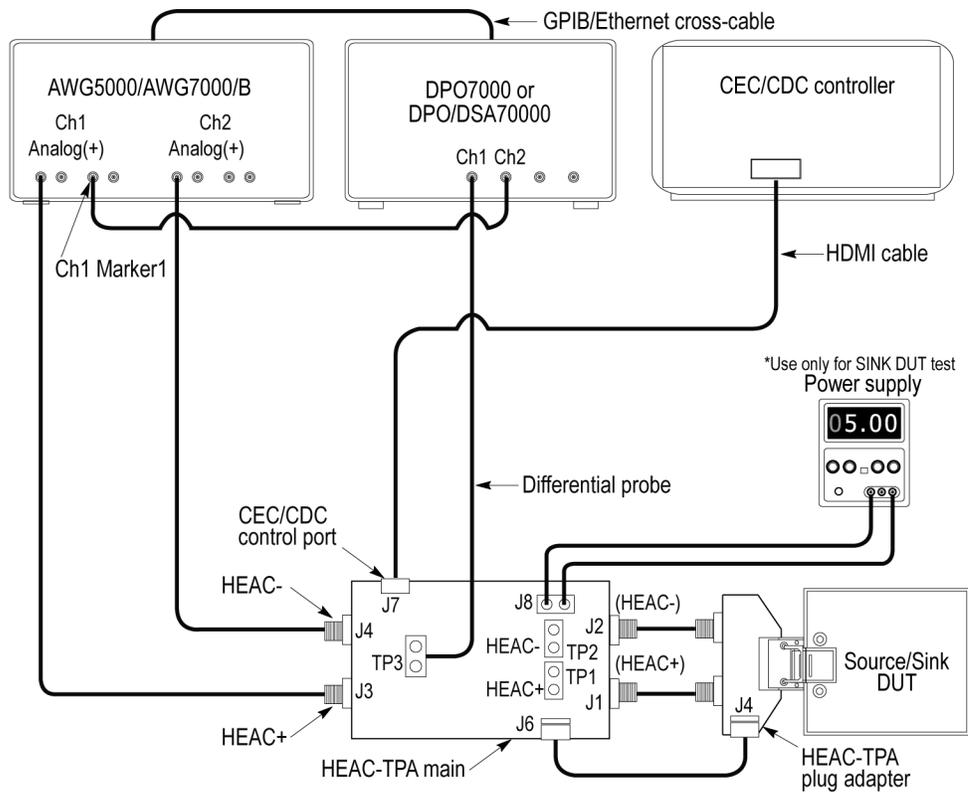
0389-114

Differential Receiver Tests

Required equipment	Model supported
Real-time oscilloscope	Tektronix DPO7000 Series, DPO70000 Series, DPO70000B Series, DSA70000 Series, DSA70000B Series, and MSO70000 Series Digital and Mixed Signal Oscilloscopes
Arbitrary waveform generator	Tektronix AWG5000 Series, AWG5000B, AWG7000 Series, or AWG7000B Series Arbitrary Waveform Generator
Probe	Tektronix P6247, P6248, P6330, or P7330 for a DPO70000 Series, DPO70000B Series, DSA70000 Series, DPO70000B, and MSO70000 Series Digital and Mixed Signal Oscilloscope Tektronix P6330, TDP1000, TDP1500, or TDP3500 for a Tektronix DPO7000 Series Digital Oscilloscope
Test fixture	TF-HEAC-TPA-P (A/C) or TF-HEAC-TPA-KIT, TF-HDMID-TPA-KIT
DUT	An HEAC sink or source device
SMA Cables	Tektronix part number 174-1428-00 (1.5 meter) Tektronix part number 174-1341-00 (1 meter)
HDMI Cable	HDMI cable with HEAC capability

This tests the DUT for compliance with differential receiver tests.

1. Connect the DUT to the equipment as shown.

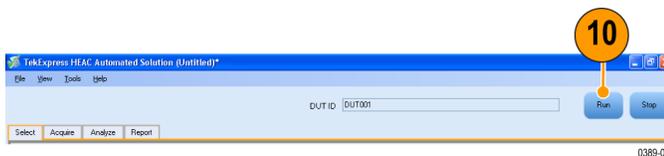
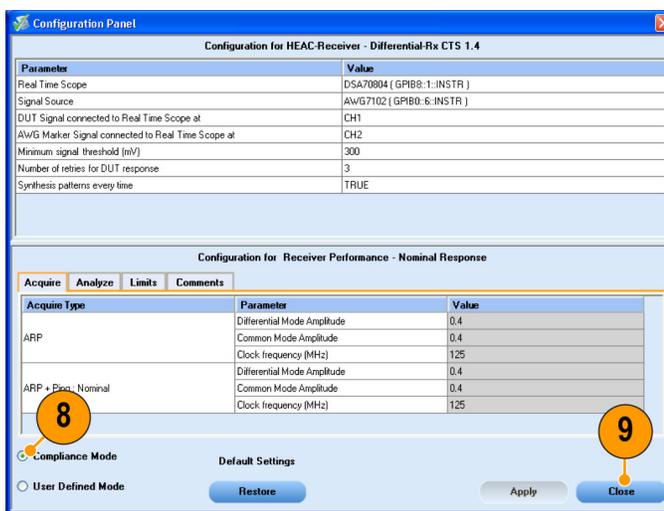
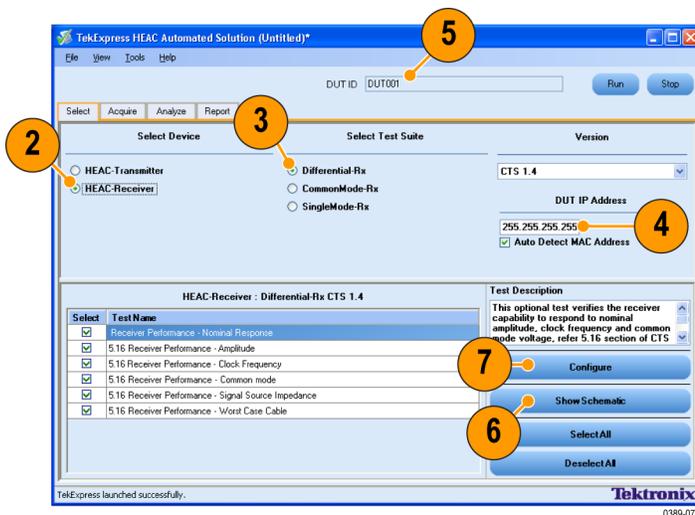


- Connect a LAN cross-cable from the digital oscilloscope to the waveform generator, and enable the TekVISA connection to the waveform generator and to the digital oscilloscope.
- Connect an SMA cable to the Ch1 Marker1 output and to Ch2 on the digital oscilloscope.
- Connect the HEAC-TPA plug board to the HEAC connector of the Source/Sink DUT.
- Connect the Ch1 Analog(+) output of the arbitrary waveform generator to the HEAC+ SMA connector on the HEAC-TPA main board and the Ch2 Analog(+) to HEAC-.
- Set the Impedance Conversion Circuit on the HEAC-TPA main board to **50 Ω**.
- Connect a differential probe to the HEAC± differential signal probe point on the HEAC-TPA main board.
- Connect the CEC or CDC Controller to the CEC/CDC Control Port of the HEAC-TPA main board.
- If you are testing a Sink DUT, set the HEAC-TPA main board to enable the Sink DUT test. Set switch S7 to the left (Off position) on the HEAC-TPA main board.
If you are testing a Source DUT, set the HEAC-TPA main board to enable the Source DUT test. Activate +4 V bias by using the +5 V power from the Source DUT. Set switch S7 to the right (On position) on the HEAC-TPA main fixture.
- Activate the HEC transmission on the HEAC Source/Sink DUT using the CEC/CDC controller.

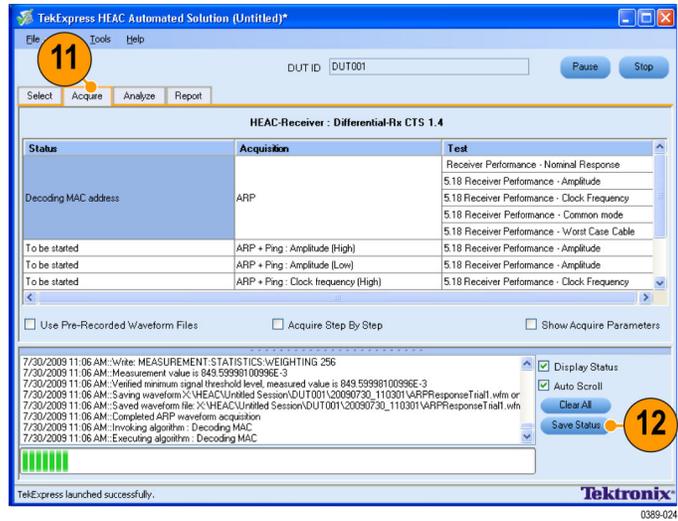
2. Select **HEAC-Receiver** as the device type.
3. Select the **Differential-Rx** as the Test Suite.
The default version CTS 1.4.
All the differential mode receiver tests are selected by default.
4. Enter the **DUT IP Address**.
5. Enter the DUT identification in the **DUT ID** field.
6. Click **Show Schematic** to display a diagram of the test setup and confirm that your test setup is correct.
7. Click **Configure** to open the Configuration panel.
8. Use the default values in the Compliance Mode to run the tests for compliance with the standards.

NOTE. The User Defined Mode is not available for HEAC Differential Receiver tests.

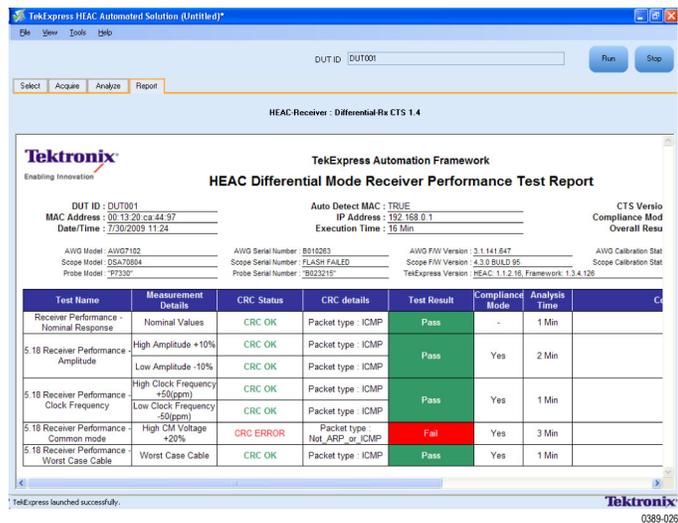
9. Click **Close**.
10. Click **Run** in the Select panel to run the test.



11. Click the **Acquire** tab to view the acquisition details.
12. The application displays the status of the tests in the Status Messages window. Click **Save Status** to save the status messages.



13. When the tests complete, the application shows a report in the Report panel.



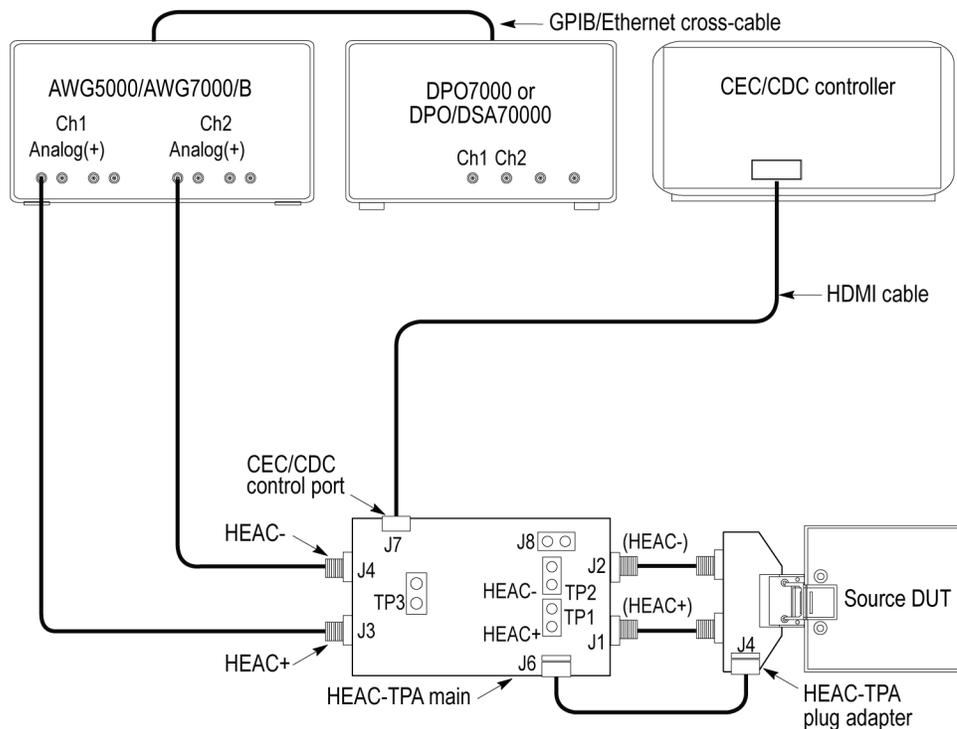
Common Mode Receiver Tests

Required equipment	Model supported
Real-time Oscilloscope	Tektronix DPO7000 Series, DPO70000 Series, DPO70000B Series, DSA70000 Series, DSA70000B Series, and MSO70000 Series Digital and Mixed Signal Oscilloscopes
Arbitrary waveform generator	Tektronix AWG5000 Series, AWG5000B Series, AWG7000, or AWG7000B Series Arbitrary Waveform Generator
HEAC TPA-P adapter	Tektronix HEAC-TPA-P
Test fixture	TF-HEAC-TPA-P (A/C) or TF-HEAC-TPA-KIT, TF-HDMID-TPA-KIT
DUT	An HEAC source device
SMA Cables	Tektronix part number 174-1428-00 (1.5 meter) Tektronix part number 174-1341-00 (1 meter)
HDMI Cable	HDMI cable with HEAC capability

This tests the DUT for common mode receiver tests.

1. Connect the DUT to the equipment as shown.

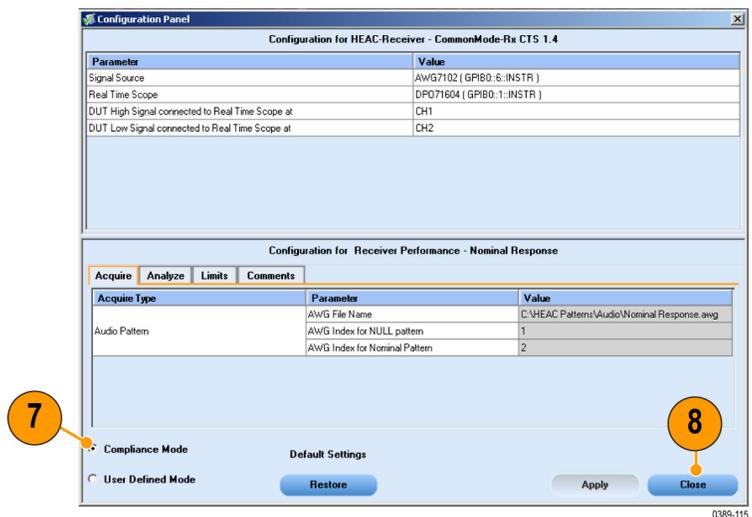
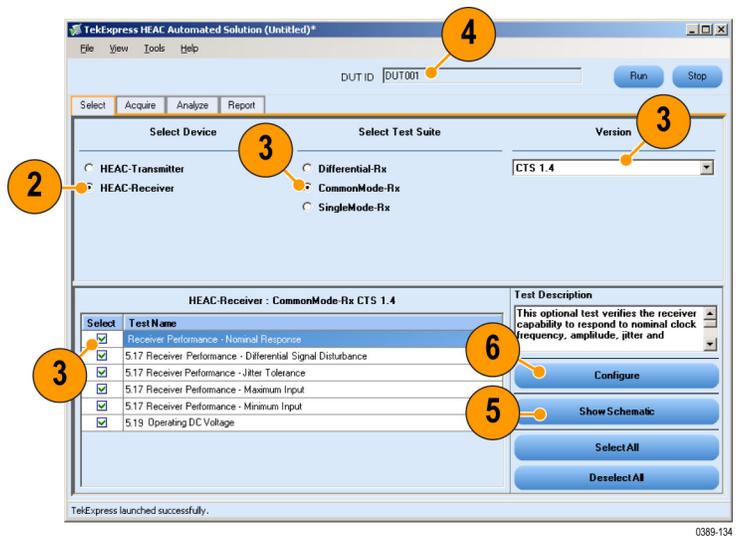
NOTE. This equipment setup diagram and connections are the same for all common mode receiver tests except the Operating DC Voltage Test.



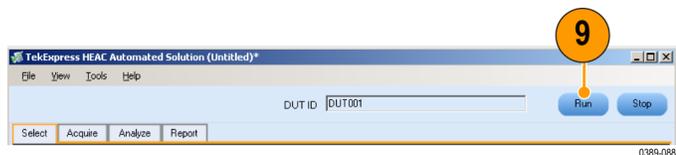
- Connect the HEAC-TPA main board to the HEAC connector on the Source DUT.
- Connect the CEC or CDC Controller to the CEC/CDC Control Port of the HEAC-TPA main board.
- Connect the Ch1 Analog(+) output from a waveform generator to the HEAC+ SMA connector of the HEAC-TPA main board, and the Ch2 Analog(+) to the HEAC- SMA connector.
- Set the Impedance Conversion Circuit on the HEAC-TPA main board to **50 Ω**.
- Set the HEAC-TPA main board to enable the Source DUT test.
- Activate +4 V bias using the +5 V power from the Source DUT.
- Activate ARC (Common mode) transmission capability for the HEAC Source DUT using the CEC/CDC controller.

2. Select **HEAC-Receiver** as the device type.
3. Select **CommonMode-Rx** as the Test Suite.
All the common mode receiver tests are selected by default.
The default version CTS 1.4.
4. Enter the DUT identification in the **DUT ID** field.
5. Click **Show Schematic** to display a diagram of the test setup and confirm that your test setup is correct.
6. Click **Configure** to open the Configuration panel.
7. Use the default values in the Compliance Mode to run the tests for compliance with the standards.

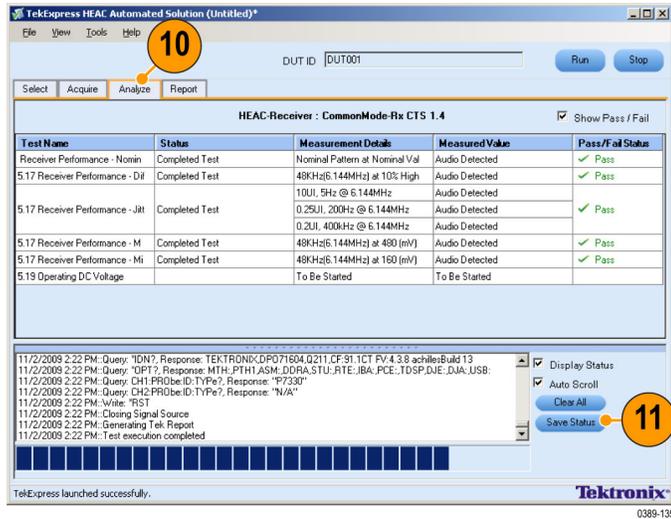
NOTE. The User Defined Mode is not available for HEAC Common Mode Receiver tests.



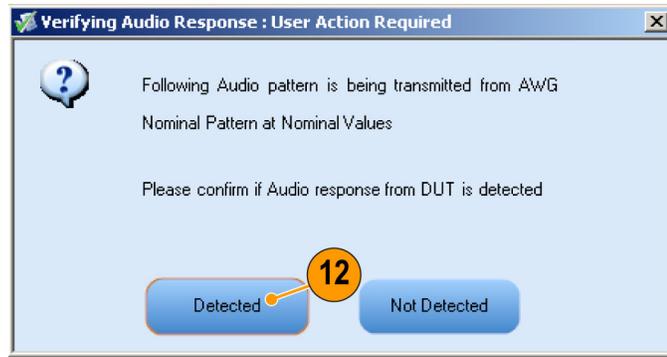
8. Click **Close**.
9. Click **Run** in the Select panel to run the test.
The application switches to the Acquire tab.



10. Click the **Analyze** tab.
11. The application displays the status of the tests in the Status Messages window. Click **Save Status**.

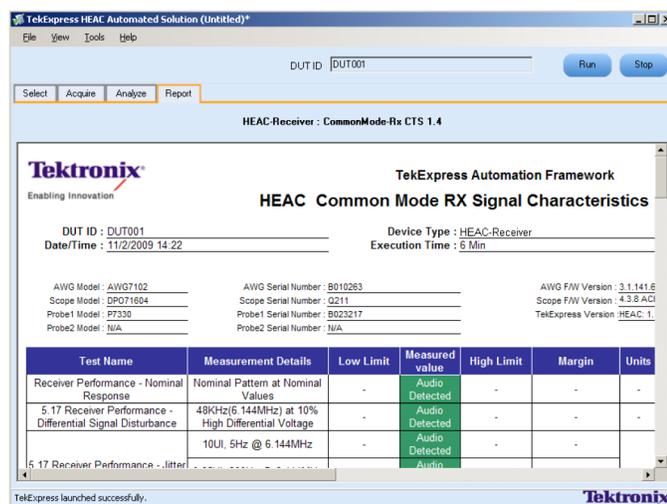


- As the selected tests are executed, the application prompts you to verify the audio response from the DUT. Click **Detected** or **Not Detected** as appropriate for each test.



0389-083

- Follow the on-screen prompts and the schematics to change the setup. Click **OK** to continue.
- When the tests complete, the application shows a report in the Report panel.



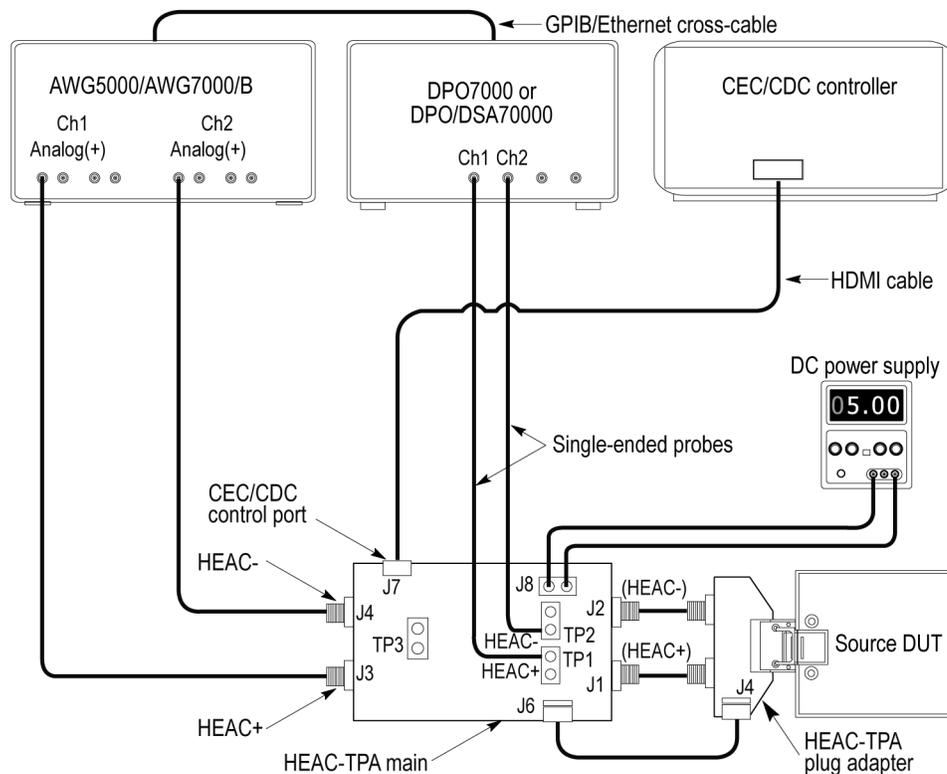
0389-136

Common Mode Operating DC Voltage Test (Receiver)

Required equipment	Model supported
Real-time oscilloscope	Tektronix DPO7000 Series, DPO70000 Series, DPO70000B Series, DSA70000 Series, DSA70000B Series, and MSO70000 Series Digital and Mixed Signal Oscilloscopes
Arbitrary waveform generator	Tektronix AWG5000 Series, AWG5000B, AWG7000 Series, and AWG7000B Series Arbitrary Waveform Generator
Probe	Tektronix P6243 or P6245 for Tektronix DPO70000 Series, DPO70000B Series, DSA70000 Series, and DSA70000B Series, and MSO7000 Series Digital and Mixed Oscilloscopes Tektronix P6243, P6245, or TAP1500 for Tektronix DPO7000 Series Digital Oscilloscopes
HEAC TPA-P adapter	Tektronix HEAC-TPA-P
Test fixture	TF-HEAC-TPA-P (A/C) or TF-HEAC-TPA-KIT, TF-HDMID-TPA-KIT
DUT	An HEAC source device
SMA Cables	Tektronix part number 174-1428-00 (1.5 meter) Tektronix part number 174-1341-00 (1 meter)
HDMI Cable	HDMI cable with HEAC capability

This tests the DUT for compliance with common mode operating DC voltage (Receiver) tests.

1. Connect the DUT to the equipment as shown.

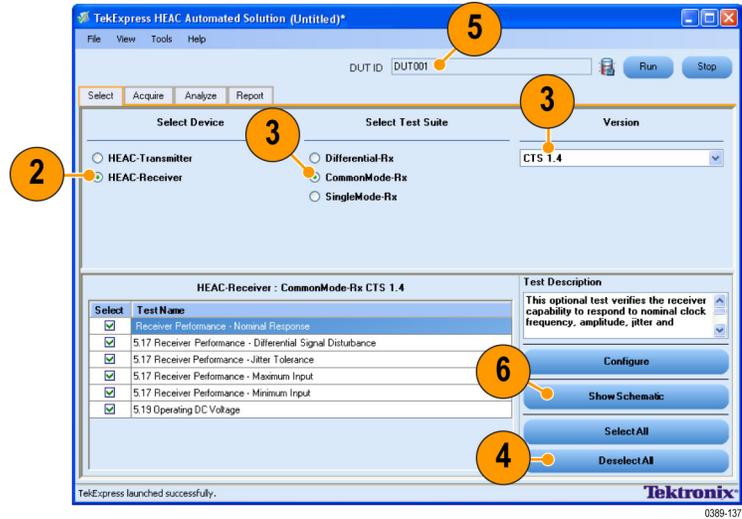


- Connect the HEAC-TPA plug board to the HEAC connector on the Source DUT.
- Connect the CEC or CDC Controller to the CEC/CDC Control Port on the HEAC-TPA main board.
- Connect the Ch1 Analog(+) output from a waveform generator to the HEAC+ SMA connector of the HEAC-TPA main board, and the Ch2 Analog(+) to the HEAC- SMA connector.
- Set the Impedance Conversion Circuit on the HEAC-TPA main board to **50 Ω**.
- Connect a single-ended probe from Ch1 of the Digital Oscilloscope to the HEAC+ probe point on the HEAC-TPA main board, and a second single-ended probe from Ch2 to the HEAC- probe point.
- Set the HEAC-TPA main board to enable the Source DUT test, and to use +5 V power from the DC Power Supply. Set switch S7 to the right (On position) on the HEAC-TPA main fixture.

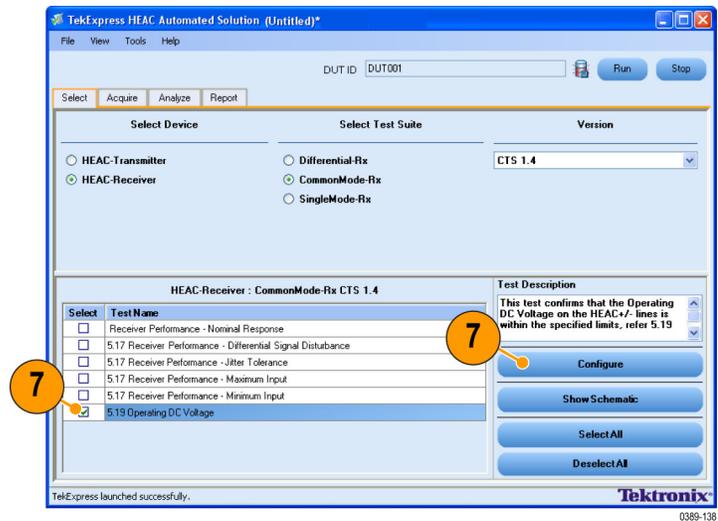
NOTE. Do not use +5 V power from the Source DUT.

- Connect and set the DC Power Supply to supply +5 V to the HEAC-TPA main board.
- Power on the Source DUT.
- Activate the ARC (Common mode) transmission on the HEAC Source DUT using the CEC/CDC controller.

2. Select **HEAC-Receiver** as the device type.
3. Select the **CommonMode-Rx** as the Test Suite.
The default version CTS 1.4.



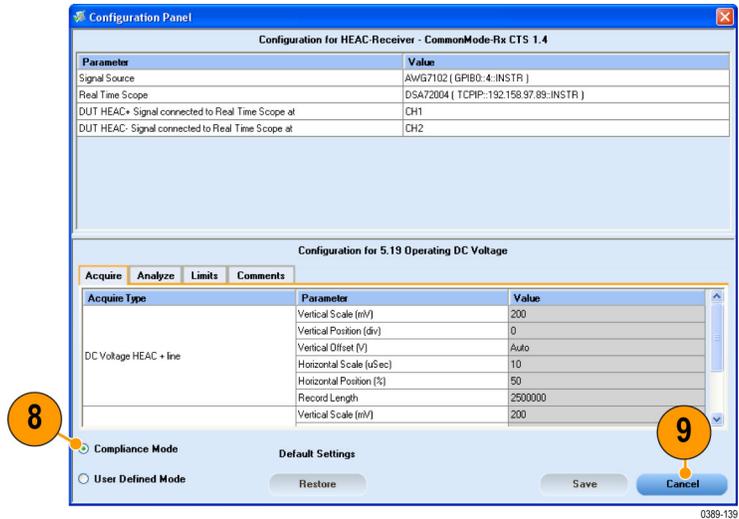
4. Click **Deselect All** and select the Operating DC Voltage Test.
5. Enter the DUT identification in the **DUT ID** field.
6. Click **Show Schematic** to display a diagram of the test setup and confirm that your test setup is correct.
7. In the Select panel, highlight the test and click **Configure**.



- Use the default values in the Compliance Mode to run the tests for compliance with the standards.

NOTE. To change acquisition parameter values, click **User Defined Mode**. A message appears prompting you that If you make changes to a test, the test may no longer be compliant. Click **OK** to proceed with the User Defined Mode.

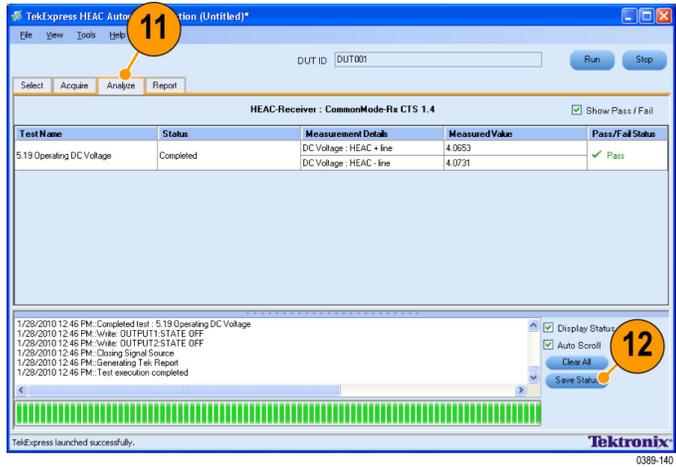
- Click **Close**.



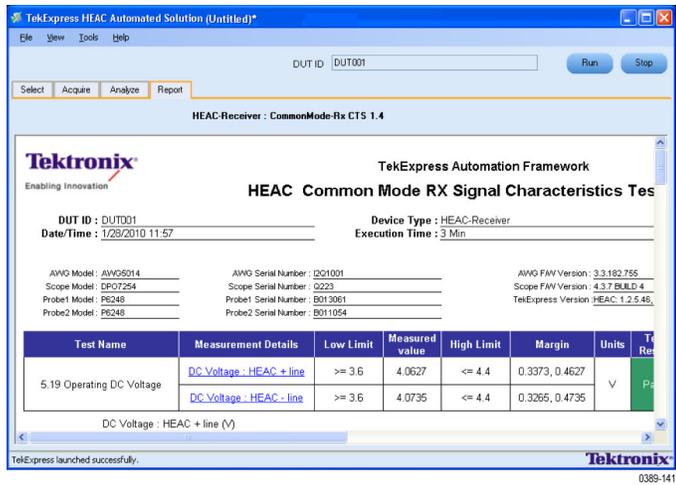
- In the Select panel, click **Run** to start the test.
The application switches to the Acquire tab.



11. Click the **Analyze** tab.
12. The application displays the status of the tests in the Status Messages window. Click **Save Status** to save the status messages.



13. When the tests complete, the application shows a report in the Report panel.

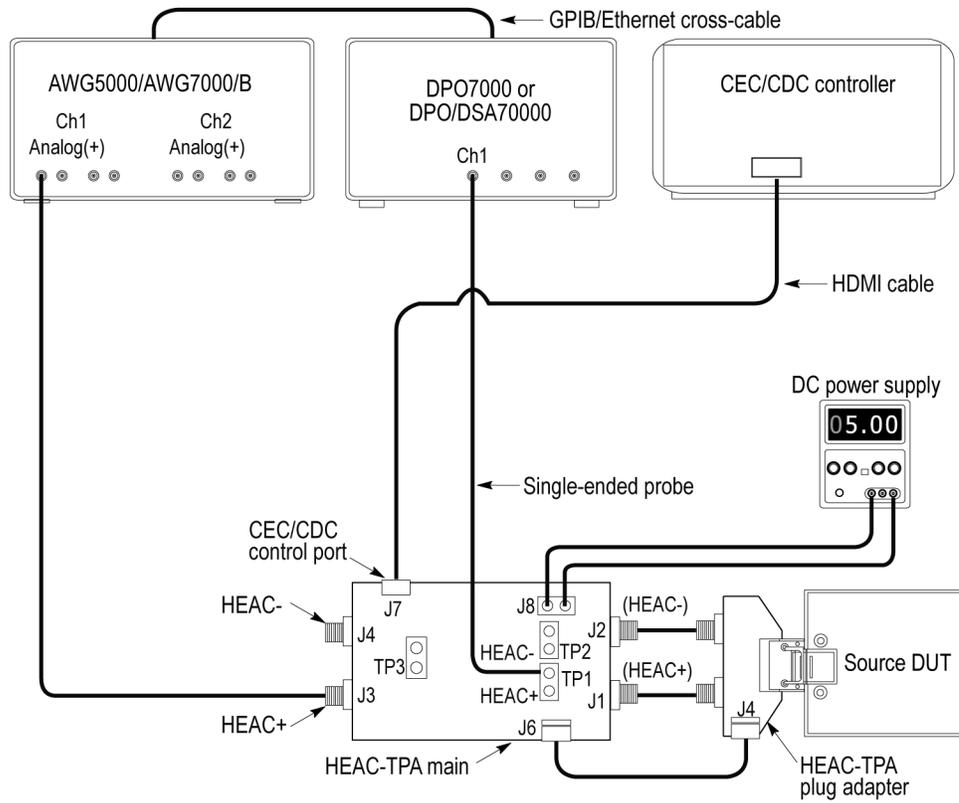


Single Mode Receiver Tests

Required equipment	Model supported
Real-time oscilloscope	Tektronix DPO7000 Series, DPO70000 Series, DPO70000B Series, DSA70000 Series, DSA70000B Series, and MSO70000 Series Digital and Mixed Signal Oscilloscopes
Arbitrary waveform generator	Tektronix AWG5000 Series, AWG5000B Series, AWG7000 Series, or AWG7000B Series Arbitrary Waveform Generator
Probe	Tektronix P6243 or P6245 for Tektronix DPO70000 Series, DPO70000B Series, DSA70000 Series, and DSA70000B Series, and MSO7000 Series Digital and Mixed Oscilloscopes Tektronix P6243, P6245, or TAP1500 for Tektronix DPO7000 Series Digital Oscilloscopes
HEAC TPA-P adapter	Tektronix HEAC-TPA-P
Test fixture	TF-HEAC-TPA-P (A/C) or TF-HEAC-TPA-KIT, TF-HDMID-TPA-KIT
DUT	An HEAC sink or source device
SMA Cables	Tektronix part number 174-1428-00 (1.5 meter) Tektronix part number 174-1341-00 (1 meter)
HDMI Cable	HDMI cable with HEAC capability

This tests the DUT for compliance with single mode (Receiver) tests.

1. Connect the DUT to the equipment as shown.



- Connect the HEAC-TPA plug board to the HEAC connector on the Source DUT.
- Connect the CEC or CDC Controller to the CEC/CDC Control Port on the HEAC-TPA main board.
- Connect the Ch1 Analog(+) output from a waveform generator to the HEAC+ SMA connector of the HEAC-TPA main board.
- Set the Impedance Conversion Circuit on the HEAC-TPA main board to **55 Ω** .
- Connect a single-ended probe from Ch1 of the digital oscilloscope to the HEAC+ probe point on the HEAC-TPA main board.
- Set the HEAC-TPA main to use +5 V power from the DC Power Supply.

NOTE. Do not use +5 V power from the Source DUT.

- Load the waveform data on the arbitrary waveform generator and generate the waveforms.
- Activate the ARC (Single mode) transmission on the HEAC Sink DUT using the CEC/CDC controller.

2. Select **HEAC-Receiver** as the device type.

3. Select the **SingleMode-Rx** as the Test Suite.

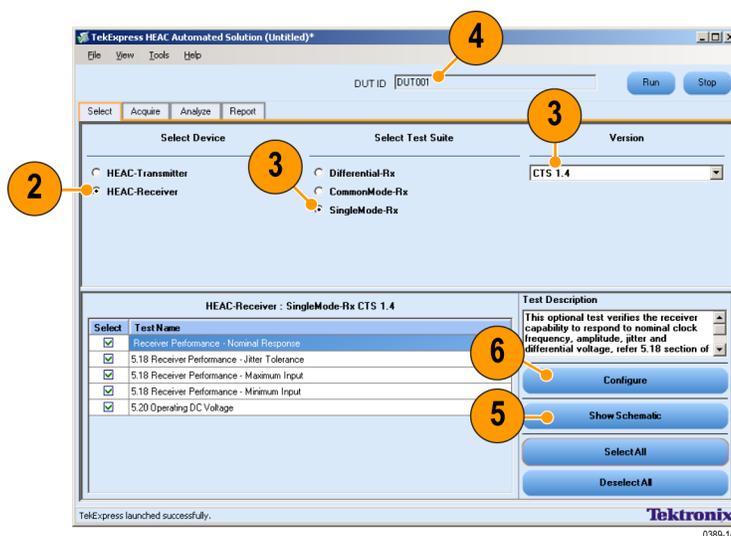
The default version CTS 1.4.

All the single mode receiver tests are selected by default.

4. Enter the DUT identification in the **DUT ID** field.

5. Click **Show Schematic** to display a diagram of the test setup and confirm that your test setup is correct.

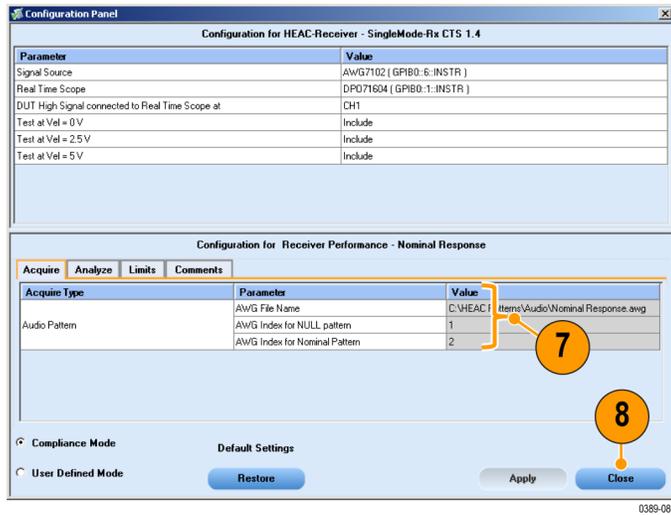
6. In the Select panel, highlight the test and click **Configure**.



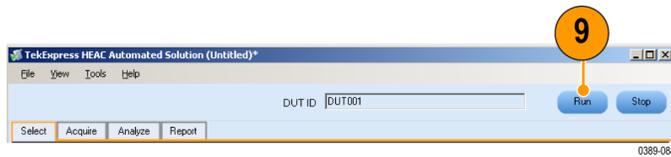
- Use the default values in the Compliance Mode to run the tests for compliance with the standards.

NOTE. To change acquisition parameter values, click **User Defined Mode**. A message appears prompting you that if you make changes to a test, the test may no longer be compliant. Click **OK** to proceed with the User Defined Mode.

- Click **Close**.

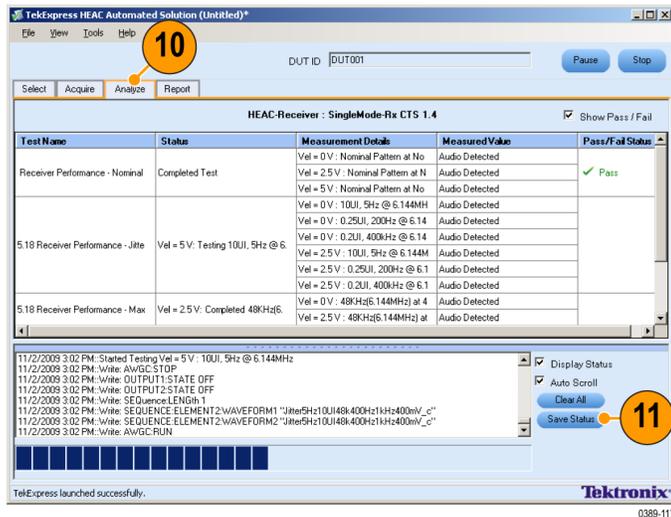


- Click **Run** in the Select panel. The application switches to the Acquire tab.



- Click the **Analyze** tab.

- The application displays the status of the tests in the Status Messages window. Click **Save Status** to save the status messages.

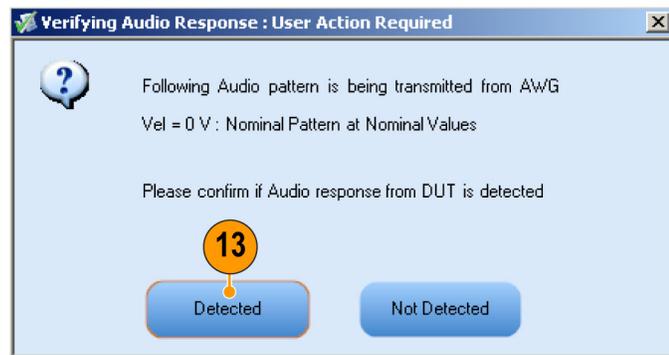


- The single mode receiver tests are run at three terminal voltage levels (Vel): 0 V, 2.5 V, and 5 V.



0389-089

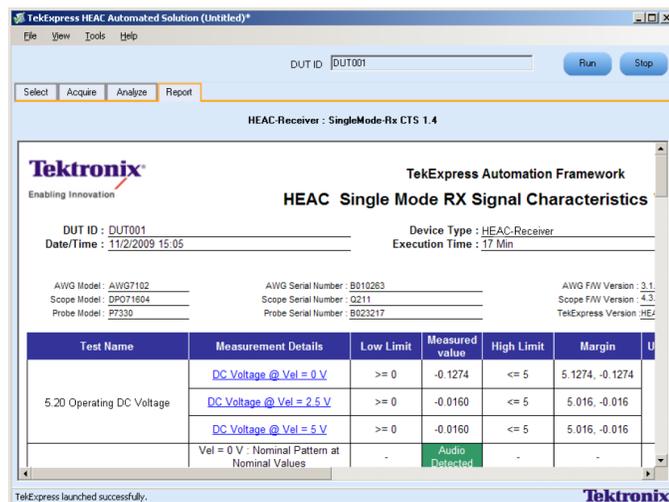
- The application prompts you to verify the audio response from the DUT. Click **Detected** or **Not Detected** as appropriate for each test.



0389-090

- Repeat Steps 13 and 14 for different terminal voltage levels and audio patterns of various frequencies.

- When the tests complete, the application shows a report in the Report panel.



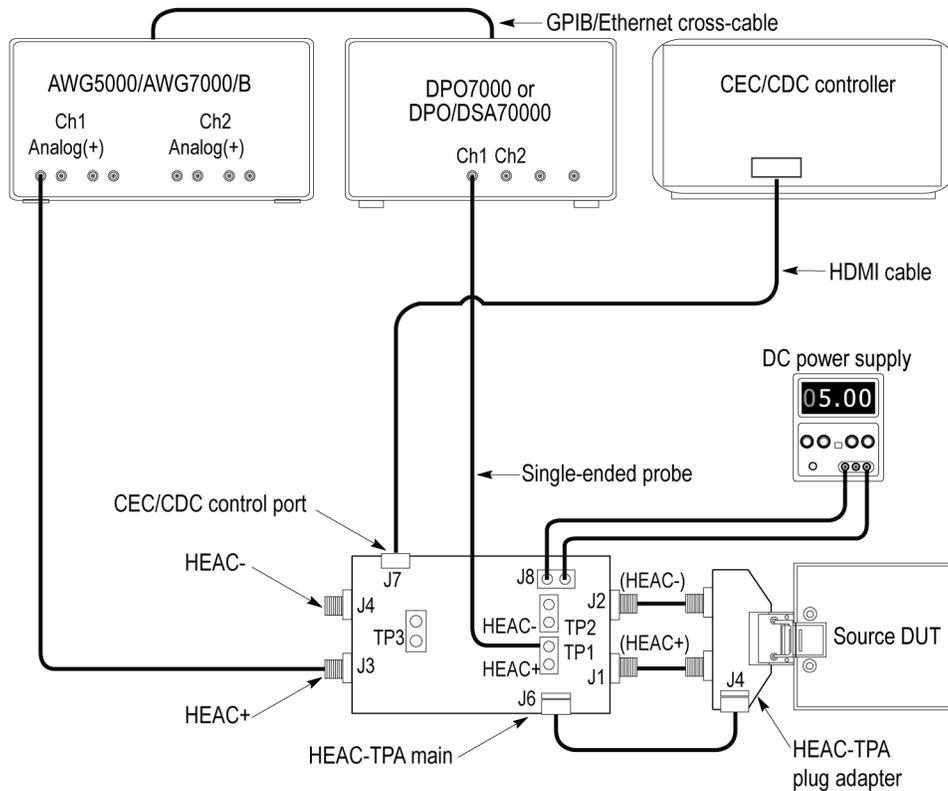
0389-143

Single Mode Operating DC Voltage Test (Receiver)

Required equipment	Model supported
Real-time oscilloscope	Tektronix DPO7000 Series, DPO70000 Series, DPO70000B Series, DSA70000 Series, DSA70000B Series, and MSO70000 Series Digital and Mixed Signal Oscilloscopes
Arbitrary waveform generator	Tektronix AWG5000 Series, AWG5000B Series, AWG7000 Series, or AWG7000B Series Arbitrary Waveform Generator
Probe	Tektronix P6243 or P6245 for Tektronix DPO70000 Series, DPO70000B Series, DSA70000 Series, and DSA70000B Series, and MSO7000 Series Digital and Mixed Oscilloscopes Tektronix P6243, P6245, or TAP1500 for Tektronix DPO7000 Series Digital Oscilloscopes
HEAC TPA-P adapter	Tektronix HEAC-TPA-P
Test fixture	TF-HEAC-TPA-P (A/C) or TF-HEAC-TPA-KIT, TF-HDMID-TPA-KIT
DUT	An HEAC source device
SMA Cables	Tektronix part number 174-1428-00 (1.5 meter) Tektronix part number 174-1341-00 (1 meter)
HDMI Cable	HDMI cable with HEAC capability

This tests the DUT for compliance with single mode operating DC voltage (Receiver) tests.

1. Connect the DUT to the equipment as shown.

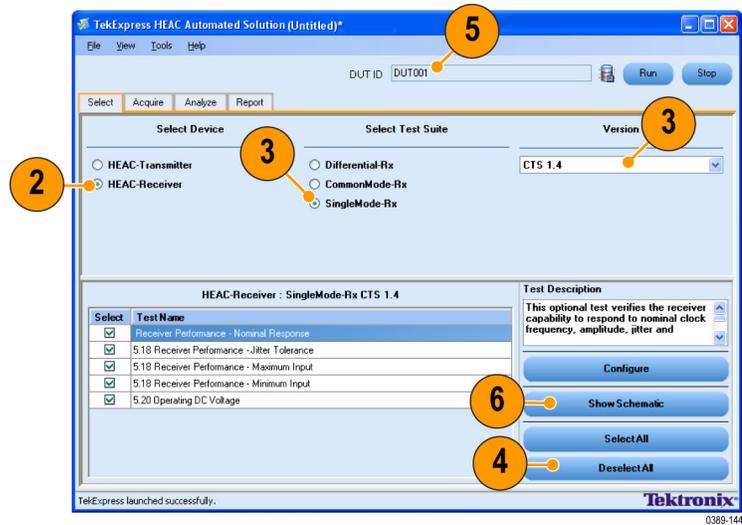


- Connect the HEAC-TPA plug board to the HEAC connector on the Source DUT.
- Connect the CEC or CDC Controller to the CEC/CDC Control Port on the HEAC-TPA main board.
- Connect the Ch1 Analog(+) output from a waveform generator to the HEAC+ SMA connector of the HEAC-TPA main board.
- Set the Coupling & Impedance Conversion Circuit on the HEAC-TPA main board to **55 Ω**.
- Connect a single-ended probe from Ch1 of the digital oscilloscope to the HEAC+ probe point on the HEAC-TPA main board.
- Set the HEAC-TPA main board to enable the Source DUT test, and to use +5 V power from the DC Power Supply. Set switch S7 to the right (On position) on the HEAC-TPA main fixture.

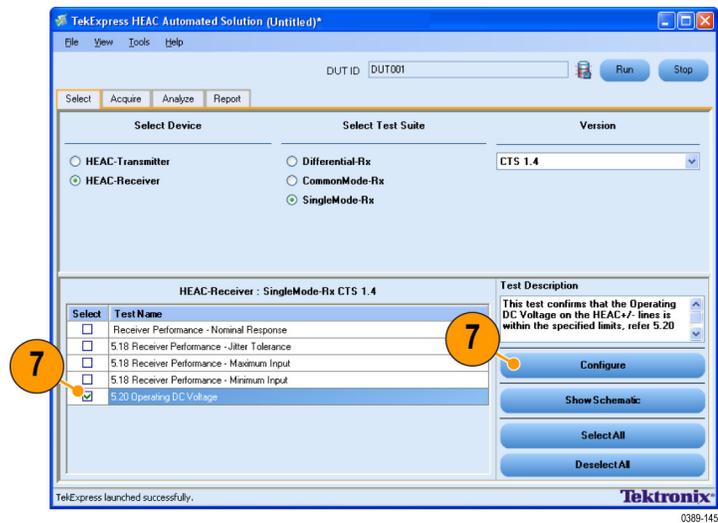
NOTE. Do not use +5 V power from the Source DUT.

- Connect and set the DC Power Supply to supply +5 V to the HEAC-TPA main board.
- Power on the Source DUT.
- Activate the ARC (Single mode) transmission on the HEAC Source DUT using the CEC/CDC controller.
- Load the nominal audio waveform data on the arbitrary waveform generator and generate the waveform.

2. Select **HEAC-Receiver** as the device type.
3. Select the **SingleMode-Rx** as the Test Suite.
The default version CTS 1.4.



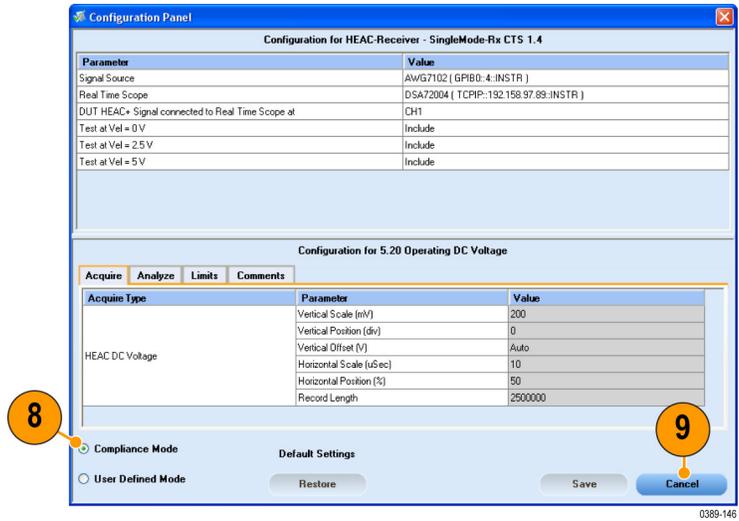
4. Click **Deselect All** and select the Operating DC Voltage test.
5. Enter the DUT identification in the **DUT ID** field.
6. Click **Show Schematic** to display a diagram of the test setup and confirm that your test setup is correct.
7. In the Select panel, highlight the test and click **Configure**.



- Use the default values in the Compliance Mode to run the tests for compliance with the standards.

NOTE. To change acquisition parameter values, click **User Defined Mode**. A message appears prompting you that If you make changes to a test, the test may no longer be compliant. Click **OK** to proceed with the User Defined Mode.

- Click **Close**.



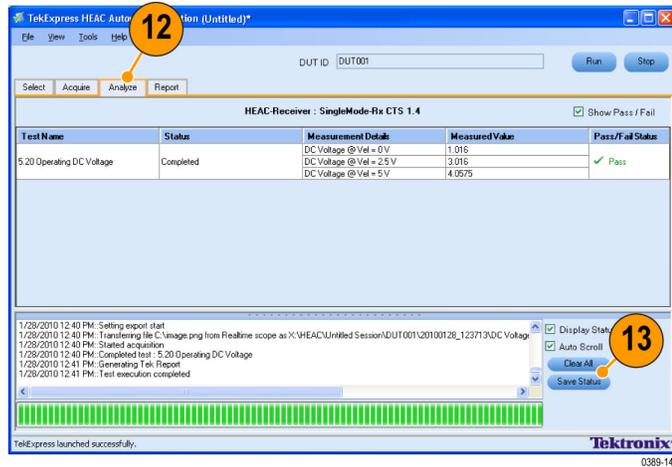
- Click **Run** in the Select panel.
The application switches to the Acquire tab.



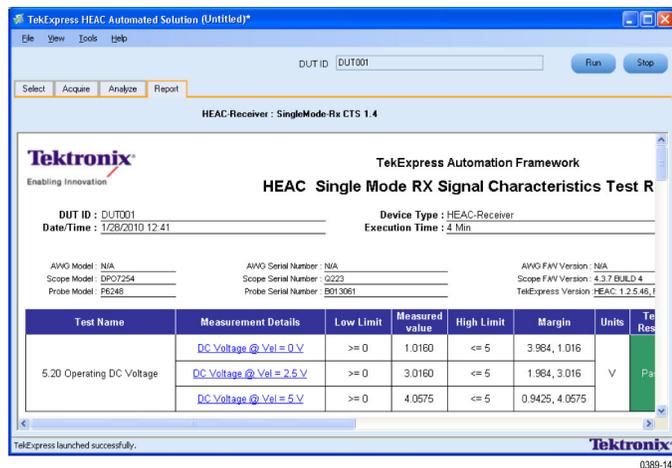
11. The operating DC voltage test runs at three terminal voltages: 0 V, 2.5 V, and 5 V. Adjust the voltage and click **OK** to continue.



12. Click the **Analyze** tab.
13. The application displays the status of the tests in the Status Messages window. Click **Save Status** to save the status messages.



14. When the tests complete, the application shows a report in the Report panel.



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