



SL-889 HDMI 2.1 Cat-3 Cable EMI Tester

User Guide

Simplay-UG-SL889-1.1

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1. Overview

The SL-889 HDMI 2.1 Cat-3 Cable EMI Tester is designed for radiated emissions testing of HDMI 2.1 Ultra High Speed cables and is compliant to the latest High Definition Multimedia Interface (HDMI®) 2.1 specifications.

This User Guide provides details on how to setup and test cables for radiated emissions for compliance in a EMI chamber to HDMI 2.1 specifications.

For the latest updates to documentation or software updates, see online at:

<https://www.simplaylabs.com/ProductsServices/Products/HDMI/> .

1.1. SL-889 Hardware

Figure 1.1, Figure 1.2, and Figure 1.3 show the top view, the front panel view, and the rear panel view of the SL-889, respectively.



Figure 1.1. SL-889 – Top View



Figure 1.2. SL-889 – Front Panel View



Figure 1.3. SL-889 – Rear Panel View

1.1.1. Signal Path

Figure 1.3 shows the internal and external signal path of the SL-889. An internal Video Generator generates an ITU-R BT-1729 test pattern which is fed to an HDMI transmitter. When an external HDMI cable DUT is connected, the Tx will begin transmitting a HDMI 2.1 Video/Audio data stream to the built-in HDMI receiver. At this point the Test Equipment can be used inside an RF chamber, and radiated emissions scans may be taken. An optional LCD monitor can be used during Pre-Scan operations to visually verify the signal has been successfully received across the DUT cable.

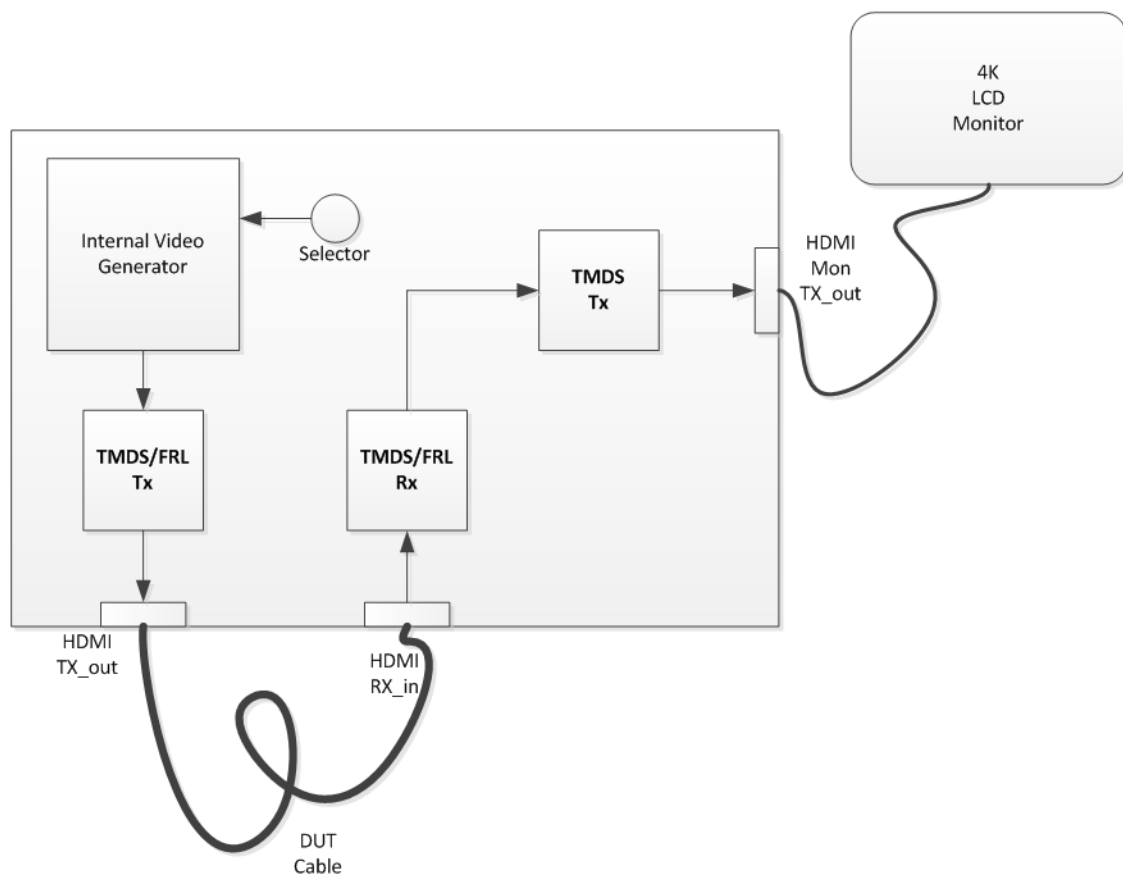


Figure 1.4. SL-889 – Signal Path

1.2. SL-889 Controls, Indicators, and Interface Connectors

Figure 1.5 shows the location of the SL-889 enclosure features: input and output ports, power and ethernet, LCD display, and resolution select rotary switch.

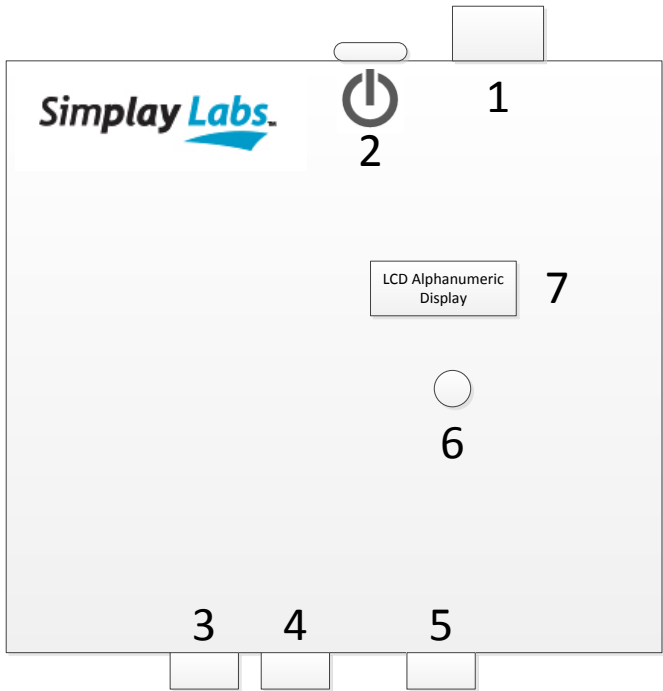


Figure 1.5. Locating SL-889 Components – Top View

Item	Label	Description
1	Network	RJ45 Ethernet Port.
2	+12 V DC	DC power receptacle, 12 V 2 A.
3	HDMI OUT1	HDMI TX0 output Port. For Cable DUT Transmit.
4	HDMI OUT2	HDMI TX1 output Port. For Optional Display Monitor output.
5	HDMI IN1	HDMI RX0 input Port. For Cable DUT Receive.
6	Selector	Resolution Select Rotary Switch
7	LCD Display	Alphanumeric LCD display that shows resolution selected and connection status.

1.3. SL-889 Test Modes

The SL-889 is designed to offer the following distinct mode of operation:

- Standard Test Mode, see [Section 1.3.1](#).

1.3.1. Standard Test Mode

In its standard test configuration, the SL-889 offers audio and video generation and reception features to enable radiated emissions compliance testing to HDMI 2.1 specifications.

1.3.1.1. Available Standard Tests

The SL-889 is ready for use in standard test mode immediately upon delivery. These are the operations that are done in standard test mode:

1. Generate a calibrated HDMI 2.1 output signal using HDMI OUT1 port
2. Receive and Analyze a HDMI 2.1 input signal using HDMI IN1 port
3. Generate an optional display monitor output signal using HDMI OUT2 port

For details of the above operations, refer to [Section 2](#).

1.3.1.2. The SL-889 LCD Display Screen in Standard Test Mode

Figure 1.6 shows the LCD display screen of the SL-889 in standard test mode under default factory configuration.

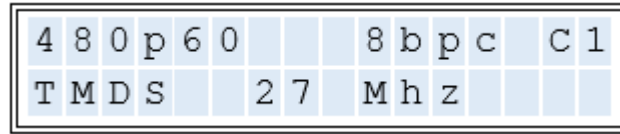


Figure 1.6. LCD Display Screen Main Window

1.3.2. Devices under Test

Standard test operations are available for:

- HDMI 2.1 Cat-3 Cables

1.4. HDMI 2.1 Video Resolution Support

The SL-889 includes support for TMDS and FRL signalling:

- 6 TMDS Frequencies supported with 4 Video Resolutions
- 2 FRL Frequencies with 2160p60 Video Resolution

Value	Description
C0	720x480p60 (16:9) RGB 8-bit 27 MHz -
C1	720x480p60 (16:9) RGB 8-bit 27 MHz
C2	720x480p60 (16:9) RGB 12-bit -40.5 MHz
C3	1920x1080p60 RGB 8-bit 148.5 MHz
C4	1920x1080p60 RGB 10-bit 185 MHz
C5	3840x2160p24 RGB 8-bit 297 MHz
C6	3840x2160p60 RGB 8-bit 594 MHz
C7	3840x2160p60 FRL 6 GHz 4 Lane FRL
C8	3840x2160p60 FRL 12GHz 4 Lane FRL + eARC
C9-C15	3840x2160p60 FRL 6 GHz 4 Lane FRL (Subject to change, reserved for future use)

Note: Resolutions in bold are required resolutions for HDMI 2.1 radiated emissions testing.

1.5. Inside the Box

The SL-889 delivery includes the following items:

- SL-889 HDMI 2.1 Cat-3 Cable EMI Test Tool
- SL-889-PS 12V power supply
- SL-889-GC 2M HDMI 2.1 Cat-3 Golden Test Cable
- Quick Start Guide
- Calibration Packet

1.5.1. 12V Power Supply

The included 12V power supply has been chosen for proper operation with the SL-889. It has been modified with the addition of a ferrite filter for lower noise operation. Please do not substitute another supply as the results of EMI scans cannot be guaranteed.



Figure 1.7. 12V Power Supply

1.5.2. 2M Golden Test HDMI Cat-3 Cable

The included 2M cable has been developed for specific use with the SL-889. It has been shown to have superior RF suppression. It should be kept as a test reference cable and can be used to calibrate your SL-889 to different RF chambers.



Figure 1.8. 2M Golden Cat-3 HDMI 2.1 Cable

2. The SL-889 in Standard Test Mode

In its standard test configuration, the SL-889 offers audio and video test features to enable radiated emissions compliance testing to HDMI 2.1 specifications.

These are the operations that are available in the standard test mode:

1. Generate a calibrated HDMI 2.1 signal output using the HDMI OUT1 port
2. Receive a HDMI 2.1 signal using the HDMI IN1 port

2.1. Calibrated HDMI 2.1 Tx Output Notes:

The SL-889 generates fixed stimulus to an HDMI 2.1 Category 3 Cable so the DUT cable's EMC Emission performance can be measured.

The SL-889 does not go through HDMI 2.1 FRL Link Training, and does not adjust the TX signal in response to the RX's measured error rate.

The documentation shipped with each SL-889 contains waveforms captured while it was sending TMDS data at 2.97 GHz and FRL data at 12.0 GBPS.

A waveform exhibiting a Rising/Falling/Rising pattern (or a Falling/Rising/Falling pattern), with the time between the first and last edges at a minimum, represents 2 bit times.

The included 12.0 GHz waveform was captured at 200 Picoseconds (ps) per division, with each division internally subdivided by four tick marks.

Each 1/5th of a division is 40 ps.

A 12.5 GBPS signal would result in a bit time of 80 ps.

In the faster waveform the time between the first and last edges of the Rising/Falling/Rising pattern is slightly more than 4 tick marks (160 ps).

One bit time is half the total time, or slightly more than 80 pS.

2.2. Setting up Connections – Pre-Test Operation

Connecting the DUT cable and optional HDMI monitor cable to the SL-889:

- When performing EMI RF scans, the DUT cable should be connected from HDMI OUT1 to HDMI IN1 as shown in [Figure 2.1](#).
- When pre-testing, an optional 4K TMDS monitor can be connected to visualize the ITU BT1729 test pattern as shown in [Figure 2.1](#). Note: As the test is intended to measure only the radiated emissions of the DUT cable, the cable from HDMI OUT2 should be disconnected from the SL-889, and the 4K Monitor should be unplugged from AC power prior to making any EMI measurement scans.

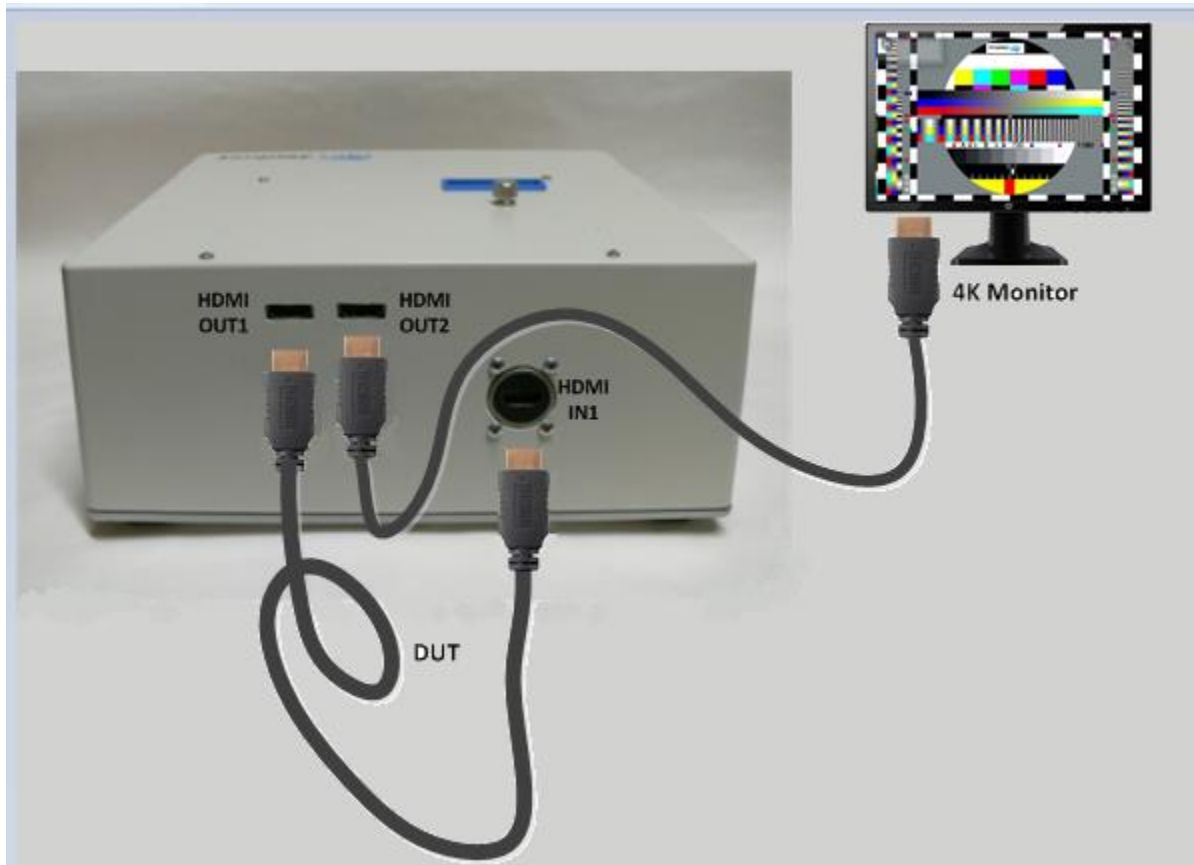


Figure 2.1. Pre-Test: Connecting the DUT cable with optional monitor output

2.3. Setting up Connections – Normal Operation

Connecting the DUT cable to the SL-889:

- When performing EMI RF scans, the DUT cable should be connected from HDMI OUT1 to HDMI IN1 as shown in [Figure 2.2](#) Figure 2.2. Test: Connecting the DUT cable in Normal Operation.

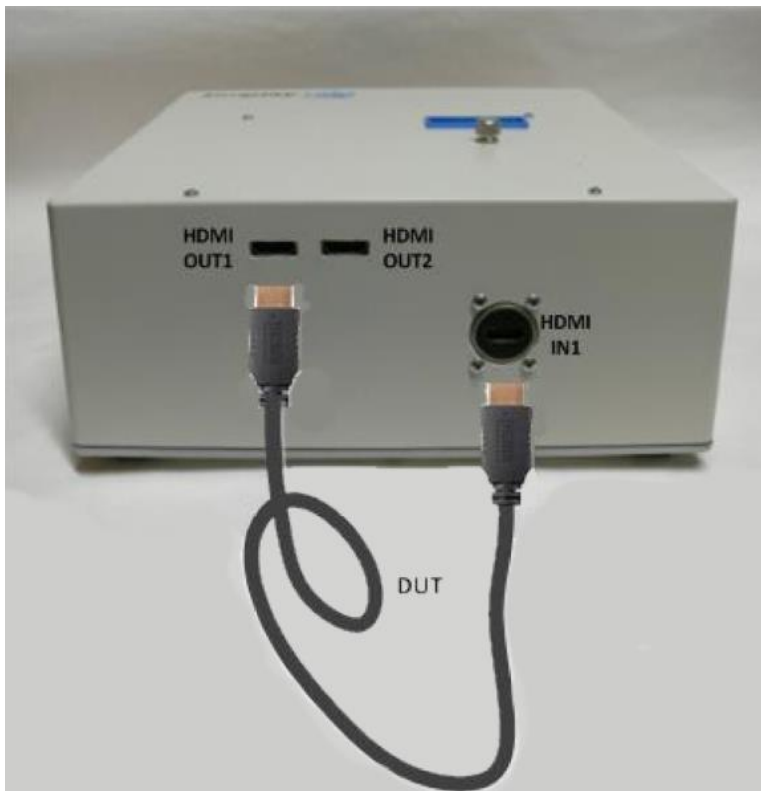


Figure 2.2. Test: Connecting the DUT cable in Normal Operation

2.4. Operation - Detailed

The SL-889 operation is as follows:

- Plug in the supplied 12V DC power supply into the unit. The LCD screen will light and the internal fan may be heard. The LCD will display a boot message, along with a down counter.



Figure 2.3. SL-889 Operation: Boot Down Counter

2. After approximately 45 seconds the boot process completes. The first line of the LCD will display a message corresponding to the last known switch position (C0-C15). The second line will display "Searching ..." if an HDMI cable has not yet been connected from HDMI OUT1 to HDMI IN1.



Figure 2.4. SL-889 Operation: C0 Resolution, V1.00 Firmware, No HDMI Cable Attached

3. Rotate the knob to select the resolution to be tested.



Figure 2.5. SL-889 Operation: Selector

4. The LCD will display the selected resolution.



Figure 2.6. SL-889 Operation: C4 Resolution, No Cable Attached

5. Attach an HDMI cable from HDMI OUT1 to HDMI IN1. The second line of the LCD will transition from “Searching...” to an informational message (ex: “TMDS 185 MHz”) when a link has been successfully connected. The unit is now ready for EMI scans to be taken.



Figure 2.7. SL-889 Operation: C4 Resolution, TMDS 185 MHz link, HDMI Cable Attached

6. Attach an optional HDMI monitor to HDMI OUT2 to display the ITU BT1729 test pattern.



Figure 2.8. SL-889 Operation: Optional Monitor Output

2.5. Operation – Quick Start

Pre-test Setup:

1. Attach the +12V power supply to the unit. You will hear the internal fans if you listen closely.
2. The LCD lights up and displays a boot down count screen as it powers up.
3. After the internal boot counts completes, the LCD will change to show the last resolution selected.
4. The selector knob chooses between 16 different resolutions.
5. Rotate the selector knob to choose the desired resolution.
6. The LCD screen shows “C0” – “C15” in the upper right.
7. Attach an optional 4K monitor to the HDMI OUT2 output connector.
8. Attach a DUT cable between the HDMI OUT1 output and HDMI IN1 input connectors.
9. The ITU-R BT.1729. (2005). Common 16:9 or 4:3 aspect ratio digital television reference test pattern should appear on the monitor.

Note: Monitor output is only available if a DUT cable is attached. (See Signal Path diagram)

Taking Scans:

10. Disconnect the Monitor from the SL-889 HDMI OUT2 output, and unplug it.

11. Take Scans

2.6. Chamber Set Up

This section provides only a cursory description of chamber set up. It is assumed that most EMI testing will take place in a chamber with the instrument placed on top of a suitable table that is capable of 360 degree rotation. Furthermore, the antenna will be at a fixed distance from the front of the table.

2.6.1. CISPR Chamber Set Up – Cable Placement

For CISPR compliance it is assumed that the SL-889 would be pushed to the front of the table facing the antenna with the DUT cable draped down the front as shown in (Figure 2.9. CISPR recommended DUT cable placement inside chamber), and tied in a loose bow to prevent it from hitting the floor. Consult the CISPR specification for details.



Figure 2.9. CISPR recommended DUT cable placement inside chamber

2.6.2. HDMI Forum Recommended Chamber Set Up – Cable Placement

For HDMI Forum compliance it is assumed that the SL-889 would be pushed to the back of the table facing the antenna with the DUT cable placed horizontally on the table down the front as shown in (Figure 2.10). Consult the HDMI Forum Guidelines for details



Figure 2.10. HDMI Forum recommended DUT cable placement inside chamber

3. RF Scans and EMI Chamber measurements with the SL-889

3.1. HDMI 2.1 EMI Measurement

The SL-889 provides a complete transmit and receive solution of a compliant HDMI 2.1 signal output in a low noise shielded enclosure. It can be used to measure the radiated emission levels of HDMI cables by taking RF level scans in a calibrated EMI chamber.

3.1.1. EMI Chamber RF Emission Scans

Generally speaking RF emission scans for multimedia equipment are usually taken in 2 distinct frequency groups: 30 MHz-1 GHz see Figure 3.1., and 1GHz-6GHz see Figure 3.2. This is usually done because antenna, amplifier and chamber requirements make this a convenient split and most standards recognize these splits. Additionally, most EMI test specifications require that the DUT (e.g.Cable) be located at a fixed distance from the antenna (usually 3m or 10m), and that horizontal and vertical scans be taken while simultaneously rotating the DUT 360 degrees while raising and lowering the antenna to discover the position of maximum radiated energy.

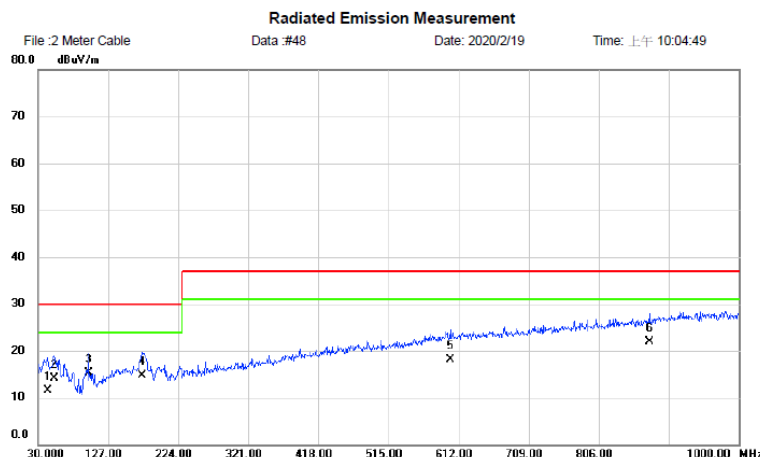


Figure 3.1. 30MHz-1000MHz Scan

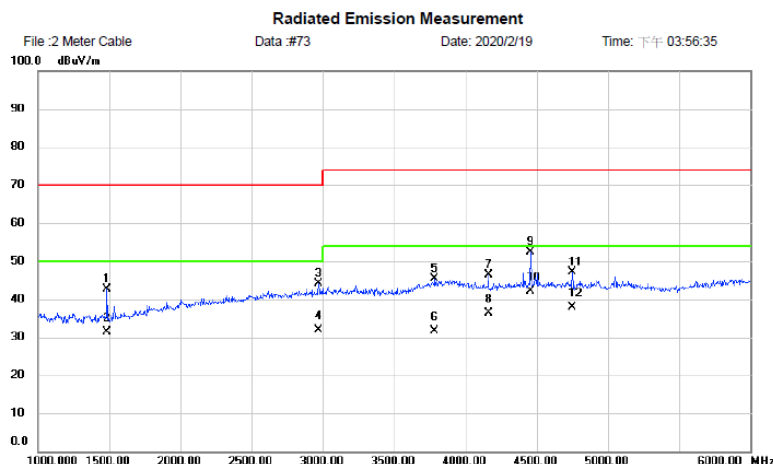


Figure 3.2. 1000MHz-6000MHz Scan

3.2. EMI Limits and Testing

EMI or electromagnetic interference is the measure of the radiated RF energy that a device puts out. The SL-889 makes measuring the amount of RF energy an HDMI cable emits easy, by providing a calibrated HDMI signal. Maximum allowable EMI limits vary from country to country, and this tool was developed to help standardize the rf emission measurement of cables regardless of country standard.

3.2.1. CISPR 32 EMI Testing Standards

EMI testing per the HDMI Forum Guidelines generally follows the International Electrotechnical Commission CISPR 32:2015 standard. The commission and standard can be found at <https://www.iec.ch/>. Please refer to the standard for test setup, chamber set up, emission levels, test pattern, etc.

3.2.2. HDMI Forum Cat-3 Cable EMI Testing Guidelines

The HDMI Forum has an interest in making sure cables that transmit HDMI signals comply with EMI limits of individual countries. And because HDMI is a worldwide standard, it made sense to establish a set of EMI Guidelines for Cat-3 cables that could be adopted worldwide. For guidance to performing the radiated emissions checking per the HDMI Forum Guidelines, please refer to the following HDMI Forum Policy: **“Category 3 Cable Assembly EMI Testing Policy and Process, dated 5/7/2020”** (www.hdmiforum.org)

The Forum Policy covers both technical requirements (cable placement, resolution(s), passing criteria, etc), as well as process requirements (number of cables tested, etc.).



Figure 3.3. HDMI Forum recommended DUT cable placement inside chamber

Appendix A. Internal Firmware Upgrade

If you received a firmware upgrade notification from Simplay Labs, or if you find issues or problems in the firmware, you can download the latest SL-889 firmware installation package from the Simplay Labs website:

<https://www.simplaylabs.com/support/>. Locate the “SL-889” section and click on the hyperlink to download the SL-889 Software Package. (Figure A.1). The *.zip package contains firmware installation files.

Note: To check the firmware version installed on the SL-889, turn the selector knob to “C0”. If the version matches with the LCD displayed value (Figure A.2), there is no need to update. The version number is also displayed on the C0 screen monitor output.

SL-889 HDMI 2.1 Cat-3 Cable EMI Tester			
Current Release			
Model Number	Software Description	Version Number	Date Posted
SL-889 Package	SL-889 Package	1.00	6/22/2020

Figure A.1. SimplayLabs SL-889 Web Support Page

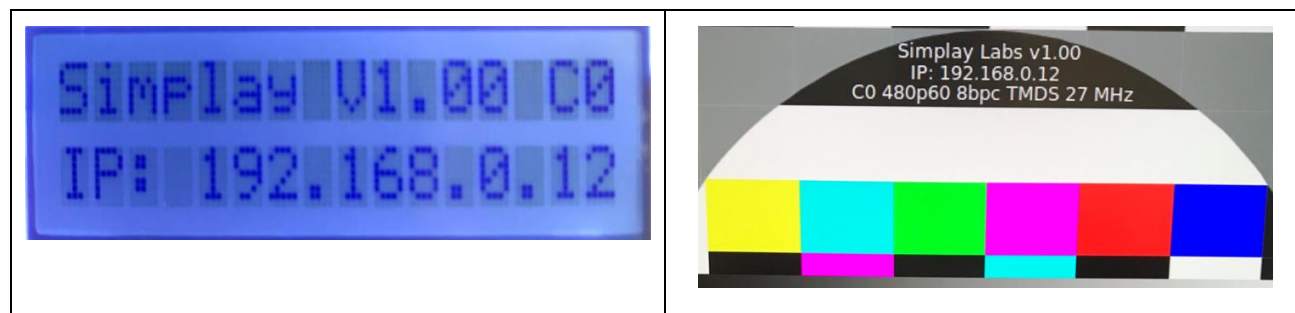
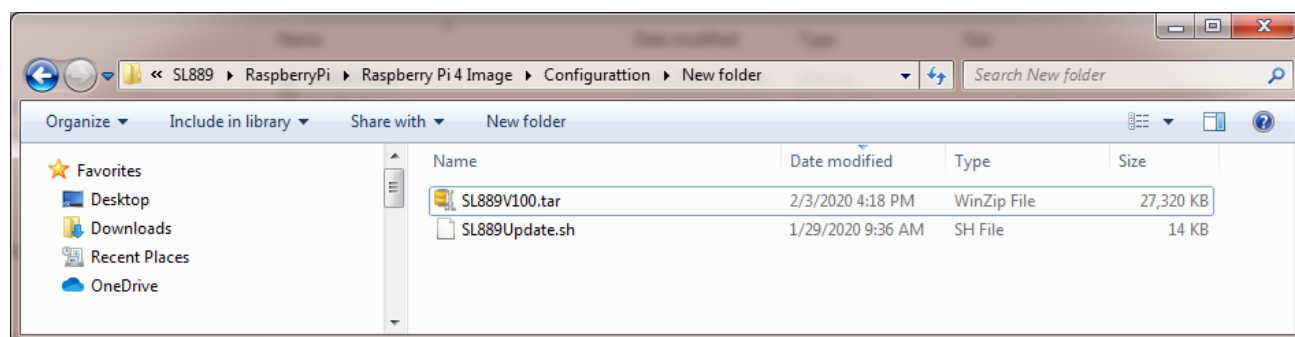


Figure A.2. SL-889 Firmware Version Display

Unzip the downloaded SL-889_Update_Version1_xx.zip file and store the extracted contents in a local directory on the host computer. The zip file contains tar file SL889V1XX.tar and SL889Update.sh.



A.1. Update Firmware/Scripts/Test Images

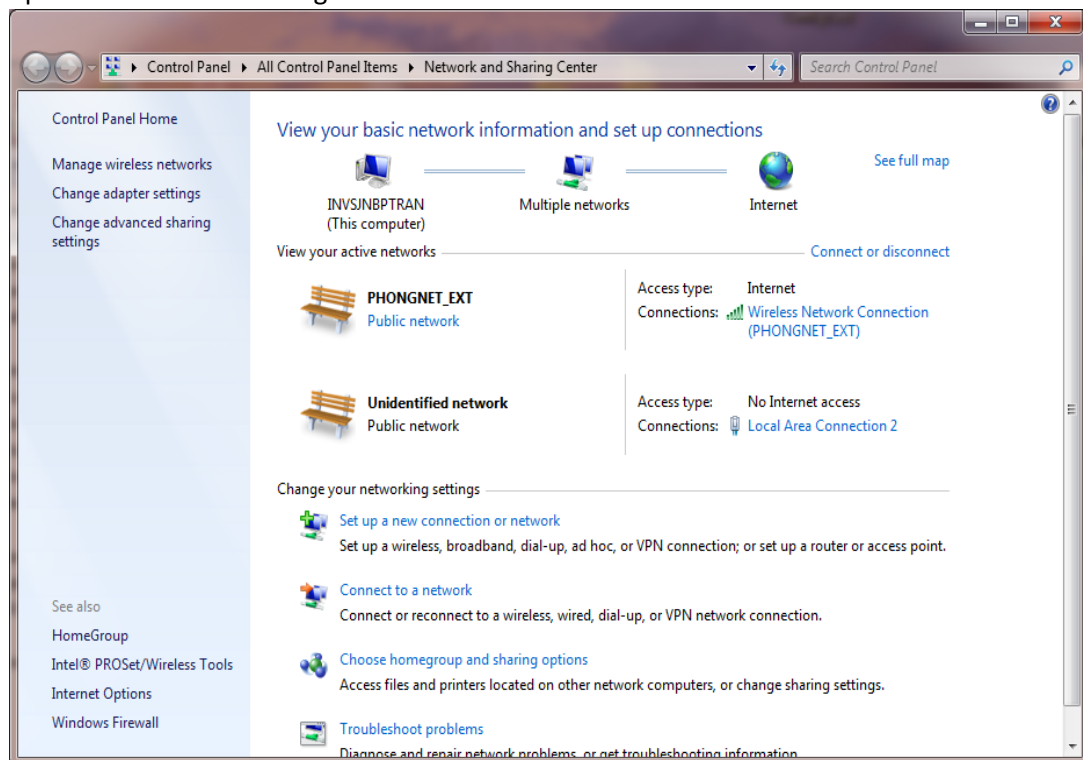
Note: You need to have PuTTY and WinSCP installed in your host computer to update the Firmware and scripts. You can download WinSCP from <https://winscp.net/eng/index.php> and PuTTY from <https://www.putty.org/>

1. Open the Shielded RJ45 network connector and use a short ethernet cable to connect directly to a host computer. Power on the SL-889.

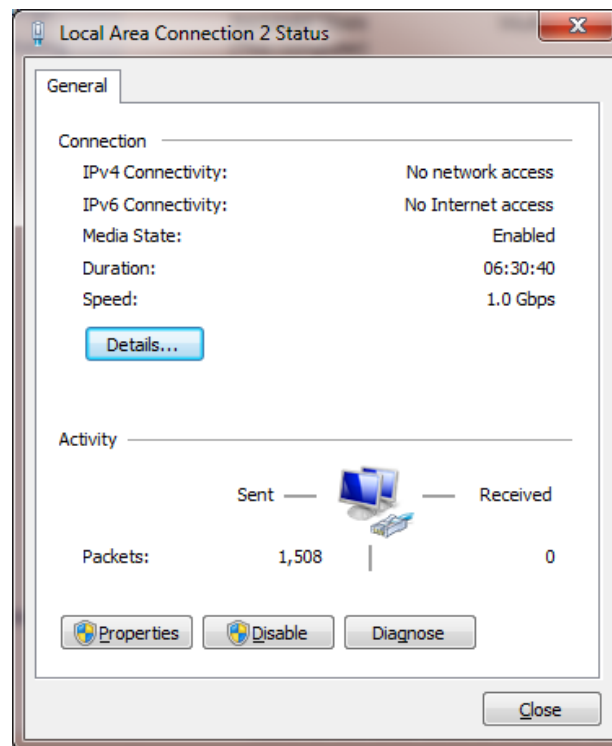


Figure A.3. SL-889 Firmware update via network port

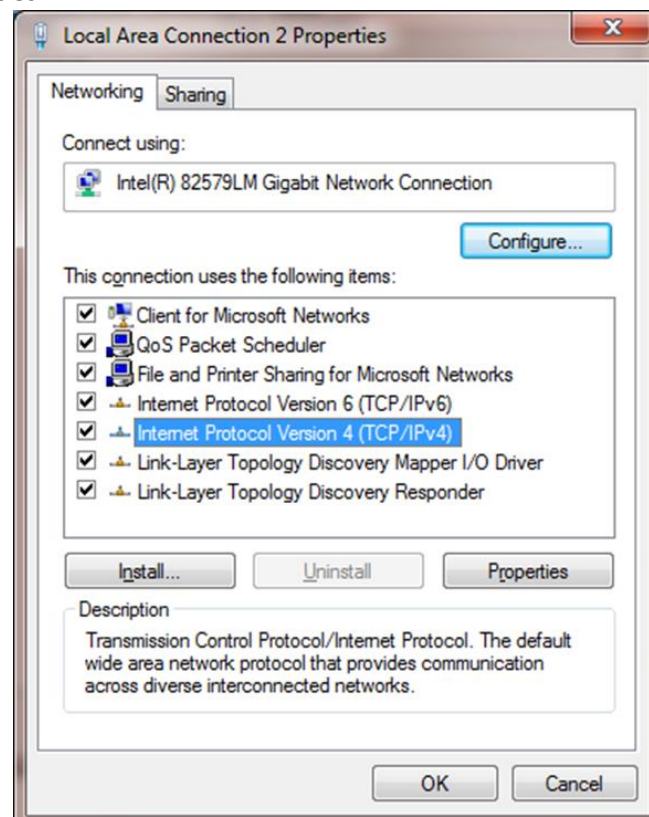
2. Open Network and Sharing Center.



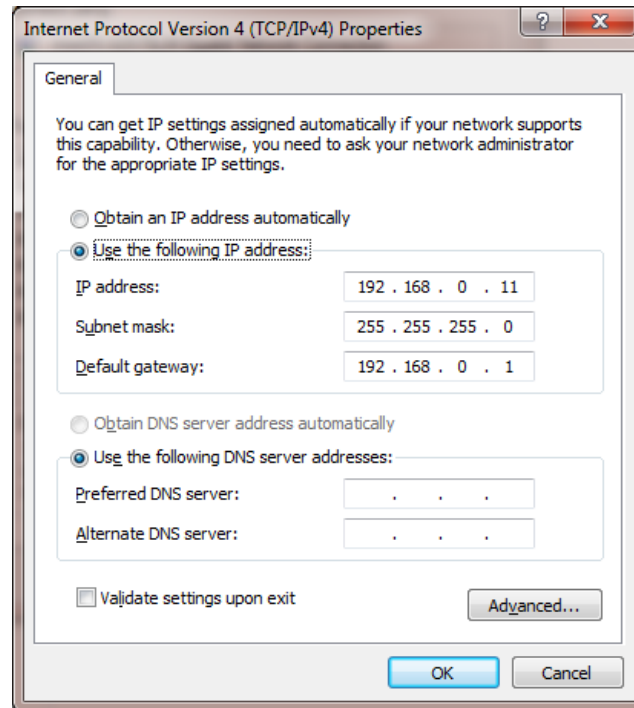
3. Select "Local Area Connection 2".



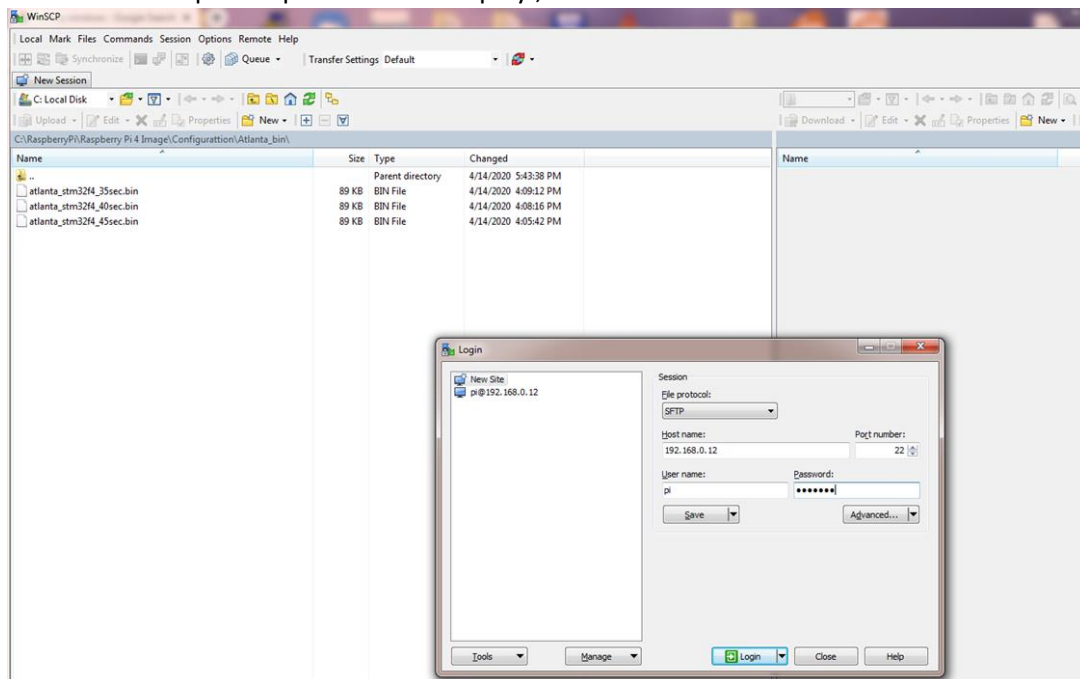
4. Select "Properties".



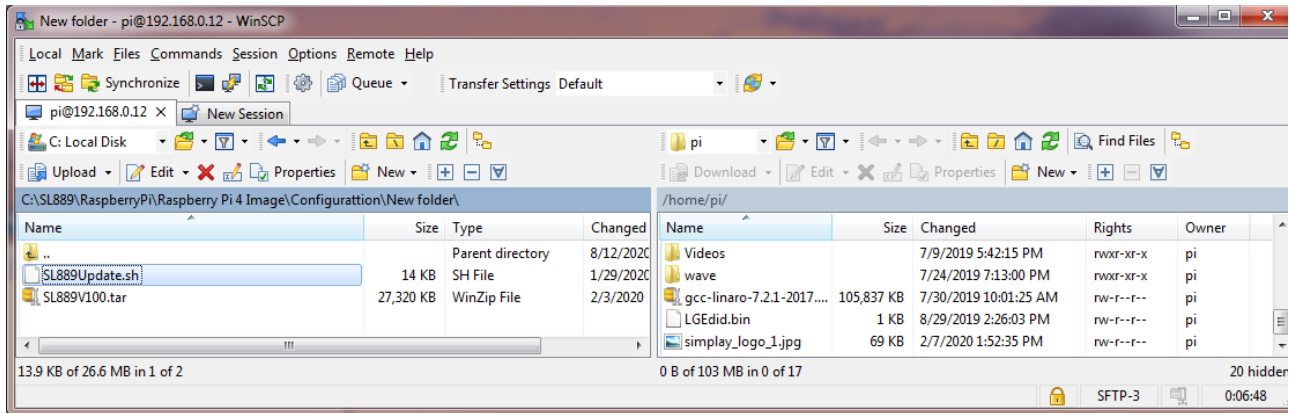
5. Select "Internet Protocol Version 4 (TCP/IPv4) and click "Properties" button.
6. Select "Use the following IP address:" radio button and enter the information as shown in the dialog below. Click "OK" button when done.



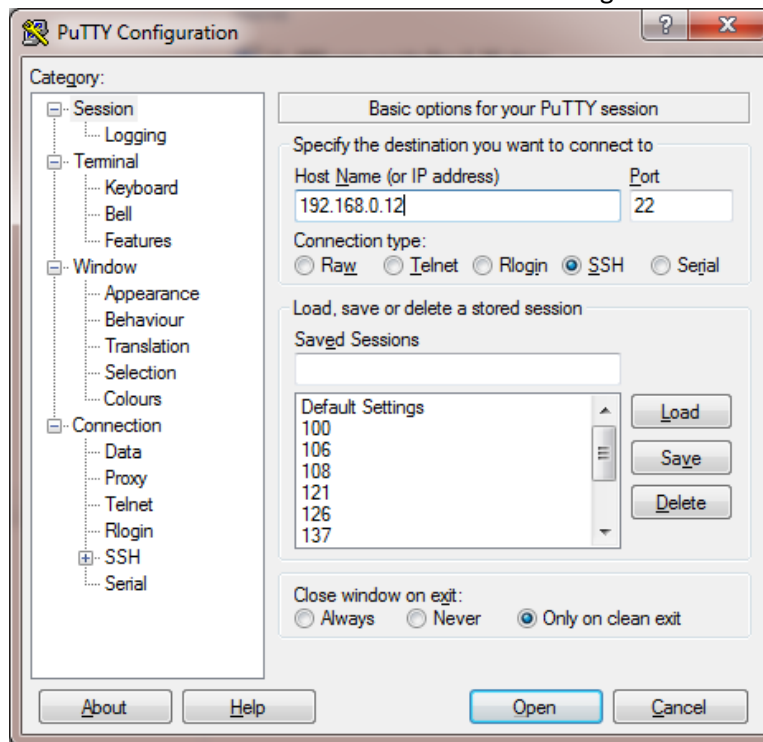
7. Open WinSCP and enter the information as shown in the dialog below. Then click 'Login' button. Username is 'pi' and password is 'Simplay', hostname is '192.168.0.12'



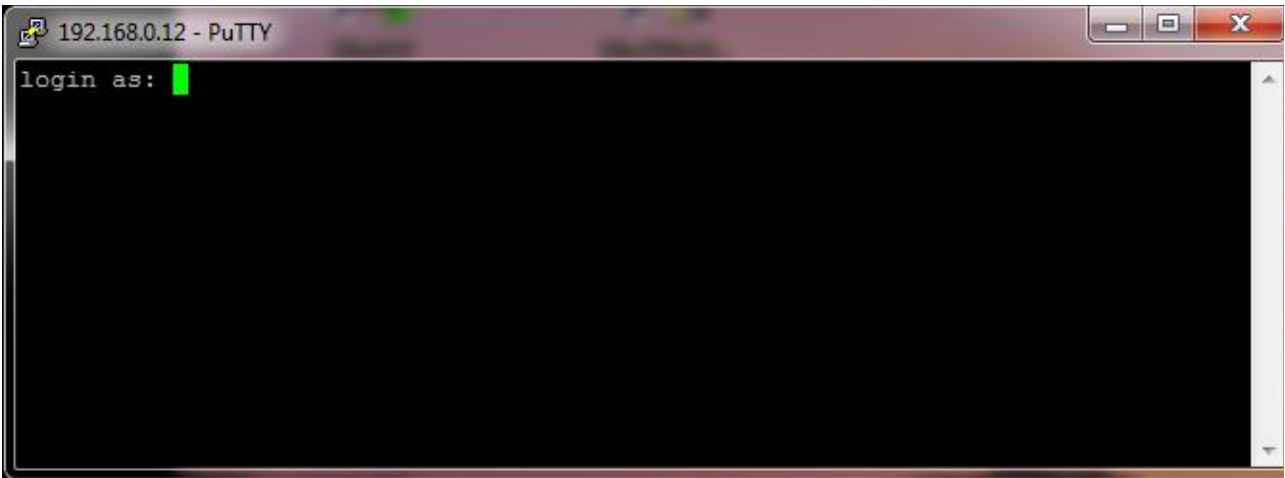
8. To update Firmware, on the right hand side, go to /home/pi/ directory. And on the left hand side, go to the local folder which was extracted from the SL_889_Update_Version1_xx.zip download.
9. Drag and drop “SL889V1XX.tar” and SL889Update.sh files on the left hand side over the right side.



10. Open PuTTY and enter the information as shown in the dialog below.




11. Click “Open” button
12. Login: Username is ‘pi’, password is ‘Simplay’



```
192.168.0.12 - PuTTY
login as: 
```

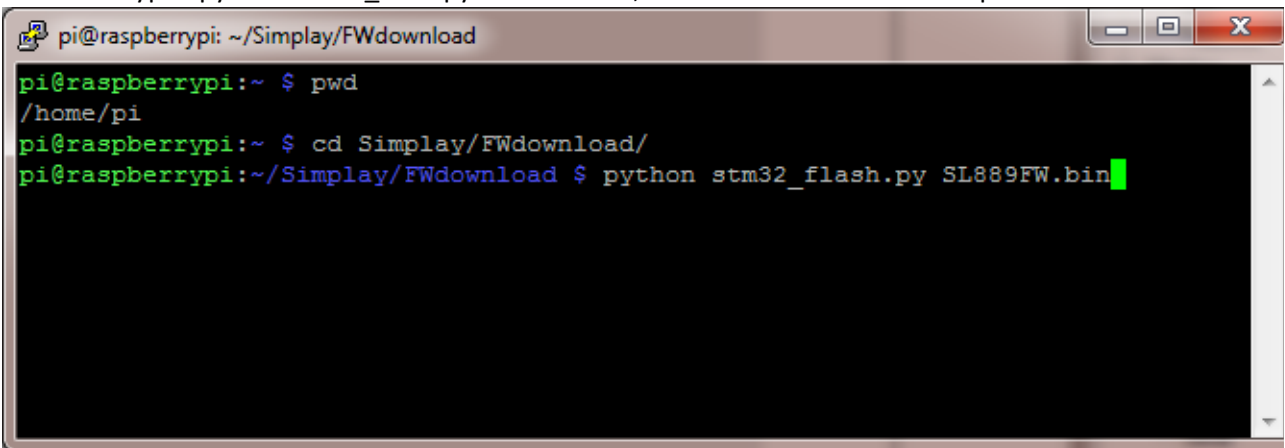
13. Type: `./sh SL889Update.sh SL889V1XX.tar`, hit “Enter” and wait for the process to finish.



```
pi@raspberrypi: ~
pi@raspberrypi:~ $ pwd
/home/pi
pi@raspberrypi:~ $ sh SL889Update.sh SL889V100.tar 
```

14. Type: `cd Simplay/FWdownload/`, hit “Enter”.

15. Type: `python stm32_flash.py SL889FW.bin`, hit “Enter” and wait for the process to finish.



```
pi@raspberrypi: ~/Simplay/FWdownload
pi@raspberrypi:~ $ pwd
/home/pi
pi@raspberrypi:~ $ cd Simplay/FWdownload/
pi@raspberrypi:~/Simplay/FWdownload $ python stm32_flash.py SL889FW.bin 
```

16. Type “`sudo reboot`” on the command prompt to reboot the SL-889

References

This is a list of the standards abbreviations appearing in this document.

Abbreviation	Standards Publication, Organization, and Date
CISPR	<i>Comité International Spécial des Perturbations Radioélectriques</i>
HDMI	<i>High Definition Multimedia Interface Version 2.1</i> , HDMI LLC,
HDMI CTS	<i>High-Definition Multimedia Interface Version 2.1 Generic Compliance Test Specification</i> , HDMI LLC,
ITU-R	<i>International Telecommunication Union – Radiocommunication Sector</i> ,

Revision History

Revision 1.1, Aug 2020

Summary of Changes and Additions:

Appendix A.1 Update Firmware/Scripts/Test Images: change to update methodology to use tar file and shell script.

Revision 1.0, July 2020

First production release

Summary of Changes and Additions:

Updated all [Error! Reference source not found](#).sections, text and figures.

Revision 0.5, Mar 2020

Pre-production release.

General Warranty Terms

Simplay Labs, LLC., (Simplay Labs), a Lattice Semiconductor company, offers a limited warranty for its Simplay Labs products. Any product first sold to your business is guaranteed to be free from defects in both components and workmanship under regular uses. The warranty period commences on the date the item ships.

Attention: Your invoice with the date of purchase, model number and serial number of the product is your proof of the date of purchase.

This International Limited Warranty is applicable and shall be honored in every country where Simplay Labs or its Authorized Service Providers offer warranty service subject to the terms and conditions provided in this International Limited Warranty Statement.

Simplay Labs Products Warranty Period

The warranty terms for Simplay Labs products are: Domestic & Asia	EU & UK
1 Year	2 Year

The International Limited warranty does not affect your statutory rights.

System Warranty

During the warranty period, the defective hardware of Simplay Labs products will be either repaired or replaced, with new or like new products, at the discretion of Simplay Labs except in the cases listed in the Limitation of Liability Clause of this document.

This International Limited Warranty covers the costs of service parts and labor required to restore your product to fully functional condition. Simplay Labs will, at its discretion, repair or replace any defective products or parts thereof covered by this International Limited warranty with refurbished parts of the product that are equivalent to new or like new products in both functionality and performance. A product or part that is repaired or replaced under this International Limited warranty shall be covered for the remainder of the original warranty period applying to the product or part, or for 90-days, whichever expires last. All exchanged parts and products under this International Limited Warranty will become the property of Simplay Labs.

Software Limited Warranty

Simplay Labs offers no warranty, either explicitly expressed or implicitly implied, for any pre-installed software, its quality, performance, functionality, or compatibility for a particular purpose. Nor does Simplay Labs warrant that the functions contained in the software will meet specific requirements or that the operation of the software will be uninterrupted or error-free. Thus, the software is sold 'as is' unless otherwise explicitly stated in writing.

Obtaining the Warranty Service

Warranty service or Returned Merchandise Authorization (RMA) under this International Limited Warranty will be honored only if claims are made within the warranty period. For notifications to Simplay Labs or products outside the warranty period, the process will be the same, but charges may apply. Contact details may be obtained on Simplay Labs website (www.simplaylabs.com/Support/Warranty/). Customers are requested to perform the following actions before claiming Simplay Labs product as defective:

Owner must notify Simplay Labs, during the warranty period, in writing of alleged defect, and allow Simplay Labs a reasonable opportunity to inspect the allegedly defective product;

No Product may be returned without Simplay Labs' consent, The Simplay Labs RMA# must accompany all returns, and all returns must be delivered to Simplay Labs within the warranty period;

Owner may, then at its own expense, return the allegedly defective Product, freight pre-paid and in the original packaging, accompanied by a brief statement explaining the alleged defect to Simplay Labs;

If Simplay Labs determines that any returned Product is not defective, or if Simplay Labs determines that the defect is not covered by the warranty, Simplay Labs will return the Product to the Owner at Owner's expense, freight collect, and Owner agrees to pay Simplay Labs' reasonable cost of handling and testing;

Upon determining that a returned product is defective, to receive warranty service Owner will need to present the invoice showing the original purchase transaction. If shipping the product, Owner will need to package it carefully and send it, transportation prepaid by a traceable, insured method, to the Simplay Labs Service Center. Package the product using adequate padding material to prevent damage in transit. The original container is ideal for this purpose. Include the RMA#, your name, return shipping address, email address and telephone number where you may be reached during business hours, inside the shipping package with the unit. Any replacement unit will be warranted under these Terms and Conditions for the remainder of the original warranty period or ninety (90) days whichever is longer.

Make sure to back up any important data and remove all confidential, proprietary information. Neither Simplay Labs nor its authorized service centers are responsible for damages to or loss of any programs, data, or other software and files in the items.

Refer to user manual enclosed within the product package and/or information on www.simplaylabs.com/ProductsServices/Products/HDMI/ for important tips on how to operate and troubleshoot the product

International Warranty

Warranty may be valid when a Simplay Labs product is purchased in one country and transferred to another country, without voiding the warranty. Please be advised that service availability and response time may vary from country to country.

Simplay Labs is not responsible for any export and import control issues, handling fees, tariffs, import duties, and all other related fees where owner is responsible for shipping its products.

Disclaimer of Warranty

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This Limited Warranty gives you specific legal rights. You may also have other rights that may vary from state to state or from country to country. You are advised to consult applicable state or country laws for full determination of your rights.

Simplay Labs products are not designed for any "critical applications." "Critical applications" shall mean life support systems, medical applications, connections to implanted medical devices, commercial transportation, nuclear facilities or systems or any other applications where product failure could lead to injury to persons or loss of life or property damage.

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Limitation of Liability

Simplay Labs reserves the rights to refuse warranty service of products under disputable conditions. Simplay Labs also holds the rights to declare final decision whether products are within warranty conditions. The following actions and damages will result in voiding the limited warranty:

Damage caused by act of nature, such as fire, flood, wind, earthquake, lightning, etc.

Damage or incompatibility caused by failure to perform a proper installation or to provide an appropriate operational environment for the product, including but not limited to unstable wired/ wireless network connection and phone lines, bad grounding, external electro-magnetic fields, direct sunlight, high humidity and vibration.

- Damage caused by impact with other objects, dropping, falls, spilled liquids, or submersion in liquids.
- Damage caused by unauthorized repair or disassembling of the product.
- Damage caused by any other abuse, misuse, mishandling, or misapplication.
- Damage caused by third party peripherals (including but not limited to visible damages on motherboard or other electronic parts of the product such as burn spots after electric discharge, melting, fusing, splitting, etc.).
- Any unauthorized software or modification of built-in software not approved by Simplay Labs.
- The serial number of the product (or serial number stickers of its parts) has been modified, removed, blurred or damaged.
- Cracks and scratches on LCD and plastic material as well as other defects caused by transportation, handling or customer abuse.



Simplay Labs, LLC
www.simplaylabs.com