



SI9777CLUC Product Qualification Summary

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1 INTRODUCTION

The Lattice Semiconductor SiI9777 is a versatile High Definition Multimedia Interface 2.0 (HDMI®) transmitter/port processor, with support for Mobile High-Definition Link 3 (MHL®) and High-bandwidth Digital Content Protection 2.2 (HDCP). The device's 18 Gb/s transmitter and receiver features support delivery of full resolution 4K Ultra High Definition (UltraHD) 4:4:4 video to a 4K television set at 50 Hz or 60 Hz frame rate.

As port processor, all four inputs support HDMI 2.0 at up to 18 Gb/s, and two of the inputs can also support MHL 3 input at resolutions of up to 4K @30 Hz. The three outputs offer a flexible configuration, including the ability to split an 18 Gb/s signal into two 9 Gb/s outputs. Audio and video can be routed to separate transmitters and two separate 300 MHz output streams can be routed from two input sources.

As a transmitter, the SiI9777 supports one output with HDMI 2.0 at up to 18 Gb/s with HDCP 2.2. A second output offers legacy-compatible HDMI 1.4 with audio output only.

In transmitter configuration, the SiI9777 can merge two video input streams up to 9 Gb/s each into one 18 Gb/s output stream. This is useful to merge two 300 MHz input streams that contain one-half of a 4K x 2K @ 60 Hz 4:4:4 frame each, into one 18 Gb/s, 600 Mega-characters/second/channel (Mcsc) stream with HDCP 2.2.

As a transmitter, the SiI9777 can also convert certain types of reduced blanking formats such as a 337 MHz TMDS™ input of 10-bit 4K @ 60 Hz 4:2:0 into an HDMI 2.0 standard 4K @ 60 Hz 4:2:2 10-bit output with HDCP 2.2. This enables the design of a set top box that can deliver full quality, 10-bit UltraHD with HDCP 2.2, using a decoder circuit built with HDMI 1.4 technology.

The SiI9777 implements the HDCP 2.2 Specification to protect the delivery of premium content. HDCP 2.2 can be applied in transmitter, receiver, and repeater configurations. HDCP 1.4 support is also included, allowing the transmitter to interoperate with the installed base of legacy source devices.

The SiI9777 transmitter/port processor supports AVR compatibility mode, which enables it to output audio/video content through one transmitter with HDCP 1.4 or 2.2 content protection, while the second transmitter outputs audio-only content through a transmitter with HDCP 1.4 protection.

An internal Microcontroller Unit (MCU) greatly simplifies software development and reduces the amount of I2C data transactions required to control the transmitter. The MCU firmware is loaded into the transmitter from external SPI flash at reset. A slim programming interface allows host control with minimal software effort.

2 FUNCTIONAL DESCRIPTION

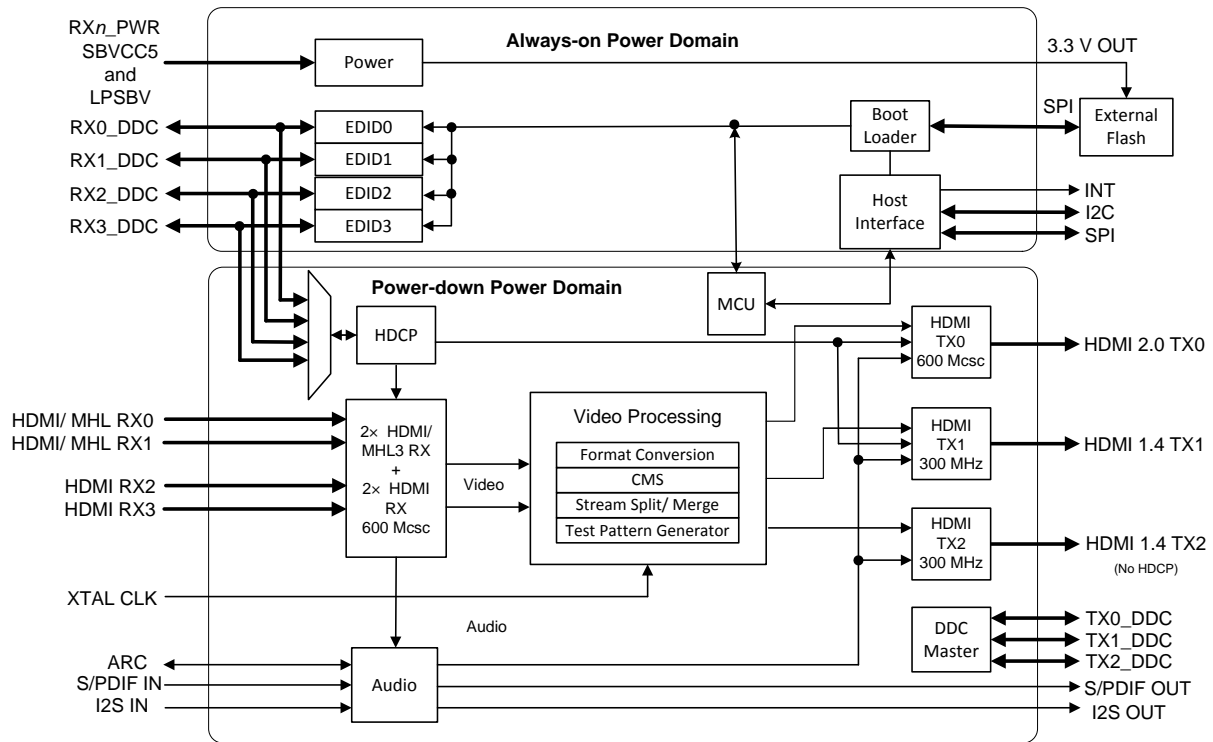


Figure 2.1. Functional Block Diagram

3 STANDARD QUALIFICATION AND REFERENCE DOCUMENTS

Description	Abv.	Reference	Condition
High Temperature Operating Life	HTOL	JESD 22A108	Tj=Not to exceed 150°C at 1.1XVdd 1000 hours
Human Body Model	HBM	JESD22-A115	+/- 2000V
Charge Device Model	CDM	JESD22-C101	+/- 500V
Machine Model	MM	JESD 22A115	+/- 200V
Latch Up	LU	JESD78	200mA current injection & 1.5X power supply overvoltage tests
Preconditioning before: THB, TC, HTSL, & UFAST	PC	JSTD 020 / JESD 22A113	JEDEC MSL Level 3 Reflow Peak Temp 260 °C
High Temperature Storage Life	HTSL	JESD 22A103	150°C for 1000 Hrs
Accelerated Moisture Resistance - unbiased HAST	uHAST	JESD 22A102	130°C / 85% R.H /33.3 psia for 96Hrs
Temperature-Humidity-Bias Life Test	THBT	JESD 22A101	85°C/85% RH with bias 1000 Hrs
Temperature Cycling	TCT	JESD 22A104	-65°C to +150 °C 1000 cycles

4 TECHNOLOGY QUALIFICATION DATA

Product: SiI9777CLUC

Packages offered: 208 LQFP epad

Process Technology Fab: TSMC Fab. 14

Process Technology Node: 55nm, 1P7M process

Wafer Size: 8 inches

Die Size: 5.439X5.259mm

5 PRODUCT LIFE (HTOL) DATA

High Temperature Operating Life (HTOL) Test:

The High Temperature Operating Life test is used to thermally accelerate those wear out and failure mechanisms that would occur as a result of operating the device continuously in a system application. Consistent with JESD22-A108 "Temperature, Bias, and Operating Life", a pattern specifically designed to exercise the maximum amount of circuitry is programmed into the device and this pattern is continuously exercised at specified voltages as described in test conditions for each device type.

Life Test (HTOL) Conditions:

Stress Duration: 168, 500, 1000 hours

Stress Conditions: Max operating supplies, Ambient = 125°C

Method: JESD22-A108

Rev. ID	Lot #	SiI9777CLUC
1.1	P6R465.13XYT	0/77
1.2	P4FAAD4.01Q	0/77

6 PRODUCT LIFE CALCULATION DATA

FITs= 60%	76.45	FITs
EFR (PPM)= 60%	5950	Hours
MTTF= 60%	13,079,613	Hours
Useful Life Time=	8.88	Years
In-Stress Device Hours=	154,000	Hours

FIT Assumptions: CL=60%, AE=0.7eV, Tjref=55C

7 ESD AND LATCH UP DATA

Electrostatic Discharge-Human Body Model:

The SII9777CLUC product was tested per JESD22-A114 Electrostatic Discharge (ESD) Sensitivity Testing Human Body Model (HBM) procedure from ESDA/JEDEC Joint Standard.

All units were tested at room ambient prior to reliability stress and after reliability stress. No failures were observed within the passing classification.

SII9777CLUC ESD-HBM:

Rev. ID	Lot #	SII9777CLUC
1.1	P6R465.13XYT	2000V
1.2	P4FAAD4.01Q	2000V

HBM classification for Commercial products, per ESD-HBM per JESD22-A114.

All HBM levels indicated are dual-polarity (\pm).

HBM worst-case performance is the package with the smallest RLC parasitic.

8 ELECTROSTATIC DISCHARGE-MACHINE MODEL:

The SII9777CLUC product was tested per JESD22-A115 Electrostatic Discharge (ESD) Sensitivity Testing Machine Model (MM) procedure.

All units were tested at room ambient prior to reliability stress and after reliability stress. No failures were observed within the passing classification.

SII9777CLUC ESD-MM:

Rev. ID	Lot #	SII9777CLUC
1.1	P6R465.13XYT	150V
1.2	P4FAAD4.01Q	150V

MM classification for Industrial products, per JESD22-A115.

All MM levels indicated are dual-polarity (\pm).

MM worst-case performance is the package with the smallest RLC parasitic.

9 ELECTROSTATIC DISCHARGE-CHARGED DEVICE MODEL:

The SiI9777CLUC product was tested per the JESD22-C101, Field-Induced Charged-Device Model Test Method for Electrostatic-Discharge-Withstand Thresholds of JEDEC Standard.

All units were tested at room ambient prior to reliability stress and after reliability stress. No failures were observed within the passing classification.

SiI9777CLUC ESD-CDM:

Rev. ID	Lot #	SiI9777CLUC
1.1	P6R465.13XYT	500V
1.2	P4FAAD4.01Q	500V

CDM classification Commercial products, per JESD22-C101.

All CDM levels indicated are dual-polarity (\pm).

CDM worst-case performance is the package with the largest bulk capacitance.

10 LATCH-UP:

The SiI9777CLUC product was tested per the JESD78D IC Latch-up Test procedure.

All units were tested at room ambient prior to reliability stress and after reliability stress. No failures were observed within the passing classification.

SiI9777CLUC Latch-up:

Rev. ID	Lot #	SiI9777CLUC
Rev1.1	P6R465.10XX	200mA
Rev1.2	P4FAAD4.01Q	200mA

I-Test classification for Commercial/Industrial products, per JESD78D.

All I-Test levels indicated are dual-polarity (\pm).

I-Test worst-case performance is the package with access to the most IOs.

11 PACKAGE QUALIFICATION DATA

The SII9777CLUC product is offered in 208 LQFP ePad. This report details the package qualification results of the SII9777CLUC product. Package qualification tests include Preconditioning (PC), Temperature Cycling (TC), Unbiased HAST (UHAST), Temperature Humidity Bias (THB) and High Temperature Storage (HTSL).

Mechanical evaluation tests include Scanning Acoustic Tomography (SAT) and visual package inspection.

12 PACKAGE DATA

Assembly information	Description	
Assembly site	ASEK	SPIL
Package type	LQFP epad	LQFP epad
Package size / Ball count	28x28x0.5mm / 208 pin	28x28x0.5mm / 208 pin
Body Thickness	1.4mm	1.4mm
Lead Frame Manufacturer	Sumitomo	Sumitomo
L/F Thickness	0.127mm	0.127mm
Plating Materials/Process	Silver / Double Ring Plating	Ag/Dual ring plating
Plating Thickness specification	100~350 u"	100~350u
Die attach material	CRM-1076WA	CRM 1033BF
Die attach Part No	1400160111	40012
Wire Supplier & Composition	Pd-Cu	Pd-Cu
Bond Pad Pitch	54/36 um staggered	54/36 um staggered
Wire Diameter	20um	20um
Mold Compound	EME-G631H	Sumitomo G631H
Longest Wire Length	3175um	132mil
Weight	2.496	2.496
Flammability	V-0	V-0

13 PACKAGE QUALIFICATION TESTING

The Surface Mount Preconditioning (SMPC) Test is used to model the surface mount assembly conditions during component solder processing. All devices stressed through Temperature Cycling, Unbiased HAST and Biased HAST and High Temperature Storage (HTSL) were preconditioned. This preconditioning is consistent with JESD22-A113F "Preconditioning Procedures of Plastic Surface Mount Devices Prior to Reliability Testing", Moisture Sensitivity Level 3 (MSL3) package moisture sensitivity and dry-pack storage requirements.

13.1.1 Surface Mount Preconditioning (MSL3)

5 Temperature Cycles, 24 hours bake @ 125°C, 30°C/60% RH, soak 192 hours, 3x IR reflow @260 °C Reflow Simulation. Performed before all package tests.

MSL3 Packages: 208 LQFP epad

Method: J-STD-020D and JESD22-A113

Package	Assembly Site	Lot #	Rej.	Qty.	Note
208 LQFP epad	ASEK	P1WX94.01Q	0	240	
208 LQFP epad	SPIL	P6R465.03XYQ	0	240	

13.1.2 Temperature Cycling Data

The Temperature Cycling test is used to accelerate those failures resulting from mechanical stresses induced by differential thermal expansion of adjacent films, layers and metallurgical interfaces in the die and package. Devices are tested at 25°C after exposure to repeated cycling between -65°C and +150°C in an air environment consistent with JESD22-A104 "Temperature Cycling", Condition C temperature cycling requirements. Prior to Temperature Cycling testing, all devices are subjected to Surface Mount Preconditioning.

MSL3 Packages: 208 LQFP epad

Stress Duration: 500cycles, 1000 cycles

Stress Conditions: Temperature cycling between -65°C to 150°C

Method: JESD22-A104 Condition C

Package	Assembly Site	Lot #	Rej.	Qty.	Note
208 LQFP epad	ASEK	P1WX94.01Q	0	80	
208 LQFP epad	SPIL	P6R465.03XYQ	0	80	

13.1.3 Unbiased HAST Data

Unbiased Highly Accelerated Stress Test (UHAST) testing uses both pressure and temperature to accelerate penetration of moisture into the package and to the die surface. The Unbiased HAST test is designed to detect ionic contaminants present within the package or on the die surface, which can cause chemical corrosion. Consistent with JESD22-A118, "Accelerated Moisture Resistance - Unbiased HAST," the Unbiased HAST condition is 96 hours exposure at 130°C and 85% relative humidity. Prior to Unbiased HAST testing, all devices are subjected to Surface Mount Preconditioning.

MSL3 Packages: 208 LQFP epad

Stress Duration: 96 Hours

Stress Conditions: 130°C/85% RH

Method: JESD22-A118

Package	Assembly Site	Lot #	Rej.	Qty.	Note
208 LQFP epad	ASEK	P1WX94.01Q	0	80	
208 LQFP epad	SPIL	P6R465.03XYQ	0	80	

13.1.4 THB: Temperature Humidity Biased Data

Temperature Humidity Biased (THB) Stress testing uses both pressure and temperature to accelerate penetration of moisture into the package and to the die surface. The Biased THB test is used to accelerate threshold shifts in the MOS device associated with moisture diffusion into the gate oxide region as well as electrochemical corrosion mechanisms within the device package. Consistent with JESD22-A101 "Steady State Temperature Humidity Bias Life Test (THB)", the biased THB conditions are with supply rails biased and alternate pin biasing in an ambient of 85°C, 85% relative humidity. Prior to Temperature Humidity Biased testing, all devices are subjected to Surface Mount Preconditioning.

MSL3 Packages: 208 LQFP epad

Stress Conditions: Maximum Operating Supplies and 85°C / 85%RH, 49.1 psig

Stress Duration: 500 hours, 1000 hours

Method: JESD22-A101

Package	Assembly Site	Lot #	Rej.	Qty.	Note
208 LQFP epad	ASEK	P1WX94.01Q	0	80	
208 LQFP epad	SPIL	P6R465.03XYQ	0	80	

13.1.5 High Temperature Storage Life (HTSL)

The High Temperature Storage Life test is used to determine the effect of time and temperature, under storage conditions, for thermally activated failure mechanisms. Consistent with JESD22-A103, the devices are subjected to high temperature storage Condition B: +150 (-0/+10) °C for 1000 hours.

MSL3 Packages: 208 LQFP epad

Stress Duration: 500 hours, 1000 hours

Temperature: 150°C (ambient)

Method: JESD22-A103

Package	Assembly Site	Lot #	Rej.	Qty.	Note
208 LQFP epad	ASEK	P1WX94.01Q	0	80	
208 LQFP epad	SPIL	P6R465.03XYQ	0	80	



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