

## FEATURES

Single-input HDMI receiver with dual channel LVDS transmitter outputs

HDMI receiver support

148.5 MHz maximum TMDS clock frequency

High-bandwidth Digital Content Protection (HDCP) 1.4 support with internal HDCP keys

Adaptive HDMI equalizer

5 V detect and hot plug assert for HDMI port

Extended colorimetry, including sYCC601, Adobe RGB, Adobe YCC 601, xvYCC extended gamut color

LVDS transmitters

Dual channel 24-bit OpenLDI interface

Supports 6-bit and 8-bit nonbalanced OpenLDI or 8-bit video electronics standards association (VESA) formats

Audio support including high bit rate (HBR) and Direct Stream Digital (DSD)

S/PDIF (IEC 60958-compatible) digital audio support

Dedicated, flexible audio output port

Dolby® TrueHD DTS-HD Master Audio™

General

Internal EDID RAM

Integrated consumer electronics control (CEC) controller

Standard identification (STDI) circuit

Any to any, 3 × 3 color space conversion (CSC) matrix

100-ball, 9 mm × 9 mm CSP\_BGA package

Qualified for automotive applications

## APPLICATIONS

Projectors

Automotive infotainment headunits

Automotive infotainment displays

Digital signage

## FUNCTIONAL BLOCK DIAGRAM

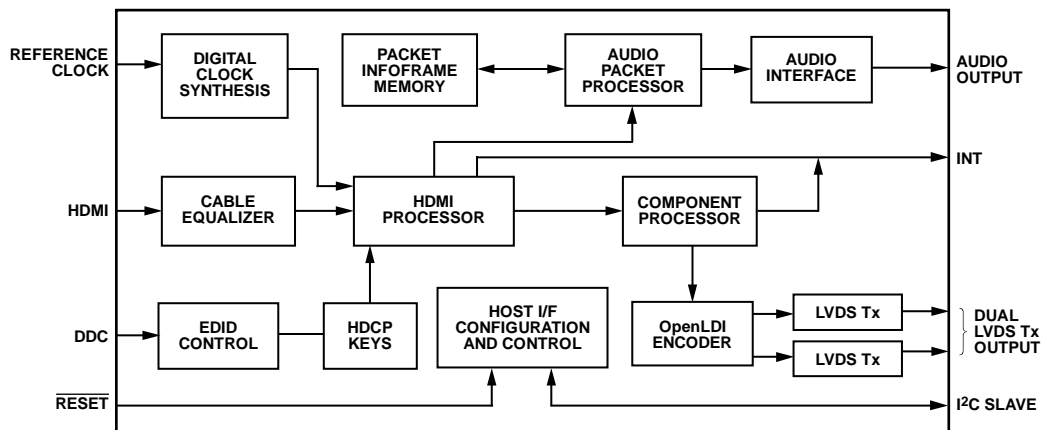


Figure 1.

## TABLE OF CONTENTS

Features .....	1	Power Supply Recommendations.....	11
Applications.....	1	Power-Up Sequence .....	11
Functional Block Diagram .....	1	Power-Down Sequence.....	11
Revision History .....	2	Theory of Operation .....	12
General Description .....	3	HDMI Receiver.....	12
Detailed Functional Block Diagram .....	3	HDCP Repeater Functionality .....	12
Specifications.....	4	Component Processor (CP).....	12
Electrical Characteristics .....	4	LVDS Transmitter Features.....	12
LVDS Transmitter (OpenLDI Mapping).....	5	I <sup>2</sup> C Interface .....	12
Data and I <sup>2</sup> C Timing Characteristics.....	5	Other Features .....	12
Absolute Maximum Ratings.....	7	Audio Output Data .....	12
Thermal Resistance .....	7	Outline Dimensions .....	13
ESD Caution.....	7	Ordering Guide .....	13
Pin Configuration and Function Descriptions.....	8	Automotive Products.....	13

## REVISION HISTORY

### 9/2018—Rev. B to Rev. C

Changes to Ordering Guide ..... 13

### 5/2017—Rev. A to Rev. B

Changes to LVDS Transmitter Features Section ..... 12

Changes to Ordering Guide ..... 13

### 12/2015—Rev. 0 to Rev. A

Changes to Ordering Guide ..... 13

### 10/2015—Revision 0: Initial Version

### GENERAL DESCRIPTION

The **ADV7613** is a high quality, low power, single-input HDMI to LVDS display bridge. It incorporates an HDMI capable receiver that supports up to 1080p, 60 Hz.

The HDMI port has dedicated 5 V detect and hot plug assert pins. The HDMI receiver also includes an integrated equalizer that ensures the robust operation of the interface with long cables.

The **ADV7613** has an audio output port for the audio data extracted from the HDMI stream. HDMI audio formats include super audio CD (SACD) via Direct Stream Digital® (DSD) and HBR. The HDMI receiver has an advanced mute controller that prevents audible extraneous noise in the audio output.

The **ADV7613** contains a component processor (CP) that processes the video signals from the HDMI receiver. It provides features such as contrast, brightness and saturation adjustments,

STDI detection block, free run, and synchronization alignment controls.

The LVDS encoder can package data into 6-bit or 8-bit non-dc balanced OpenLDI mapping or 8-bit VESA mapping. The **ADV7613** can output 24-bit OpenLDI data via dual-channel LVDS transmitters, up to a maximum resolution of 1080p, 60 Hz received at the input. The maximum output clock supported by a single LVDS output port is 92 MHz.

The **ADV7613** is offered in an automotive grade and a consumer grade. The operating temperature range is -40°C to +85°C.

Fabricated in an advanced CMOS process, the **ADV7613** is provided in a 9 mm × 9 mm, 100-ball CSP\_BGA, RoHS-compliant package.

### DETAILED FUNCTIONAL BLOCK DIAGRAM

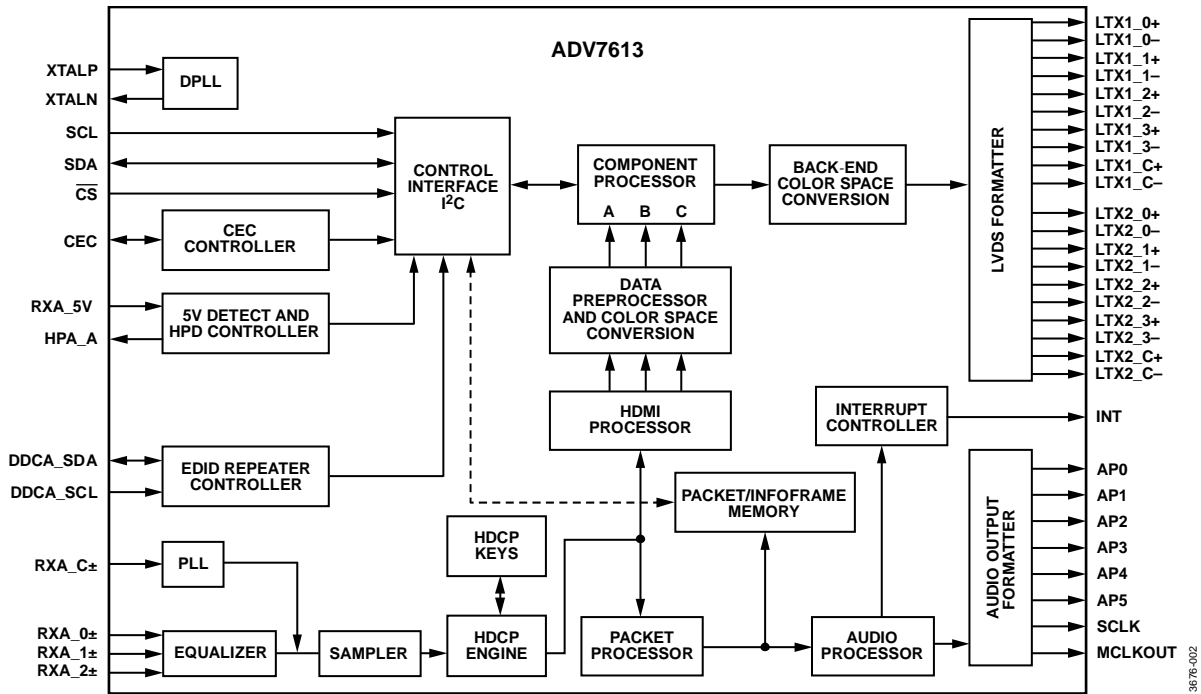


Figure 2. Detailed Functional Block Diagram

## SPECIFICATIONS

### ELECTRICAL CHARACTERISTICS

DVDD = 1.71 V to 1.89 V, DVDDIO = 3.135 V to 3.465 V, PVDD = 1.71 V to 1.89 V, TVDD = 3.135 V to 3.465 V, CVDD = 1.71 V to 1.89 V, LTX\_VDD = 1.71 V to 1.89 V. T<sub>MIN</sub> to T<sub>MAX</sub> = -40°C to +85°C, unless otherwise noted.

Table 1.

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
<b>DIGITAL INPUTS</b>						
Input High Voltage	V <sub>IH</sub>	XTALN and XTALP pins	1.2			V
		Other digital inputs	2			V
Input Low Voltage	V <sub>IL</sub>	XTALN and XTALP pins			0.4	V
		Other digital inputs			0.8	V
Input Current	I <sub>IN</sub>	$\overline{CS}$ pin	-60		+60	μA
		XTALN and XTALP pins		±15		μA
		Other digital inputs		±10		μA
Input Capacitance <sup>1</sup>	C <sub>IN</sub>				10	pF
<b>DIGITAL INPUTS (5 V TOLERANT)<sup>2</sup></b>						
Input High Voltage	V <sub>IH</sub>	DDCA_SCL, DDCA_SDA	2.6			V
Input Low Voltage	V <sub>IL</sub>				0.8	V
Input Current	I <sub>IN</sub>		-80		+80	μA
Input Leakage Current	I <sub>IN</sub>	RXA_5V	-100		+100	μA
<b>DIGITAL OUTPUTS</b>						
Output High Voltage	V <sub>OH</sub>		2.4			V
Output Low Voltage	V <sub>OL</sub>				0.4	V
High Impedance Leakage Current	I <sub>LEAK</sub>	HPA_A <sup>3</sup>	-100		+100	μA
		Other digital outputs	-10		+10	μA
Output Capacitance <sup>4</sup>	C <sub>OUT</sub>				20	pF
<b>POWER REQUIREMENTS</b>						
Termination Power Supply	TVDD		3.135	3.3	3.465	V
Digital Input/Output (I/O) Power Supply	DVDDIO		3.135	3.3	3.465	V
Digital Core Power Supply	DVDD		1.71	1.8	1.89	V
Phase-Locked Loop (PLL) Power Supply	PVDD		1.71	1.8	1.89	V
Comparator Power Supply	CVDD		1.71	1.8	1.89	V
LVDS Power Supply	LTX_VDD		1.71	1.8	1.89	V
<b>CURRENT CONSUMPTION<sup>4</sup></b>						
<b>Configuration 1</b>						
		Pseudorandom test pattern; 1360 × 768p at 60 Hz input resolution; 85 MHz pixel clock; 25°C operating temperature; DVDD, PVDD, CVDD, and LTX_DVDD = 1.8 V; DVDDIO and TVDD = 3.3 V; LVDS Port 2 used				
Termination Power Supply	I <sub>TVDD</sub>			50		mA
Digital I/O Power Supply	I <sub>DVDDIO</sub>			6		mA
Digital Core Power Supply	I <sub>DVDD</sub>			68		mA
PLL Power Supply	I <sub>PVDD</sub>			29		mA
Comparator Power Supply	I <sub>CVDD</sub>			65		mA
LVDS Power Supply	I <sub>LTX_VDD</sub>			45		mA
<b>Configuration 2</b>						
		Checker one-dot × one-dot test pattern; 1920 × 720p at 60 Hz input resolution; 92 MHz pixel clock; 25°C operating temperature; DVDD, PVDD, CVDD, and LTX_DVDD = 1.8 V; DVDDIO and TVDD = 3.3 V; LVDS Port 2 used				
Termination Power Supply	I <sub>TVDD</sub>			58		mA
Digital I/O Power Supply	I <sub>DVDDIO</sub>			6		mA
Digital Core Power Supply	I <sub>DVDD</sub>			102		mA

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
PLL Power Supply	I <sub>PVDD</sub>	Pseudorandom test pattern; 1920 × 1080p at 60 Hz input resolution; 148.5 MHz pixel clock; 85°C operating temperature; DVDD, PVDD, CVDD, and LTX_DVDD = 1.89 V; DVDDIO and TVDD = 3.465 V; LVDS Port 1 and LVDS Port 2 used		29		mA
Comparator Power Supply	I <sub>CVDD</sub>			66		mA
LVDS Power Supply Configuration 3	I <sub>LTX_VDD</sub>			43		mA
Termination Power Supply	I <sub>TVDD</sub>				70	mA
Digital I/O Power Supply	I <sub>DVDDIO</sub>				15	mA
Digital Core Power Supply	I <sub>DVDD</sub>				147	mA
PLL Power Supply	I <sub>PVDD</sub>				44	mA
Comparator Power Supply	I <sub>CVDD</sub>				96	mA
LVDS Power Supply	I <sub>LTX_VDD</sub>				88	mA
POWER-DOWN CURRENT <sup>4</sup>						
Terminator Power Supply	I <sub>TVDD_PD</sub>			327	μA	
Digital I/O Power Supply	I <sub>DVDDIO_PD</sub>			387	μA	
Digital Core Power Supply	I <sub>DVDD_PD</sub>			102	μA	
PLL Power Supply	I <sub>PVDD_PD</sub>			223	μA	
Comparator Power Supply	I <sub>CVDD_PD</sub>			74	μA	
LVDS Power Supply	I <sub>LTX_VDD_PD</sub>			323	μA	

<sup>1</sup> Data characterized by evaluation.

<sup>2</sup> The following pins are 5 V tolerant inputs: DDCA\_SCL, DDCA\_SDA, and RXA\_5V.

<sup>3</sup> The HPA\_A pin is a 5 V tolerant output.

<sup>4</sup> Data characterized by evaluation.

## LVDS TRANSMITTER (OpenLDI MAPPING)

Table 2.

Parameter	Symbol	Min	Typ	Max	Unit
OpenLDI OUTPUTS <sup>1</sup>					
Differential Output Voltage	V <sub>OD</sub>	247	350	454	mV
Offset Output Voltage	V <sub>OS</sub>	1.125	1.2	1.375	V
Change in V <sub>OD</sub> Mismatch				50	mV
Change in V <sub>OS</sub> Mismatch				50	mV
OpenLDI TRANSMITTER <sup>2</sup>					
OpenLDI Output Rise Time	t <sub>R</sub>		0.21 × UI	0.3 × UI	ps
OpenLDI Output Fall Time	t <sub>F</sub>		0.21 × UI	0.3 × UI	ps

<sup>1</sup> Measurement performed using a 100 Ω termination resistor.

<sup>2</sup> Data characterized by evaluation, using a 100 Ω source termination resistor. UI is unit interval, that is, the bit width.

## DATA AND I<sup>2</sup>C TIMING CHARACTERISTICS

Table 3.

Parameter	Symbol	Min	Typ	Max	Unit
CLOCK AND CRYSTAL					
Crystal (XTAL) Frequency			28.63636		MHz
XTAL Frequency Stability				±50	ppm
Input Clock Range (TMDS)		25		148.5	MHz
OpenLDI Output Clock Range		25		92	MHz
I <sup>2</sup> C PORTS					
SCL Frequency				400	kHz
SCL Minimum Pulse Width High	t <sub>1</sub>	600			ns
SCL Minimum Pulse Width Low	t <sub>2</sub>	1.3			μs
Start Condition Hold Time	t <sub>3</sub>	600			ns

Parameter	Symbol	Min	Typ	Max	Unit
Start Condition Setup Time	$t_4$	600			ns
SDA Setup Time	$t_5$	100			ns
SCL and SDA Rise Time	$t_6$			300	ns
SCL and SDA Fall Time	$t_7$			300	ns
Stop Condition Setup Time	$t_8$	0.6			$\mu$ s
<b>RESET FEATURE</b>					
Reset Pulse Width		5			ms
Reset Pulse to First I <sup>2</sup> C Transaction		5			ms
<b>I<sup>2</sup>S PORT, MASTER MODE</b>					
SCLK Mark to Space Ratio	$t_{15}:t_{16}$	45:55		55:45	% Duty Cycle
Left/Right Clock (LRCLK) Data Transition Time	$t_{17}$			10	ns
	$t_{18}$			10	ns
I <sup>2</sup> Sx <sup>1</sup> Data Transition Time	$t_{19}$			5	ns
	$t_{20}$			5	ns

<sup>1</sup> I<sup>2</sup>Sx signals (where x = 0, 1, 2, or 3) are available on the AP1 to AP4 pins (see Table 6).

**Timing Diagrams**

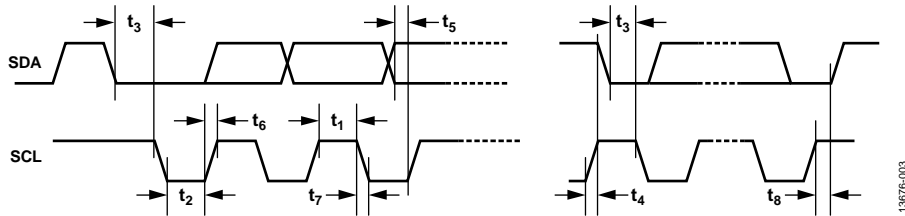
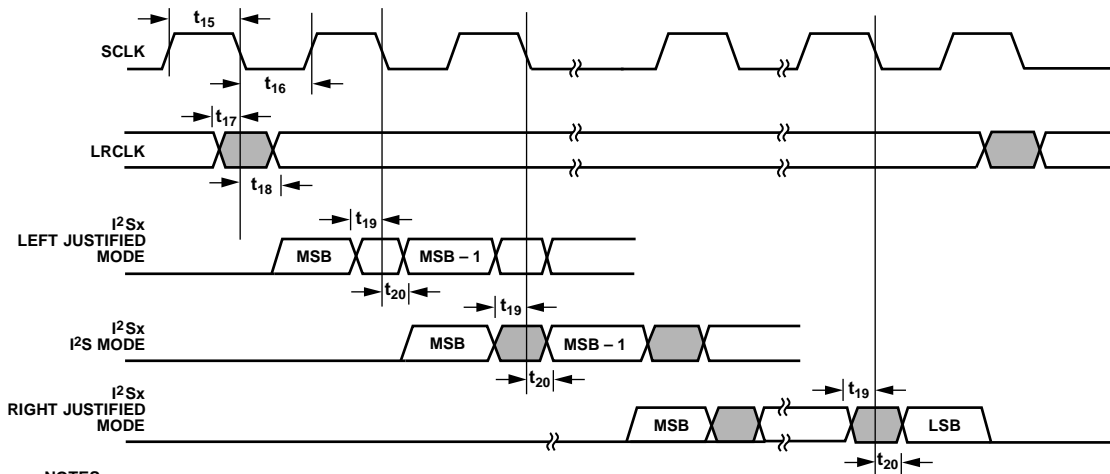


Figure 3. I<sup>2</sup>C Timing



- NOTES  
 1. THE LRCLK SIGNAL IS AVAILABLE ON THE AP5 PIN.  
 2. I<sup>2</sup>Sx SIGNALS (WHERE x = 0, 1, 2, OR 3) ARE AVAILABLE ON THE FOLLOWING PINS: AP1, AP2, AP3, AND AP4.

Figure 4. I<sup>2</sup>S Timing

## ABSOLUTE MAXIMUM RATINGS

Table 4.

Parameter	Rating
DVDD to GND	2.2 V
PVDD to GND	2.2 V
DVDDIO to GND	4.0 V
CVDD to GND	2.2 V
TVDD to GND	4.0 V
LTX_VDD to GND	2.2 V
Digital Inputs to GND	GND – 0.3 V to DVDDIO + 0.3 V
5 V Tolerant Digital Inputs to GND <sup>1</sup>	5.3 V
Digital Outputs to GND	GND – 0.3 V to DVDDIO + 0.3 V
XTALP, XTALN	–0.3 V to PVDD + 0.3 V
SCL, SDA Data Pins to DVDDIO	DVDDIO – 0.3 V to DVDDIO + 3.6 V
Maximum Junction Temperature ( $T_{JMAX}$ )	125°C
Storage Temperature Range	–60°C to +150°C
Infrared Reflow Soldering (20 sec)	260°C
Operating Temperature Range	–40°C to +85°C

<sup>1</sup> The following inputs are 3.3 V inputs but are 5 V tolerant: DDCA\_SCL and DDCA\_SDA.

Stresses at or above those listed under Absolute Maximum Ratings may cause permanent damage to the product. This is a stress rating only; functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

## THERMAL RESISTANCE

To reduce power consumption when using the ADV7613, turn off the unused sections of the device.

Due to printed circuit board (PCB) metal variation and, therefore, variation in PCB heat conductivity, the value of  $\theta_{JA}$  may differ for various PCBs.

It is possible to obtain the most efficient measurement solution by using the package surface temperature to estimate the die temperature because this solution eliminates the variance associated with the  $\theta_{JA}$  value.

When using the device, the maximum junction temperature ( $T_{JMAX}$ ) must not go above 125°C. The following equation calculates the junction temperature using the measured package surface temperature and applies only when no heat sink is used on the device under test (DUT):

$$T_J = T_S + (\Psi_{JT} \times W_{TOTAL}).$$

where:

$T_J$  is the junction temperature.

$T_S$  is the package surface temperature (°C).

$\Psi_{JT} = 0.81^\circ\text{C}/\text{W}$  for the 100-ball CSP\_BGA (based on a 2s2p test board defined in the JEDEC specification).

$$W_{TOTAL} = ((PVDD \times I_{PVDD}) + (0.2 \times TVDD \times I_{TVDD}) + (CVDD \times I_{CVDD}) + (DVDD \times I_{DVDD}) + (DVDDIO \times I_{DVDDIO}) + (LTX_VDD \times I_{LTX_VDD})).$$

where 0.2 is 20% of the TVDD power that is dissipated on the device itself.

## ESD CAUTION



**ESD (electrostatic discharge) sensitive device.** Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

### PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

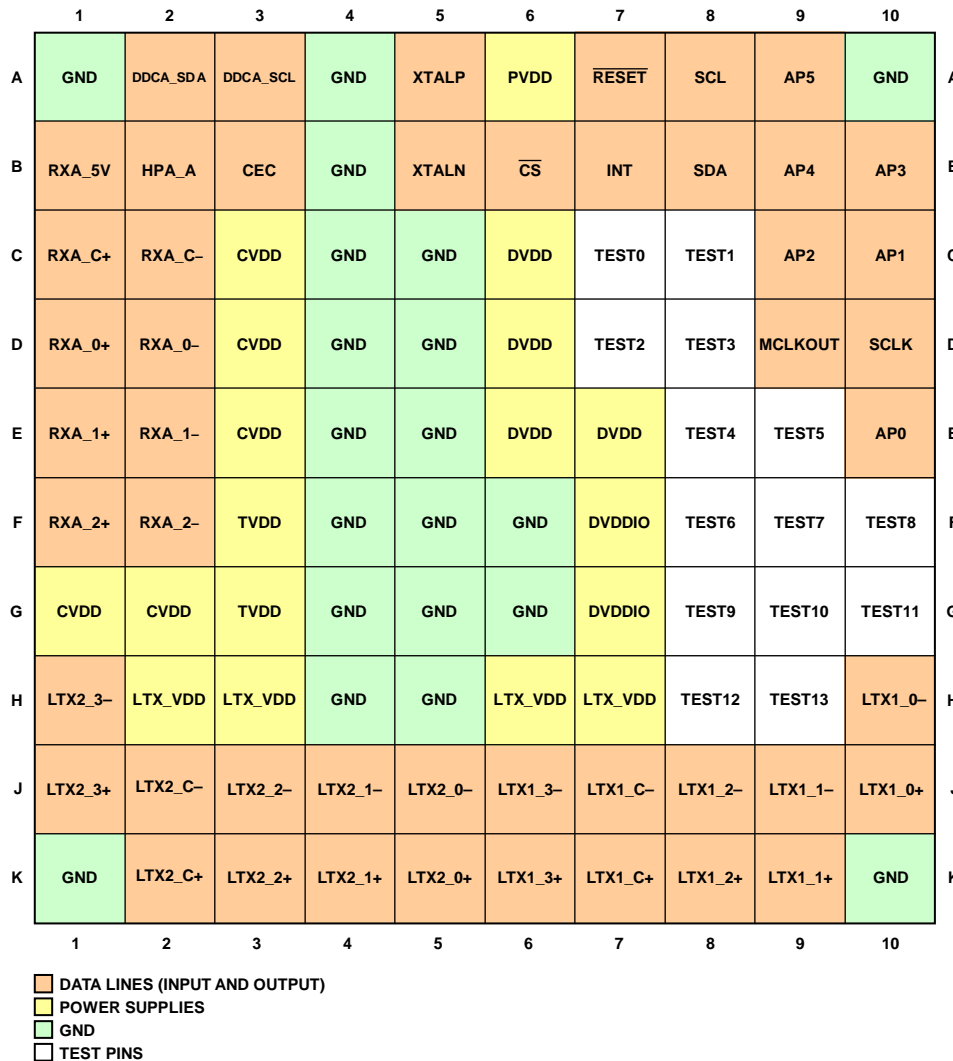


Figure 5. Pin Configuration

Table 5. Pin Function Descriptions

Pin No	Mnemonic	Type	Description
A1, A4, A10, B4, C4, C5, D4, D5, E4, E5, F4 to F6, G4 to G6, H4, H5, K1, K10	GND	Ground	Ground.
A2	DDCA_SDA	HDMI Rx DDC	HDCP Slave Serial Data for HDMI Port A.
A3	DDCA_SCL	HDMI Rx DDC	HDCP Slave Serial Clock for HDMI Port A.
A5	XTALP	Miscellaneous analog	Input for 28.63636 MHz Crystal or an External 1.8 V, 28.63636 MHz Clock Oscillator Source to Clock the <a href="#">ADV7613</a> .
A6	PVDD	Power	Digital PLL Supply Voltage (1.8 V).
A7	RESET	Miscellaneous digital	System Reset Input, Active Low. A minimum low reset pulse width of 5 ms is required to reset the <a href="#">ADV7613</a> circuitry.
A8	SCL	Miscellaneous digital	I <sup>2</sup> C Port Serial Clock Input. SCL is the clock line for the control port.
A9	AP5	Audio output	Audio Output Pin 5. This pin is configurable to output S/PDIF digital audio, HBR or DSD. The AP5 pin typically provides the LRCLK signal for the I <sup>2</sup> S modes.
B1	RXA_5V	HDMI input	5 V Detect Pin for HDMI Port A.



Pin No	Mnemonic	Type	Description
B2	HPA_A	Miscellaneous digital	Hot Plug Assert. This pin can be configured to output the hot plug assert signal for HDMI Port A.
B3	CEC	Digital input/output	Consumer Electronics Control Channel.
B5	XTALN	Miscellaneous analog	Crystal Output.
B6	$\overline{\text{CS}}$	Miscellaneous digital	Chip Select. This pin must be set low for the ADV7613 to process I <sup>2</sup> C messages. Pulling this line up causes the I <sup>2</sup> C state machine to ignore I <sup>2</sup> C transmission.
B7	INT	Miscellaneous digital	Interrupt. This pin can be active low or active high, open drain or transistor to transistor logic (TTL). The events that trigger an interrupt are under user configuration.
B8	SDA	Miscellaneous digital	I <sup>2</sup> C Port Serial Data Input/Output. SDA is the data line for the control port.
B9	AP4	Audio output	Audio Output 4. This pin is configurable to output S/PDIF digital audio, HBR, or I <sup>2</sup> S.
B10	AP3	Audio output	Audio Output 3. This pin is configurable to output S/PDIF digital audio, HBR, or I <sup>2</sup> S.
C1	RXA_C+	HDMI input	Digital Input Clock True of HDMI Port A.
C2	RXA_C-	HDMI input	Digital Input Clock Complement of HDMI Port A.
C3, D3, E3, G1, G2	CVDD	Power	HDMI Analog Block Supply Voltage (1.8 V).
C6, D6, E6, E7	DVDD	Power	Digital Core Supply Voltage (1.8 V).
C7, C8, D7, D8, E8, E9, F8 to F10, G8 to G10, H8, H9	TEST0 to TEST13	Miscellaneous	Test Pins. Connect these pins to ground via 1 k $\Omega$ resistors.
C9	AP2	Audio output	Audio Output 2. This pin is configurable to output S/PDIF digital audio, HBR, DSD, or I <sup>2</sup> S mode.
C10	AP1	Audio output	Audio Output 1. This pin is configurable to output S/PDIF digital audio, HBR, or DSD.
D1	RXA_0+	HDMI input	Digital Input Channel 0 True of HDMI Port A.
D2	RXA_0-	HDMI input	Digital Input Channel 0 Complement of HDMI Port A.
D9	MCLKOUT	Audio output	Master Clock. This pin is configurable to output the audio master clock signal.
D10	SCLK	Audio output	Serial Clock. This pin is configurable to output the audio serial clock.
E1	RXA_1+	HDMI input	Digital Input Channel 1 True of HDMI Port A.
E2	RXA_1-	HDMI input	Digital Input Channel 1 Complement HDMI Port A.
E10	AP0	Audio Output	Audio Output 0. This pin is configurable to output S/PDIF digital audio, HBR, DSD, or I <sup>2</sup> S.
F1	RXA_2+	HDMI input	Digital Input Channel 2 True of HDMI Port A.
F2	RXA_2-	HDMI input	Digital Input Channel 2 Complement of HDMI Port A.
F3, G3	TVDD	Power	Termination Supply Voltage (3.3 V).
F7, G7	DVDDIO	Power	Digital I/O Supply Voltage (3.3 V).
H1	LTX2_3-	LVDS output	LVDS Output Channel 3 Complement of LVDS Output Port 2.
H2, H3, H6, H7	LTX_VDD	Power	LVDS Supply Voltage (1.8 V).
H10	LTX1_0-	LVDS output	LVDS Output Channel 0 Complement of LVDS Output Port 1.
J1	LTX2_3+	LVDS output	LVDS Output Channel 3 True of LVDS Output Port 2.
J2	LTX2_C-	LVDS output	LVDS Clock Complement of LVDS Output Port 2.
J3	LTX2_2-	LVDS output	LVDS Output Channel 2 Complement of LVDS Output Port 2.
J4	LTX2_1-	LVDS output	LVDS Output Channel 1 Complement of LVDS Output Port 2.
J5	LTX2_0-	LVDS output	LVDS Output Channel 0 Complement of LVDS Output Port 2.
J6	LTX1_3-	LVDS output	LVDS Output Channel 3 Complement of LVDS Output Port 1.
J7	LTX1_C-	LVDS output	LVDS Clock Complement of LVDS Output Port 1.
J8	LTX1_2-	LVDS output	LVDS Output Channel 2 Complement of LVDS Output Port 1.
J9	LTX1_1-	LVDS output	LVDS Output Channel 1 Complement of LVDS Output Port 1.
J10	LTX1_0+	LVDS output	LVDS Output Channel 0 True of LVDS Output Port 1.
K2	LTX2_C+	LVDS output	LVDS Clock True of LVDS Output Port 2.
K3	LTX2_2+	LVDS output	LVDS Output Channel 2 True of LVDS Output Port 2.

Pin No	Mnemonic	Type	Description
K4	LTX2_1+	LVDS output	LVDS Output Channel 1 True of LVDS Output Port 2.
K5	LTX2_0+	LVDS output	LVDS Output Channel 0 True of LVDS Output Port 2.
K6	LTX1_3+	LVDS output	LVDS Output Channel 3 True of LVDS Output Port 1.
K7	LTX1_C+	LVDS output	LVDS Clock True of LVDS Output Port 1.
K8	LTX1_2+	LVDS output	LVDS Output Channel 2 True of LVDS Output Port 1.
K9	LTX1_1+	LVDS output	LVDS Output Channel 1 True of LVDS Output Port 1.

## POWER SUPPLY RECOMMENDATIONS

### POWER-UP SEQUENCE

The recommended power-up sequence for the [ADV7613](#) is to power up the 3.3 V supplies first, followed by the 1.8 V supplies. Hold the `RESET` line low for at least 5 ms after the supplies have powered up. Allow a minimum additional 5 ms before carrying out the first I<sup>2</sup>C transaction.

Alternatively, power up the [ADV7613](#) by asserting all supplies simultaneously. In this case, take care while the supplies are being established to ensure that a lower voltage supply does not go above a higher voltage supply level. Hold the `RESET` line low for at least 5 ms after the supplies have powered up. Allow a minimum additional 5 ms before carrying out the first I<sup>2</sup>C transaction.

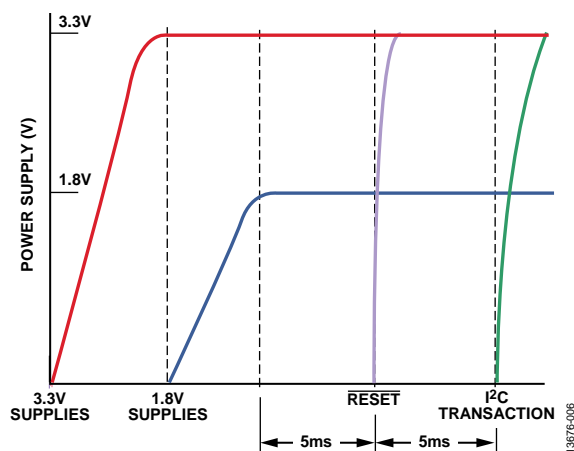


Figure 6. Recommended Power-Up Sequence

### POWER-DOWN SEQUENCE

The [ADV7613](#) power supplies can be deasserted simultaneously as long as a higher rated supply (for example, TVDD/DVDDIO) does not fall to a voltage level less than a lower rated supply (for example, DVDD), and the absolute maximum ratings specifications are followed.

## THEORY OF OPERATION

### HDMI RECEIVER

The HDMI receiver supports HDTV formats of up to 1080p. The HDMI-compatible receiver on the [ADV7613](#) allows active equalization of the HDMI data signals. This equalization compensates for the high frequency losses inherent in HDMI and DVI cabling, especially at longer cable lengths and higher frequencies. The HDMI-compatible receiver is capable of equalizing for cable lengths up to 20 meters to achieve robust receiver performance.

The HDMI receiver offers advanced audio functionality. The receiver contains an audio mute controller that can detect a variety of conditions that may result in audible extraneous noise in the audio output. Upon detection of these conditions, the audio signal can be ramped down or muted to prevent audio clicks or pops. The HDMI receiver supports the reception of all types of audio data described in the HDMI specifications, including the following:

- LPCM (uncompressed audio)
- IEC 61937 (compressed audio)
- DSD audio (1-bit audio)
- HBR audio (high bit rate compressed audio)
- Audio sample, HBR, DSD packet support
- Support for EDID RAM

There is no Deep Color support in the [ADV7613](#).

### HDCP REPEATER FUNCTIONALITY

With the inclusion of HDCP, displays can receive encrypted video content. The HDMI interface of the [ADV7613](#) allows authentication of a video receiver, decryption of encoded data at the receiver, and renewability of that authentication during transmission, as specified by the HDCP 1.4 specification.

### COMPONENT PROCESSOR (CP)

The [ADV7613](#) has two any to any,  $3 \times 3$  color space conversion (CSC) matrices. The first CSC block is located in front of the CP section. The second CSC block is located at the back of the CP section. Each CSC enables YCrCb to RGB and RGB to YCrCb conversions.

CP features include

- Support for 525p, 625p, 720p, 1080p, as well as some graphics standard (WVGA, WXGA)
- Manual adjustments including gain (contrast), offset (brightness), hue, and saturation
- Free run output mode that provides stable timing when no video input is present
- Standard identification enabled by the STDI block

### LVDS TRANSMITTER FEATURES

The LVDS or OpenLDI encoder can package data into 6-bit or 8-bit non-dc balanced OpenLDI mapping, or 8-bit VESA mapping. The [ADV7613](#) can output 24-bit OpenLDI data over

two LVDS transmitters up to a maximum input resolution of 1080p at 60 Hz.

The two LVDS output ports (Port 1 and Port 2) can drive two identical LVDS display panels with video streams from a single video data stream received by the HDMI receiver block.

In the dual LVDS transmitter mode of the [ADV7613](#), the OpenLDI encoder splits the single video stream received by the HDMI block into two video streams; the odd video stream and the even video stream. LVDS Output Port 1 outputs the even video stream and LVDS Output Port 2 outputs the odd video stream.

When connected to the dual LVDS receiver panel, LVDS Output Port 1 must be connected to the even LVDS receiver port of the LVDS panel. LVDS Output Port 2 must be connected to the odd receiver port of the LVDS panel.

In the single LVDS transmitter mode, the video is output on either LVDS Output Port 1 or LVDS Output Port 2.

The maximum video resolution supported by a single LVDS output port must have a clock frequency of 92 MHz or less.

### I<sup>2</sup>C INTERFACE

The [ADV7613](#) supports a 2-wire serial (I<sup>2</sup>C-compatible) interface.

### OTHER FEATURES

Other features of the [ADV7613](#) include the following:

- Programmable interrupt output pin, INT
- Chip select,  $\overline{CS}$

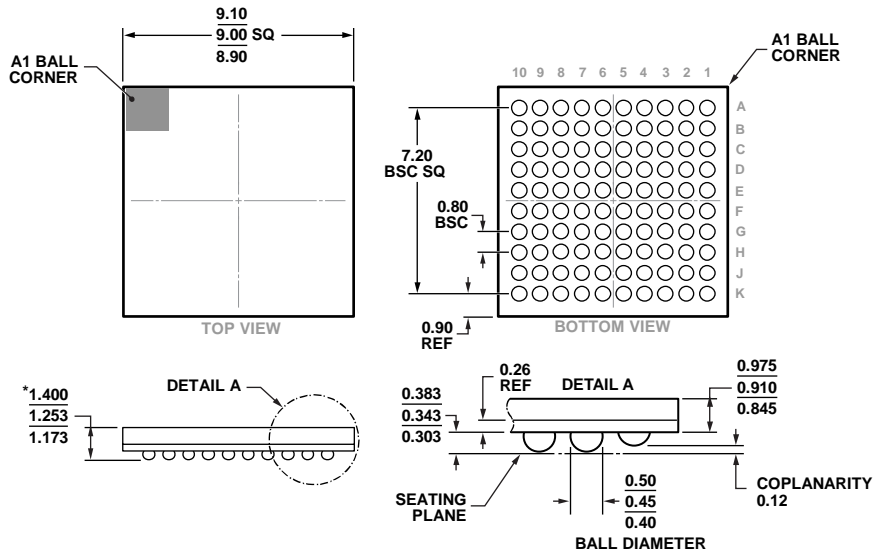
### AUDIO OUTPUT DATA

The audio output pins (AP0 to AP5) can output audio data in a number of formats as described in Table 6.

**Table 6. Description of Audio Formats Supported**

Pin No.	Mnemonic	I <sup>2</sup> S/SPDIF Interface	DSD Interface
E10	AP0	SPDIF0	DSD0A (first DSD channel)
C10	AP1	I <sup>2</sup> S0/SPDIF0	DSD0B (second DSD channel)
C9	AP2	I <sup>2</sup> S1/SPDIF1	DSD1A (third DSD channel)
B10	AP3	I <sup>2</sup> S2/SPDIF2	DSD1B (fourth DSD channel)
B9	AP4	I <sup>2</sup> S3/SPDIF3	DSD2A (fourth DSD channel)
A9	AP5	LRCLK (left/right channel clock output)	DSD2B (fifth DSD channel)
D9	MCLKOUT	Master clock output (MCLK)	Not applicable
D10	SCLK	Bit or serial clock output (SCLK)	Not applicable

### OUTLINE DIMENSIONS



\*COMPLIANT TO JEDEC STANDARDS MO-275-DDAB-1 WITH THE EXCEPTION OF THE PACKAGE HEIGHT

03-14-2013-A

Figure 7. 100-Ball Chip Scale Package Ball Grid Array [CSP\_BGA] (BC-100-4)  
Dimensions shown in millimeters

### ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option
ADV7613BBCZ	-40°C to +85°C	100-Ball Chip Scale Package Ball Grid Array [CSP_BGA]	BC-100-4
ADV7613BBCZ-RL	-40°C to +85°C	100-Ball Chip Scale Package Ball Grid Array [CSP_BGA]	BC-100-4
ADV7613WBBCZ	-40°C to +85°C	100-Ball Chip Scale Package Ball Grid Array [CSP_BGA]	BC-100-4
ADV7613WBBCZ-RL	-40°C to +85°C	100-Ball Chip Scale Package Ball Grid Array [CSP_BGA]	BC-100-4
ADV7613WBBCZ-P	-40°C to +85°C	100-Ball Chip Scale Package Ball Grid Array [CSP_BGA]	BC-100-4
ADV7613WBBCZ-P-RL	-40°C to +85°C	100-Ball Chip Scale Package Ball Grid Array [CSP_BGA]	BC-100-4
EVAL-ADV7613FEBZ		Evaluation Board	

### AUTOMOTIVE PRODUCTS

The [ADV7613W](#) models are available with controlled manufacturing to support the quality and reliability requirements of automotive applications. Note that these automotive models may have specifications that differ from the commercial models; therefore, designers should review the Specifications section of this data sheet carefully. Only the automotive grade products shown are available for use in automotive applications. Contact your local Analog Devices account representative for specific product ordering information and to obtain the specific Automotive Reliability reports for these models.

I<sup>2</sup>C refers to a communications protocol originally developed by Philips Semiconductors (now NXP Semiconductors).