Low Power, 165 MHz HDMI Receiver

Data Sheet **ADV7610**

FEATURES

- High-Definition Multimedia Interface (HDMI®)
  - All mandatory and additional 3D video formats supported
  - Extended colorimetry, including sYCC601, Adobe RGB, Adobe YCC 601, and xvYCC extended gamut color
  - CEC 1.4-compatible
- HDMI receiver
- 165 MHz maximum transition-minimized differential signaling (TMDS) clock frequency
  - 24-bit output pixel bus
  - High-bandwidth Digital Content Protection (HDCP) 1.4 support with internal high definition copy protocol (HDCP) keys
  - HDCP repeater support: up to 127 KSVs supported
  - Integrated consumer electronics control (CEC) controller
  - Programmable HDMI equalizer
  - 5 V detect and Hot Plug™ assert for HDMI port
- Audio support
  - S/PDIF (IEC 60958-compatible) digital audio
  - HDMI audio extraction support
  - Advanced audio mute feature
  - I²S, 4 streams for 8 channels
- General
  - Interrupt controller with two interrupt outputs
  - Standard identification (STDI) circuit
  - Highly flexible 24-bit pixel output interface
- Internal extended display identification data (EDID) RAM
  - Any-to-any 3 × 3 color space conversion (CSC) matrix
  - 2-layer printed circuit board (PCB) design supported
  - 76-ball, 6 mm × 6 mm, chip-scale package BGA

APPLICATIONS

- Portable applications
- Pico projectors
- Digital video cameras

FUNCTIONAL BLOCK DIAGRAM

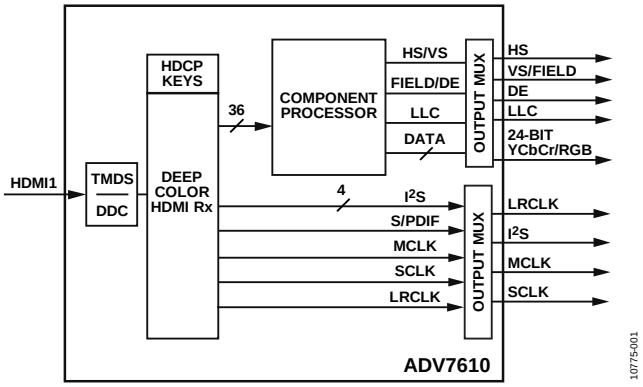

Figure 1.

Advantiv
Advanced Television Solutions by Analog Devices

Rev. 0 **Document Feedback**

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Documentation

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- AN-1180: Optimizing Video Platforms for Automated Post-Production Self-Tests

Data Sheet

- ADV7610: Low Power, 165 MHz HDMI Receiver Data Sheet

User Guides

- UG-438: Advantiv ADV7610 HDMI Receiver Functionality and Features

Tools and Simulations

- ADV7xx Limit MCLK Output Frequency
- ADV7610 IBIS Model

Reference Materials

Technical Articles

- Enabling HDMI in the Automotive Segment

Design Resources

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- PCN-PDN Information
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REVISION HISTORY

12/12—Revision 0: Initial Version

GENERAL DESCRIPTION

The ADV7610 is offered in professional (no HDCP) and industrial versions. The operating temperature range is −40°C to +85°C.

The ADV7610 is a high quality, single input HDMI-capable receiver. It incorporates an HDMI-capable receiver that supports all mandatory 3D TV defined in HDMI specification. The ADV7610 supports formats up to UXGA 60 Hz at eight bits.

It integrates a CEC controller that supports the capability discovery and control (CDC) feature.

The ADV7610 has a 4-channel stereo audio output port for the audio data extracted from the HDMI stream. The HDMI receiver has an advanced mute controller that prevents audible extraneous noise in the audio output.

The following audio formats are accessible:

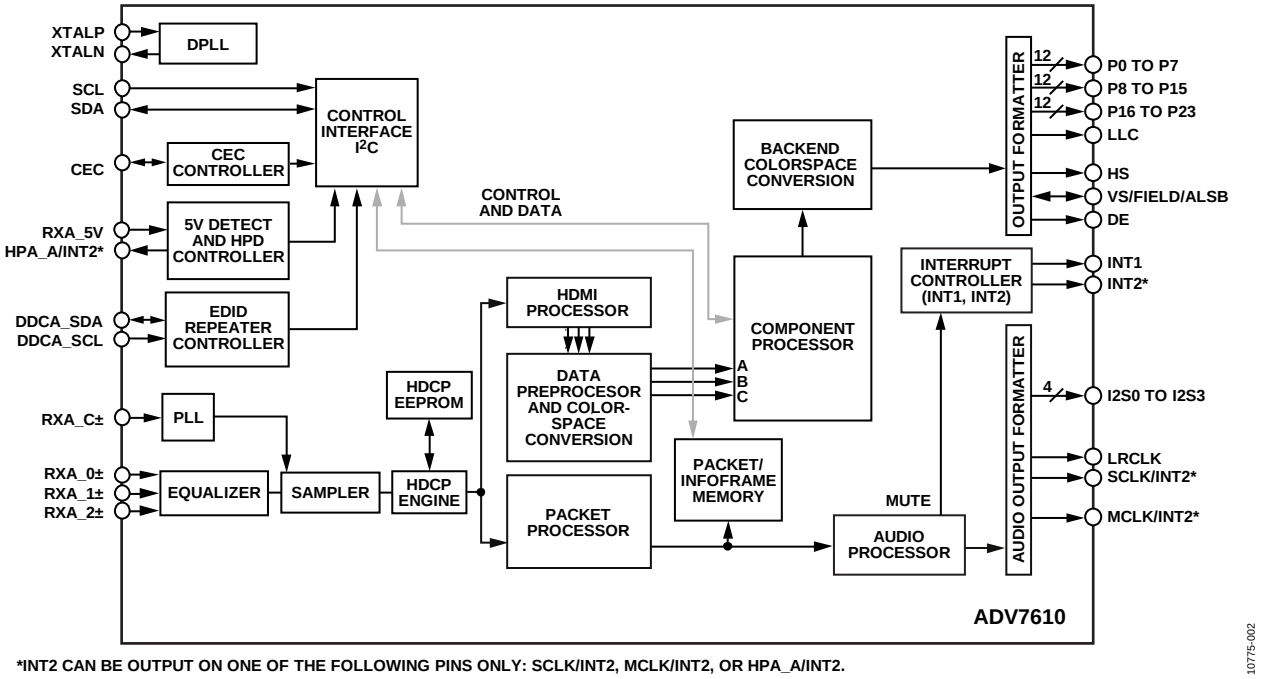
- Four streams from the I²S serializer (eight channels)
- A stream from the S/PDIF serializer (two uncompressed channels or N compressed channels, for example, AC3)
- A DST stream

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 ADV7610 contains one main component processor (CP) that processes the video signals from the HDMI receiver. It provides features such as contrast, brightness, saturation adjustments, STDI detection block, free run, and synchronization alignment controls.

Fabricated in an advanced CMOS process, the ADV7610 is provided in a 6 mm × 6 mm, 76-ball CSP_BGA, RoHS-compliant package and is specified over the −40°C to +85°C temperature range.

DETAILED FUNCTIONAL BLOCK DIAGRAM



*INT2 CAN BE OUTPUT ON ONE OF THE FOLLOWING PINS ONLY: SCLK/INT2, MCLK/INT2, OR HPA_A/INT2.

Figure 2. Detailed Functional Block Diagram

SPECIFICATIONS

DVDD = 1.71 V to 1.89 V, DVDDIO = 3.14 V to 3.46 V, PVDD = 1.71 V to 1.89 V, TVDD = 3.14 V to 3.46 V, CVDD = 1.71 V to 1.89 V, T_{MIN} to T_{MAX} = −40°C to +85°C, unless otherwise noted.

ELECTRICAL CHARACTERISTICS

Table 1.

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
DIGITAL INPUTS[1]						
Input High Voltage	V_{IH}	XTALN and XTALP	1.2			V
	V_{IH}	Other digital inputs	2			V
Input Low Voltage	V_{IL}	XTALN and XTALP			0.4	V
	V_{IL}	Other digital inputs			0.8	V
Input Current	I_{IN}	$\overline{\text{RESET}}$ pin		±45	±60	µA
		Other digital inputs		±10		µA
Input Capacitance	C_{IN}				10	pF
DIGITAL INPUTS (5 V TOLERANT)[1, 2]						
Input High Voltage	V_{IH}		2.6			V
Input Low Voltage	V_{IL}				0.8	V
Input Current	I_{IN}		−82		+82	µA
DIGITAL OUTPUTS[1]						
Output High Voltage	V_{OH}		2.4			V
Output Low Voltage	V_{OL}				0.4	V
High Impedance Leakage Current	I_{LEAK}	VS/FIELD/ALSB pin		±35	±60	µA
		HPA_A/INT2 pin			±82	µA
		Other		10		µA
Output Capacitance	C_{OUT}				20	pF
POWER REQUIREMENTS[3]						
Digital Core Power Supply	DVDD		1.71	1.8	1.89	V
Digital I/O Power Supply	DVDDIO		3.14	3.3	3.46	V
PLL Power Supply	PVDD		1.71	1.8	1.89	V
Terminator Power Supply	TVDD		3.14	3.3	3.46	V
Comparator Power Supply	CVDD		1.71	1.8	1.89	V
Digital Core Supply Current	I_{DVDD}	UXGA 60 Hz at eight bits		95.7	188.1	mA
Digital I/O Supply Current	I_{DVDDIO}	UXGA 60 Hz at eight bits		12.9	178.5	mA
PLL Supply Current	I_{PVDD}	UXGA 60 Hz at eight bits		30.7	36.9	mA
Terminator Supply Current	I_{TVDD}	UXGA 60 Hz at eight bits		50.9	57.6	mA
Comparator Supply Current	I_{CVDD}	UXGA 60 Hz at eight bits		95.8	114.4	mA
POWER-DOWN CURRENTS[4]						
Digital Core Supply Current	I_{DVDD_PD}	Power-Down Mode 1		0.2	0.5	mA
Digital I/O Supply Current	I_{DVDDIO_PD}	Power-Down Mode 1		1.3	1.7	mA
PLL Supply Current	I_{PVDD_PD}	Power-Down Mode 1		1.5	1.8	mA
Terminator Supply Current	I_{TVDD_PD}	Power-Down Mode 1		0.1	0.3	mA
Comparator Supply Current	I_{CVDD_PD}	Power-Down Mode 1		1.3	1.7	mA
Power-Up Time	t_{PWRUP}			25		ms

[1] Data guaranteed by characterization.
[2] The following pins are 5 V tolerant: DDCA_SCL, DDCA_SDA, and RXA_5V.
[3] Maximum current consumption values are recorded with maximum rated voltage supply levels, Moire X video pattern, and at maximum rated temperature.
[4] Power-Down Mode 0 (I/O map, Register 0x0C = 0x62), ring oscillator powered down (HDMI map, Register 0x48 = 0x01), and DDC pads off (HDMI map, Register 0x73 = 0x01).

DATA AND I²C TIMING CHARACTERISTICS

Table 2.

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
CLOCK AND CRYSTAL						
Crystal Frequency, XTALP				28.63636		MHz
Crystal Frequency Stability					±50	ppm
LLC Frequency Range[1]			13.5		165	MHz
I²C PORTS						
SCL Frequency					400	kHz
SCL Minimum Pulse Width High[2]	t_1		600			ns
SCL Minimum Pulse Width Low[2]	t_2		1.3			µs
Start Condition Hold Time[2]	t_3		600			ns
Start Condition Setup Time[2]	t_4		600			ns
SDA Setup Time[2]	t_5		100			ns
SCL and SDA Rise Time[2]	t_6				300	ns
SCL and SDA Fall Time[2]	t_7				300	ns
Stop Condition Setup Time[2]	t_8		0.6			µs
$\overline{\text{RESET}}$ FEATURE						
$\overline{\text{RESET}}$ Pulse Width			5			ms
CLOCK OUTPUTS						
LLC Mark:Space Ratio[2]	t_9:t_{10}		45:55		55:45	% duty cycle
DATA AND CONTROL OUTPUTS[3]						
Data Output Transition Time[2, 4]	t_{11}	End of valid data to negative clock edge		1.0	2.2	ns
	t_{12}	Negative clock edge to start of valid data		0.0	0.3	ns
I²S PORT, MASTER MODE						
SCLK Mark:Space Ratio[2]	t_{15}:t_{16}		45:55		55:45	% duty cycle
LRCLK Data Transition Time[2]	t_{17}	End of valid data to negative SCLK edge			10	ns
LRCLK Data Transition Time[2]	t_{18}	Negative SCLK edge to start of valid data			10	ns
I²S Data Transition Time[2]	t_{19}	End of valid data to negative SCLK edge			5	ns
I²S Data Transition Time[2]	t_{20}	Negative SCLK edge to start of valid data			5	ns

[1] Maximum LLC frequency is limited by the clock frequency of UXGA 60 Hz at eight bits.
[2] Data guaranteed by characterization.
[3] With the DLL block on the output clock bypassed.
[4] DLL bypassed on the clock path.

Timing Diagrams

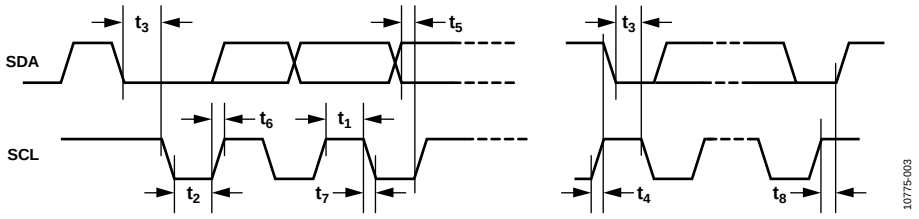


Figure 3. I²C Timing

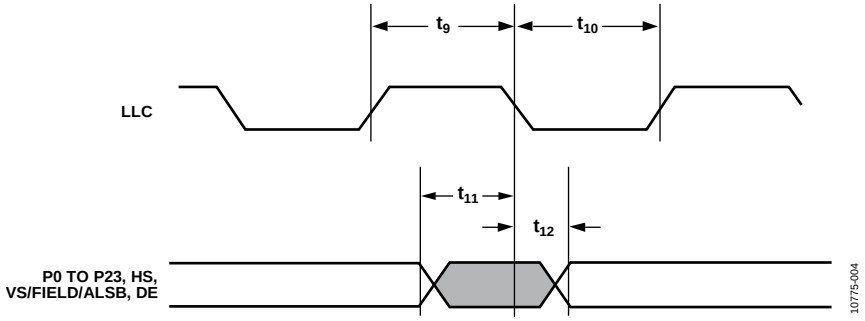


Figure 4. Pixel Port and Control SDR Output Timing

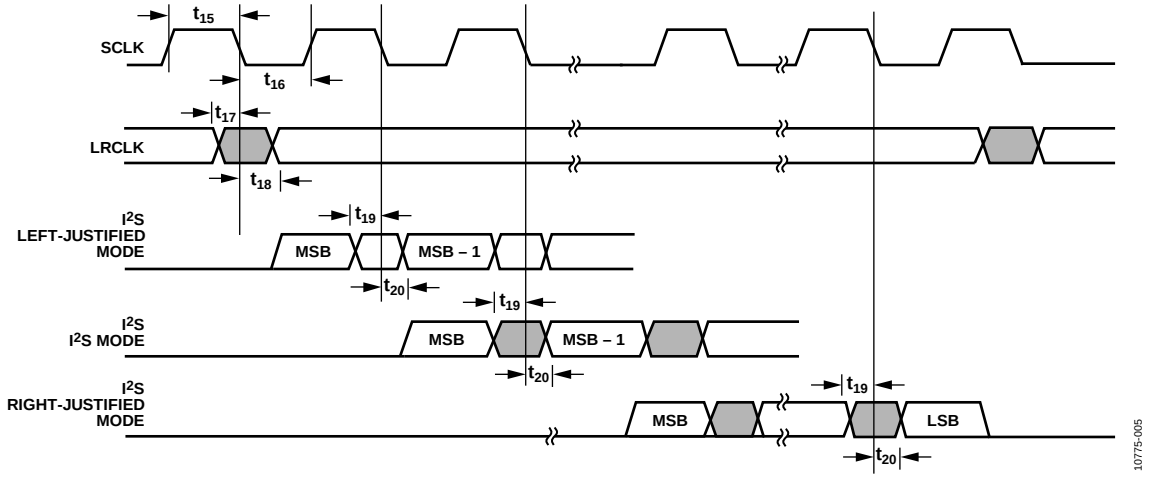


Figure 5. I²S Timing

ABSOLUTE MAXIMUM RATINGS

Table 3.

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
Digital Inputs Voltage to GND	GND − 0.3 V to DVDDIO + 0.3 V
5 V Tolerant Digital Inputs to GND[1]	5.3 V
Digital Outputs Voltage to GND	GND − 0.3 V to DVDDIO + 0.3 V
XTALP, XTALN	GND − 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 ($T_{J\ MAX}$)	125°C
Storage Temperature Range	−60°C to +150°C
Infrared Reflow Soldering (20 sec)	260°C

[1] The following inputs are 3.3 V inputs but are 5 V tolerant: DDCA_SCL, DDCA_SDA, and RXA_5V.

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

PACKAGE THERMAL PERFORMANCE

To reduce power consumption when using the ADV7610, turn off the unused sections of the part.

Due to the PCB metal variation and, therefore, variation in PCB heat conductivity, the value of θ_{JA} may differ for various PCBs.

The most efficient measurement solution is obtained using the package surface temperature to estimate the die temperature because this eliminates the variance associated with the θ_{JA} value.

Do not exceed the maximum junction temperature ($T_{J\ MAX}$) of 125°C. The following equation calculates the junction temperature using the measured package surface temperature, and it applies only when a heat sink is not used on the device under test (DUT):

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

where:
T_S is the package surface temperature (°C).
Ψ_{JT} = 0.4°C/W for the 76-ball CSP_BGA.

$$W_{TOTAL} = ((PVDD \times I_{PVDD}) + (0.05 \times TVDD \times I_{TVDD}) + (CVDD \times I_{CVDD}) + (DVDD \times I_{DVDD}) + (DVDDIO \times I_{DVDDIO}))$$

where 0.05 is 5% 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

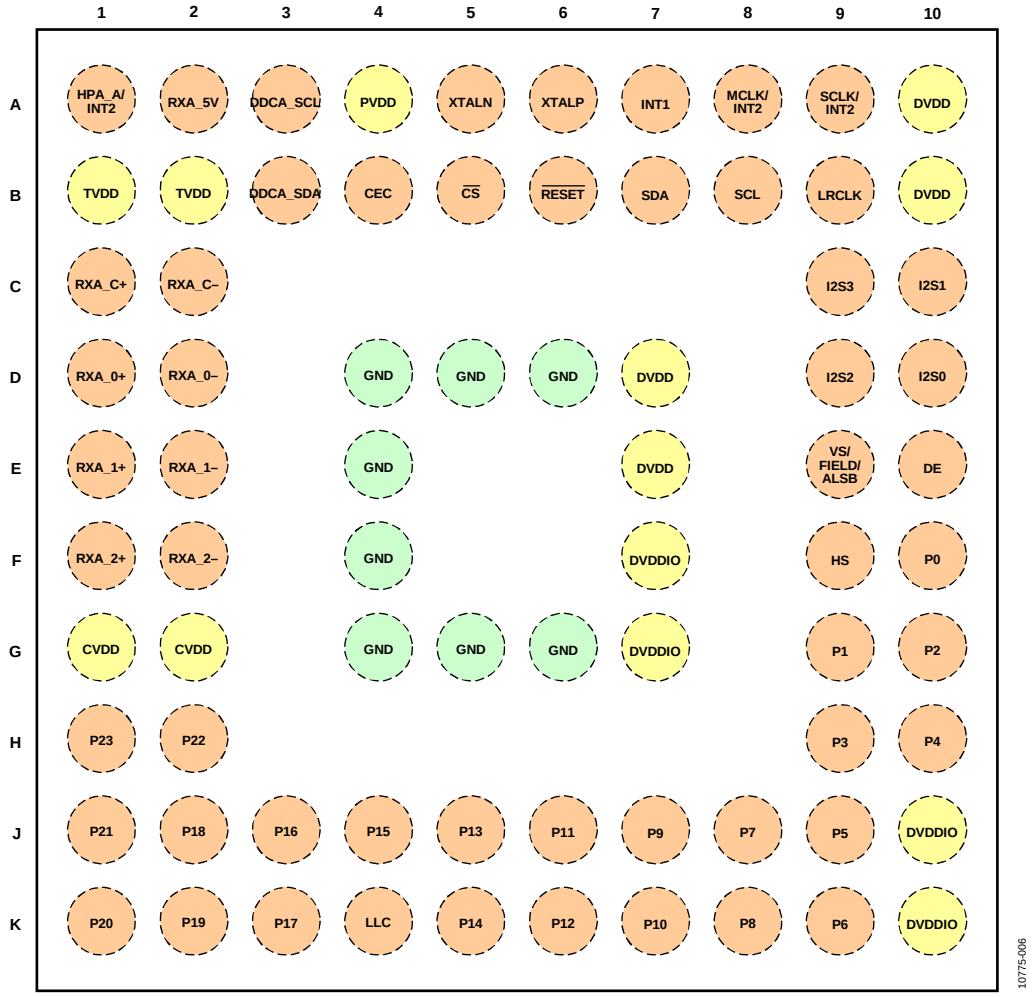


Figure 6. Pin Configuration

Table 4. Pin Function Descriptions

Ball No.	Mnemonic	Type	Description
D4, D5, D6, E4, F4, G4, G5, G6	GND	Ground	Ground.
A1	HPA_A/INT2	Miscellaneous digital	A dual function pin that can be configured to output a Hot Plug assert signal (for HDMI Port A) or an Interrupt 2 signal.
G1, G2	CVDD	Power	HDMI Analog Block Supply Voltage (1.8 V).
B1, B2	TVDD	Power	Terminator Supply Voltage (3.3 V).
F7, G7, J10, K10	DVDDIO	Power	Digital I/O Supply Voltage (3.3 V).
A10, B10, D7, E7	DVDD	Power	Digital Core Supply Voltage (1.8 V).
A4	PVDD	Power	PLL Supply Voltage (1.8 V).
C2	RXA_C–	HDMI input	Digital Input Clock Complement of Port A in the HDMI Interface.
C1	RXA_C+	HDMI input	Digital Input Clock True of Port A in the HDMI Interface.
D2	RXA_0–	HDMI input	Digital Input Channel 0 Complement of Port A in the HDMI Interface.
D1	RXA_0+	HDMI input	Digital Input Channel 0 True of Port A in the HDMI Interface.
E2	RXA_1–	HDMI input	Digital Input Channel 1 Complement of Port A in the HDMI Interface.
E1	RXA_1+	HDMI input	Digital Input Channel 1 True of Port A in the HDMI Interface.
F2	RXA_2–	HDMI input	Digital Input Channel 2 Complement of Port A in the HDMI Interface.
F1	RXA_2+	HDMI input	Digital Input Channel 2 True of Port A in the HDMI Interface.

Ball No.	Mnemonic	Type	Description
H1	P23	Digital video output	Video Pixel Output Port.
H2	P22	Digital video output	Video Pixel Output Port.
J1	P21	Digital video output	Video Pixel Output Port.
K1	P20	Digital video output	Video Pixel Output Port.
K2	P19	Digital video output	Video Pixel Output Port.
J2	P18	Digital video output	Video Pixel Output Port.
K3	P17	Digital video output	Video Pixel Output Port.
J3	P16	Digital video output	Video Pixel Output Port.
K4	LLC	Digital video output	Line Locked Output Clock for the Pixel Data the Range is 13.5 MHz to 162.5 MHz.
J4	P15	Digital video output	Video Pixel Output Port.
K5	P14	Digital video output	Video Pixel Output Port.
J5	P13	Digital video output	Video Pixel Output Port.
K6	P12	Digital video output	Video Pixel Output Port.
J6	P11	Digital video output	Video Pixel Output Port.
K7	P10	Digital video output	Video Pixel Output Port.
J7	P9	Digital video output	Video Pixel Output Port.
K8	P8	Digital video output	Video Pixel Output Port.
J8	P7	Digital video output	Video Pixel Output Port.
K9	P6	Digital video output	Video Pixel Output Port.
J9	P5	Digital video output	Video Pixel Output Port.
H10	P4	Digital video output	Video Pixel Output Port.
H9	P3	Digital video output	Video Pixel Output Port.
G10	P2	Digital video output	Video Pixel Output Port.
G9	P1	Digital video output	Video Pixel Output Port.
F10	P0	Digital video output	Video Pixel Output Port.
E10	DE	Miscellaneous digital	Data Enable. DE is a signal that indicates active pixel data.
F9	HS	Digital video output	Horizontal Synchronization Output Signal.
E9	VS/FIELD/ALSB	Digital input/output	Vertical Synchronization Output Signal. Field Synchronization Output Signal in All Interlaced Video Modes. VS or FIELD can be configured for this pin. The ALSB allows selection of the I^2C address.
D10, C10, D9, C9	I2S0 to I2S3	Miscellaneous digital	Audio Output Pins. These pins can be configured to output S/PDIF digital audio (S/PDIF) or I^2S.
A9	SCLK/INT2	Miscellaneous digital	A dual function pin that can be configured to output an audio serial clock or an Interrupt 2 signal.
B9	LRCLK	Miscellaneous digital	Audio Left/Right Clock.
A8	MCLK/INT2	Miscellaneous digital	A dual function pin that can be configured to output an audio master clock or an Interrupt 2 signal.
B8	SCL	Miscellaneous digital	I^2C Port Serial Clock Input. SCL is the clock line for the control port.
B7	SDA	Miscellaneous digital	I^2C Port Serial Data Input/Output Pin. SDA is the data line for the control port.
A7	INT1	Miscellaneous digital	Interrupt 1. This pin can be active low or active high. When status bits change, this pin is triggered. The events that trigger an interrupt are under user configuration.
B6	$\overline{\text{RESET}}$	Miscellaneous digital	System Reset Input. Active low. A minimum low reset pulse width of 5 ms is required to reset the ADV7610 circuitry.
A6	XTALP	Miscellaneous analog	Input Pin for 28.63636 MHz Crystal or an External 1.8 V, 28.63636 MHz Clock Oscillator Source to Clock the ADV7610.
A5	XTALN	Miscellaneous analog	Crystal Input. Input pin for 28.63636 MHz crystal.
B4	CEC	Digital input/output	Consumer Electronic Control Channel.
B5	$\overline{\text{CS}}$	Miscellaneous digital	Chip Select (Bar). Pulling this line high causes the I^2C state machine to ignore the I^2C transmission.
A3	DDCA_SCL	HDMI input	HDCP Slave Serial Clock Port A. DDCA_SCL is a 3.3 V input that is 5 V tolerant.
B3	DDCA_SDA	HDMI input	HDCP Slave Serial Data Port A. DDCA_SDA is a 3.3 V input that is 5 V tolerant.
A2	RXA_5V	HDMI input	5 V Detect Pin for Port A in the HDMI Interface.

POWER SUPPLY SEQUENCING

POWER-UP SEQUENCE

The recommended power-up sequence of the ADV7610 is to power up the 3.3 V supplies first, followed by the 1.8 V supplies. Hold reset low while the supplies are powered up.

Alternatively, the ADV7610 can be powered up by asserting all supplies simultaneously. In this case, care must be taken while the supplies are being established to ensure that a lower rated supply does not rise above a higher rated supply level.

POWER-DOWN SEQUENCE

The ADV7610 supplies can be deasserted simultaneously as long as a higher rated supply does not fall below a lower rated supply.

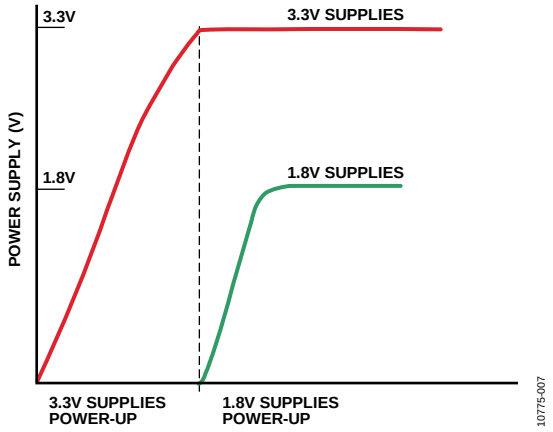


Figure 7. Recommended Power-Up Sequence

FUNCTIONAL OVERVIEW

HDMI RECEIVER

The receiver supports all mandatory and many optional 3D formats. It supports HDTV formats up to UXGA at eight bits.

The HDMI-compatible receiver on the ADV7610 incorporates programmable equalization of the HDMI data signals. This equalization compensates for the high frequency losses inherent in HDMI and DVI cabling, especially at longer lengths and higher frequencies. It is capable of equalizing for cable lengths of up to 30 meters to achieve robust receiver performance.

With the inclusion of HDCP, displays can receive encrypted video content. The HDMI interface of the ADV7610 allows for 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 protocol.

The ADV7610 has a synchronization regeneration block to regenerate the DE based on the measurement of the video format being displayed and to filter the horizontal and vertical synchronization signals to prevent glitches. The HDMI receiver also supports TERC4 error detection for detection of corrupted HDMI packets following a cable disconnect.

The HDMI receiver contains an audio mute controller that can detect a variety of conditions that may result in audible extraneous noise in the audio output. On detection of these conditions, the audio signal can be ramped to prevent audio clicks or pops. Audio output can be formatted to LPCM and IEC 61937.

The HDMI receiver features include:

- 162.5 MHz (UXGA at eight bits) maximum TMDS clock frequency
- 3D format support defined in the HDMI specification
- Integrated equalizer for cable lengths of up to 30 meters
- HDCP 1.4
- Internal HDCP keys
- PCM audio packet support
- TDM I²S audio packet support
- Repeater support
- Internal EDID RAM
- Hot Plug assert output pin for an HDMI port
- CEC controller

COMPONENT PROCESSOR (CP)

The ADV7610 has an any-to-any 3 × 3 CSC matrix. The CSC block is placed in the output section of the component processor. The CSC enables YPrPb-to-RGB and RGB-to-YCrCb conversions. Many other standards of colorspace can be implemented using the colorspace converter.

CP features include:

- 525i, 625i, 525p, 625p, 720p, 1080i, 1080p, and other formats
- Manual adjustments including gain (contrast) and offset (brightness), hue, and saturation
- Free run output mode that provides stable timing when no video input is present
- 162.5 MHz processing rate
- Contrast, brightness, hue, and saturation controls
- Standard identification enabled by STDI block
- RGB that can be color space converted to YCrCb and decimated to a 4:2:2 format for videocentric back-end IC interfacing
- DE output signal supplied for direct connection to an HDMI/DVI transmitter

OTHER FEATURES

The ADV7610 has HS, VS, FIELD, and DE output signals with programmable position, polarity, and width.

The ADV7610 has programmable interrupt request output pins, including INT1 and INT2 (INT2 is accessible only via one of following pins: MCLK/INT2, SCLK/INT2, or HPA_A/INT2). It also features a low power-down mode. The I²C address of the main map is 0x98 after reset. This can be changed after reset to 0x9A if pull-up is attached to the VS/FIELD/ALSB pin and the I²C command SAMPLE_ALSB is issued.

The ADV7610 is provided in a 6 mm × 6 mm, RoHS-compliant BGA package and is specified over the −40°C to +85°C temperature range.

For more detailed product information about the ADV7610, contact the local Analog Devices, Inc., sales office.

PIXEL INPUT/OUTPUT FORMATTING

The output section of the ADV7610 is highly flexible. The pixel output bus can support up to 24-bit 4:4:4 YCrCb. The pixel data supports both single data rate mode and double data rate mode. In SDR mode, a 16-/24-bit 4:2:2 or 24-bit 4:4:4 output is possible. In DDR mode, the pixel output port can be configured in an 8-/12-bit 4:2:2 YCrCb or 24-bit 4:4:4 RGB.

Bus rotation is supported. Table 5 and Table 6 outline the various output formats that are supported. All output modes are controlled via I^2C.

PIXEL DATA OUTPUT MODES FEATURES

The output pixel port features include:

- 8-/12-bit ITU-R BT.656 4:2:2 YCrCb with embedded time codes and/or HS, VS, and FIELD output signals
- 16-/24-bit YCrCb with embedded time codes and/or HS and VS/FIELD pin timing
- 24-bit YCrCb/RGB with embedded time codes and/or HS and VS/FIELD pin timing
- DDR 8-/12-bit 4:2:2 YCrCb
- DDR 24-bit 4:4:4 RGB

Table 5. SDR 4:2:2 and 4:4:4 Output Modes

	SDR 4:2:2				SDR 4:4:4
OP_FORMAT_SEL[7:0]	**0x0**	**0x0A**	**0x80**	**0x8A**	**0x40**
Pixel Output	**8-Bit SDR ITU-R BT.656 Mode 0**	**12-Bit SDR ITU-R BT.656 Mode 2**	**16-Bit SDR ITU-R BT.656 4:2:2 Mode 0**	**24-Bit SDR ITU-R BT.656 4:2:2 Mode 2**	**24-Bit SDR 4:4:4 Mode 0**
P23	High-Z	Y3, Cb3, Cr3	High-Z	Y3	R7
P22	High-Z	Y2, Cb2, Cr2	High-Z	Y2	R6
P21	High-Z	Y1, Cb1, Cr1	High-Z	Y1	R5
P20	High-Z	Y0, Cb0, Cr0	High-Z	Y0	R4
P19	High-Z	High-Z	High-Z	Cb3, Cr3	R3
P18	High-Z	High-Z	High-Z	Cb2, Cr2	R2
P17	High-Z	High-Z	High-Z	Cb1, Cr1	R1
P16	High-Z	High-Z	High-Z	Cb0, Cr0	R0
P15	Y7, Cb7, Cr7	Y11, Cb11, Cr11	Y7	Y11	G7
P14	Y6, Cb6, Cr6	Y10, Cb10, Cr10	Y6	Y10	G6
P13	Y5, Cb5, Cr5	Y9, Cb9, Cr9	Y5	Y9	G5
P12	Y4, Cb4, Cr4	Y8, Cb8, Cr8	Y4	Y8	G4
P11	Y3, Cb3, Cr3	Y7, Cb7, Cr7	Y3	Y7	G3
P10	Y2, Cb2, Cr2	Y6, Cb6, Cr6	Y2	Y6	G2
P9	Y1, Cb1, Cr1	Y5, Cb5, Cr5	Y1	Y5	G1
P8	Y0, Cb0, Cr0	Y4, Cb4, Cr4	Y0	Y4	G0
P7	High-Z	High-Z	Cb7, Cr7	Cb11, Cr11	B7
P6	High-Z	High-Z	Cb6, Cr6	Cb10, Cr10	B6
P5	High-Z	High-Z	Cb5, Cr5	Cb9, Cr9	B5
P4	High-Z	High-Z	Cb4, Cr4	Cb8, Cr8	B4
P3	High-Z	High-Z	Cb3, Cr3	Cb7, Cr7	B3
P2	High-Z	High-Z	Cb2, Cr2	Cb6, Cr6	B2
P1	High-Z	High-Z	Cb1, Cr1	Cb5, Cr5	B1
P0	High-Z	High-Z	Cb0, Cr0	Cb4, Cr4	B0

Table 6. DDR 4:2:2 and 4:4:4 Output Modes

	DDR 4:2:2 Mode (Clock/2)		DDR 4:2:2 Mode (Clock/2)		DDR 4:4:4 Mode (Clock/2)[1, 2]	
OP_FORMAT_SEL[7:0]	**0x20**		**0x2A**		**0x60**	
	8-Bit DDR ITU-656 (Clock/2 Output) 4:2:2 Mode 0		**12-Bit DDR ITU-656 (Clock/2 Output) 4:2:2 Mode 2**		**24-Bit DDR RGB (Clock/2 Output)**	
Pixel Output	**Clock Rise**	**Clock Fall**	**Clock Rise**	**Clock Fall**	**Clock Rise**	**Clock Fall**
P23	High-Z	High-Z	Cb3, Cr3	Y3	R7-0	R7-1
P22	High-Z	High-Z	Cb2, Cr2	Y2	R6-0	R6-1
P21	High-Z	High-Z	Cb1, Cr1	Y1	R5-0	R5-1
P20	High-Z	High-Z	Cb0, Cr0	Y0	R4-0	R4-1
P19	High-Z	High-Z	High-Z	High-Z	R3-0	R3-1
P18	High-Z	High-Z	High-Z	High-Z	R2-0	R2-1
P17	High-Z	High-Z	High-Z	High-Z	R1-0	R1-1
P16	High-Z	High-Z	High-Z	High-Z	R0-0	R0-1
P15	Cb7, Cr7	Y7	Cb11, Cr11	Y11	G7-0	G7-1
P14	Cb6, Cr6	Y6	Cb12, Cr12	Y12	G6-0	G6-1
P13	Cb5, Cr5	Y5	Cb9, Cr9	Y9	G5-0	G5-1
P12	Cb4, Cr4	Y4	Cb8, Cr8	Y8	G4-0	G4-1
P11	Cb3, Cr3	Y3	Cb7, Cr7	Y7	G3-0	G3-1
P10	Cb2, Cr2	Y2	Cb6, Cr6	Y6	G2-0	G2-1
P9	Cb1, Cr1	Y1	Cb5, Cr5	Y5	G1-0	G1-1
P8	Cb0, Cr0	Y0	Cb4, Cr4	Y4	G0-0	G0-1
P7	High-Z	High-Z	High-Z	High-Z	B7-0	B7-1
P6	High-Z	High-Z	High-Z	High-Z	B6-0	B6-1
P5	High-Z	High-Z	High-Z	High-Z	B5-0	B5-1
P4	High-Z	High-Z	High-Z	High-Z	B4-0	B4-1
P3	High-Z	High-Z	High-Z	High-Z	B3-0	B3-1
P2	High-Z	High-Z	High-Z	High-Z	B2-0	B2-1
P1	High-Z	High-Z	High-Z	High-Z	B1-0	B1-1
P0	High-Z	High-Z	High-Z	High-Z	B0-0	B0-1

[1] -0 = even samples.
[2] -1 = odd samples.

OUTLINE DIMENSIONS

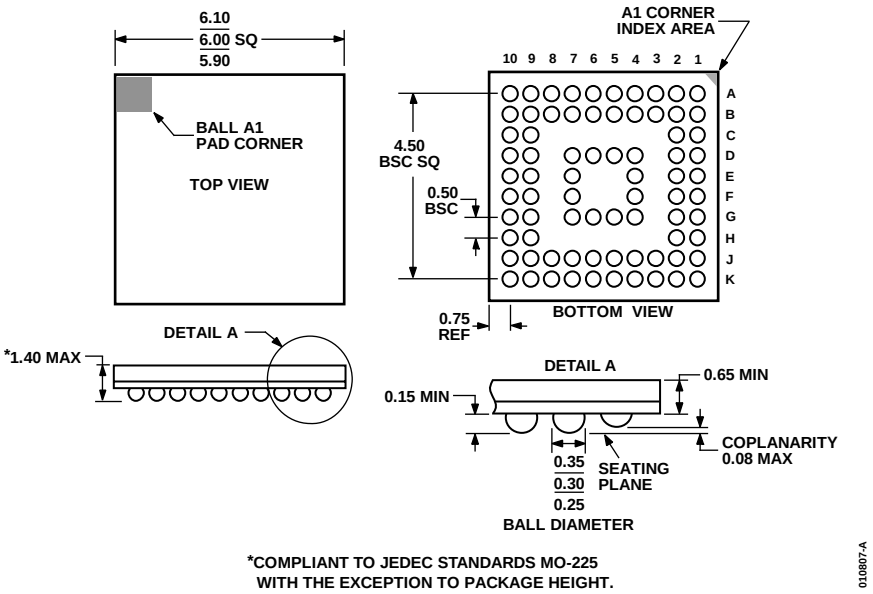


Figure 8. 76-Ball Chip Scale Package Ball Grid Array [CSP_BGA]
(BC-76-1)
Dimensions shown in millimeters

ORDERING GUIDE

Model[1]	Temperature Range	Package Description	Package Option
ADV7610BBCZ	−40°C to +85°C	76-Ball Chip Scale Package Ball Grid Array [CSP_BGA]	BC-76-1
ADV7610BBCZ-RL	−40°C to +85°C	76-Ball Chip Scale Package Ball Grid Array [CSP_BGA], 13″ Tape and Reel	BC-76-1
ADV7610BBCZ-P	−40°C to +85°C	76-Ball Chip Scale Package Ball Grid Array [CSP_BGA], NonHDCP Version	BC-76-1
ADV7610BBCZ-P-RL	−40°C to +85°C	76-Ball Chip Scale Package Ball Grid Array [CSP_BGA], 13″ Tape and Reel, NonHDCP Version	BC-76-1

[1] Z = RoHS Compliant Part.

NOTES

NOTES

D10775-0-12/12(0)