165 MHz, High Performance HDMI Transmitter

Data Sheet

ADV7513

FEATURES

General
- Incorporates HDMI v1.4 features, including 3D video support
- 165 MHz supports all video formats up to 1080p and UXGA
- Supports gamut metadata packet transmission
- Integrated CEC buffer/controller
- Compatible with DVI v1.0 and HDCP v1.4
- Video/audio inputs accept logic levels from 1.8 V to 3.3 V

Digital video
- 3D video ready
- Programmable, 2-way color space converter
- Supports RGB, YCbCr, and DDR
- Supports ITU-656-based embedded syncs
- Automatic input video format timing detection (CEA-861-E)

Digital audio
- Supports standard S/PDIF for stereo linear pulse code modulation (LPCM) or compressed audio up to 192 kHz
- High bit rate (HBR) audio
- 8-channel uncompressed LPCM I²S audio up to 192 kHz

Special features for easy system design
- 5 V tolerant I²C and Hot Plug™ detect (HPD) I/Os, no extra device needed
- No audio master clock needed for supporting S/PDIF and I²S
- On-chip MPU with I²C master performs HDCP operations and EDID reading operations
- On-chip MPU reports HDMI events through interrupts and registers

APPLICATIONS

- Gaming consoles
- PCs
- DVD players and recorders
- Digital set-top boxes
- A/V receivers

FUNCTIONAL BLOCK DIAGRAM

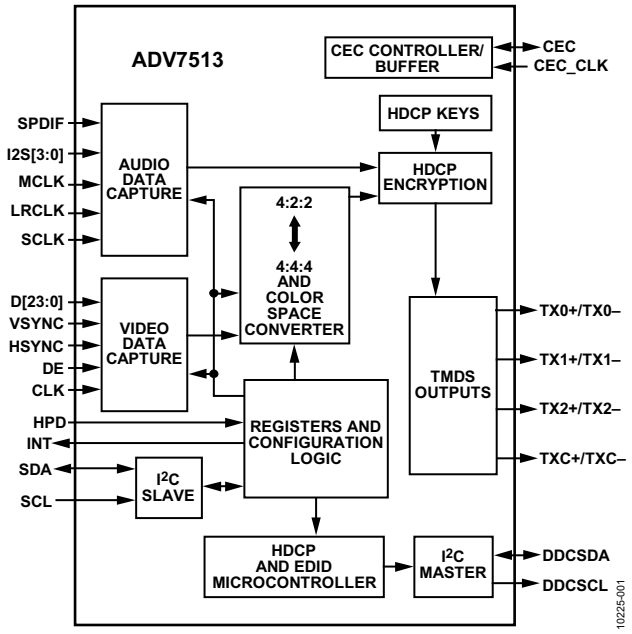

Figure 1.

GENERAL DESCRIPTION

The ADV7513 is a 165 MHz, High-Definition Multimedia Interface (HDMI®) transmitter that is ideal for DVD players/recorders, digital set-top boxes, A/V receivers, gaming consoles, and PCs.

The digital video interface contains an HDMI v1.4/DVI v1.0-compatible transmitter and supports all HDTV formats. The ADV7513 supports HDMI v1.4-specific features, including 3D video. The ADV7513 also supports x.v.Color™, high bit rate (HBR) audio, and the programmable auxiliary video information (AVI) InfoFrame features. With the inclusion of HDCP, the ADV7513 allows the secure transmission of protected content as specified by the HDCP v1.4 protocol.

The ADV7513 supports both S/PDIF and 8-channel I²S audio. Its high fidelity 8-channel I²S interface can transmit either stereo or 7.1 surround audio up to 768 kHz. The S/PDIF interface can carry compressed audio, including Dolby® Digital, DTS®, and THX®. Fabricated in an advanced CMOS process, the ADV7513 is provided in a 64-lead LQFP surface-mount plastic package with exposed pad and is specified over the −25°C to +85°C temperature range.

Rev. A
Document Feedback

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TABLE OF CONTENTS

REVISION HISTORY

1/13—Rev. 0 to Rev. A

Updated Outline Dimensions 9
Changes to Ordering Guide 9

11/11—Revision 0: Initial Version

SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

Table 1.

Parameter	Symbol	Temp	Test Level[1]	Min	Typ	Max	Unit
DIGITAL INPUTS							
Data Inputs, Video and Audio, CEC_CLK							
Input Voltage, High	V_{IH}	Full	VI	1.35		3.5	V
Input Voltage, Low	V_{IL}	Full	VI	−0.3		+0.7	V
Input Capacitance		25°C	VIII		1.0	1.5	pF
CEC_CLK Frequency[2]		Full	VIII	3	12	100	MHz
CEC_CLK Accuracy		Full	VIII	−2		+2	%
DDC I²C Lines (DDCSDA, DDCSCL)							
Input Voltage, High	V_{IH}	Full	IV	1.4		5.5	V
Input Voltage, Low	V_{IL}	Full	IV	−0.3		+0.7	V
I²C Lines (SDA, SCL)							
Input Voltage, High	V_{IH}	Full	VI	1.4		5.5	V
Input Voltage, Low	V_{IL}	Full	VI	−0.3		+0.7	V
CEC Pin							
Input Voltage, High	V_{IH}	Full	VI	2.0		5.5	V
Input Voltage, Low	V_{IL}	Full	VI	−0.3		+0.8	V
Output Voltage, High	V_{OH}	Full	VI	2.5		3.63	V
Output Voltage, Low	V_{OL}	Full	VI	−0.3		+0.6	V
HPD Pin							
Input Voltage, High	V_{IH}	Full	VI	1.3		5.5	V
Input Voltage, Low	V_{IL}	Full	VI	−0.3		+0.8	V
THERMAL CHARACTERISTICS							
Thermal Resistance							
Junction-to-Case	θ_{JC}	Full	V		20		°C/W
Junction-to-Ambient	θ_{JA}	Full	V		43		°C/W
Ambient Temperature		Full	V	−25	+25	+85	°C
DC SPECIFICATIONS							
Input Leakage Current	I_{IL}	25°C	VI	−1		+1	µA
POWER SUPPLY							
1.8 V Supply Voltage (DVDD, AVDD, PVDD, BGVDD)		Full	IV	1.71	1.8	1.90	V
3.3 V Supply Voltage (DVDD_3V)		Full	IV	3.15	3.3	3.45	V
Power-Down Current		25°C	IV			300	µA
Transmitter Total Power[3]							
At 1.8 V		Full	VI			256	mW
At 3.3 V		Full	VI			1	mW
AC SPECIFICATIONS							
TMDS Output Clock Frequency		25°C	IV	20		165	MHz
TMDS Output Clock Duty Cycle		25°C	IV	48		52	%
Input Video Clock Frequency		Full	IV			165	MHz
Input Video Data Setup Time[4]	t_{VSU}	Full	IV	1.8			ns
Input Video Data Hold Time[4]	t_{VHLD}	Full	IV	1.3			ns
TMDS Differential Swing		25°C	VII	800	1100	1200	mV
Differential Output Timing							
Low-to-High Transition Time		25°C	VII	75	95		ps
High-to-Low Transition Time		25°C	VII	75	95		ps
VSYNC and HSYNC Delay							
From DE Falling Edge		25°C	IV		1		UI[5]

Parameter	Symbol	Temp	Test Level[1]	Min	Typ	Max	Unit
To DE Rising Edge		25°C	IV		1		UI[5]
AUDIO AC TIMING							
SCLK Duty Cycle							
N/2 Is an Even Number		Full	IV	40	50	60	%
N/2 Is an Odd Number		Full	IV	49	50	51	%
I2S[3:0], S/PDIF Setup Time	t_{ASU}	Full	IV	2			ns
I2S[3:0], S/PDIF Hold Time	t_{AHLD}	Full	IV	2			ns
LRCLK Setup Time	t_{ASU}	Full	IV	2			ns
LRCLK Hold Time	t_{AHLD}	Full	IV	2			ns
I^2C INTERFACE							
SCL Clock Frequency		Full				400	kHz
SDA Setup Time	t_{DSU}	Full		100			ns
SDA Hold Time	t_{DHO}	Full		100			ns
Setup Time for Start Condition	t_{STASU}	Full		0.6			µs
Hold Time for Start Condition	t_{STAH}	Full		0.6			µs
Setup Time for Stop Condition	t_{STOSU}	Full		0.6			µs

[1] See the Explanation of Test Levels section.
[2] 12 MHz crystal oscillator for default register settings.
[3] 1080p, 24-bit typical random pattern.
[4] The video data setup and hold times are measured at 0.9 V. The relationship between the clock and data is programmable in 400 ps steps.
[5] UI is the unit interval.

ABSOLUTE MAXIMUM RATINGS

Table 2.

Parameter	Rating
Digital Inputs (SDA, SCL, DDCSDA, DDCSCL, HPD, PD)	−0.3 V to +5.5 V
Audio/Video Digital Inputs (D[23:0], MCLK, CLK, LRCLK, CEC, CEC_CLK, SPDIF, I2S[3:0], SCLK, HSYNC, DE, VSYNC)	−0.3 V to +3.63 V
Digital Output Current	20 mA
Operating Temperature Range	−40°C to +100°C
Storage Temperature Range	−65°C to +150°C
Maximum Junction Temperature	150°C
Maximum Case Temperature	150°C

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.

EXPLANATION OF TEST LEVELS

I. 100% production tested.

II. 100% production tested at 25°C and sample tested at specified temperatures.

III. Sample tested only.

IV. Parameter is guaranteed by design and characterization testing.

V. Parameter is a typical value only.

VI. 100% production tested at 25°C; guaranteed by design and characterization testing.

VII. Limits defined by HDMI specification; guaranteed by design and characterization testing.

VIII. Parameter is guaranteed by design.

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

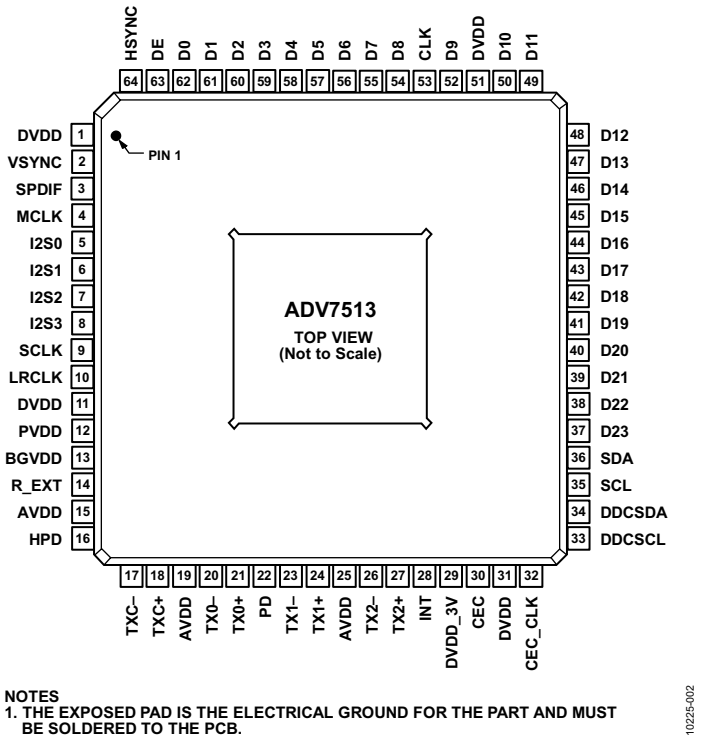

Figure 2. Pin Configuration

Table 3. Pin Function Descriptions

Pin No.	Mnemonic	Type	Description
1, 11, 31, 51	DVDD	Power	1.8 V Power Supply. These pins should be filtered and as quiet as possible.
2	VSYNC	Input	Vertical Synchronization Input.
3	SPDIF	Input	S/PDIF (Sony/Philips Digital Interface) Audio Input.
4	MCLK	Input	Audio Reference Clock Input.
5	I2S0	Input	I²S Channel 0 Audio Data Input.
6	I2S1	Input	I²S Channel 1 Audio Data Input.
7	I2S2	Input	I²S Channel 2 Audio Data Input.
8	I2S3	Input	I²S Channel 3 Audio Data Input.
9	SCLK	Input	I²S Audio Clock Input.
10	LRCLK	Input	Left/Right Channel Signal Input.
12	PVDD	Power	1.8 V PLL Power Supply.
13	BGVDD	Power	1.8 V Band Gap Power Supply.
14	R_EXT	Input	This pin sets the internal reference currents.
15, 19, 25	AVDD	Power	1.8 V Power Supply for TMDS Outputs.
16	HPD	Input	Hot Plug Detect Signal Input.
17, 18	TXC−, TXC+	Differential output	Differential TMDS Clock Output.
20, 21	TX0−, TX0+	Differential output	Differential TMDS Output Channel 0.
22	PD	Input	Power-Down Control and I²C Address Selection.
23, 24	TX1−, TX1+	Differential output	Differential TMDS Output Channel 1.
26, 27	TX2−, TX2+	Differential output	Differential TMDS Output Channel 2.

Pin No.	Mnemonic	Type	Description
28	INT	Output	Interrupt Signal Output.
29	DVDD_3V	Power	3.3 V Power Supply.
30	CEC	Input/output	CEC Data Signal.
32	CEC_CLK	Input	CEC Clock (Oscillator from 3 MHz to 100 MHz).
33	DDCSCL	Control	Serial Port Data Clock to Sink.
34	DDCSDA	Control	Serial Port Data Input/Output to Sink.
35	SCL	Control	Serial Port Data Clock Input.
36	SDA	Control	Serial Port Data Input/Output.
37 to 50, 52, 54 to 62	D[23:0]	Input	Video Data Inputs.
53	CLK	Input	Video Input Clock.
63	DE	Input	Data Enable Signal for Digital Video.
64	HSYNC	Input	Horizontal Synchronization Input.
	EPAD	Power	The exposed pad is the electrical ground for the part and must be soldered to the PCB.

APPLICATIONS INFORMATION

DESIGN RESOURCES

Evaluation kits, reference design schematics, hardware and software guides, and other support documentation are available under a nondisclosure agreement (NDA). For more information, contact ATV_VideoTx_Apps@analog.com.

Other references include the following:

- *EIA/CEA-861-E*—this technical specification document describes audio and video InfoFrames, as well as the E-EDID structure for HDMI. It is available from the Consumer Electronics Association (CEA).
- *High-Definition Multimedia Interface Specification Version 1.4*, a defining document for HDMI v1.4, and the *HDMI Compliance Test Specification (CTS) Version 1.3a* are available from HDMI Licensing, LLC.
- *High-Bandwidth Digital Content Protection System Revision 1.4*, the defining technical specification document for HDCP Revision 1.4, is available from Digital Content Protection, LLC.

OUTLINE DIMENSIONS

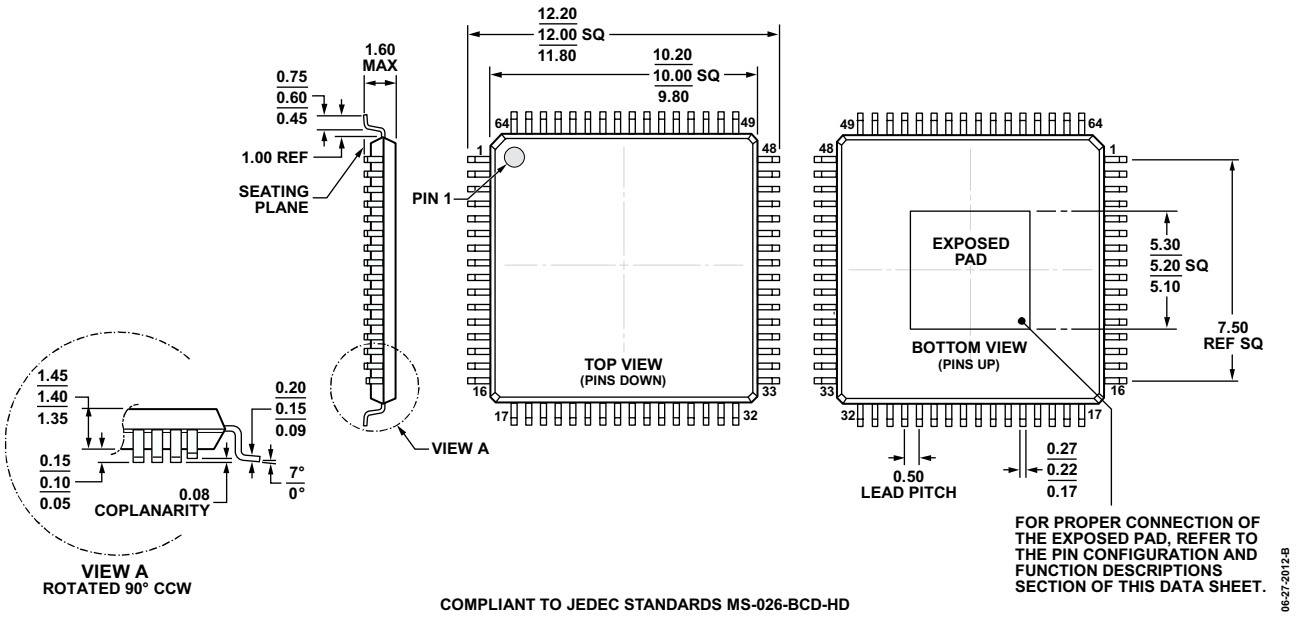

Figure 3. 64-Lead Low Profile Quad Flat Package [LQFP_EP]
(SW-64-2)
Dimensions shown in millimeters

ORDERING GUIDE

Model[1]	Temperature Range	Package Description	Package Option
ADV7513BSWZ	−25°C to +85°C	64-Lead Low Profile Quad Flat Package, Exposed Pad [LQFP_EP]	SW-64-2
EVAL-ADV7513-HRZ		Evaluation kit with HDCP keys	

[1] Z = RoHS Compliant Part.

NOTES

NOTES

NOTES

I²C refers to a communications protocol originally developed by Philips Semiconductors (now NXP Semiconductors).

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