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3Gb/s, HD, SD SDI Receiver Complete with SMPTE Audio and Video Processing

Key Features

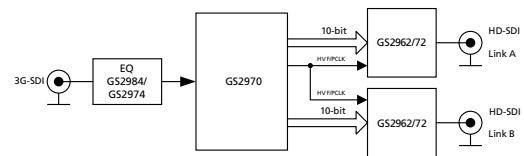
- Operation at 2.970Gb/s, 2.970/1.001Gb/s, 1.485Gb/s, 1.485/1.001Gb/s and 270Mb/s
- Supports SMPTE 425M (Level A and Level B), SMPTE 424M, SMPTE 292, SMPTE 259M-C and DVB-ASI
- Integrated Reclocker
- Integrated low phase noise VCO
- Serial digital reclocked, or non-reclocked loop-through output
- Integrated audio de-embedder for 8 channels of 48kHz audio
- Integrated audio clock generator
- Ancillary data extraction
- Optional conversion from SMPTE 425M Level B to Level A for 1080p 50/59.94/60 4:2:2 10-bit inputs
- Parallel data bus selectable as either 20-bit or 10-bit
- Comprehensive error detection and correction features
- Output H, V, F or CEA 861 timing signals
- 1.2V digital core power supply, 1.2V and 3.3V analog power supplies, and selectable 1.8V or 3.3V I/O power supply
- GSPI host interface
- -20°C to +85°C operating temperature range
- Low power operation (typically 350mW)
- Small 11mm x 11mm 100-ball BGA package
- Pb-free and RoHS compliant

Errata

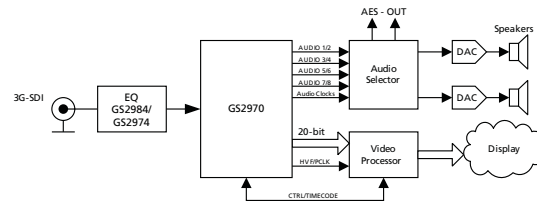
Refer to Errata document entitled **GS2970/GS2971 Errata** for this device (document number 53092).

Applications

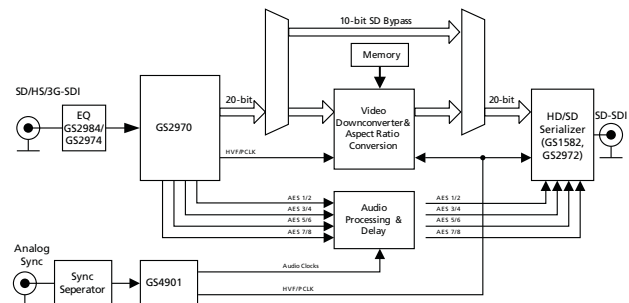
Application: Single Link (3G-SDI) to Dual Link (HD-SDI) Converter



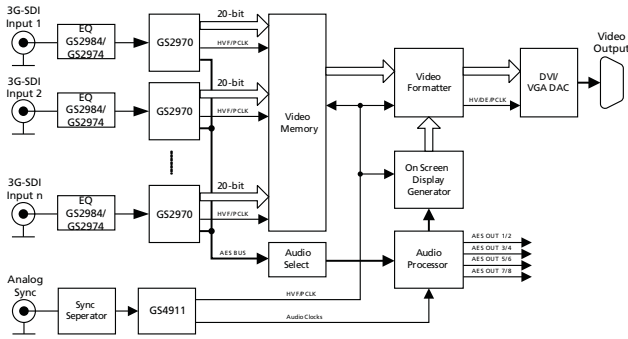
Application: 1080p50/60 Monitor



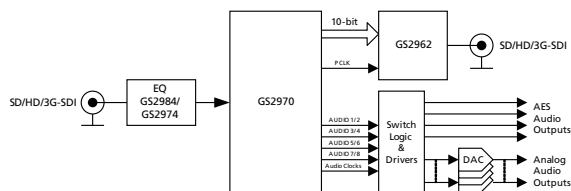
Application: Multi-format Downconverter



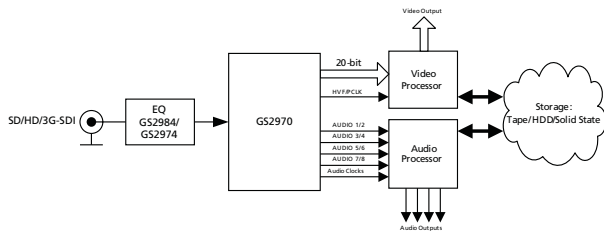
Application: Multi-input Video Monitoring System



Application: Multi-format Audio De-embedder Module



Application: Multi-format Digital VTR/Video Server



Description

The GS2970 is a multi-rate SDI Receiver which includes complete SMPTE processing, as per SMPTE 425M, 292 and SMPTE 259M-C. The SMPTE processing features can be bypassed to support signals with other coding schemes.

The device features an Integrated Reclocker with an internal VCO and a wide Input Jitter Tolerance (IJT) of 0.7UI.

A serial digital loop-through output is provided, which can be configured to output either reclocked or non-reclocked serial digital data. The serial digital output can be connected to an external cable driver.

The device operates in one of four basic modes: SMPTE mode, DVB-ASI mode, Data-Through mode or Standby mode.

In SMPTE mode (the default operating mode), the GS2970 performs full SMPTE processing, and features a number of data integrity checks and measurement capabilities.

The device also supports ancillary data extraction, and can provide entire ancillary data packets through host-accessible registers. It also provides a variety of other packet detection and error handling features. All of these processing features are optional, and may be individually enabled or disabled through register programming.

Both SMPTE 425M Level A and Level B inputs are supported with optional conversion from Level B to Level A for 1080p 50/59.94/60 4:2:2 10-bit inputs.

In DVB-ASI mode, sync word detection, alignment and 8b/10b decoding is applied to the received data stream.

In Data-Through mode all forms of SMPTE and DVB-ASI processing are disabled, and the device can be used as a simple serial to parallel converter.

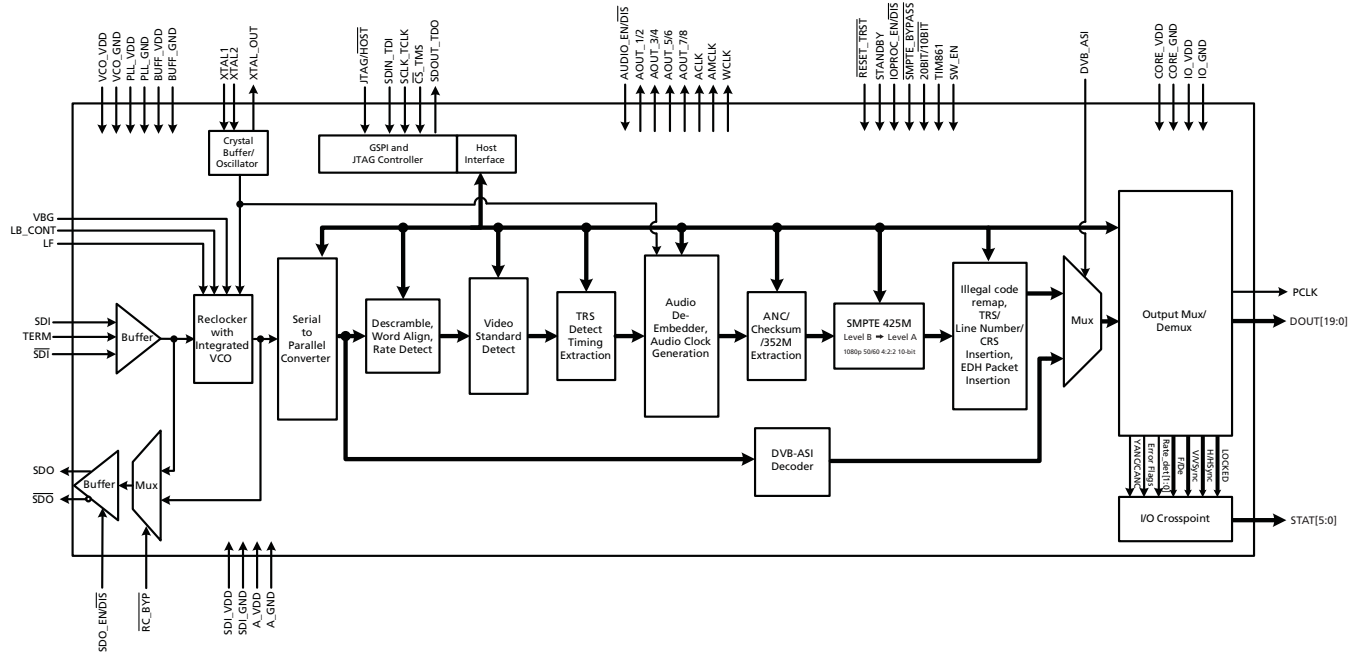
The device can also operate in a lower power Standby mode. In this mode, no signal processing is carried out and the parallel output is held static.

Parallel data outputs are provided in 20-bit or 10-bit format for 3Gb/s, HD and SD video rates, with a variety of mapping options. As such, this parallel bus can interface directly with video processor ICs, and output data can be multiplexed onto 10 bits for a low pin count interface.

Up to eight channels (two audio groups) of serial digital audio may be extracted from the video data stream, in accordance with SMPTE 272M-C and SMPTE 299M.

The output audio formats supported by the device include AES/EBU and I²S, and two other industry standard serial digital formats. A variety of audio processing features are provided to ease implementation. Audio clocks are internally generated and provided by the device.

Functional Block Diagram



GS2970 Functional Block Diagram

Revision History

Version	ECR	PCN	Date	Changes and/or Modifications
4	158468	–	September 2012	Changes throughout the document.
3	153143	53865	November 2009	Added reference to GS2970/GS2971 Errata (document number 53092).
2	151817	–	June 2009	Corrections to Timing Diagrams in Figure 4-4 , Figure 4-5 and Figure 4-6 . Clarification to Section 4.18.8 . Updates to all sections.
1	150800	–	December 2008	Converted to Data Sheet. Updates to all sections.
0	150716	–	October 2008	Converted to Preliminary Data Sheet.
D	149446	–	August 2008	Updated document with new format. Changed programming table for STAT2_CONFIG register (bits 14-10 in register 008h) in Table 4-29: Video Core Configuration and Status Registers . Added Table 4-3: Input Clock Requirements . Added Figure 4-3: 27MHz Clock Sources . Changed SCLK period in Table 4-28 . Removed Flywheel references from the Block Diagram and TAC.
C	148809	–	January 2008	Updates to all sections.
B	148768	–	December 2007	Updates and revised 5.1 Typical Application Circuit .
A	147986	–	December 2007	New Document.

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1. Pin Out

1.1 Pin Assignment

	1	2	3	4	5	6	7	8	9	10
A	VBG	LF	LB_CONT	VCO_VDD	STAT0	STAT1	IO_VDD	PCLK	DOUT18	DOUT17
B	A_VDD	PLL_VDD	RSV	VCO_GND	STAT2	STAT3	IO_GND	DOUT19	DOUT16	DOUT15
C	SDI	A_GND	PLL_VDD	PLL_VDD	STAT4	STAT5	$\overline{\text{RESET_TRST}}$	DOUT12	DOUT14	DOUT13
D	$\overline{\text{SDI}}$	A_GND	A_GND	PLL_GND	CORE_GND	CORE_VDD	SW_EN	JTAG/HOST	IO_GND	IO_VDD
E	SDI_VDD	SDI_GND	A_GND	PLL_GND	CORE_GND	CORE_VDD	SDOUT_TDO	SDIN_TDI	DOUT10	DOUT11
F	TERM	RSV	A_GND	PLL_GND	CORE_GND	CORE_VDD	$\overline{\text{CS_TMS}}$	SCLK_TCK	DOUT8	DOUT9
G	RSV	RSV	$\overline{\text{RC_BYP}}$	RSV	CORE_GND	CORE_VDD	$\overline{\text{SMPTE_BYPASS}}$	DVB_ASI	IO_GND	IO_VDD
H	BUFF_VDD	BUFF_GND	AUDIO_EN/DIS	WCLK	TIM_861	XTAL_OUT	20bit/10bit	IOPROC_EN/DIS	DOUT6	DOUT7
J	SDO	$\overline{\text{SDO_EN/DIS}}$	AOUT_1/2	ACLK	AOUT_5/6	XTAL2	IO_GND	DOUT1	DOUT4	DOUT5
K	$\overline{\text{SDO}}$	STANDBY	AOUT_3/4	AMCLK	AOUT_7/8	XTAL1	IO_VDD	DOUT0	DOUT2	DOUT3

1.2 Pin Descriptions

Table 1-1: Pin Descriptions

Pin Number	Name	Timing	Type	Description
A1	VBG		Analog Input	Band Gap voltage filter connection.
A2	LF		Analog Input	Loop Filter component connection.
A3	LB_CONT		Analog Input	Connection for loop bandwidth control resistor.
A4	VCO_VDD		Input Power	POWER pin for the VCO. Connect to 1.2V±5% analog supply followed by a RC filter (see 5. Application Reference Design). A 105Ω 1% resistor must be used in the RC filter circuit. VCO_VDD is nominally 0.7V.

Table 1-1: Pin Descriptions (Continued)

Pin Number	Name	Timing	Type	Description																												
A5, A6, B5, B6, C5, C6	STAT[0:5]		Output	<p>MULTI-FUNCTIONAL OUTPUT PORT.</p> <p>Please refer to the Output Logic parameters in the DC Electrical Characteristics table for logic level threshold and compatibility.</p> <p>Each of the STAT [0:5] pins can be configured individually to output one of the following signals:</p> <table border="1"> <thead> <tr> <th>Signal</th> <th>Default</th> </tr> </thead> <tbody> <tr> <td>H/HSYNC</td> <td>STAT0</td> </tr> <tr> <td>V/VSYNC</td> <td>STAT1</td> </tr> <tr> <td>F/DE</td> <td>STAT2</td> </tr> <tr> <td>LOCKED</td> <td>STAT3</td> </tr> <tr> <td>Y/1ANC</td> <td>STAT4</td> </tr> <tr> <td>C/2ANC</td> <td>–</td> </tr> <tr> <td><u>DATA ERROR</u></td> <td>STAT5</td> </tr> <tr> <td><u>VIDEO ERROR</u></td> <td>–</td> </tr> <tr> <td><u>AUDIO ERROR</u></td> <td>–</td> </tr> <tr> <td>EDH DETECTED</td> <td>–</td> </tr> <tr> <td>CARRIER DETECT</td> <td>–</td> </tr> <tr> <td>RATE_DET0</td> <td>–</td> </tr> <tr> <td>RATE_DET1</td> <td>–</td> </tr> </tbody> </table>	Signal	Default	H/HSYNC	STAT0	V/VSYNC	STAT1	F/DE	STAT2	LOCKED	STAT3	Y/1ANC	STAT4	C/2ANC	–	<u>DATA ERROR</u>	STAT5	<u>VIDEO ERROR</u>	–	<u>AUDIO ERROR</u>	–	EDH DETECTED	–	CARRIER DETECT	–	RATE_DET0	–	RATE_DET1	–
Signal	Default																															
H/HSYNC	STAT0																															
V/VSYNC	STAT1																															
F/DE	STAT2																															
LOCKED	STAT3																															
Y/1ANC	STAT4																															
C/2ANC	–																															
<u>DATA ERROR</u>	STAT5																															
<u>VIDEO ERROR</u>	–																															
<u>AUDIO ERROR</u>	–																															
EDH DETECTED	–																															
CARRIER DETECT	–																															
RATE_DET0	–																															
RATE_DET1	–																															
A7, D10, G10, K7	IO_VDD		Input Power	POWER connection for digital I/O. Connect to 3.3V or 1.8V DC digital.																												
A8	PCLK		Output	<p>PARALLEL DATA BUS CLOCK</p> <p>Please refer to the Output Logic parameters in the DC Electrical Characteristics table for logic level threshold and compatibility.</p> <table border="1"> <tbody> <tr> <td>3G 10-bit or 20-bit mode</td> <td>PCLK @ 148.5 or 148.5/1.001MHz</td> </tr> <tr> <td>HD 10-bit mode</td> <td>PCLK @ 148.5 or 148.5/1.001MHz</td> </tr> <tr> <td>HD 20-bit mode</td> <td>PCLK @ 74.25 or 74.25/1.001MHz</td> </tr> <tr> <td>SD 10-bit mode</td> <td>PCLK @ 27MHz</td> </tr> <tr> <td>SD 20-bit mode</td> <td>PCLK @ 13.5MHz</td> </tr> </tbody> </table>	3G 10-bit or 20-bit mode	PCLK @ 148.5 or 148.5/1.001MHz	HD 10-bit mode	PCLK @ 148.5 or 148.5/1.001MHz	HD 20-bit mode	PCLK @ 74.25 or 74.25/1.001MHz	SD 10-bit mode	PCLK @ 27MHz	SD 20-bit mode	PCLK @ 13.5MHz																		
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SD 10-bit mode	PCLK @ 27MHz																															
SD 20-bit mode	PCLK @ 13.5MHz																															

Table 1-1: Pin Descriptions (Continued)

Pin Number	Name	Timing	Type	Description
A9, A10, B8, B9, B10, C8, C9, C10, E9, E10	DOUT18, 17, 19, 16, 15, 12, 14, 13, 10, 11		Output	<p>PARALLEL DATA BUS</p> <p>Please refer to the Output Logic parameters in the DC Electrical Characteristics table for logic level threshold and compatibility.</p> <hr/> <p>20-bit mode 20bit/10bit = HIGH</p> <p>SMPTE mode ($\overline{\text{SMPTE_BYPASS}}$ = HIGH and DVB_ASI = LOW): Luma data output for SD and HD data rates; Data Stream 1 for 3G data rate</p> <p>DVB-ASI mode ($\overline{\text{SMPTE_BYPASS}}$ = LOW and DVB_ASI = HIGH): Not defined</p> <p>Data-Through mode ($\overline{\text{SMPTE_BYPASS}}$ = LOW and DVB_ASI = LOW): Data output</p> <hr/> <p>10-bit mode 20bit/10bit = LOW</p> <p>SMPTE mode ($\overline{\text{SMPTE_BYPASS}}$ = HIGH and DVB_ASI = LOW): Multiplexed Luma/Chroma data output for SD and HD data rates; Multiplexed Data Stream 1&2 for 3G data rate</p> <p>DVB-ASI mode ($\overline{\text{SMPTE_BYPASS}}$ = LOW and DVB_ASI = HIGH): 8b/10b decoded DVB-ASI data</p> <p>Data-Through mode ($\overline{\text{SMPTE_BYPASS}}$ = LOW and DVB_ASI = LOW): Data output</p>
B1	A_VDD		Input Power	POWER pin for analog circuitry. Connect to 3.3V DC analog.
B2, C3, C4	PLL_VDD		Input Power	POWER pins for the Reclocker PLL. Connect to 1.2V DC analog.
B3, F2, G1, G2, G4	RSV			These pins must be left unconnected.
B4	VCO_GND		Input Power	GND pin for the VCO. Connect to analog GND.
B7, D9, G9, J7	IO_GND		Input Power	GND connection for digital I/O. Connect to digital GND.
C1, D1	SDI, $\overline{\text{SDI}}$		Analog Input	Serial Digital Differential Input.
C2, D2, D3, E3, F3	A_GND		Input Power	GND pins for sensitive analog circuitry. Connect to analog GND.

Table 1-1: Pin Descriptions (Continued)

Pin Number	Name	Timing	Type	Description
C7	$\overline{\text{RESET_TRST}}$		Input	<p>CONTROL SIGNAL INPUT</p> <p>Please refer to the Input Logic parameters in the DC Electrical Characteristics table for logic level threshold and compatibility.</p> <p>Used to reset the internal operating conditions to default settings and to reset the JTAG sequence.</p> <p>Normal mode ($\text{JTAG}/\overline{\text{HOST}} = \text{LOW}$):</p> <p>When LOW, all functional blocks are set to default conditions and all digital output signals become high impedance.</p> <p>When HIGH, normal operation of the device resumes.</p> <p>JTAG test mode ($\text{JTAG}/\overline{\text{HOST}} = \text{HIGH}$):</p> <p>When LOW, all functional blocks are set to default and the JTAG test sequence is reset.</p> <p>When HIGH, normal operation of the JTAG test sequence resumes after $\overline{\text{RESET_TRST}}$ is de-asserted.</p>
D4, E4, F4	PLL_GND		Input Power	GND pins for the Reclocker PLL. Connect to analog GND.
D5, E5, F5, G5	CORE_GND		Input Power	GND connection for device core. Connect to digital GND.
D6, E6, F6, G6	CORE_VDD		Input Power	POWER connection for device core. Connect to 1.2V DC digital.
D7	SW_EN		Input	<p>CONTROL SIGNAL INPUT</p> <p>Please refer to the Input Logic parameters in the DC Electrical Characteristics table for logic level threshold and compatibility.</p> <p>Used to enable switch-line locking, as described in Section 4.10.1.</p>
D8	$\text{JTAG}/\overline{\text{HOST}}$		Input	<p>CONTROL SIGNAL INPUT</p> <p>Please refer to the Input Logic parameters in the DC Electrical Characteristics table for logic level threshold and compatibility.</p> <p>Used to select JTAG test mode or host interface mode.</p> <p>When $\text{JTAG}/\overline{\text{HOST}}$ is HIGH, the host interface port is configured for JTAG test.</p> <p>When $\text{JTAG}/\overline{\text{HOST}}$ is LOW, normal operation of the host interface port resumes.</p>
E1	SDI_VDD		Input Power	POWER pin for SDI buffer. Connect to 3.3V DC analog.
E2	SDI_GND		Input Power	GND pin for SDI buffer. Connect to analog GND.
E7	SDOUT_TDO		Output	<p>COMMUNICATION SIGNAL OUTPUT</p> <p>Please refer to the Output Logic parameters in the DC Electrical Characteristics table for logic level threshold and compatibility.</p> <p>GSPI serial data output/test data out.</p> <p>In JTAG mode ($\text{JTAG}/\overline{\text{HOST}} = \text{HIGH}$), this pin is used to shift test results from the device.</p> <p>In host interface mode, this pin is used to read status and configuration data from the device.</p> <p>Note: GSPI is slightly different than the SPI. For more details on GSPI, please refer to 4.20 GSPI - HOST Interface.</p>

Table 1-1: Pin Descriptions (Continued)

Pin Number	Name	Timing	Type	Description				
E8	SDIN_TDI		Input	<p>COMMUNICATION SIGNAL INPUT</p> <p>Please refer to the Input Logic parameters in the DC Electrical Characteristics table for logic level threshold and compatibility.</p> <p>GSPI serial data in/test data in.</p> <p>In JTAG mode ($JTAG/\overline{HOST} = \text{HIGH}$), this pin is used to shift test data into the device.</p> <p>In host interface mode, this pin is used to write address and configuration data words into the device.</p>				
F1	TERM		Analog Input	Decoupling for internal SDI termination resistors.				
F7	$\overline{CS_TMS}$		Input	<p>COMMUNICATION SIGNAL INPUT</p> <p>Please refer to the Input Logic parameters in the DC Electrical Characteristics table for logic level threshold and compatibility.</p> <p>Chip select / test mode start.</p> <p>In JTAG mode ($JTAG/\overline{HOST} = \text{HIGH}$), this pin is Test Mode Start, used to control the operation of the JTAG test.</p> <p>In host interface mode ($JTAG/\overline{HOST} = \text{LOW}$), this pin operates as the host interface chip select and is active LOW.</p>				
F8	SCLK_TCK		Input	<p>COMMUNICATION SIGNAL INPUT</p> <p>Please refer to the Input Logic parameters in the DC Electrical Characteristics table for logic level threshold and compatibility.</p> <p>Serial data clock signal.</p> <p>In JTAG mode ($JTAG/\overline{HOST} = \text{HIGH}$), this pin is the JTAG clock.</p> <p>In host interface mode ($JTAG/\overline{HOST} = \text{LOW}$), this pin is the host interface serial bit clock.</p> <p>All JTAG/host interface addresses and data are shifted into/out of the device synchronously with this clock.</p>				
F9, F10, H9, H10, J8, J9, J10, K8, K9, K10	DOUT8, 9, 6, 7, 1, 4, 5, 0, 2, 3		Output	<p>PARALLEL DATA BUS</p> <p>Please refer to the Output Logic parameters in the DC Electrical Characteristics table for logic level threshold and compatibility.</p> <table border="0" style="width: 100%;"> <tr> <td style="width: 50%; vertical-align: top;"> <p>20-bit mode $20\text{bit}/\overline{10\text{bit}} = \text{HIGH}$</p> </td> <td style="width: 50%; vertical-align: top;"> <p>SMPTE mode ($\overline{SMPTE_BYPASS} = \text{HIGH}$ and $\text{DVB_ASI} = \text{LOW}$): Chroma data output for SD and HD data rates; Data Stream 2 for 3G data rate</p> <p>DVB-ASI mode ($\overline{SMPTE_BYPASS} = \text{LOW}$ and $\text{DVB_ASI} = \text{HIGH}$): Not defined</p> <p>Data-Through mode ($\overline{SMPTE_BYPASS} = \text{LOW}$ and $\text{DVB_ASI} = \text{LOW}$): Data output</p> </td> </tr> <tr> <td style="vertical-align: top;"> <p>10-bit mode $20\text{bit}/\overline{10\text{bit}} = \text{LOW}$</p> </td> <td style="vertical-align: top;"> <p>Forced LOW</p> </td> </tr> </table>	<p>20-bit mode $20\text{bit}/\overline{10\text{bit}} = \text{HIGH}$</p>	<p>SMPTE mode ($\overline{SMPTE_BYPASS} = \text{HIGH}$ and $\text{DVB_ASI} = \text{LOW}$): Chroma data output for SD and HD data rates; Data Stream 2 for 3G data rate</p> <p>DVB-ASI mode ($\overline{SMPTE_BYPASS} = \text{LOW}$ and $\text{DVB_ASI} = \text{HIGH}$): Not defined</p> <p>Data-Through mode ($\overline{SMPTE_BYPASS} = \text{LOW}$ and $\text{DVB_ASI} = \text{LOW}$): Data output</p>	<p>10-bit mode $20\text{bit}/\overline{10\text{bit}} = \text{LOW}$</p>	<p>Forced LOW</p>
<p>20-bit mode $20\text{bit}/\overline{10\text{bit}} = \text{HIGH}$</p>	<p>SMPTE mode ($\overline{SMPTE_BYPASS} = \text{HIGH}$ and $\text{DVB_ASI} = \text{LOW}$): Chroma data output for SD and HD data rates; Data Stream 2 for 3G data rate</p> <p>DVB-ASI mode ($\overline{SMPTE_BYPASS} = \text{LOW}$ and $\text{DVB_ASI} = \text{HIGH}$): Not defined</p> <p>Data-Through mode ($\overline{SMPTE_BYPASS} = \text{LOW}$ and $\text{DVB_ASI} = \text{LOW}$): Data output</p>							
<p>10-bit mode $20\text{bit}/\overline{10\text{bit}} = \text{LOW}$</p>	<p>Forced LOW</p>							
G3	$\overline{RC_BYP}$		Input	<p>CONTROL SIGNAL INPUT</p> <p>Please refer to the Input Logic parameters in the DC Electrical Characteristics table for logic level threshold and compatibility.</p> <p>When this pin is LOW, the serial digital output is the buffered version of the input serial data. When this pin is HIGH, the serial digital output is the reclocked version of the input serial data.</p>				

Table 1-1: Pin Descriptions (Continued)

Pin Number	Name	Timing	Type	Description
G7	$\overline{\text{SMPTE_BYPASS}}$		Input/Output	<p>CONTROL SIGNAL INPUT/OUTPUT</p> <p>Please refer to the Input/Output Logic parameters in the DC Electrical Characteristics table for logic level threshold and compatibility.</p> <p>Indicates the presence of valid SMPTE data.</p> <p>When the $\text{AUTO}/\overline{\text{MAN}}$ bit in the host interface register is HIGH (Default), this pin is an OUTPUT. $\overline{\text{SMPTE_BYPASS}}$ is HIGH when the device locks to a SMPTE compliant input. $\overline{\text{SMPTE_BYPASS}}$ is LOW under all other conditions.</p> <p>When the $\text{AUTO}/\overline{\text{MAN}}$ bit in the host interface register is LOW, this pin is an INPUT:</p> <p>No SMPTE scrambling takes place, and none of the I/O processing features of the device are available when $\overline{\text{SMPTE_BYPASS}}$ is set LOW.</p> <p>When $\overline{\text{SMPTE_BYPASS}}$ is set HIGH, the device carries out SMPTE scrambling and I/O processing.</p> <p>When $\overline{\text{SMPTE_BYPASS}}$ and DVB_ASI are both set LOW, the device operates in Data-Through mode.</p>
G8	DVB_ASI		Input/Output	<p>CONTROL SIGNAL INPUT</p> <p>Please refer to the Input/Output Logic parameters in the DC Electrical Characteristics table for logic level threshold and compatibility.</p> <p>Used to enable/disable DVB-ASI data extraction in manual mode.</p> <p>When the $\text{AUTO}/\overline{\text{MAN}}$ bit in the host interface is LOW, this pin is an input and when the DVB_ASI pin is set HIGH the device will carry out DVB_ASI data extraction and processing. The $\overline{\text{SMPTE_BYPASS}}$ pin must be set LOW. When $\overline{\text{SMPTE_BYPASS}}$ and DVB_ASI are both set LOW, the device operates in Data-Through mode.</p> <p>When the $\text{AUTO}/\overline{\text{MAN}}$ bit in the host interface is HIGH (default), DVB-ASI is configured as a status output (set LOW), and DVB-ASI input streams are not supported or recognized.</p>
H1	BUFF_VDD		Input Power	POWER pin for the serial digital output 50Ω buffer. Connect to 3.3V DC analog.
H2	BUFF_GND		Input Power	GND pin for the cable driver buffer. Connect to analog GND.
H3	$\text{AUDIO_EN}/\overline{\text{DIS}}$		Input	<p>CONTROL SIGNAL INPUT</p> <p>Please refer to the Input Logic parameters in the DC Electrical Characteristics table for logic level threshold and compatibility.</p> <p>Enables or disables audio extraction.</p>
H4	WCLK		Output	48kHz word clock for Audio.
H5	TIM_861		Input	<p>CONTROL SIGNAL INPUT</p> <p>Please refer to the Input Logic parameters in the DC Electrical Characteristics table for logic level threshold and compatibility.</p> <p>Used to select CEA-861 timing mode.</p> <p>When TIM_861 is HIGH, the device outputs CEA 861 timing signals (HSYNC/VSYNC/DE) instead of H:V:F digital timing signals.</p>
H6	XTAL_OUT		Digital Output	Buffered 27MHz crystal output. Can be used to cascade the crystal signal.

Table 1-1: Pin Descriptions (Continued)

Pin Number	Name	Timing	Type	Description
H7	20bit/ $\overline{10bit}$		Input	CONTROL SIGNAL INPUT Please refer to the Input Logic parameters in the DC Electrical Characteristics table for logic level threshold and compatibility. Used to select the output bus width. HIGH = 20-bit, LOW = 10-bit.
H8	IOPROC_EN/ \overline{DIS}		Input	CONTROL SIGNAL INPUT Please refer to the Input Logic parameters in the DC Electrical Characteristics table for logic level threshold and compatibility. Used to enable or disable audio and video processing features. When IOPROC_EN is HIGH, the audio and video processing features of the device are enabled. When IOPROC_EN is LOW, the processing features of the device are disabled, and the device is in a low-latency operating mode.
J1, K1	SDO, \overline{SDO}		Output	Serial Data Output Signal. 50Ω CML buffer for interfacing to an external cable driver. Serial digital output signal operating at 2.97Gb/s, 2.97/1.001Gb/s, 1.485Gb/s, 1.485/1.001Gb/s and 270Mb/s.
J2	SDO_EN/ \overline{DIS}		Input	CONTROL SIGNAL INPUT Please refer to the Input Logic parameters in the DC Electrical Characteristics table for logic level threshold and compatibility. Used to enable/disable the serial digital output stage. When SDO_EN/ \overline{DIS} is LOW, the serial digital output signals, SDO and \overline{SDO} , are both pulled HIGH. When SDO_EN/ \overline{DIS} is HIGH, the serial digital output signals, SDO and \overline{SDO} , are enabled.
J3	AOUT_1/2		Output	Serial Audio Output; Channels 1 and 2.
J4	ACLK		Output	64fs sample clock for audio.
J5	AOUT_5/6		Output	Serial Audio Output; Channels 5 and 6.
J6, K6	XTAL2, XTAL1		Analog Input	Input connection for 27MHz crystal.
K2	STANDBY		Input	CONTROL SIGNAL INPUT Please refer to the Input Logic parameters in the DC Electrical Characteristics table for logic level threshold and compatibility. When this pin is set HIGH, the device is placed in a power-saving mode. No data processing occurs, and the digital I/Os are powered down. In this mode, the serial digital output signals, SDO and \overline{SDO} , are both pulled HIGH.
K3	AOUT_3/4		Output	Serial Audio Output; Channels 3 and 4.
K4	AMCLK		Output	Oversampled master clock for audio (128fs, 256fs, 512fs selectable).
K5	AOUT_7/8		Output	Serial Audio Output; Channels 7 and 8.

2. Electrical Characteristics

2.1 Absolute Maximum Ratings

Table 2-1: Absolute Maximum Ratings

Parameter	Value/Units
Supply Voltage, Digital Core (CORE_VDD)	-0.3V to +1.5V
Supply Voltage, Digital I/O (IO_VDD)	-0.3V to +4.0V
Supply Voltage, Analog 1.2V (PD_VDD, VCO_VDD)	-0.3V to +1.5V
Supply Voltage, Analog 3.3V (SDI_VDD, BUFF_VDD, A_VDD)	-0.3V to +4.0V
Input Voltage Range (digital inputs)	-2.0V to +5.25V
Ambient Operating Temperature (T_A)	$-40^{\circ}\text{C} \leq T_A \leq 95^{\circ}\text{C}$
Storage Temperature (T_{STG})	$-40^{\circ}\text{C} \leq T_{STG} \leq 125^{\circ}\text{C}$
Peak Reflow Temperature (JEDEC J-STD-020C)	260°C
ESD Sensitivity, HBM (JESD22-A114)	2kV

NOTES:

Absolute Maximum Ratings are those values beyond which damage may occur. Functional operation under these conditions or at any other condition beyond those indicated in the AC/DC Electrical Characteristics sections is not implied.

2.2 Recommended Operating Conditions

Table 2-2: Recommended Operating Conditions

Parameter	Symbol	Conditions	Min	Typ	Max	Units	Notes
Operating Temperature Range, Ambient	T_A	–	-20	–	85	°C	–
Supply Voltage, Digital Core	CORE_VDD	–	1.14	1.2	1.26	V	–
Supply Voltage, Digital I/O	IO_VDD	1.8V mode	1.71	1.8	1.89	V	–
		3.3V mode	3.13	3.3	3.47	V	–
Supply Voltage, PLL	PLL_VDD	–	1.14	1.2	1.26	V	–
Supply Voltage, VCO	VCO_VDD	–	–	0.7	–	V	1
Supply Voltage, Analog	A_VDD	–	3.13	3.3	3.47	V	2
Supply Voltage, Serial Digital Input	SDI_VDD	–	3.13	3.3	3.47	V	2
Supply Voltage, CD Buffer	BUFF_VDD	–	3.13	3.3	3.47	V	2

NOTES

1. This is 0.7V rather than 1.2V because there is a voltage drop across an external 105Ω resistor. See [Typical Application Circuit on page 140](#).
2. The 3.3V supplies must track the 3.3V supply of an external EQ and external CD.

2.3 DC Electrical Characteristics

Table 2-3: DC Electrical Characteristics

Guaranteed over recommended operating conditions unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Units	Notes
System							
+1.2V Supply Current	I_{1V2}	10bit 3G	–	220	265	mA	–
		20bit 3G	–	215	265	mA	–
		10/20bit HD	–	175	215	mA	–
		10/20bit SD	–	145	180	mA	–
		DVB_ASI	–	135	165	mA	–
+1.8V Supply Current	I_{1V8}	10bit 3G	–	32	34	mA	–
		20bit 3G	–	32	34	mA	–
		10/20bit HD	–	20	21	mA	–
		10/20bit SD	–	6	7	mA	–
		DVB_ASI	–	6	7	mA	–
+3.3V Supply Current	I_{3V3}	10bit 3G	–	95	105	mA	–
		20bit 3G	–	95	105	mA	–
		10/20bit HD	–	65	75	mA	–
		10/20bit SD	–	35	45	mA	–
		DVB_ASI	–	35	45	mA	–
Total Device Power (IO_VDD = 1.8V)	P_{1D8}	10bit 3G	–	380	470	mW	–
		20bit 3G	–	350	435	mW	–
		10/20bit HD	–	300	360	mW	–
		10/20bit SD	–	235	305	mW	–
		DVB_ASI	–	235	305	mW	–
		Reset	–	200	–	mW	–
		Standby	–	16	44	mW	–
Total Device Power (IO_VDD = 3.3V)	P_{3D3}	10bit 3G	–	580	700	mW	–
		20bit 3G	–	580	695	mW	–
		10/20bit HD	–	430	530	mW	–
		10/20bit SD	–	290	370	mW	–
		DVB_ASI	–	290	370	mW	–
		Reset	–	220	–	mW	–
		Standby	–	16	44	mW	–
Digital I/O							
Input Logic LOW	V_{IL}	3.3V or 1.8V operation	IO_VSS -0.3	–	0.3 x IO_VDD	V	–
Input Logic HIGH	V_{IH}	3.3V or 1.8V operation	0.7 x IO_VDD	–	IO_VDD +0.3	V	–

Table 2-3: DC Electrical Characteristics (Continued)

Guaranteed over recommended operating conditions unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Units	Notes
Output Logic LOW	V_{OL}	IOL = 5mA, 1.8V operation	–	–	0.2	V	–
		IOL = 8mA, 3.3V operation	–	–	0.4	V	–
Output Logic HIGH	V_{OH}	IOH = 5mA, 1.8V operation	1.4	–	–	V	–
		IOH = 8mA, 3.3V operation	2.4	–	–	V	–
Serial Input							
Serial Input Common Mode Voltage	–	50Ω load	2.5	SDI_VDD -(0.75/2)	SDI_VDD -(0.55/2)	V	–
Serial Output							
Serial Output Common Mode Voltage	–	50Ω load	BUFF_VDD -(0.6/2)	BUFF_VDD -(0.45/2)	BUFF_VDD -(0.35/2)	V	–

Notes:

The output drive strength of the digital outputs can be programmed through the host interface. please see [Table 4-29: Video Core Configuration and Status Registers](#), register 06Dh for details.

2.4 AC Electrical Characteristics

Table 2-4: AC Electrical Characteristics

Guaranteed over recommended operating conditions unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Units	Notes
System							
Device Latency: AUDIO_EN = 1, SMPTE mode, IOPROC_EN = 1	-	3G (Level A)	80	-	83	PCLK	-
		3G (Level B)	143	-	151	PCLK	-
		HD	80	-	83	PCLK	-
		SD	50	-	55	PCLK	-
Device Latency: AUDIO_EN = 0, SMPTE mode, IOPROC_EN = 1	-	3G (Level A)	44	-	48	PCLK	-
		3G (Level B)	108	-	116	PCLK	-
		HD	44	-	48	PCLK	-
		SD	44	-	48	PCLK	-
Device Latency: AUDIO_EN = 0, SMPTE mode, IOPROC_EN = 0	-	3G (Level A)	33	-	36	PCLK	-
		HD	33	-	36	PCLK	-
		SD	32	-	35	PCLK	-
Device Latency: AUDIO_EN = 0, SMPTE bypass, IOPROC_EN = 0	-	3G (Level A)	6	-	9	PCLK	-
		HD	6	-	9	PCLK	-
		SD	5	-	9	PCLK	-
Device Latency: DVB-ASI	-	SD	12	-	16	PCLK	-
Reset Pulse Width	t _{reset}	-	1	-	-	ms	-
Parallel Output							
Parallel Clock Frequency	f _{PCLK}	-	13.5	-	148.5	MHz	-
Parallel Clock Duty Cycle	DC _{PCLK}	-	40	-	60	%	-

Table 2-4: AC Electrical Characteristics (Continued)

Guaranteed over recommended operating conditions unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Units	Notes			
Output Data Hold Time (1.8V)	t_{oh}	3G 10-bit 6pF Cload	SPI	1.5	–	–	ns	1		
			AUDIO	1.5	–	–	ns	1		
			DBUS	0.4	–	–	ns	1		
			STAT	0.45	–	–	ns	1		
		3G 20-bit 6pF Cload	DBUS	1.0	–	–	ns	1		
			STAT	1.0	–	–	ns	1		
		HD 10-bit 6pF Cload	DBUS	1.0	–	–	ns	1		
			STAT	1.0	–	–	ns	1		
		HD 20-bit 6pF Cload	DBUS	1.0	–	–	ns	1		
			STAT	1.0	–	–	ns	1		
		SD 10-bit 6pF Cload	DBUS	19.4	–	–	ns	1		
			STAT	19.4	–	–	ns	1		
		SD 20-bit 6pF Cload	DBUS	38.0	–	–	ns	1		
			STAT	38.0	–	–	ns	1		
		Output Data Hold Time (3.3V)	t_{oh}	3G 10-bit 6pF Cload	SPI	1.5	–	–	ns	2
					AUDIO	1.5	–	–	ns	2
DBUS	0.45				–	–	ns	2		
STAT	0.45				–	–	ns	2		
3G 20-bit 6pF Cload	DBUS			1.0	–	–	ns	2		
	STAT			1.0	–	–	ns	2		
HD 10-bit 6pF Cload	DBUS			1.0	–	–	ns	2		
	STAT			1.0	–	–	ns	2		
HD 20-bit 6pF Cload	DBUS			1.0	–	–	ns	2		
	STAT			1.0	–	–	ns	2		
SD 10-bit 6pF Cload	DBUS			19.4	–	–	ns	2		
	STAT			19.4	–	–	ns	2		
SD 20-bit 6pF Cload	DBUS			38.0	–	–	ns	2		
	STAT			38.0	–	–	ns	2		

Table 2-4: AC Electrical Characteristics (Continued)

Guaranteed over recommended operating conditions unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Units	Notes	
Output Data Delay Time (1.8V)	t_{od}	3G 10-bit 15pF Cload	SPI	–	–	14.0	ns	3
			AUDIO	–	–	7.0	ns	3
			DBUS	–	–	1.8	ns	3
			STAT	–	–	2.5	ns	3
		3G 20-bit 15pF Cload	DBUS	–	–	3.7	ns	3
			STAT	–	–	4.4	ns	3
		HD 10-bit 15pF Cload	DBUS	–	–	3.7	ns	3
			STAT	–	–	4.4	ns	3
		HD 20-bit 15pF Cload	DBUS	–	–	3.7	ns	3
			STAT	–	–	4.4	ns	3
		SD 10-bit 15pF Cload	DBUS	–	–	22.2	ns	3
			STAT	–	–	22.2	ns	3
		SD 20-bit 15pF Cload	DBUS	–	–	41.0	ns	3
			STAT	–	–	41.0	ns	3
Output Data Delay Time (3.3V)	t_{od}	3G 10-bit 15pF Cload	SPI	–	–	14.0	ns	4
			AUDIO	–	–	7.0	ns	4
			DBUS	–	–	1.9	ns	4
			STAT	–	–	2.2	ns	4
		3G 20-bit 15pF Cload	DBUS	–	–	3.7	ns	4
			STAT	–	–	4.1	ns	4
		HD 10-bit 15pF Cload	DBUS	–	–	3.7	ns	4
			STAT	–	–	4.1	ns	4
		HD 20-bit 15pF Cload	DBUS	–	–	3.7	ns	4
			STAT	–	–	4.1	ns	4
		SD 10-bit 15pF Cload	DBUS	–	–	22.2	ns	4
			STAT	–	–	22.2	ns	4
		SD 20-bit 15pF Cload	DBUS	–	–	41.0	ns	4
			STAT	–	–	41.0	ns	4

Table 2-4: AC Electrical Characteristics (Continued)

Guaranteed over recommended operating conditions unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Units	Notes			
Output Data Rise/Fall Time (1.8V)	t_r/t_f	3G 10-bit 6pF Cloud	STAT	–	–	0.4	ns	1		
			DBUS	–	–	0.3	ns	1		
			AUDIO	–	–	0.6	ns	1		
		All other modes 6pF Cloud	STAT	–	–	0.4	ns	1		
			DBUS	–	–	0.4	ns	1		
			AUDIO	–	–	0.6	ns	1		
		3G 10-bit 15pF Cloud	STAT	–	–	1.5	ns	3		
			DBUS	–	–	1.1	ns	3		
			AUDIO	–	–	2.3	ns	3		
		All other modes 15pF Cloud	STAT	–	–	1.5	ns	3		
			DBUS	–	–	1.4	ns	3		
			AUDIO	–	–	2.3	ns	3		
Output Data Rise/Fall Time (3.3V)	t_r/t_f	3G 10-bit 6pF Cloud	STAT	–	–	0.5	ns	2		
			DBUS	–	–	0.4	ns	2		
			AUDIO	–	–	0.6	ns	2		
		All other modes 6pF Cloud	STAT	–	–	0.5	ns	2		
			DBUS	–	–	0.4	ns	2		
			AUDIO	–	–	0.6	ns	2		
		Output Data Rise/Fall Time (3.3V)	t_r/t_f	3G 10-bit 15pF Cloud	STAT	–	–	1.6	ns	4
					DBUS	–	–	1.5	ns	4
					AUDIO	–	–	2.2	ns	4
All other modes 15pF Cloud	STAT			–	–	1.6	ns	4		
	DBUS			–	–	1.4	ns	4		
	AUDIO			–	–	2.2	ns	4		
Serial Digital Input										
Serial Input Data Rate	DR_{SDI}	–	0.27	–	2.97	Gb/s	–			
Serial Input Swing	ΔV_{SDI}	Differential with 100 Ω load	500	800	1100	mVp-p	–			
Serial Input Jitter Tolerance	IJT	Nominal loop bandwidth	Square wave mod.	0.7	0.8	–	UI	–		
Serial Digital Output										
Serial Output Data Rate	DR_{SDO}	–	0.27	–	2.97	Gb/s	–			

Table 2-4: AC Electrical Characteristics (Continued)

Guaranteed over recommended operating conditions unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Units	Notes
Serial Output Swing	ΔV_{SDO}	Differential with 100 Ω load	350	–	600	mVp-p	–
Serial Output Rise Time 20% ~ 80%	t_{rSDO}	–	–	–	180	ps	–
Serial Output Fall Time 20% ~ 80%	t_{fSDO}	–	–	–	180	ps	–
Serial Output Intrinsic Jitter	t_{OJ}	SMPTE colour bar 3G signal	–	–	100	ps	–
		SMPTE colour bar HD signal	–	–	100	ps	–
		SMPTE colour bar SD signal	–	–	400	ps	–
Serial Output Duty Cycle Distortion	DCD_{SDO}	3G	–	10	–	ps	–
		HD	–	10	–	ps	–
		SD	–	20	–	ps	–
Synchronous lock time	–	–	–	–	25	μ s	–
Asynchronous lock time	–	–	100	–	350	μ s	–
Lock time from power-up	–	After 20 minutes at -20°C	–	325	–	ms	–
GSPI							
GSPI Input Clock Frequency	f_{SCLK}	–	–	–	60	MHz	5
GSPI Input Clock Duty Cycle	DC_{SCLK}	50% levels 3.3V or 1.8V operation	40	50	60	%	5
GSPI Input Data Setup Time	–	–	1.5	–	–	ns	5
GSPI Input Data Hold Time	–	–	1.5	–	–	ns	5
GSPI Output Data Hold Time	–	–	1.5	–	–	ns	5
\overline{CS} low before SCLK rising edge	–	50% levels 3.3V or 1.8V operation	1.5	–	–	ns	5
Time between end of command word (or data in Auto-Increment mode) and the first SCLK of the following data word - write cycle	–	50% levels 3.3V or 1.8V operation	37.1	–	–	ns	5
Time between end of command word (or data in Auto-Increment mode) and the first SCLK of the following data word - read cycle	–	50% levels 3.3V or 1.8V operation	148.4	–	–	ns	5

Table 2-4: AC Electrical Characteristics (Continued)

Guaranteed over recommended operating conditions unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Units	Notes
\overline{CS} high after SCLK falling edge	–	50% levels 3.3V or 1.8V operation	37.1	–	–	ns	5

Notes:

1. 1.89V and 0°C.
2. 3.47V and 0°C.
3. 1.71V and 85°C
4. 3.13V and 85°C
5. Timing parameters defined in [Section 4.20.3](#)

3. Input/Output Circuits

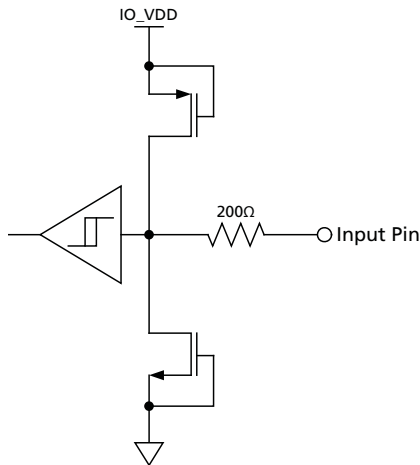


Figure 3-1: Digital Input Pin with Schmitt Trigger (20bit/10bit, AUDIO_EN/DIS, CS_TMS, SW_EN, IOPROC_EN/DIS, JTAG/HOST, RC_BYP, RESET_TRST, SCLK_TCK, SDIN_TDI, SDO_EN/DIS, STANDBY, TIM_861)

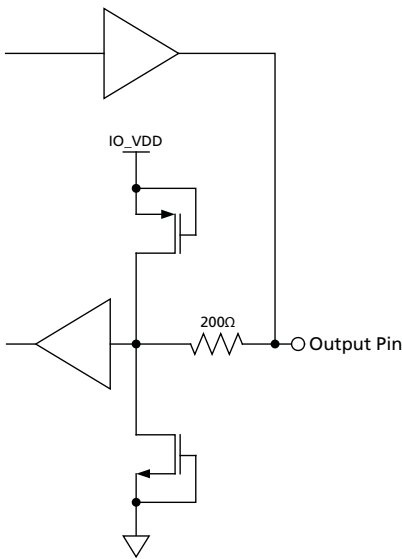


Figure 3-2: Bidirectional Digital Input/Output Pin - Configured to Output unless in Reset Mode. (ACLK, AMCLK, AOUT_1/2, AOUT_3/4, AOUT_5/6, AOUT_7/8, DVB_ASI, SMPTE_BYPASS, WCLK)