

## DisplayPort to TMDS Translator

### FEATURES

- DisplayPort Physical Layer Input Port to TMDS Physical Layer Output Port
- Integrated TMDS Level Translator With Receiver Equalization
- Supports Data Rates up to 2.5 Gbps
- Integrated I<sup>2</sup>C Logic Block for DVI / HDMI Connector Recognition
- Integrated Active I<sup>2</sup>C Buffer
- Enhanced ESD: 12 kV on all Pins
- Enhanced Commercial Temperature Range: 0°C to 85°C
- 36 Pin 6 × 6 QFN Package

### APPLICATIONS

- Personal Computer Market
  - DP/TMDS Hardware Key (Dongle)
  - Desktop PC
  - Notebook PC
  - Docking Station
  - Standalone Video Card

### DESCRIPTION

The SN75DP129 is a Dual-Mode DisplayPort input to Transition-Minimized Differential Signaling (TMDS) output. The TMDS output has a built-in level translator, compliant with [Digital Visual Interface 1.0 \(DVI\)](#) and [High Definition Multimedia Interface 1.3 \(HDMI\)](#) standards. The SN75DP129 is specified up to a maximum data rate of 2.5 Gbps, supporting resolutions greater than 1920 x 1200 or HDTV 12-bit color depth at 1080p (progressive scan).

An integrated Active I<sup>2</sup>C buffer isolates the capacitive loading of the source system from that of the sink and interconnecting cable. This isolation improves overall signal integrity of the system and provides greater design margin within the source system for DVI / HDMI compliance testing.

A logic block was designed into the SN75DP129 to assist with TMDS connector identification. Through the use of the I<sup>2</sup>C\_EN pin, this logic block can be enabled to indicate the translated port is an HDMI port; therefore legally supporting HDMI content.

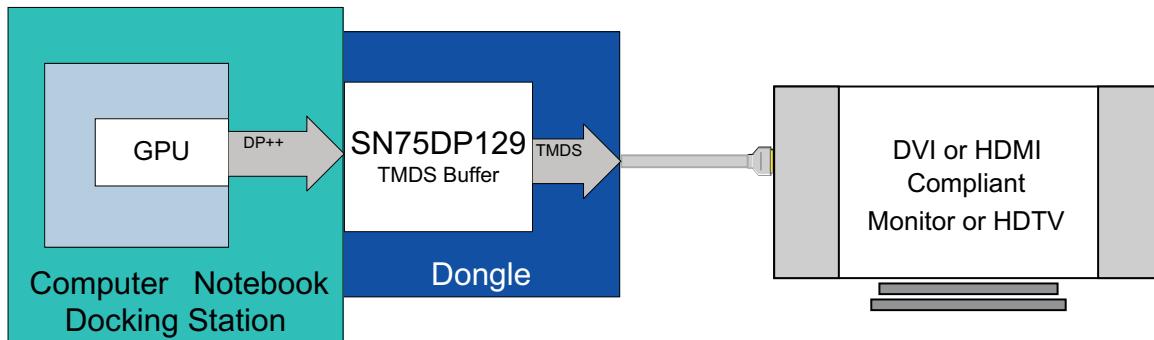


Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

## TYPICAL APPLICATION



GPU—Graphics Processing Unit

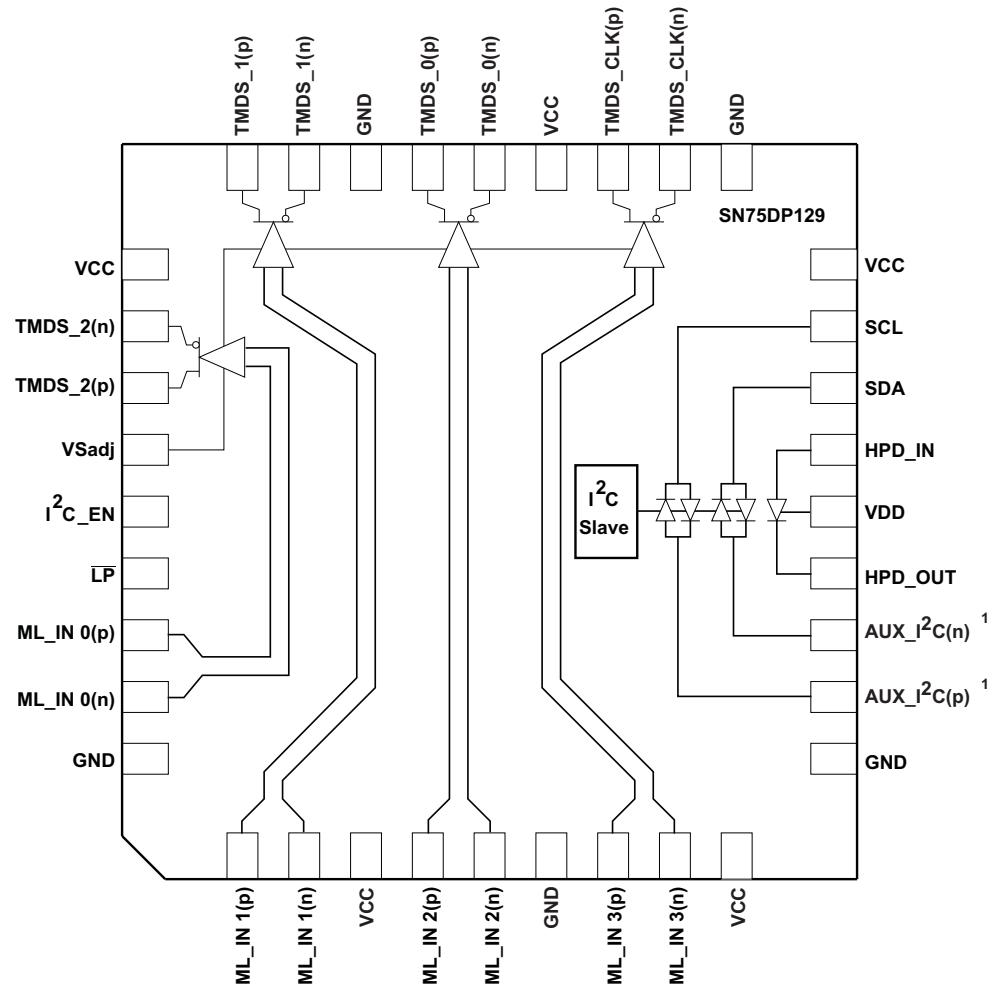
DP++—Dual-Mode DisplayPort

TMDS—Transition-Minimized Differential Signaling

DVI—Digital Visual Interface

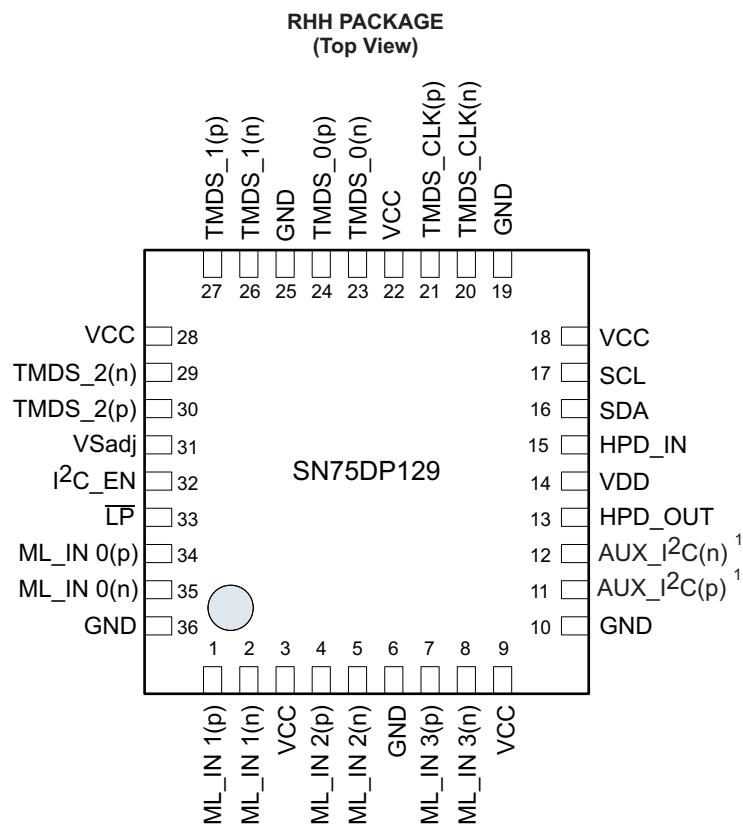
HDMI—High Definition Multimedia Interface

## INTERNAL DATA CONNECTION DIAGRAM



(1) I<sup>2</sup>C bus data (n-SDA) and clock (p-SCL) lines.

## PIN CONFIGURATION



(1) I<sup>2</sup>C bus data (n-SDA) and clock (p-SCL) lines.

## TERMINAL FUNCTIONS

TERMINAL		I/O	DESCRIPTION	TYPE
NAME	NO. <sup>(1)</sup>			
AUX_I <sup>2</sup> C <sup>(2)</sup>	11(p), 12(n)	I/O	Source Side Bidirectional DisplayPort Auxiliary Data Line	DDC LINK (Source)
GND	6, 10, 19, 25, 36		Ground	Ground
HPD_IN	15	I	Hot Plug Detect (HPD) Input	Hot Plug Detect
HPD_OUT	13	O	Hot Plug Detect (HPD) Output	Hot Plug Detect
I <sup>2</sup> C_EN	32	I	Internal I <sup>2</sup> C register enable, used for HDMI / DVI connector differentiation	Control
LP	33	I	Low Power Select Bar	Control
ML_IN 0	34(p), 35(n)	I	DisplayPort Main Link Channel 0 Differential Input	Main Link Input Pins
ML_IN 1	1(p), 2(n)	I	DisplayPort Main Link Channel 1 Differential Input	Main Link Input Pins
ML_IN 2	4(p), 5(n)	I	DisplayPort Main Link Channel 2 Differential Input	Main Link Input Pins
ML_IN 3	7(p), 8(n)	I	DisplayPort Main Link Channel 3 Differential Input	Main Link Input Pins
TMDS_2	30(p), 29(n)	O	TMDS Data 2 Differential Output	Main Link Output
TMDS_1	27(p), 26(n)	O	TMDS Data 1 Differential Output	Main Link Output
TMDS_0	24(p), 23(n)	O	TMDS Data 0 Differential Output	Main Link Output
TMDS_CLK	21(p), 20(n)	O	TMDS Data Clock Differential Output	Main Link Output
SCL	17	I/O	TMDS Port Bidirectional I <sup>2</sup> C Clock Line	DDC Link (Sink)
SDA	16	I/O	TMDS Port Bidirectional I <sup>2</sup> C Data Line	DDC Link (Sink)
VCC	3, 9, 18, 22, 28		3.3 V Supply	Voltage Supply

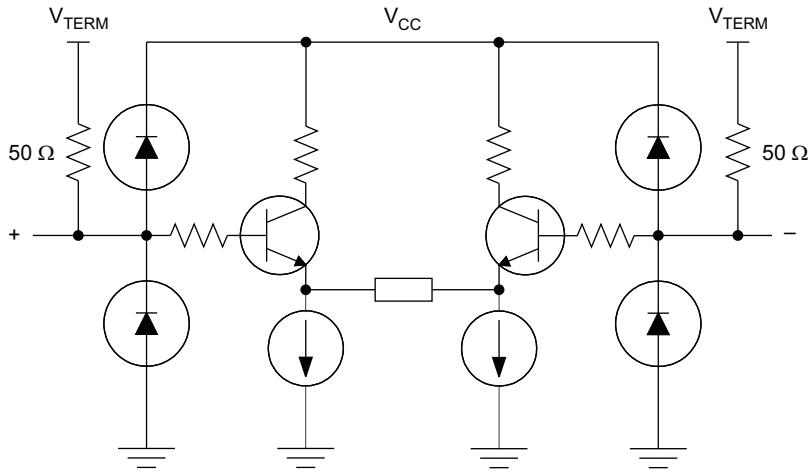
(1) (p) Positive; (n) Negative

(2) I<sup>2</sup>C bus data (n-SDA) and clock (p-SCL) lines.

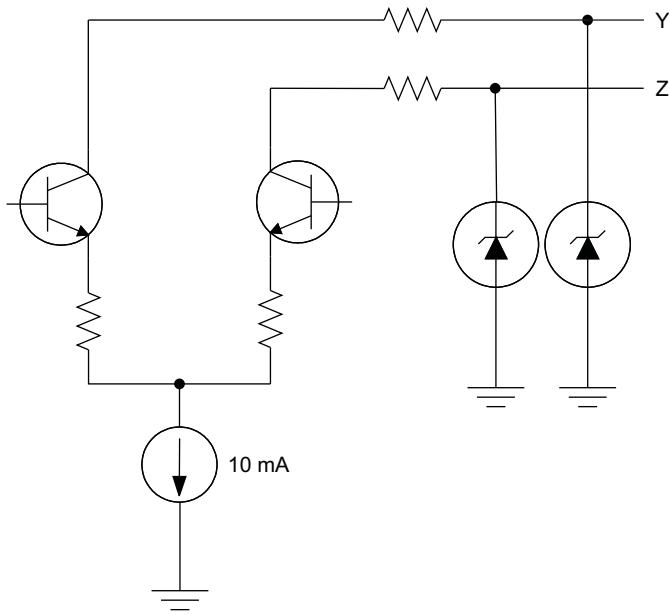
**TERMINAL FUNCTIONS (continued)**

TERMINAL		I/O	DESCRIPTION	TYPE
NAME	NO. <sup>(1)</sup>			
VDD	14		HPD Supply	Voltage Supply
VSadj	31	I	TMDS-Compliant Voltage Swing Control	Reference

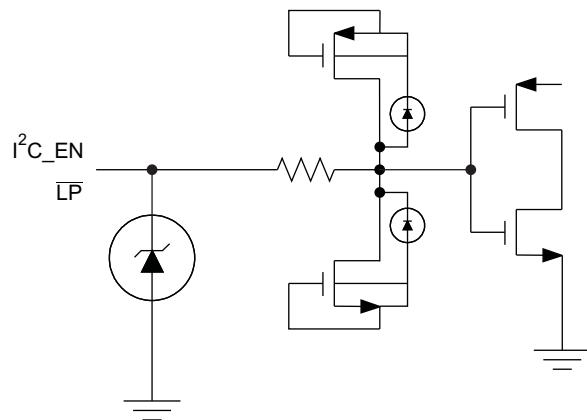
**Input/Output Equivalent Circuits**



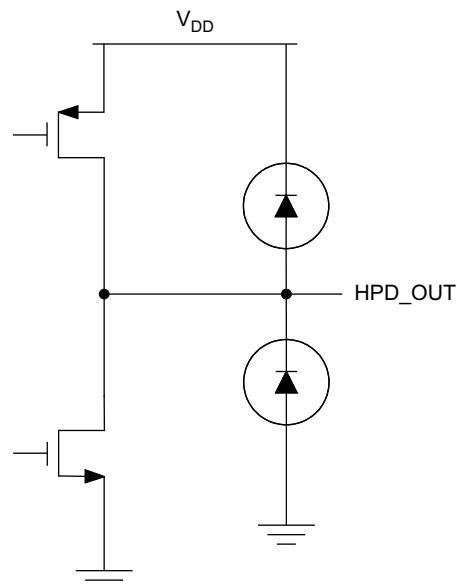
**Figure 1. DisplayPort Input Stage**



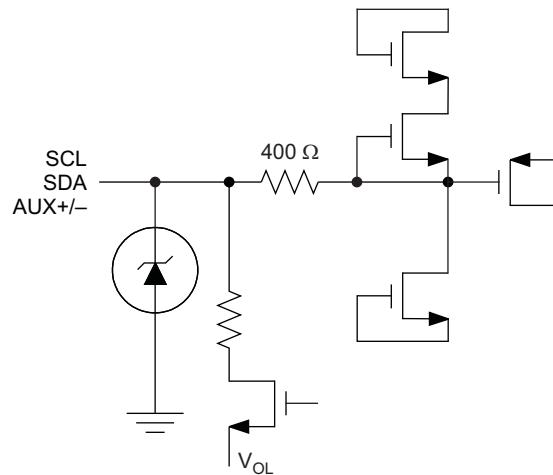
**Figure 2. TMDS Output Stage**



**Figure 3. HPD and Control Input Stage**



**Figure 4. HPD Output Stage**



**Figure 5. I<sup>2</sup>C Input and Output Stage**

**Table 1. Control Pin Lookup Table<sup>(1)</sup>**

SIGNAL	LEVEL	STATE	DESCRIPTION
LP	H	Normal Mode	Normal operational mode for device
	L	Low Power Mode	Device is forced into a Low Power state causing the outputs to go to a high impedance state. All other inputs are ignored.
I <sup>2</sup> C_EN	H	HDMI	Internal I <sup>2</sup> C register is active and readable, indicating the connector in use is HDMI-compliant.
	L	DVI	Internal I <sup>2</sup> C register is disabled and unreadable, indicating the connector in use is DVI-compliant.
VS <sub>adj</sub>	4.65 kΩ	Compliant Voltage Swing	Driver output voltage swing precision control to aid with system compliance.

(1) (H) Logic High; (L) Logic Low

### ORDERING INFORMATION<sup>(1)</sup>

PART NUMBER	PART MARKING	PACKAGE
SN75DP129RHH	DP129	36-pin QFN Reel (large)
SN75DP129RHHT	DP129	36-pin QFN Reel (small)

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at [www.ti.com](http://www.ti.com).

## ABSOLUTE MAXIMUM RATINGS

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

		VALUE	UNIT
Supply voltage range <sup>(2)</sup>	VCC	-0.3 to 3.6	V
Supply voltage range	VDD	-0.3 to 3.6	V
Voltage range	Main link I/O (ML_IN x, DP_SINK x) differential voltage	1.5	V
	TMDS I/O	-0.3 to 4	V
	HPD I/O	-0.3 to 5.5	V
	Auxiliary I/O	-0.3 to 5.5	V
	Control I/O	-0.3 to 5.5	V
Electrostatic discharge	Human body model <sup>(3)</sup>	±12000	V
	Charged-device model <sup>(4)</sup>	±1000	V
	Machine model <sup>(5)</sup>	±200	V
Continuous power dissipation	See Dissipation Ratings Table		

(1) Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any conditions beyond those indicated under recommended operating conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

(2) All voltage values, except differential voltages, are with respect to network ground terminal.

(3) Tested in accordance with JEDEC Standard 22, Test Method A114-B

(4) Tested in accordance with JEDEC Standard 22, Test Method C101-A

(5) Tested in accordance with JEDEC Standard 22, Test Method A115-A

## DISSIPATION RATINGS

PACKAGE	PCB JEDEC STANDARD	T <sub>A</sub> ≤ 25°C	DERATING FACTOR <sup>(1)</sup> ABOVE T <sub>A</sub> = 25°C	T <sub>A</sub> = 85°C POWER RATING
36-pin QFN (RHH)	Low-K	1398 mW	13.98 mW/°C	559 mW
	High-K	2941 mW	29.41 mW/°C	1176 mW

(1) This is the inverse of the junction-to-ambient thermal resistance when board-mounted and with no air flow.

## THERMAL CHARACTERISTICS

over operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$R_{\theta JB}$	Junction-to-board thermal resistance		9.44 <sup>(1)</sup>		°C/W
$R_{\theta JC}$	Junction-to-case thermal resistance		24.74		°C/W
$P_D$	Device power dissipation <sup>(2)</sup> PRBS; I <sup>2</sup> C: $V_{ID} = 3.3$ V, 100 Kbps PRBS; HPD = 5 V	380	490		mW
$P_{SD}$	$\overline{LP} = 0$ V	5	20		μW

(1) The maximum rating is simulated under 3.6 V  $V_{CC}$  and  $V_{DD}$  unless otherwise noted.

(2) Power dissipation is the sum of the power consumption from the  $V_{CC}$  and  $V_{DD}$  pins, plus the 132 mW of power from the AVCC (Receiver Termination Supply).

## RECOMMENDED OPERATING CONDITIONS

		MIN	NOM	MAX	UNIT
$V_{CC}$	Supply voltage	3	3.3	3.6	V
$V_{DD}$	Supply voltage	1.65		3.6	V
$T_A$	Operating free-air temperature	0		85	°C
<b>MAIN LINK DIFFERENTIAL INPUT PINS</b>					
$V_{ID}$	Peak-to-peak input differential voltage	0.15		1.40	V
$d_R$	Data rate			2.5	Gbps
<b>TMDS DIFFERENTIAL OUTPUT PINS</b>					
$AV_{CC}$	TMDS output termination voltage	3	3.3	3.6	V
$d_R$	Data rate			2.5	Gbps
$R_t$	Termination resistance	45	50	55	Ω
<b>AUXILIARY AND I<sup>2</sup>C PINS</b>					
$V_I$	Input voltage	0		5.5	V
$d_{R(I^2C)}$	I <sup>2</sup> C data rate			100	kHz
<b>HPD AND CONTROL PINS</b>					
$V_{IH}$	High-level input voltage	2		5.5	V
$V_{IL}$	Low-level input voltage	0		0.8	V

## Device Power

The SN75DP129 is designed to operate from one or two supply voltages, depending on the implementation of the integrated Hot Plug Detect (HPD) level translator. The TMDS level translator is powered from a single 3.3-V supply. The HPD translator is powered using the VDD pin and its voltage can range from 1.8 V to 3.3 V. This voltage determines the HIGH-level output voltage of the HPD\_OUT pin.

## ELECTRICAL CHARACTERISTICS

over recommended operating conditions (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$I_{CC}$	Supply current $LP = 3.6$ V, $V_{CC} = V_{DD}$ , ML: $V_{ID} = 500$ mV, 2.7 Gbps PRBS	50	75	112	mA
$I_{DD}$	Supply current AUX: $V_I = 3.3$ V, 100 kHz PRBS HPD: HPD_IN = 5 V		1	2	mA
$I_{SD}$	$\overline{LP} = 0$ V	1	5		μA

## Hot Plug and Cable Adapter Detect

The SN75DP129 has a built-in level shifter for the HPD outputs. The output voltage level of the HPD pin is defined by the voltage level of the VDD pin.

## ELECTRICAL CHARACTERISTICS

over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V <sub>OH3.3</sub>	High-level output voltage	I <sub>OH</sub> = -100 $\mu$ A, V <sub>DDx1</sub> = 3.3 V	3	3.3	3.3	V
		I <sub>OH</sub> = -100 A, V <sub>DDx1</sub> = 2.5 V	2.25	2.5	2.5	V
		I <sub>OH</sub> = -100 A, V <sub>DDx1</sub> = 1.8 V	1.62	1.8	1.8	V
V <sub>OL</sub>	Low-level output voltage	I <sub>OH</sub> = 100 $\mu$ A	0	0.4	0.4	V
I <sub>H</sub>	High-level input current	V <sub>IH</sub> = 2.0 V, V <sub>DD</sub> = 3.6 V	-10	10	10	$\mu$ A
I <sub>L</sub>	Low-level input current	V <sub>IL</sub> = 0.8 V, V <sub>DD</sub> = 3.6 V	-10	10	10	$\mu$ A

## SWITCHING CHARACTERISTICS

over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t <sub>PD(HPD)</sub>	Propagation delay	V <sub>DD</sub> = 3.6 V	5	5	30	ns

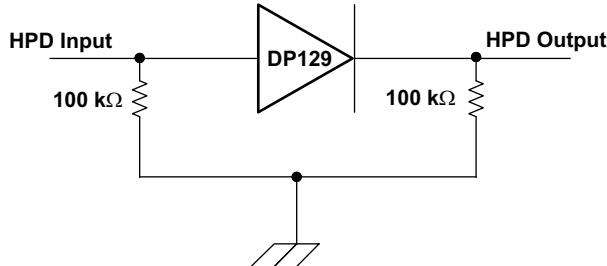


Figure 6. HPD Test Circuit

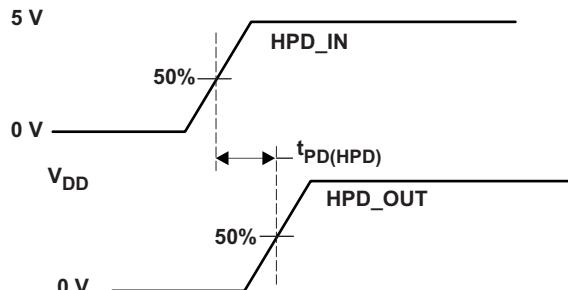


Figure 7. HPD Timing Diagram

## AUX / I<sup>2</sup>C Pins

The SN75DP129 utilizes an active I<sup>2</sup>C repeater. The repeater isolates the parasitic effects of the system to aid with system level compliance.

In addition to the I<sup>2</sup>C repeater, the SN75DP129 supports the connector detection I<sup>2</sup>C register. This register is enabled using the I<sup>2</sup>C\_EN pin. When active, an internal memory register is readable using the AUX\_I<sup>2</sup>C pins. This I<sup>2</sup>C register block functionality is described in the [APPLICATION INFORMATION](#) section.

## ELECTRICAL CHARACTERISTICS

over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$I_L$	Low input current	$V_{CC} = 3.6$ V, $V_I = 0$ V	-10	10	10	$\mu$ A
$I_{lkg(AUX)}$	Input leakage current	AUX_I <sup>2</sup> C pins	$V_{CC} = 3.6$ V, $V_I = 3.6$ V	-10	10	$\mu$ A
$C_{IO(AUX)}$	Input/output capacitance	AUX_I <sup>2</sup> C pins	DC bias = 1.65 V, AC = 2.1 V <sub>p-p</sub> , f = 100 kHz		15	pF
$V_{IH(AUX)}$	High-level input voltage	AUX_I <sup>2</sup> C pins		1.6	5.5	V
$V_{IL(AUX)}$	Low-level input voltage	AUX_I <sup>2</sup> C pins		-0.2	0.4	V
$V_{OL(AUX)}$	Low-level output voltage	AUX_I <sup>2</sup> C pins	$I_O = 4$ mA	0.5	0.6	V
$I_{lkg(I2C)}$	Input leakage current	I <sup>2</sup> C SDA/SCL pins	$V_{CC} = 3.6$ V, $V_I = 4.95$ V	-10	10	$\mu$ A
$C_{IO(I2C)}$	Input/output capacitance	I <sup>2</sup> C SDA/SCL pins	DC bias = 2.5 V, AC = 3.5 V <sub>p-p</sub> , f = 100 kHz		15	pF
$V_{IH(I2C)}$	High-level input voltage	I <sup>2</sup> C SDA/SCL pins		2.1	5.5	V
$V_{IL(I2C)}$	Low-level input voltage	I <sup>2</sup> C SDA/SCL pins		-0.2	1.5	V
$V_{OL(I2C)}$	Low-level output voltage	I <sup>2</sup> C SDA/SCL pins	$I_O = 4$ mA		0.2	V

## SWITCHING CHARACTERISTICS

over recommended operating conditions (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{PLH1}$	Propagation delay time, low to high	Source to Sink	204	459	ns
$t_{PHL1}$	Propagation delay time, high to low	Source to Sink	35	200	ns
$t_{PLH2}$	Propagation delay time, low to high	Sink to Source	80	251	ns
$t_{PHL2}$	Propagation delay time, high to low	Sink to Source	35	200	ns
$t_{f1}$	Output signal fall time	Sink Side	20	72	ns
$t_{f2}$	Output signal fall time	Source Side	20	72	ns
$f_{SCL}$	SCL clock frequency for internal register	Source Side		100	kHz
$t_{W(L)}$	Clock LOW period for I <sup>2</sup> C register	Source Side	4.7		$\mu$ s
$t_{W(H)}$	Clock HIGH period for internal register	Source Side	4.0		$\mu$ s
$t_{SU1}$	Internal register setup time, SDA to SCL	Source Side	250		ns
$t_{h(1)}$	Internal register hold time, SCL to SDA	Source Side	0		$\mu$ s
$t_{(buf)}$	Internal register bus free time between STOP and START	Source Side	4.7		$\mu$ s
$t_{su(2)}$	Internal register setup time, SCL to START	Source Side	4.7		$\mu$ s
$t_{h(2)}$	Internal register hold time, START to SCL	Source Side	4.0		$\mu$ s
$t_{su(3)}$	Internal register hold time, SCL to STOP	Source Side	4.0		$\mu$ s

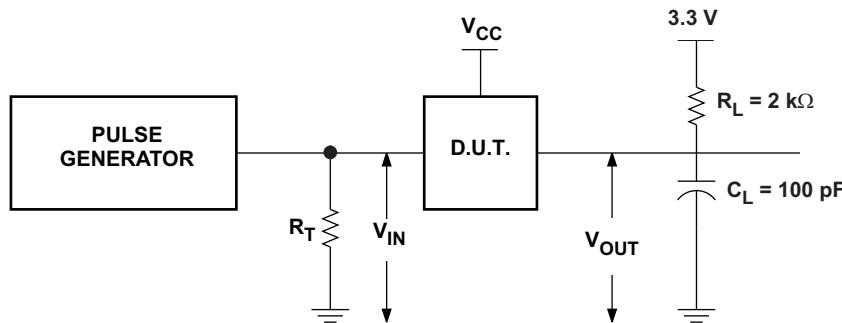


Figure 8. Source Side Test Circuit (AUX\_I<sup>2</sup>C)

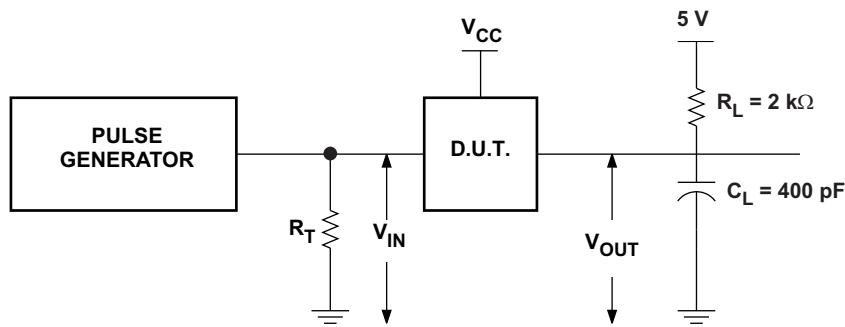


Figure 9. Sink Side Test Circuit (SCL, SDA)

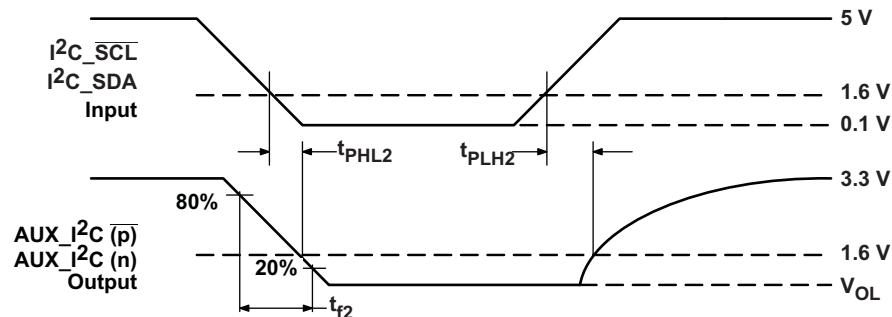


Figure 10. Source Side Output AC Measurements

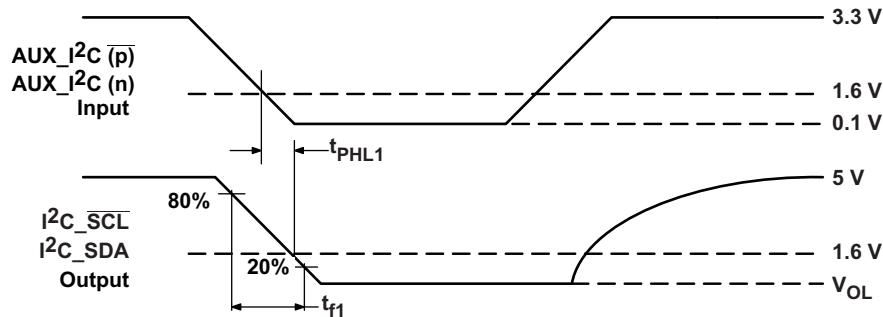


Figure 11. Sink Side Output AC Measurements

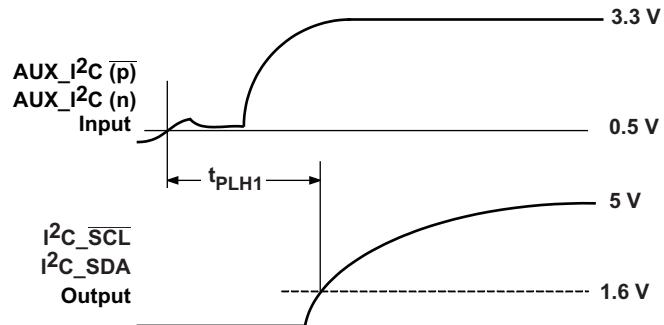


Figure 12. Sink Side Output AC Measurements (continued)

## TMDS and Main Link Pins

The main link inputs are designed to be compliant with the DisplayPort 1.1 specification. The TMDS outputs of the SN75DP129 are designed to be compliant with the Digital Visual Interface 1.0 (DVI) and High Definition Multimedia Interface 1.3 (HDMI) specifications. The differential output voltage swing can be fine-tuned with the VSadj (TMDS-compliant Voltage Swing Control) resistor.

## ELECTRICAL CHARACTERISTICS

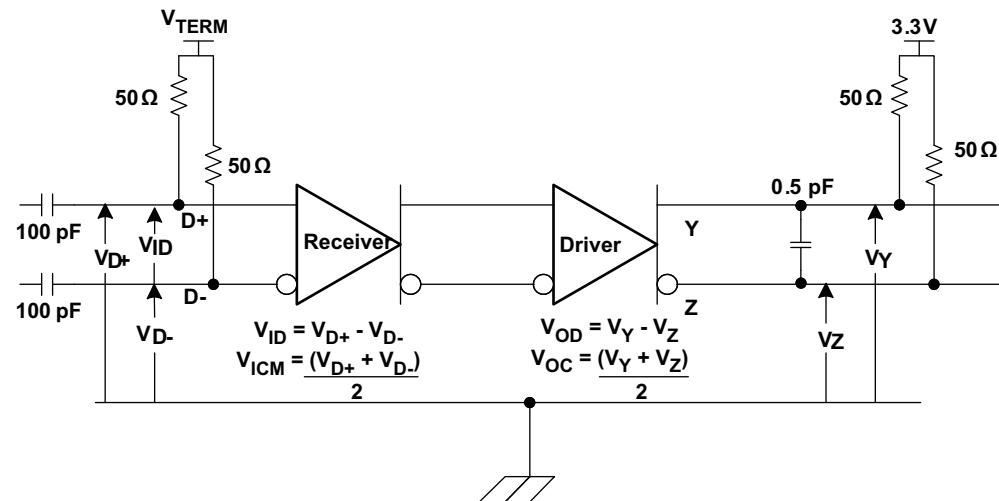
over recommended operating conditions (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$V_{OH}$	Single-ended HIGH level output voltage AVCC = 3.3 V, $R_T = 50 \Omega$	AVCC–10		AVCC+10	mV
$V_{OL}$		AVCC–600		AVCC–400	mV
$V_{SWING}$		400		600	mV
$V_{OC(SS)}$		–5		5	mV
$V_{OD(PP)}$		800		1200	mV
$V_{(O)SBY}$	Single-ended standby output voltage AVCC = 3.3 V, $R_T = 50 \Omega$ , $L_P = 0$	AVCC–10		AVCC+10	mV
$I_{(O)OFF}$	Single-ended power down output current $0 V \leq V_{CC} \geq 1.5 V$ , AVCC = 3.3 V, $R_T = 50 \Omega$	–10		10	$\mu A$
$I_{os}$	Short circuit output current $V_{ID} = 500 mV$	–15		15	mA
$R_{INT}$	Input termination impedance	45	50	55	$\Omega$
$V_{term}$	Input termination voltage	1		2	V

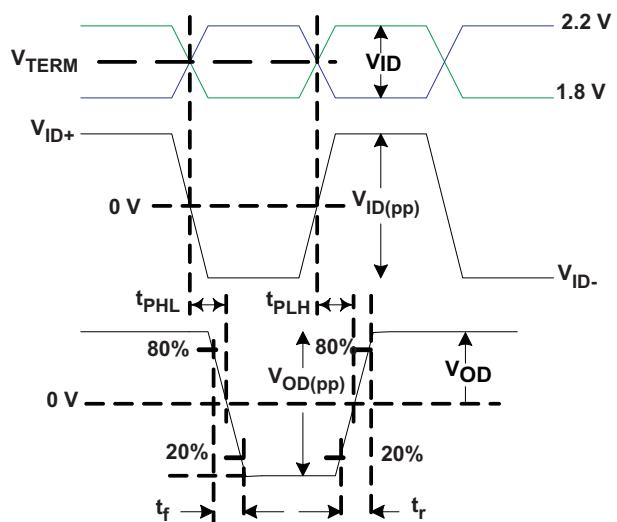
## SWITCHING CHARACTERISTICS

over recommended operating conditions (unless otherwise noted)

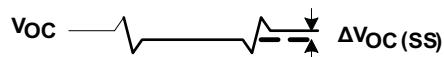
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{PLH}$	Propagation delay time AVCC = 3.3 V, $R_T = 50 \Omega$ , $f = 1$ MHz	250	350	600	ps
$t_{PHL}$		250	350	600	ps
$t_R$		60	90	140	ps
$t_F$		60	90	140	ps
$t_{SK(P)}$		8	15	ps	
$t_{SK(D)}$	Intra-pair skew	20	40	ps	
$t_{SK(O)}$	Inter-pair skew	20	65	ps	
$t_{JTD(PP)}$	Peak-to-peak output residual data jitter AVCC = 3.3 V, $R_T = 50 \Omega$ , $dR = 2.5$ Gbps	14	50	ps	
$t_{JTC(PP)}$	Peak-to-peak output residual clock jitter AVCC = 3.3 V, $R_T = 50 \Omega$ , $f = 250$ MHz	8	30	ps	



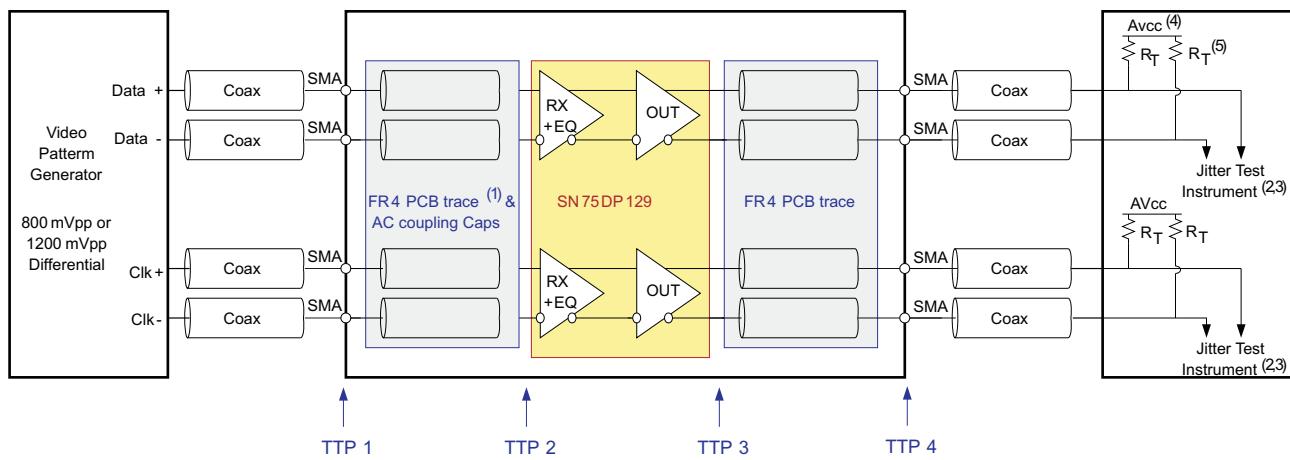
**Figure 13. TMDS Main Link Test Circuit**



**Figure 14. TMDS Main Link Timing Measurements**

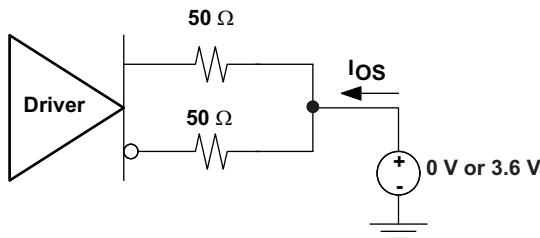


**Figure 15. TMDS Main Link Common Mode Measurements**



- (1) The FR4 trace between TTP1 and TTP2 is designed to emulate 8 inches of FR4, a connector, and another 8 inches of FR4.
- (2) All jitter is measured at a BER of  $10^{-12}$
- (3) Residual jitter reflects the total jitter measured at TTP4 minus the jitter measured at TTP1.
- (4) AVCC = 3.3 V
- (5)  $R_T = 50 \Omega$

**Figure 16. TMDS Jitter Measurements**



**Figure 17. TMDS Main Link Short Circuit Output Circuit**

## TYPICAL CHARACTERISTICS

Power dissipation is the sum of the power consumption from the VCC and VDD pins, plus the 132 mW of power from the AVCC (Receiver Termination Supply).

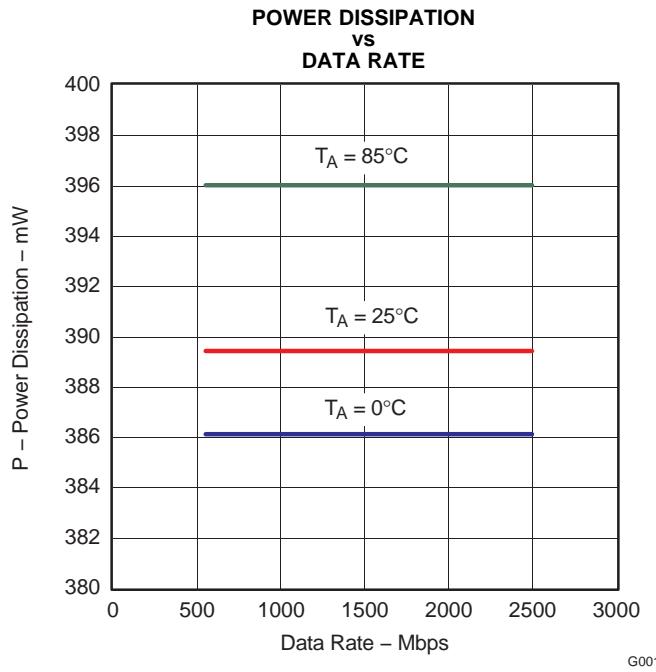


Figure 18.

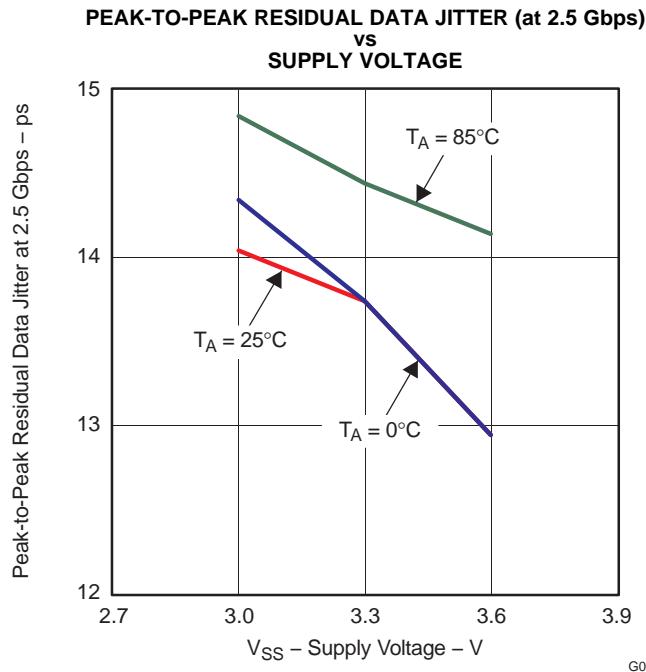


Figure 19.

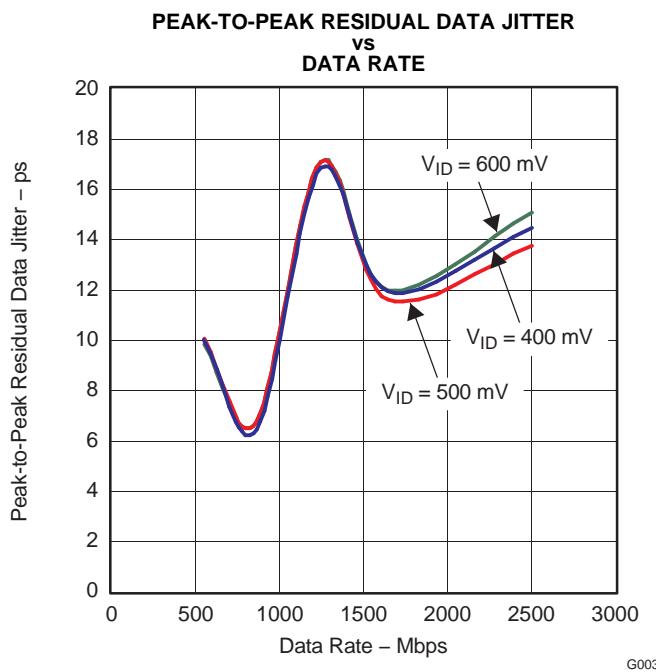


Figure 20.

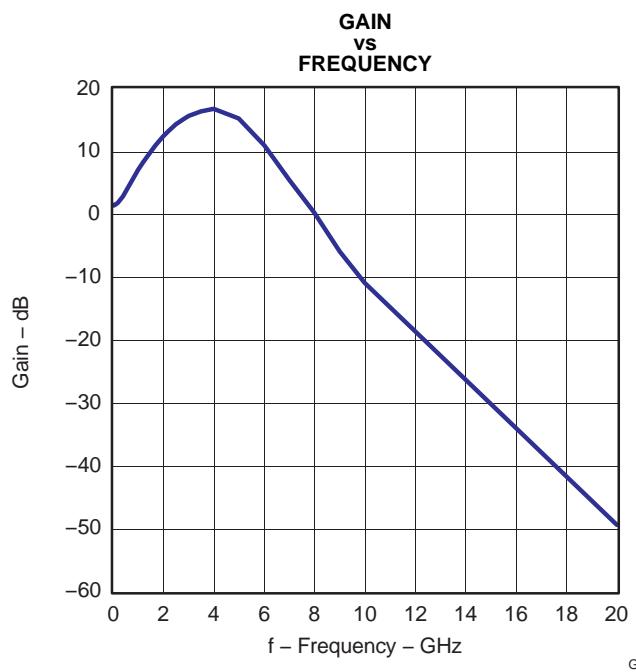


Figure 21.

**TYPICAL CHARACTERISTICS (continued)**

Power disipation is the sum of the power consumption from the VCC and VDD pins, plus the 132 mW of power from the AVCC (Receiver Termination Supply).

PEAK-TO-PEAK DROPOUT VOLTAGE  
vs  
RESISTANCE

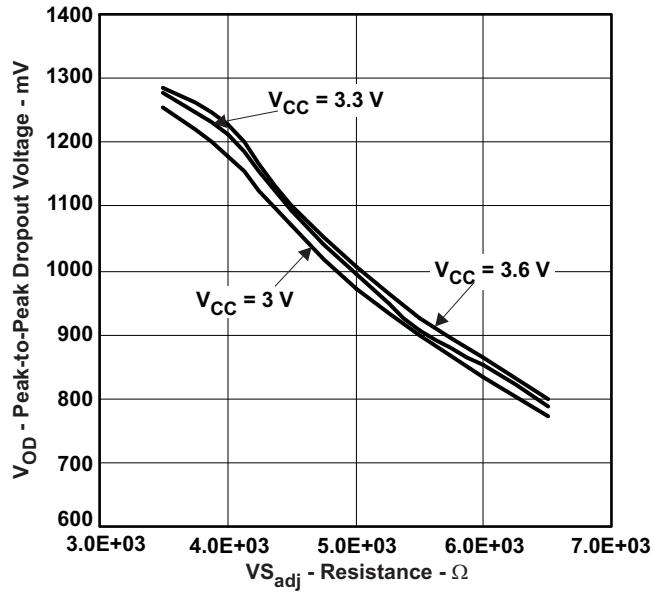


Figure 22.

## APPLICATION INFORMATION

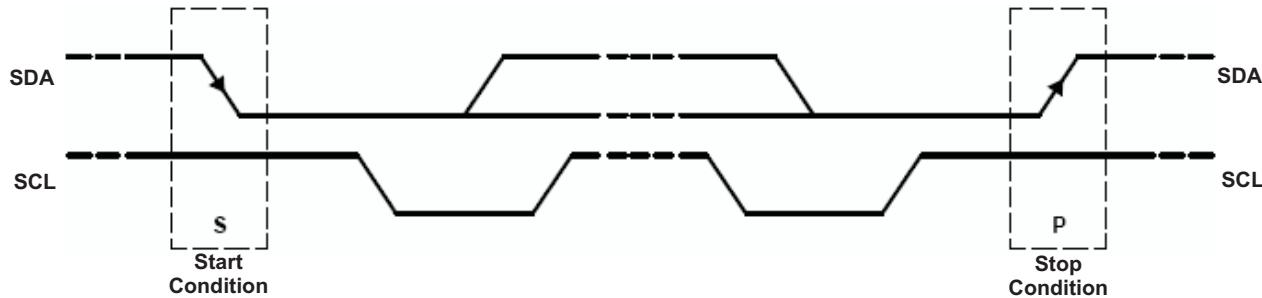
### I<sup>2</sup>C INTERFACE NOTES

The I<sup>2</sup>C interface can access the internal memory of the SN75DP129. I<sup>2</sup>C is a two-wire serial interface developed by Philips Semiconductor (see [I<sup>2</sup>C-Bus Specification, Version 2.1, January 2000](#)). The bus consists of a data line (SDA) and a clock line (SCL) with pull-up structures. When the bus is *idle*, both SDA and SCL lines are pulled high. All the I<sup>2</sup>C compatible devices connect to the I<sup>2</sup>C bus through open drain I/O pins, SDA and SCL. A *master* device, usually a microcontroller or a digital signal processor, controls the bus. The master is responsible for generating the SCL signal and device addresses. The master also generates specific conditions that indicate the START and STOP of data transfer. A *slave* device receives and/or transmits data on the bus under control of the master device. The SN75DP129 works as a slave and supports the standard mode transfer (100 kbps) as defined in the I<sup>2</sup>C-Bus Specification.

The basic I<sup>2</sup>C start and stop access cycles are shown in [Figure 23](#).

The basic access cycle consists of the following:

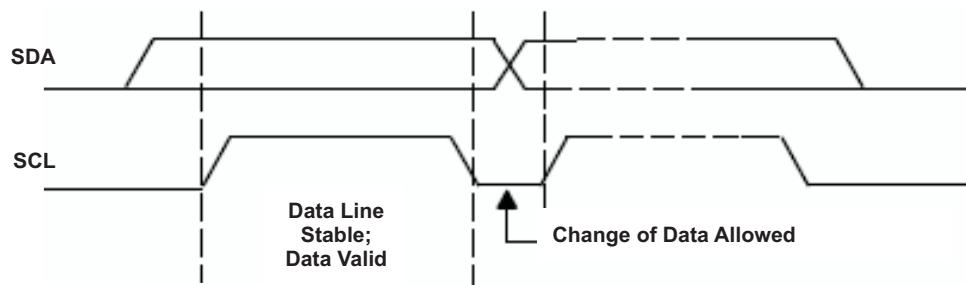
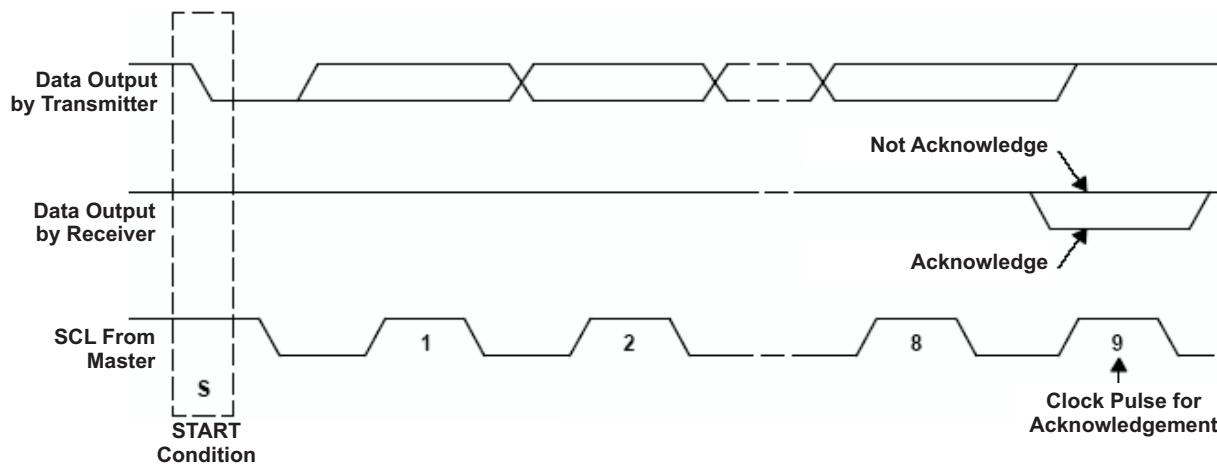
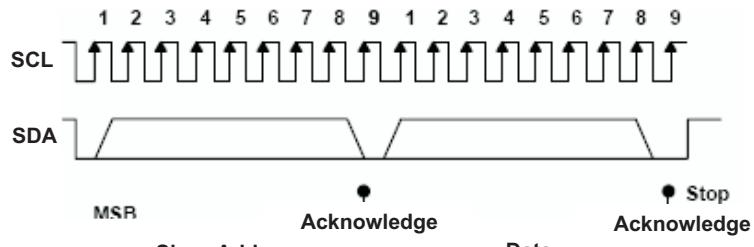
- A start condition
- A slave address cycle
- Any number of data cycles
- A stop condition



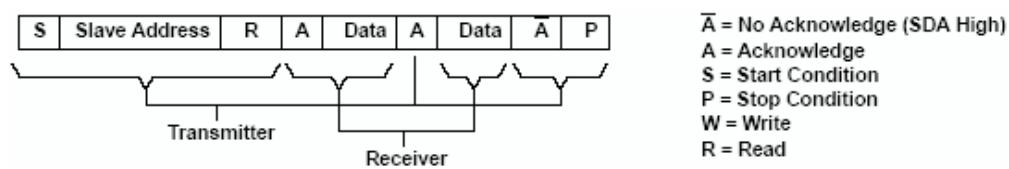
**Figure 23. I<sup>2</sup>C Start and Stop Conditions**

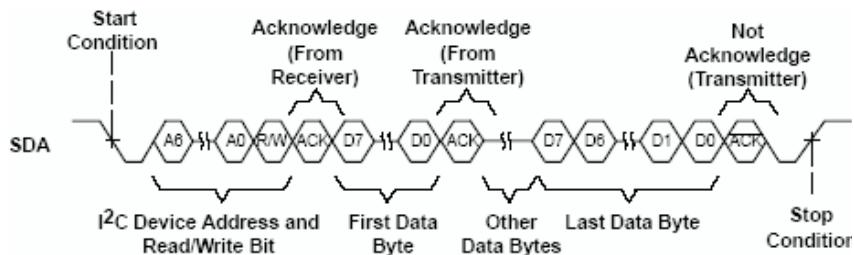
### GENERAL I<sup>2</sup>C PROTOCOL

- The master initiates data transfer by generating a *start condition*. The *start condition* is when a high-to-low transition occurs on the SDA line the SCL line is high, as shown in [Figure 25](#). All I<sup>2</sup>C-compliant devices should recognize a *start condition*.
- The master generates the SCL pulses and transmits the 7-bit address and the *read/write direction bit* R/W on the SDA line. During all transmissions, the master ensures that data is *valid*. A *valid data* condition requires the SDA line to be stable during the entire high period of the clock pulse (see [Figure 24](#)). All devices recognize the address sent by the master and compare it to their internal fixed addresses. Only the slave device with a matching address generates an *acknowledge* (see [Figure 25](#)) by pulling the SDA line low during the entire high period of the ninth SCL cycle. On detecting this acknowledge, the master knows that a communication link with a slave has been established.
- The master generates further SCL cycles to transmit data to the slave (R/W bit 0) or receive data from the slave (R/W bit 1). In either case, the *receiver* needs to acknowledge the data sent by the *transmitter*. So an *acknowledge* signal can either be generated by the master or by the slave, depending on which one is the receiver. The 9-bit valid data sequences consisting of 8-bit data and 1-bit acknowledge can continue as long as necessary (see [Figure 26](#)).
- To signal the end of the data transfer, the master generates a *stop condition* by pulling the SDA line from low to high while the SCL line is high (see [Figure 26](#)). This releases the bus and stops the communication link with the addressed slave. All I<sup>2</sup>C compatible devices must recognize the stop condition. Upon the receipt of a *stop condition*, all devices know that the bus is released, and they wait for a *start condition*, followed by a matching address.

Figure 24. I<sup>2</sup>C Bit TransferFigure 25. I<sup>2</sup>C AcknowledgeFigure 26. I<sup>2</sup>C Address and Data Cycles

During a read cycle, the slave receiver acknowledges the initial address byte if it decodes the address as its address. Following this initial acknowledge by the slave, the master device becomes a receiver and acknowledges data bytes sent by the slave. When the master has received all of the requested data bytes from the slave, the not acknowledge (A) condition is initiated by the master by keeping the SDA signal high just before it asserts the stop (P) condition. This sequence terminates a read cycle as shown in Figure 27 and Figure 28. See the [Reading from the SN75DP129, an example](#) section for more information.

Figure 27. I<sup>2</sup>C Read Cycle



**Figure 28. Multiple Byte Read Transfer**

### Slave Address

Both SDA and SCL must be connected to a positive supply voltage via a pull-up resistor. These resistors should comply with the I<sup>2</sup>C specification that ranges from 2 kΩ to 19 kΩ. When the bus is free, both lines are high. The address byte is the first byte received following the START condition from the master device. The 7 bit address is factory preset to 1000000. [Table 2](#) lists the calls that the SN75DP129 will respond to.

**Table 2. SN75DP129 Slave Address**

FIXED ADDRESS							READ/WRITE BIT
BIT 7 (MSB)	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0 (R/W)
1	0	0	0	0	0	0	1

### Sink Port Selection Register and Source Plug-In Status Register Description (Sub-Address)

The SN75DP129 operates using a multiple byte transfer protocol similar to [Figure 28](#). The internal memory of the SN75DP129 contains the phrase *DP-HDMI ADAPTOR<EOT>* converted to ASCII characters. The internal memory address registers and the corresponding values can be found in [Table 3](#).

During a read cycle, the SN75DP129 sends the data (within its selected sub-address) in a single transfer to the master device requesting the information. See the [Reading from the SN75DP129](#), an [Example](#) section of this data sheet for the proper procedure.

**Table 3. SN75DP129 Sink Port and Source Plug-In Status Registers Selection**

ADDRESS	0x00	0x01	0x02	0x03	0x04	0x05	0x06	0x07	0x08	0x09	0x0A	0x0B	0x0C	0x0D	0x0E	0x0F	0x10
Data	44	50	2D	48	44	4D	49	20	41	44	41	50	54	4F	52	04	FF

## READING FROM THE SN75DP129, AN EXAMPLE

The read operation consists of several steps. The I<sup>2</sup>C master begins the communication with the transmission of the start sequence, followed by the slave address of the SN75DP129 and logic address of **00h**. The SN75DP129 acknowledges its presence to the master and begins to transmit the memory registers contents. After each byte is transferred, the SN75DP129 waits for an acknowledge (ACK) or a not-acknowledge (NACK) from the master. If an ACK is received, the next byte of data is transmitted. If a NACK is received, the data transmission sequence is expected to end and the master should send the stop command.

The SN75DP129 continues to send data until the master fails to acknowledge each byte transmission. If an ACK is received after the transmission of byte **0x0F**, the SN75DP129 transmits byte **0x10** and continues to transmit byte **0x10** for all further ACK's until a NACK is received.

### SN75DP129 Read Phase

<b>Step 1<sup>(1)</sup></b>	<b>0</b>
I <sup>2</sup> C Start (Master)	S

(1) The SN75DP129 also supports an accelerated read mode in which steps 1 through 6 can be skipped.

<b>Step 2</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
I <sup>2</sup> C General Address Write (Master)	1	0	0	0	0	0	0	0

<b>Step 3</b>	<b>9</b>
I <sup>2</sup> C Acknowledge (Slave)	A

<b>Step 4</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
I <sup>2</sup> C Logic Address (Master)	1	0	0	0	0	0	0	0

<b>Step 5</b>	<b>9</b>
I <sup>2</sup> C Acknowledge (Slave)	A

<b>Step 6</b>	<b>0</b>
I <sup>2</sup> C Stop (Master)	P

<b>Step 7</b>	<b>0</b>
I <sup>2</sup> C Start (Master)	S

<b>Step 8</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
I <sup>2</sup> C General Address Read (Master)	1	0	0	0	0	0	0	1

<b>Step 9</b>	<b>9</b>
I <sup>2</sup> C Acknowledge (Slave)	A

<b>Step 10</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
I <sup>2</sup> C Read Data (Slave)	Data							

Where Data is determined by the Logic values Contained in the Sink Port Register

<b>Step 11</b>	<b>9</b>
I <sup>2</sup> C Not-Acknowledge (Master)	X

Where X is an A (Acknowledge) or  $\bar{A}$  (Not-Acknowledge)

An A causes the pointer to increment and step 10 is repeated.

An  $\bar{A}$  causes the slave to stop transmitting and proceeds to step 12.

<b>Step 12</b>	<b>0</b>
I <sup>2</sup> C Stop (Master)	P

## Revision History

<b>Changes from Original (January 2008) to Revision A</b>	<b>Page</b>
• Changed device power dissipation from 250 mW typ to 380 mW typ.....	8
• Changed device power dissipation from 400 mW max to 490 mW max.....	8
• Changed propagation delay time, high to low, sink to source from 140 ns max to 200 ns max.....	10
• Changed $t_{PHL1}$ to $t_{PLH1}$ in <a href="#">Figure 12</a> .....	11
• Changed $t_{PHL}$ propagation delay time from 800 ps max to 600 ps max.....	12
• Changed $t_{JTD(PP)}$ peak-to-peak output residual data jitter from 20 ps typ to 14 ps typ.....	12
• Changed $t_{JTC(PP)}$ peak-to-peak output residual clock jitter from 10 ps typ to 8 ps typ.....	12
• Added peak-to-peak dropout voltage vs resistance curves.....	16

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
SN75DP129RHHR	ACTIVE	QFN	RHH	36	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR
SN75DP129RHHRG4	ACTIVE	QFN	RHH	36	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR
SN75DP129RHHT	ACTIVE	QFN	RHH	36	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR
SN75DP129RHHTG4	ACTIVE	QFN	RHH	36	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR

<sup>(1)</sup> The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBsolete:** TI has discontinued the production of the device.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

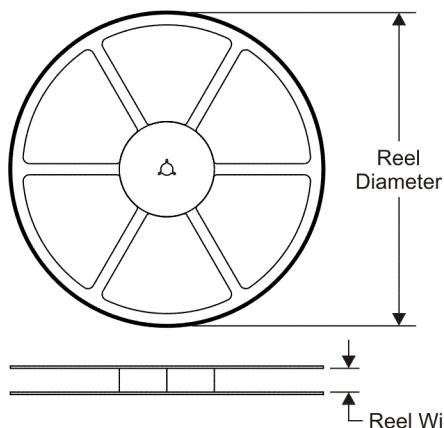
<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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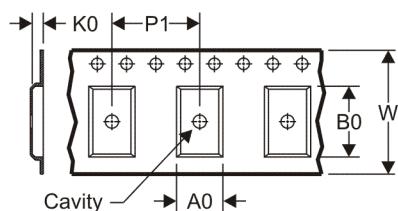
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**TAPE AND REEL INFORMATION**

**REEL DIMENSIONS**

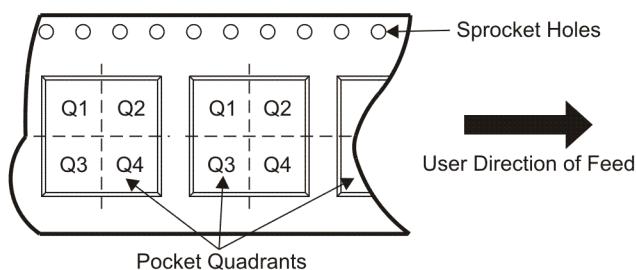


**TAPE DIMENSIONS**



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

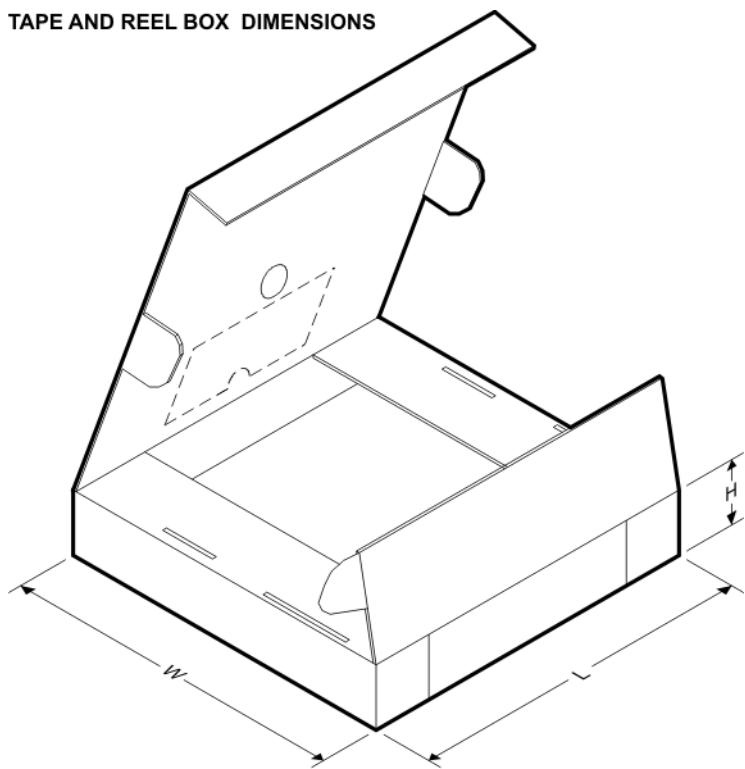
**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN75DP129RHHR	QFN	RHH	36	2500	330.0	16.4	6.3	6.3	1.5	12.0	16.0	Q2
SN75DP129RHHT	QFN	RHH	36	250	180.0	16.4	6.3	6.3	1.5	12.0	16.0	Q2

**TAPE AND REEL BOX DIMENSIONS**



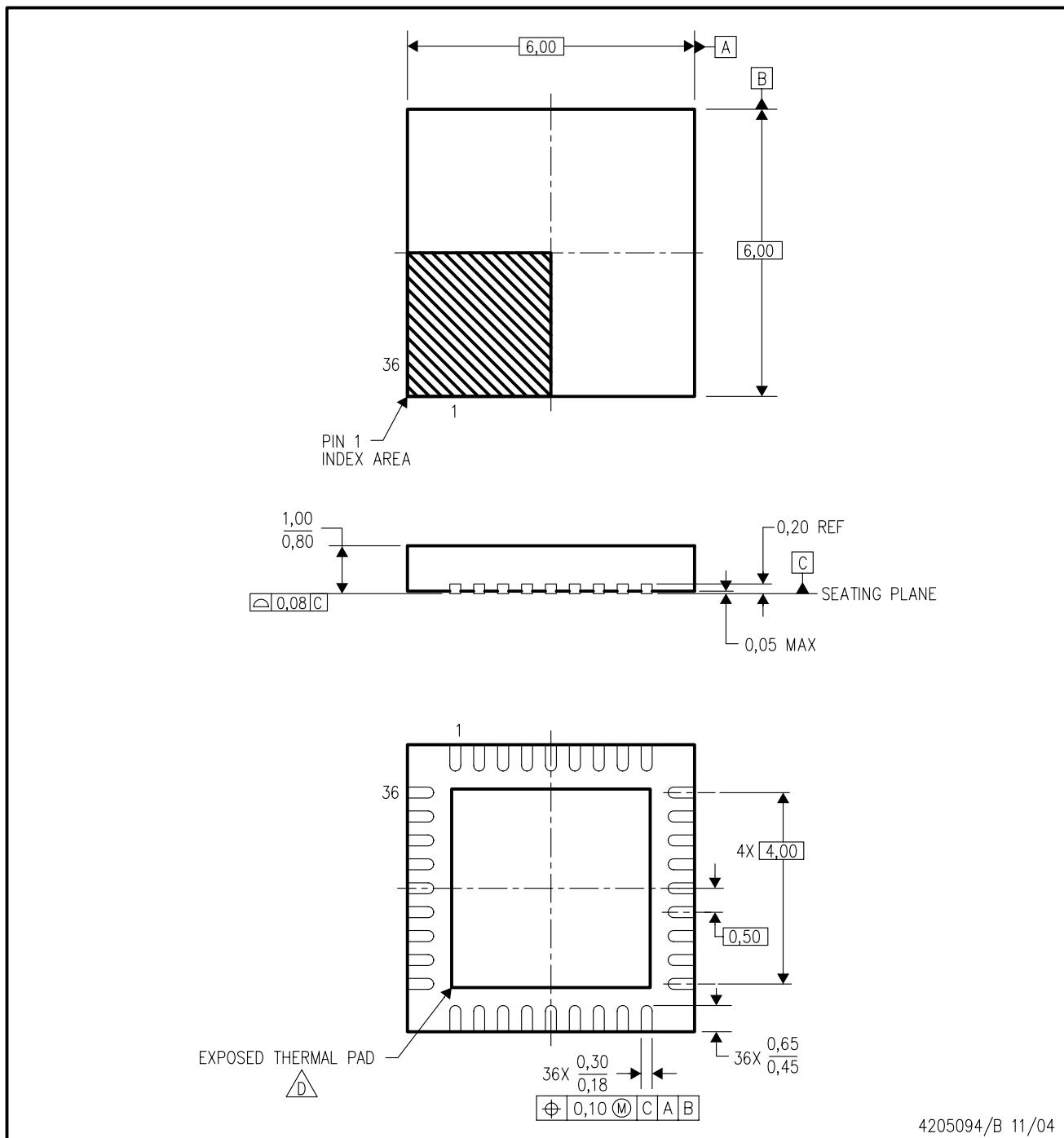
\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN75DP129RHHR	QFN	RHH	36	2500	346.0	346.0	33.0
SN75DP129RHHT	QFN	RHH	36	250	190.5	212.7	31.8

## MECHANICAL DATA

RHH (S-PQFP-N36)

PLASTIC QUAD FLATPACK



NOTES: A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.

B. This drawing is subject to change without notice.

C. QFN (Quad Flatpack No-Lead) Package configuration.

 The package thermal pad must be soldered to the board for thermal and mechanical performance. See the Product Data Sheet for details regarding the exposed thermal pad dimensions.

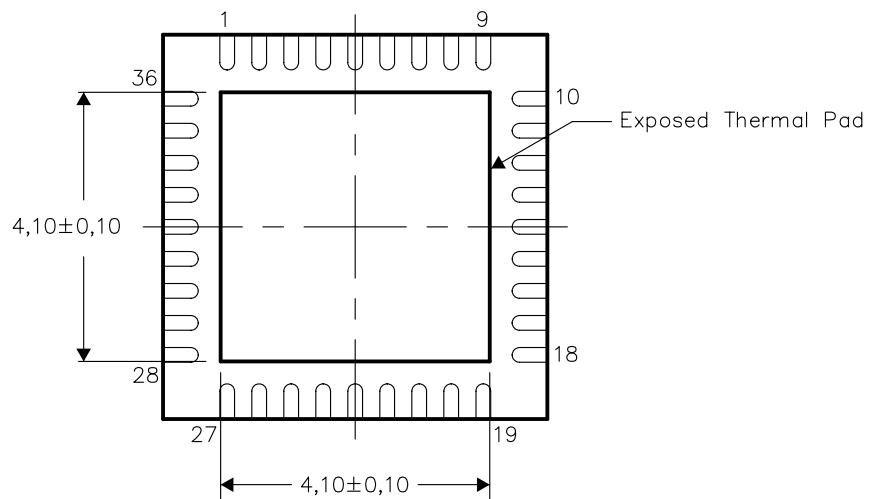
E. Falls within JEDEC MO-220.

## THERMAL INFORMATION

This package incorporates an exposed thermal pad that is designed to be attached directly to an external heatsink. The thermal pad must be soldered directly to the printed circuit board (PCB). After soldering, the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to the appropriate copper plane shown in the electrical schematic for the device, or alternatively, can be attached to a special heatsink structure designed into the PCB. This design optimizes the heat transfer from the integrated circuit (IC).

For information on the Quad Flatpack No-Lead (QFN) package and its advantages, refer to Application Report, Quad Flatpack No-Lead Logic Packages, Texas Instruments Literature No. SCBA017. This document is available at [www.ti.com](http://www.ti.com).

The exposed thermal pad dimensions for this package are shown in the following illustration.

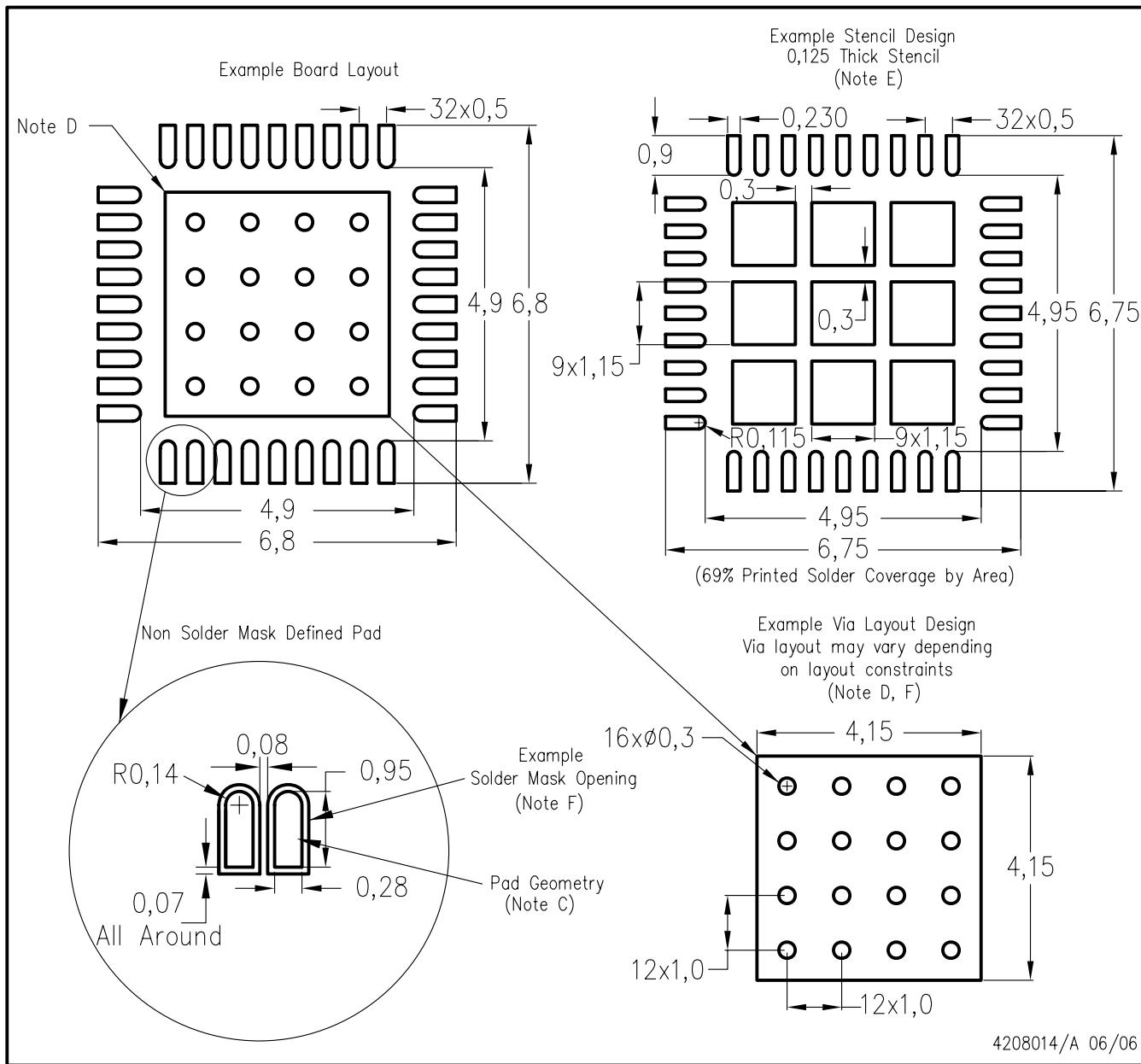


Bottom View

NOTE: All linear dimensions are in millimeters

Exposed Thermal Pad Dimensions

RHH (S-PQFP-N36)



NOTES:

- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Publication IPC-7351 is recommended for alternate designs.
- D. This package is designed to be soldered to a thermal pad on the board. Refer to Application Note, Quad Flat-Pack Packages, Texas Instruments Literature No. SCBA017, SLUA271, and also the Product Data Sheets for specific thermal information, via requirements, and recommended board layout. These documents are available at [www.ti.com](http://www.ti.com) <<http://www.ti.com>>.
- E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC 7525 for stencil design considerations.
- F. Customers should contact their board fabrication site for recommended solder mask tolerances and via tenting recommendations for vias placed in the thermal pad.

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Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Broadband	<a href="http://www.ti.com/broadband">www.ti.com/broadband</a>
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Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Military	<a href="http://www.ti.com/military">www.ti.com/military</a>
Optical Networking	<a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Telephony	<a href="http://www.ti.com/telephony">www.ti.com/telephony</a>
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