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**PI3WVR646****2:1 MIPI 4-Data Lane Switch****Features**

- 4-lane, 2:1 switches that support DHY
- Data rate: 2.5 Gbps
- Supports 2:1 clock differential signal
- -3 dB Bandwidth: 4.5 GHz Typical
- Low Crosstalk: -30 dB@1.25 GHz
- Low Off Isolation: -26 dB@1.25 GHz
- Input Signals 0 to 1.3V
- $R_{ON}$ : 6 $\Omega$  Typical LP & HS MIPI
- $\Delta R_{ON}$ : 0.1 $\Omega$  Typical LP & HS MIPI
- $R_{ON\_FLAT}$ : 0.3 $\Omega$  Typical LP & HS MIPI
- $I_{CCZ}$ : 1 $\mu$ A Maximum
- $I_{CC}$ : 15 $\mu$ A Typical
- $C_{ON}$ : 1.5pF Typical
- Skew of Opposite Transitions of the Same Output: 2ps Typical
- $V_{DD}$  Operating Range: 1.5V to 5V
- ESD Tolerance: 2kV HBM
- Packaging (Pb-free & Green): 36-Pin, CSP (GE) 2.44x2.44

**Description**

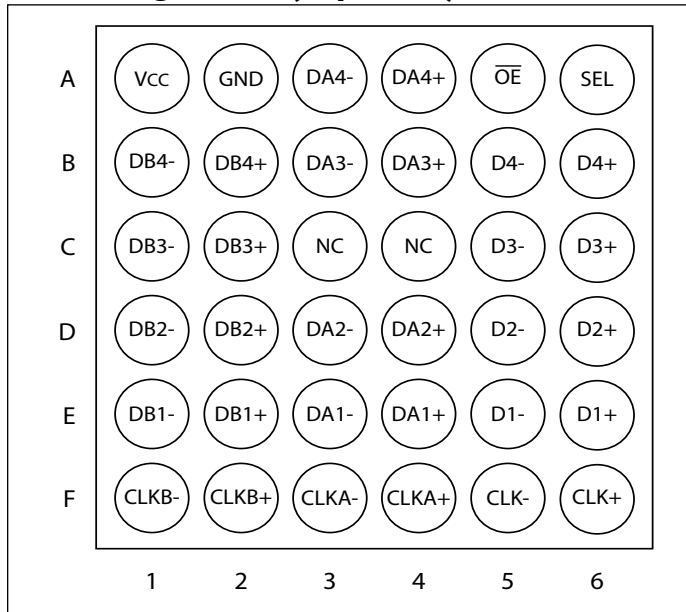
Diodes' PI3WVR646 is a four-data-lane MIPI-D-PHY switch. This 10 channel single-pole, double-throw (SPDT) switch is optimized for switching between two high-speed (HS) or low-power (LP) MIPI signal. The PI3WVR646 is designed for the MIPI specification and allows connection to a CSI or DSI module.

**Applications**

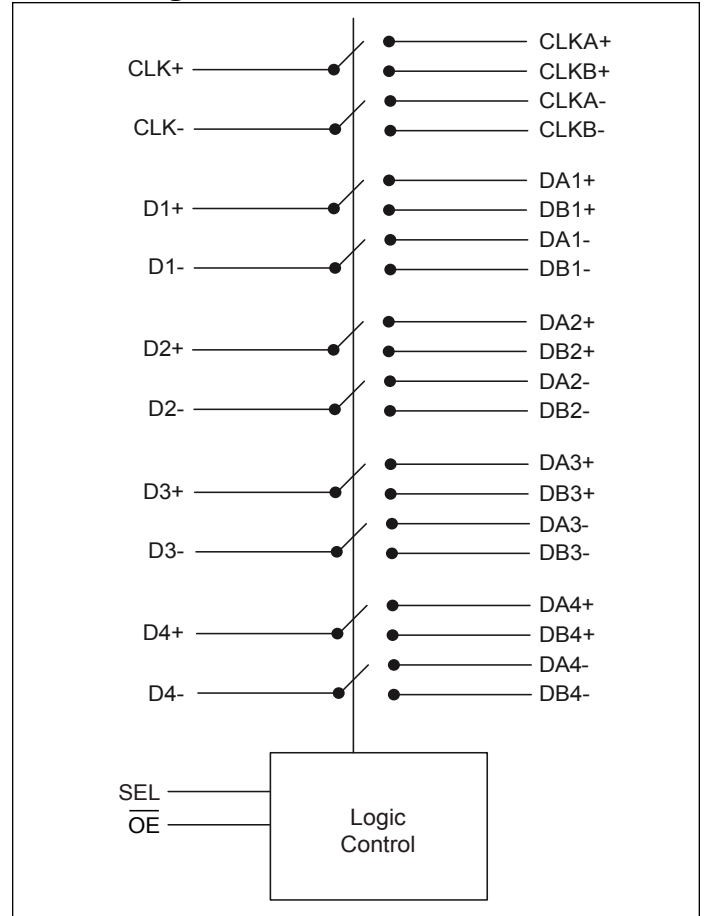
- Cellular Phones, Smart Phone
- Tablets
- Laptops
- Displays

**PI3WVR646**

**Pin Configuration(Top View)**



**Block Diagram**



**Truth Table**

SEL	$\overline{OE}$	Function
LOW	LOW	CLK+ = CLKA+, CLK- = CLKA-, Dn(+/-) = DAN(+/-)
HIGH	LOW	CLK+ = CLKB+, CLK- = CLKB-, Dn(+/-) = DBn(+/-)
X	HIGH	Clock and Data Ports High Impedance

## Pin Description

Pin#	Pin Name	Signal Type	Description
A1	V <sub>CC</sub>	Power	1.5V to 5V power supply
A2	GND	Ground	Ground
A3	DA4-	I/O	Negative differential signal 4 for port A
A4	DA4+	I/O	Positive differential signal 4 for port A
A5	$\overline{\text{OE}}$	I	Output enable. if OE is low, IC is enabled. if OE is high, IC is power down and all I/Os are Hi-Z
A6	SEL	I/O	Switch logic control
B1	DB4-	I/O	Negative differential signal 4 for port B
B2	DB4+	I/O	Positive differential signal 4 for port B
B3	DA3-	I/O	Negative differential signal 3 for port A
B4	DA3+	I/O	Positive differential signal 3 for port A
B5	D4-	I/O	Negative differential signal 4 for COM port
B6	D4+	I/O	Positive differential signal 4 for COM port
C1	DB3-	I/O	Negative differential signal 3 for port B
C2	DB3+	I/O	Positive differential signal 3 for port B
C3	NC	-	Not Connect
C4	NC	-	Not Connect
C5	D3-	I/O	Negative differential signal 3 for COM port
C6	D3+	I/O	Positive differential signal 3 for COM port
D1	DB2-	I/O	Negative differential signal 2 for port B
D2	DB2+	I/O	Positive differential signal 2 for port B
D3	DA2-	I/O	Negative differential signal 2 for port A
D4	DA2+	I/O	Positive differential signal 2 for port A
D5	D2-	I/O	Negative differential signal 2 for COM port
D6	D2+	I/O	Positive differential signal 2 for COM port
E1	DB1-	I/O	Negative differential signal 1 for port B
E2	DB1+	I/O	Positive differential signal 1 for port B
E3	DA1-	I/O	Negative differential signal 1 for port A
E4	DA1+	I/O	Positive differential signal 1 for port A
E5	D1-	I/O	Negative differential signal 1 for COM port
E6	D1+	I/O	Positive differential signal 1 for COM port
F1	CLKB-	I/O	Clock negative differential signal for port B
F2	CLKB+	I/O	Clock positive differential signal for port B
F3	CLKA-	I/O	Clock negative differential signal for port A
F4	CLKA+	I/O	Clock positive differential signal for port A
F5	CLK-	I/O	Clock negative differential signal for COM port
F6	CLK+	I/O	Clock positive differential signal for COM port

## Absolute Maximum Ratings

(Above which useful life may be impaired. For user guidelines, not tested.)

V <sub>CC</sub> , Supply Voltage, .....	-0.5V to 6.0V
V <sub>CNTRL</sub> , DC Input Voltage ( $\overline{OE}$ , SEL) <sup>(1)</sup> .....	-0.5V to V <sub>CC</sub>
V <sub>SW</sub> , DC Switch I/O Voltage <sup>(1,2)</sup> .....	-0.3V to 4.0V
I <sub>IK</sub> , DC Input Diodes Current .....	-50mA
I <sub>OUT</sub> , DC Output Current .....	25mA
T <sub>STG</sub> , Storage Temperature .....	-65°C to +150°C
T <sub>j</sub> , Junction Temperature.....	125°C
ESD:	
Human Body Model, JEDEC: JESD22-A114, All Pins .....	2.0kV
Charged Device Model, JEDEC: JESD22-C101.....	1.0kV

### Note:

Stresses greater than those listed under MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

### Note:

1. The input and output negative ratings may be exceeded if the input and output diode current ratings are observed.
2. V<sub>SW</sub> refers to analog data switch paths.

## Recommended Operating Conditions

The Recommended operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications.

Symbol	Description	Test Conditions	Min.	Max.	Units
V <sub>CC</sub>	Supply Voltage		1.5	5.0	V
V <sub>CNTRL</sub>	Control Input Voltage (SEL, $\overline{OE}$ ) <sup>(1)</sup>		0	V <sub>CC</sub>	V
V <sub>SW</sub>	Switch I/O Voltage (CLK-, D-, CLKA-, CLKB-, DA-, DB-)	- HS Mode	0	0.5	V
		- LP Mode	0	1.3	V
T <sub>A</sub>	Operating Temperature		-40	+85	°C

### Note:

1. The control inputs must be held HIGH or LOW; they must not float.

## DC and Transient Characteristics

All typical values are at T<sub>A</sub> = 25°C unless otherwise specified.

Symbol	Description	Test Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> = -40°C to +85°C			Units
				Min.	Typ.	Max.	
V <sub>IK</sub>	Clamp Diode Voltage ( $\overline{OE}$ , SEL)	I <sub>IN</sub> = -18mA	1.5	-1.2		-0.6	V
V <sub>IH</sub>	Input Voltage High	SEL, $\overline{OE}$	1.5 to 5	1.3			V
V <sub>IL</sub>	Input Voltage Low	SEL, $\overline{OE}$	1.5 to 5			0.5	V
I <sub>IN</sub>	Control Input Leakage ( $\overline{OE}$ , SEL)	V <sub>CNTRL</sub> = 0 to V <sub>CC</sub>	5	-0.5		0.5	μA
I <sub>NO(OFF)</sub> I <sub>NC(OFF)</sub>	Off Leakage Current of Port CLKA-, DA-, CLKB- and DB-	V <sub>SW</sub> = 0.0 ≤ DATA ≤ 1.3V	5	-0.5		0.5	μA
I <sub>A(ON)</sub>	On Leakage Current of Common Ports (CLK-, D-)	V <sub>SW</sub> = 0.0 ≤ DATA ≤ 1.3V	5	-0.5		0.5	μA

**DC and Transient Characteristics Cont.**

Symbol	Description	Test Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> = -40°C to +85°C			Units
				Min.	Typ.	Max.	
I <sub>OFF</sub>	Power-Off Leakage Current (All I/O Ports)	V <sub>SW</sub> = 0.0 or 1.3V	0	-0.5		0.5	μA
I <sub>OZ</sub>	Off-State Leakage	V <sub>SW</sub> = 0.0 ≤ DATA ≤ 1.3V, OE = High	5	-0.5		0.5	μA
R <sub>ON_MIPI_HS</sub>	Switch On Resistance for HS MIPI	I <sub>ON</sub> = -8mA, OE = 0V, SEL = V <sub>CC</sub> or 0V, CLKA, CLKB, DB- or DA- = 0.2V	1.5		6		Ω
			2.5				
			3.3				
			5				
R <sub>ON_MIPI_LP</sub>	Switch On Resistance for LP MIPI	I <sub>ON</sub> = -8mA, OE = 0V, SEL = V <sub>CC</sub> or 0V, CLKA, CLKB, DB- or DA- = 1.2V	1.5		6		Ω
			2.5				
			3.3				
			5				
ΔR <sub>ON_MIPI_HS</sub>	On Resistance Matching Between HS MIPI Channels <sup>(1)</sup>	I <sub>ON</sub> = -8mA, OE = 0V, SEL = V <sub>CC</sub> or 0V, CLKA, CLKB, DB- or DA- = 0.2V	1.5		0.1		Ω
			2.5				
			3.3				
			5				
ΔR <sub>ON_MIPI_LP</sub>	On Resistance Matching Between LP MIPI Channels <sup>(1)</sup>	I <sub>ON</sub> = -8mA, OE = 0V, SEL = V <sub>CC</sub> or 0V, CLKA, CLKB, DB- or DA- = 1.2V	1.5		0.1		Ω
			2.5				
			3.3				
			5				
R <sub>ON_FLAT_MIPI_HS</sub>	On Resistance Flatness for HS MIPI	I <sub>ON</sub> = -8mA, OE = 0V, SEL = V <sub>CC</sub> or 0V, CLKA, CLKB, DB- or DA- = 0 to 0.3V	1.5		0.3		Ω
			2.5				
			3.3				
			5				
R <sub>ON_FLAT_MIPI_LP</sub>	On Resistance Flatness for LP MIPI	I <sub>ON</sub> = -8mA, OE = 0V, SEL = V <sub>CC</sub> or 0V, CLKA, CLKB, DB- or DA- = 0 to 1.3V	1.5		0.3		Ω
			2.5				
			3.3				
			5				
I <sub>CC</sub>	Quiescent Supply Current	V <sub>SEL</sub> = 0 or V <sub>CC</sub> , I <sub>OUT</sub> = 0, OE = 0V	5		15	30	μA
I <sub>CCZ</sub>	Quiescent Supply Current (High Impedance)	V <sub>SEL</sub> = 0 or V <sub>CC</sub> , I <sub>OUT</sub> = 0, OE = 0V	5			1	μA
I <sub>CCCT</sub>	Increase in I <sub>CC</sub> Current Per Control Voltage and V <sub>CC</sub>	V <sub>SEL</sub> = 0 or V <sub>CC</sub> , OE = 1.5V	5		1		μA

## AC Electrical Characteristics

All typical values are for  $V_{CC} = 3.3V$  and  $T_A = 25^\circ C$  unless otherwise specified.

Symbol	Description	Test Conditions	$V_{CC}$ (V)	$T_A = -40^\circ C$ to $+85^\circ C$			Units
				Min.	Typ.	Max.	
$t_{INIT}$	Initialization Time $V_{CC}$ to Output <sup>(1)</sup>	$R_L = 50\Omega$ , $C_L = 0pF$ , $V_{SW} = 0.6V$	1.5 to 5		60		$\mu s$
$t_{EN}$	Enable Time $\overline{OE}$ to Output	$R_L = 50\Omega$ , $C_L = 0pF$ , $V_{SW} = 0.6V$	1.5 to 5		60	150	$\mu s$
$t_{DIS}$	Disable Time $\overline{OE}$ to Output	$R_L = 50\Omega$ , $C_L = 0pF$ , $V_{SW} = 0.6V$	1.5 to 5		35	250	ns
$t_{ON}$	Turn-On Time SEL to Output	$R_L = 50\Omega$ , $C_L = 0pF$ , $V_{SW} = 0.6V$	1.5 to 5		350	1100	ns
$t_{OFF}$	Turn-Off Time SEL to Output	$R_L = 50\Omega$ , $C_L = 0pF$ , $V_{SW} = 0.6V$	1.5 to 5		125	800	ns
$t_{BBM}$	Break-Before-Make Time	$R_L = 50\Omega$ , $C_L = 0pF$ , $V_{SW} = 0.6V$	1.5 to 5			450	ns
$t_{PD}$	Propagation Delay <sup>(1)</sup>	$C_L = 0pF$ , $R_L = 50\Omega$	1.5 to 5			0.25	ns
$O_{IRR}$	Off Isolation for MIPI <sup>(1)</sup>	$R_L = 50\Omega$ , $f = 1250MHz$ , $\overline{OE} = HIGH$ , $V_{SW} = 0.2V_{PP}$	1.5 to 5		-26		dB
$X_{TALK}$	Crosstalk for MIPI <sup>(1)</sup>	$R_L = 50\Omega$ , $f = 1250MHz$ , SEL = HIGH, $V_{SW} = 0.2V_{PP}$	1.5 to 5			-30	dB
		$R_L = 50\Omega$ , $f = 1250MHz$ , SEL = LOW, $V_{SW} = 0.2V_{PP}$				-30	
$I_{LOSS}$	Insertion Loss <sup>(1)</sup>	$R_L = 50\Omega$ , $C_L = 0pF$ , $f = 1250MHz$ , $V_{SW} = 0.2V_{PP}$	1.5 to 5		-0.9		dB
		$R_L = 50\Omega$ , $C_L = 0pF$ , $f = 750MHz$ , $V_{SW} = 0.2V_{PP}$	1.5 to 5		-0.7		
BW	-3db Bandwidth <sup>(1)</sup>	$R_L = 50\Omega$ , $C_L = 0pF$ , $V_{SW} = 0.2V_{PP}$	1.5 to 5	3.0	4.5		GHz

**Note:**

1. Guaranteed by characterization.

## High-Speed-Related AC Electrical Characteristics

Symbol	Description	Test Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> = -40°C to +85°C			Units
				Min.	Typ.	Max.	
t <sub>SK(P)</sub>	HS Mode Skew of Opposite Transitions of the Same Output <sup>(1)</sup>	R <sub>L</sub> = 50Ω, C <sub>L</sub> = 0pF, V <sub>SW</sub> = 0.3V	1.5 to 5		2	4	ps
	HS Mode Slew of all group A or group B channels <sup>(1)</sup>	R <sub>L</sub> = 50Ω, C <sub>L</sub> = 0pF, V <sub>SW</sub> = 0.3V	1.5 to 5		4	7	

**Note:**

1. Guaranteed by characterization.

## Capacitance

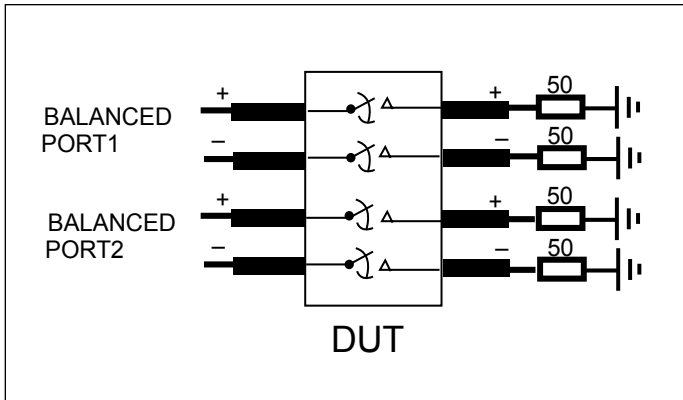
Symbol	Description	Test Conditions	T <sub>A</sub> = -40°C to +85°C			Units
			Min.	Typ.	Max.	
C <sub>IN</sub>	Control Pin Input Capacitance <sup>(1)</sup>	V <sub>CC</sub> = 0V, f = 1MHz		2.1		pF
C <sub>ON</sub>	On Capacitance <sup>(1)</sup>	V <sub>CC</sub> = 3.3V, $\overline{\text{OE}}$ = 0V, f = 1250MHz (In HS common value)		1.5		pF
C <sub>OFF</sub>	Off Capacitance <sup>(1)</sup>	V <sub>CC</sub> or $\overline{\text{OE}}$ = 3.3V, f = 1250MHz (Both sides in HS common value)		0.9		pF

**Note:**

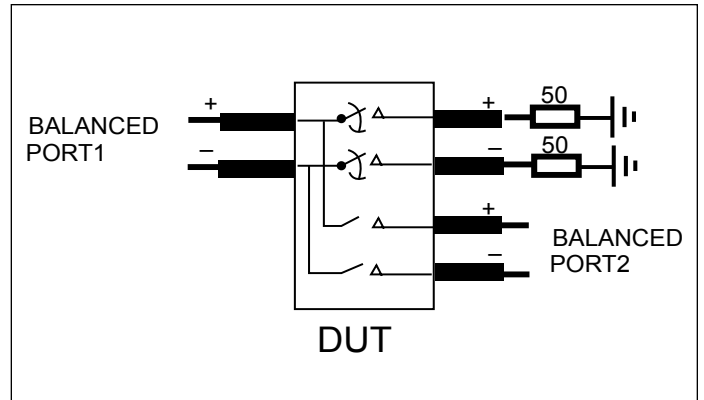
1. Guaranteed by characterization.



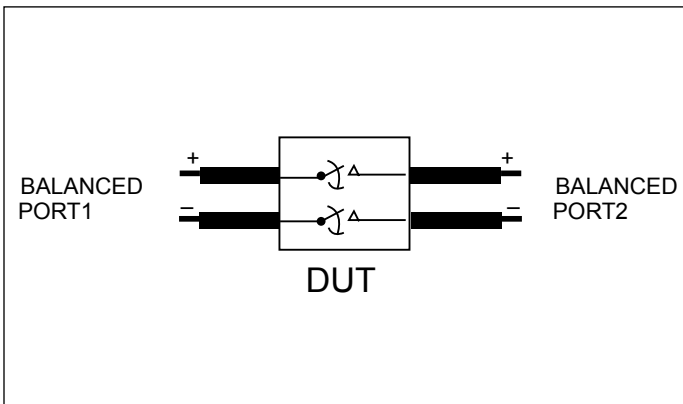
**PI3WVR646**



**Fig 1. Crosstalk Setup**

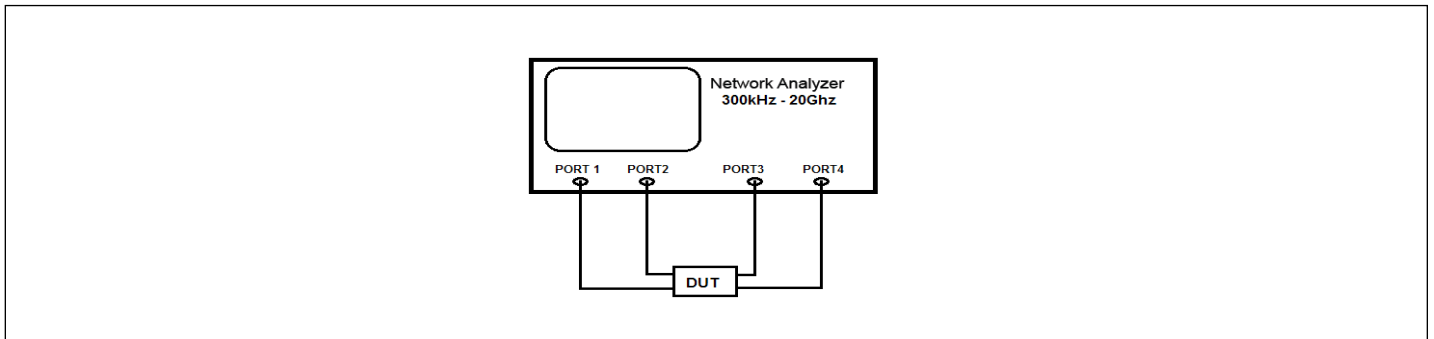


**Fig 2. Off-isolation setup**

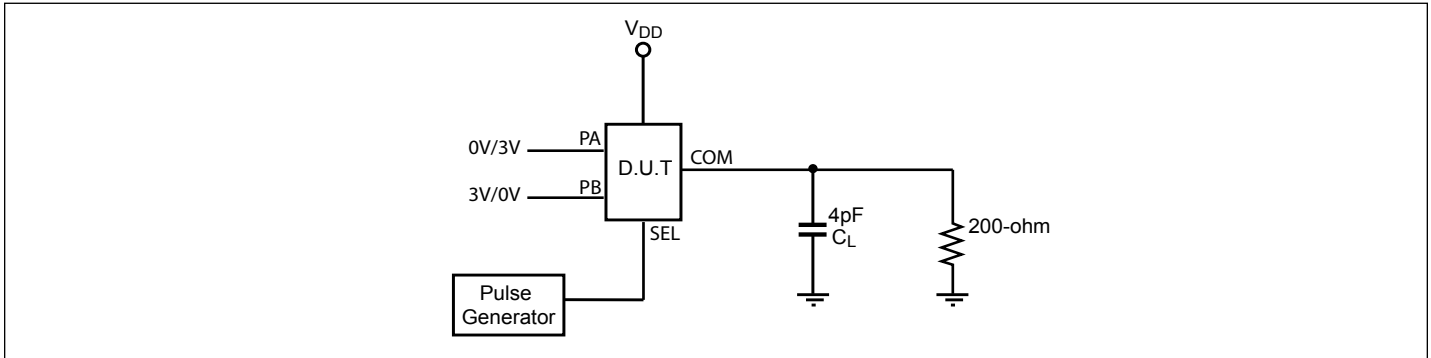


**Fig 3. Differential Insertion Loss**

**Test Circuit for Dynamic Electrical Characteristics**



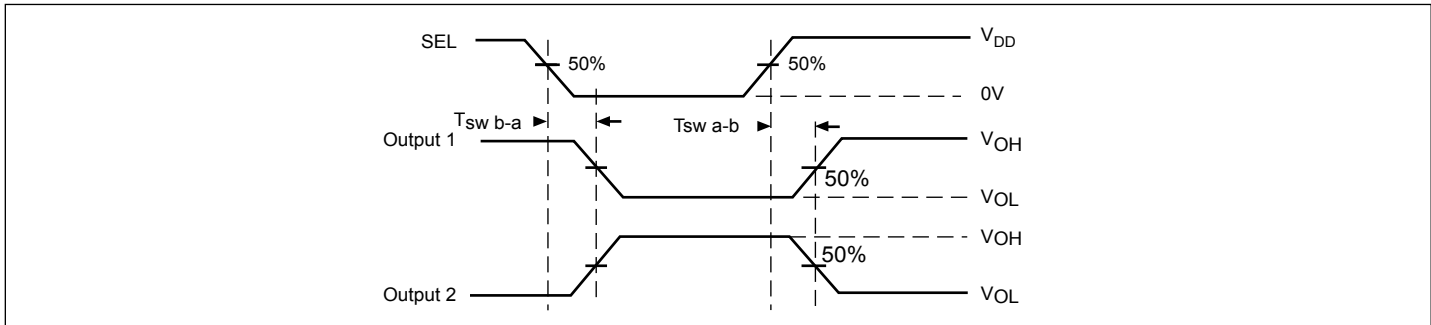
**Test Circuit for Electrical Characteristics<sup>(1-4)</sup>**



**Notes:**

1.  $C_L$  = Load capacitance: includes jig and probe capacitance.
2.  $R_T$  = Termination resistance: should be equal to  $Z_{OUT}$  of the Pulse Generator
3. All input impulses are supplied by generators having the following characteristics:  $PRR \leq \text{MHz}$ ,  $Z_O = 50\Omega$ ,  $t_R \leq 2.5\text{ns}$ ,  $t_F \leq 2.5\text{ns}$ .
4. The outputs are measured one at a time with one transition per measurement.

**Switching Waveforms**



**Voltage Waveforms for Select Timing**

**Test Condition**

Output 1 Test Condition	Output 2 Test Condition
PA = Low	PA = High
PB = High	PB = Low

**Part Marking**

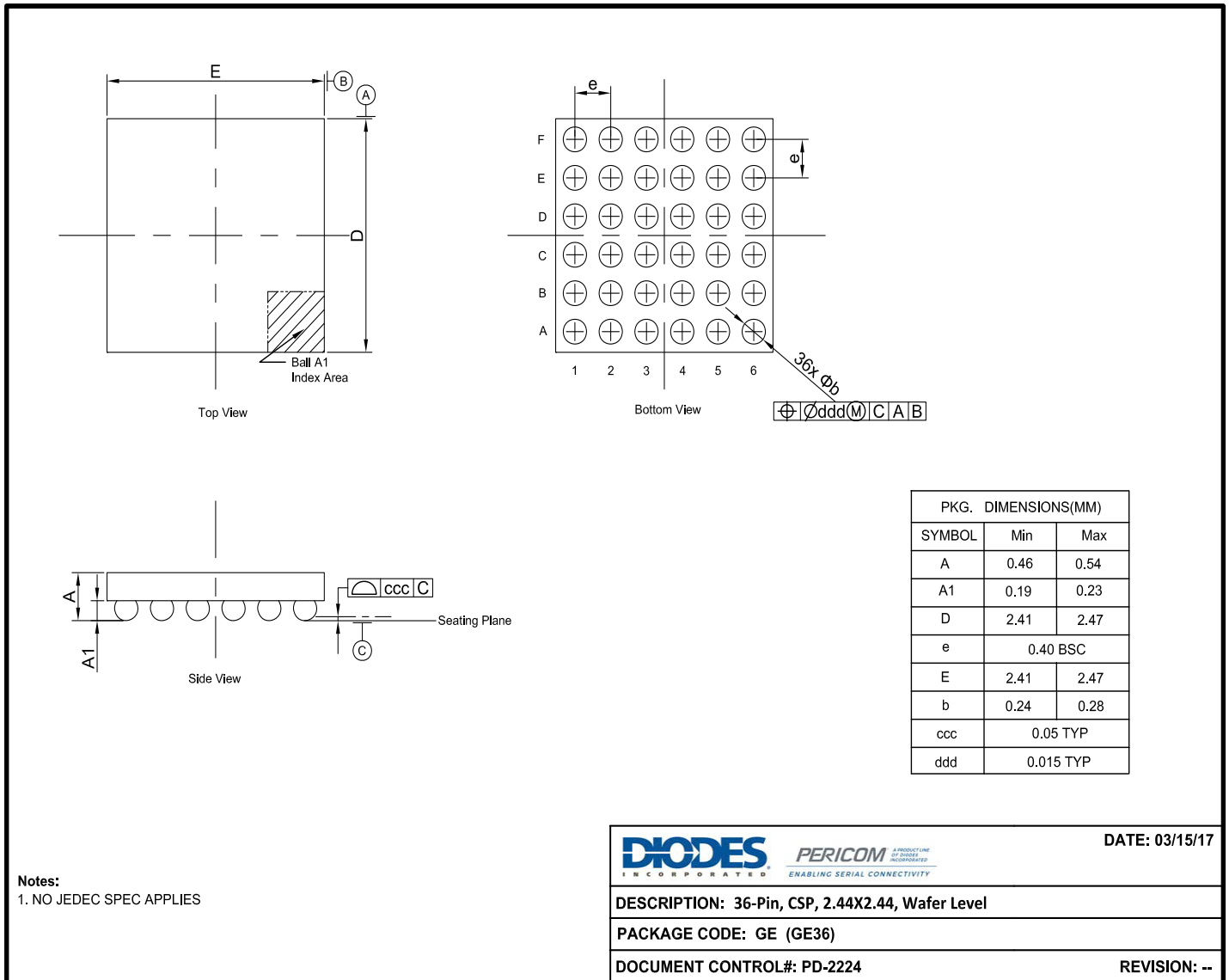
CSP Package



Z: Die Rev  
 YY: Year  
 WW: Workweek  
 1st X: Assembly Site Code  
 2nd X: Fab Site Code

**PI3WVR646**

**Packaging Mechanical: 36-CSP (GE)**



For latest package info.

please check: <http://www.diodes.com/design/support/packaging/pericom-packaging/packaging-mechanicals-and-thermal-characteristics/>

**Ordering Information**

Ordering Code	Package Code	Package Description
PI3WVR646GEEX	GE	36-Pin, 2.44x2.44, Wafer Level (CSP)

**Notes:**

1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See <http://www.diodes.com/quality/lead-free/> for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free. Thermal characteristics can be found on the company web site at [www.diodes.com/design/support/packaging/](http://www.diodes.com/design/support/packaging/)
3. E = Pb-free and Green
4. X suffix = Tape/Reel

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