A product Line of
Diodes Incorporated

PI3WVR12412

HDMI 2.0, DisplayPort 1.2 Video Switch

Features

- 4-lane, 1:2 mux/demux that will support RBR, HBR1, or HBR2
- Data rate: 3.4 Gbps to 6.0 Gbps for high data channels
- Supports DDC with HPD channel mux/demux @ HDMI
- Supports 720 Mbps high-speed DP AUX @ DP
- -1.7 dB Insertion Loss for Dx channels @ 3.0 GHz
- -3 dB Bandwidth for Dx channels: 4.8 GHz
- Return loss for Dx channels @ 3.0 GHz: -16 dB
- Low Crosstalk for high speed channels: -25 dB@6.0 Gbps
- Low Off Isolation for high speed channels: -22dB@6.0 Gbps
- Low channel-to-channel skew, 35ps max
- Low Bit-to-Bit Skew, 5ps typ (between '+' and '-' bits)
- V_{DD} Operating Range: 3.3V +/-10%
- ESD Tolerance: 2kV HBM
- Packaging (Pb-free & Green): 42 TQFN (ZHE)

Description

The PI3WVR12412 is a multi-standard video switch with wide voltage range capability. It supports HDMI 2.0, DisplayPort 1.2, and emerging and proprietary standard.

PI3WVR12412 can pass high-speed signals up to 1.2 V peak-to-peak differential with a common-mode voltage from 0 to 3.4V for TMDS signal.

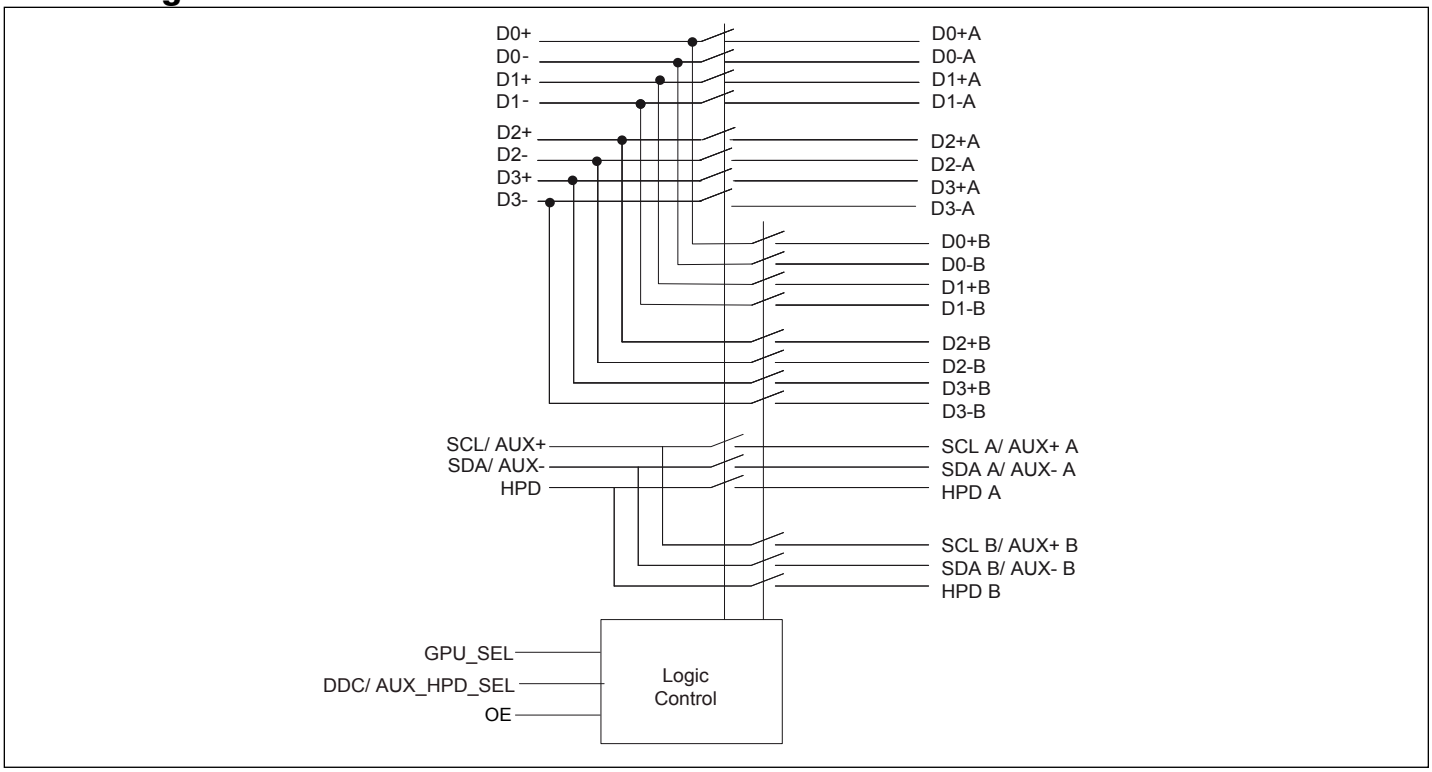
The wide voltage range allow DC-coupled multi-standard operation. Eliminating AC coupling capacitors saves board space and improves signal integrity for dense PCB design. The high speed channels can also pass 0V-3.3V CMOS signals up to 1MHz.

In addition to four high-speed lanes, PI3WVR12412 also switches the DDC and HPD signals or AUX and HPD signals using the DDC/ AUX and HPD channel mux/demux.

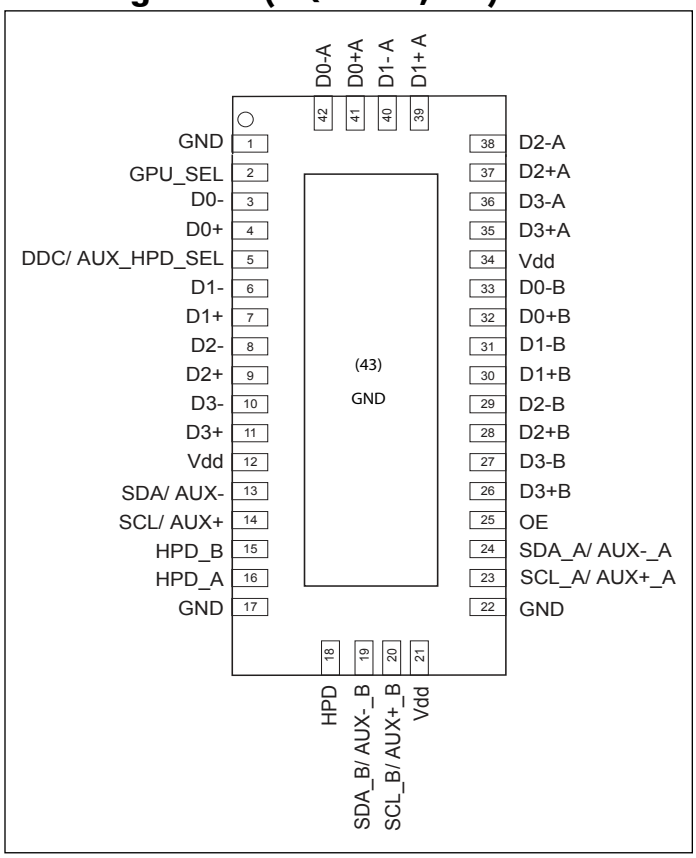
Application

- Routing of HDMI 2.0 video signals with low signal attenuation between source and sink for 4K2K ultra high definition video display and broadcast video equipment.
- Routing of DisplayPort video signals with low signal attenuation between source and sink for PC and monitor.

Block Diagram



Pin Assignment (TQFN-42, ZH)



Truth Table

Control			Switch Function		
OE	**GPU_SEL**	**DDC/ AUX_HPD_SEL**	**D0-D3**	**DDC/ AUX**	**HPD**
High	Low	Low	A	DDC A/ AUX A	HPD A
High	Low	High	A	DDC B/ AUX B	HPD B
High	High	Low	B	DDC A/AUX A	HPD A
High	High	High	B	DDC B/ AUX B	HPD B
Low	x	x	Hi-Z	Hi-Z	Hi-Z

Pin Description

Pin#	Pin Name	Signal Type	Description
1	GND	Ground	Ground
2	GPU_SEL	I	switch logic control
3	D0-	I/O	negative differential signal 0 for COM port
4	D0+	I/O	positive differential signal 0 for COM port
5	DDC/ AUX_HPD_SEL	I	Switch logic control for DDC/ AUX and HPD
6	D1-	I/O	negative differential signal 1 for COM port
7	D1+	I/O	positive differential signal 1 for COM port
8	D2-	I/O	negative differential signal 2 for COM port
9	D2+	I/O	positive differential signal 2 for COM port
10	D3-	I/O	negative differential signal 3 for COM port
11	D3+	I/O	positive differential signal 3 for COM port
12	VDD	Power	3.3V +/-10% power supply
13	SDA/ AUX-	I/O	SDA signal for DDC COM port, or negative differential signal for AUX COM port
14	SCL/ AUX+	I/O	SCLl signal for DDC COM port, or positive differential signal for AUX COM port
15	HPD_B	I/O	HPD for port B
16	HPD_A	I/O	HPD for port A
17	GND	Ground	Ground
18	HPD	I/O	HPD for COM port
19	SDA_B/ AUX-_B	I/O	SDA signal for DDC, port B, or negative differential signal for AUX COM port
20	SCL_B/ AUX+_B	I/O	SCL signal for DDC, port B, or positive differential signal for AUX COM port
21	VDD	Power	3.3V +/-10% power supply
22	GND	Ground	Ground
23	SCL_A/ AUX+_A	I/O	SCL signal for DDC, port A, or positive differential signal for AUX COM port
24	SDA_A/ AUX-_A	I/O	SDA signal for DDC, port A, or negative differential signal for AUX COM port
25	OE	I	output enable. if OE is high, IC is enabled. if OE is low, IC is power down and all I/Os are Hi-Z
26	D3+B	I/O	positive differential signal 3 for portB
27	D3-B	I/O	negative differential signal 3 for portB
28	D2+B	I/O	positive differential signal 2 for portB
29	D2-B	I/O	negative differential signal 2 for portB
30	D1+B	I/O	positive differential signal 1 for portB
31	D1-B	I/O	negative differential signal 1 for portB

Pin#	Pin Name	Signal Type	Description
32	D0+B	I/O	positive differential signal 0 for portB
33	D0-B	I/O	negative differential signal 0 for portB
34	VDD	Power	3.3V +/-10% power supply
35	D3+A	I/O	positive differential signal 3 for port A
36	D3-A	I/O	negative differential signal 3 for port A
37	D2+A	I/O	positive differential signal 2 for port A
38	D2-A	I/O	negative differential signal 2 for port A
39	D1+A	I/O	positive differential signal 1 for port A
40	D1-A	I/O	negative differential signal 1 for port A
41	D0+A	I/O	positive differential signal 0 for port A
42	D0-A	I/O	negative differential signal 0 for port A
43	Center pad	Ground	Ground

Maximum Ratings

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

Storage Temperature	–65°C to +150°C
Junction Temperature	125°C
Supply Voltage to Ground Potential	–0.5V to +4.2V
High Speed Data Channel	–0.5V to 3.8V
HPD_x, SDA_x, SCL_x	–0.5V to 5.5V
DC Input Voltage	–0.5V to V_{DD}
DC Output Current	120mA
Power Dissipation	0.5W

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.

DC Electrical Characteristics for Switching over Operating Range

(T_A = –40°C to +105°C, V_{DD} = 3.3V ±10%)

Parameter	Description	Test Conditions(1)	Min.	Typ.(2)	Max.	Units
V_{IH}	Input HIGH Voltage (SEL & OE)	Guaranteed HIGH level	1.5			V
V_{IL}	Input LOW Voltage (SEL & OE)	Guaranteed LOW level			0.75	
V_{IK}	Clamp Diode Voltage (HS Channel)	V_{DD} = Max., I_{IN} = –18mA		–1.6V	–1.8	
V_{IK}	Clamp Diode Voltage (DDC/ AUX, Cntrl)	V_{DD} = Max., I_{IN} = –18mA		–0.7	–1.5	
IIH	Input HIGH Current	V_{DD} = Max., V_{IN} = V_{DD}			±5	µA
I_{IL}	Input LOW Current	V_{DD} = Max., V_{IN} = GND			±5	
I_{OFF_SB}	I/O leakage when part is off for side-band signals only (DDC/ AUX, HPD)	V_{DD} = 0V, V_{INPUT} = 0V to 3.6V			20	
R_{ON_HS}	On resistance between input to output for high speed signals	$V_{INPUT,cm}$ = 0V to 3.4V, $V_{INPUT,diff}$ < $1.2V_{p-p,diff}$, V_{DD} = 3.0V, I_{INPUT} = 20mA		11		Ohm
$R_{ON\_DDC/\ AUX}$	On resistance between input to output for side-band signals (DDC/ AUX)	V_{DD} = 3.0V, Vinput = 0 to 3.3V, I_{INPUT} = 20mA		7		Ohm
R_{ON_HPD}	On resistance between input to output for HPD channel	V_{DD} = 3.0V, Vinput = 0 to 3.0V, I_{INPUT} = 20mA		7		Ohm
$V_{DDC/\ AUX\_SS}$	Signal Swing Tolerance in DDC/ AUX path	V_{DD} = 3.0V	–0.5		5.5	V
V_{HPD_I}	Input voltage on HPD path				5.5	V
V_{HPD_O}	Output voltage tolerance on HPD path	HPD input from 3.3V to 5.25V		3.3	3.6	V

Power Supply Characteristics

(T_A = –40°C to +105°C)

Parameter	Description	Test Conditions(1)	Min.	Typ.(2)	Max.	Units
I_{DD}	Power Supply Current	V_{DD} = 3.3V, V_{IN} = GND or V_{DD}		1	3	mA
$I_{DD,Off}$	Power Supply Current, Disabled	V_{DD} = 3.3V, V_{IN} = GND or V_{DD}, V_{OE} < V_{IL}		1	50	µA

Note:

1. For Max. or Min. conditions, use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values are at V_{DD} = 3.3V, T_A = 25°C ambient and maximum loading.

Dynamic Electrical Characteristics over Operating Range

(T_A = -40° to +105°C, V_{DD} = 3.3V ±10%)

Parameter	Description	Test Conditions(1)		Min.	Typ.(2)	Max.	Units
X_{TALK}	Crosstalk on High Speed Channels	See Fig. 1 for Measurement Setup	f= 3.0 GHz		-25	-22	dB
			f= 2.7 GHz		-28	-25	
			f = 1.7 GHz		-31	-28	
			f = 1.35 GHz		-32	-28	
O_{IRR}	OFF Isolation on High Speed Channels	See Fig. 2 for Measurement Setup	f= 3.0 GHz		-22	-20	
			f= 2.7 GHz		-22	-20	
			f = 1.7 GHz		-29	-26	
			f = 1.35 GHz		-30	-27	
I_{LOSS}	Differential Insertion Loss on High Speed Channels	@3.0 GHz (see figure 3)		-2.0	-1.7		dB
		@5.4 Gbps (see figure 3)		-2.0	-1.7		
R_{loss}	Differential Return Loss on high speed channels	@ 3.0 GHz (6.0Gbps)			-16.0	-14	dB
		@ 2.7 GHz (5.4Gbps)			-14.0	-12.5	
BW_Dx±	Bandwidth -3dB for Main high speed path (Dx±)	See figure 3		3.7	4.8		GHz
BW_DDC/ AUX/ HPD	-3dB BW for DDC/ AUX and HPD signals	See figure 3		1.35	1.5		GHz

Note:

1. For Max. or Min. conditions, use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values are at V_{DD} = 3.3V, T_A = 25°C ambient and maximum loading.

Switching Characteristics

(T_A= -40° to +105°C, V_{DD} = 3.3V±10%)

Parameter	Description	Min.	Typ.	Max.	Units
T_{pd}	Propagation delay (input pin to output pin) on all channels		80		ps
t_{b-b}	Bit-to-bit skew within the same differential pair of Dx± channels		5	7	ps
t_{ch-ch}	Channel-to-channel skew of Dx± channels			35	ps
Tsw a-b	time it takes to switch from port A to port B			0.1	us
Tsw b-a	time it takes to switch from port B to port A			0.1	us
Tstartup	V_{DD} valid to channel enable			10	us
Twakeup	Enabling output by changing OE from low to High			10	us

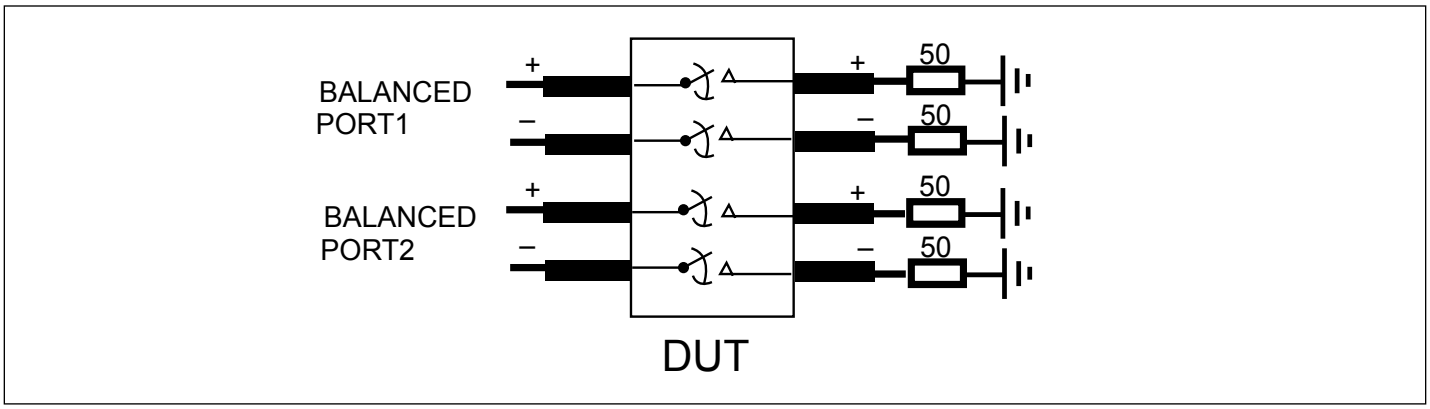


Fig 1. Crosstalk Setup

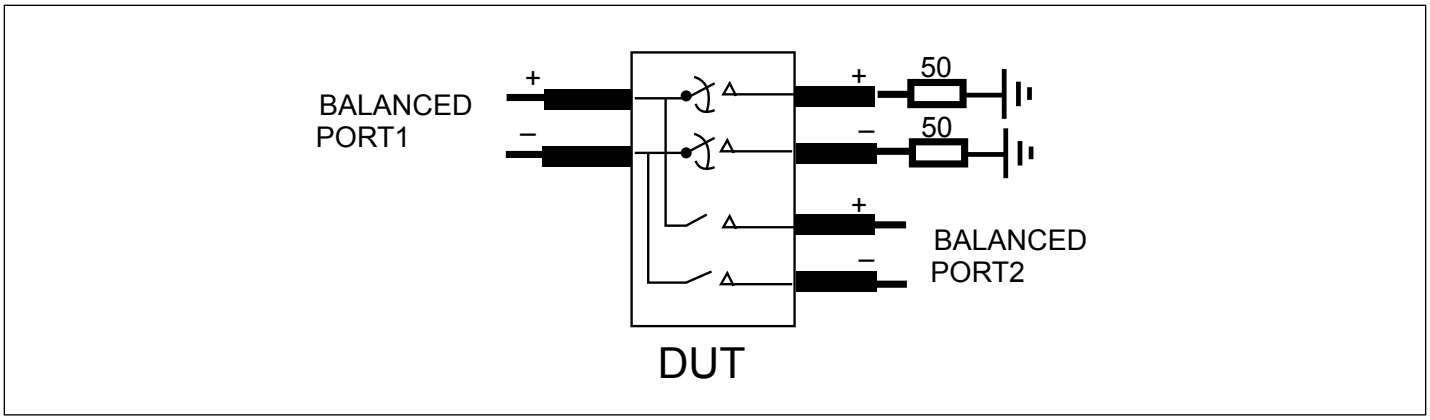


Fig 2. Off-isolation setup

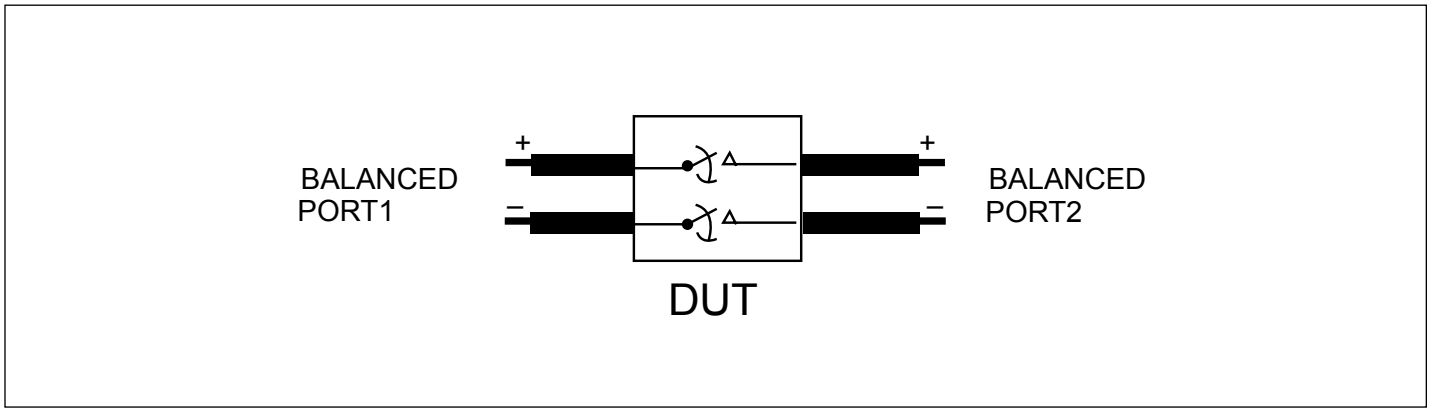
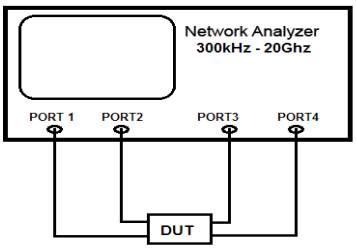


Fig 3. Differential Insertion Loss

Test Circuit for Dynamic Electrical Characteristics



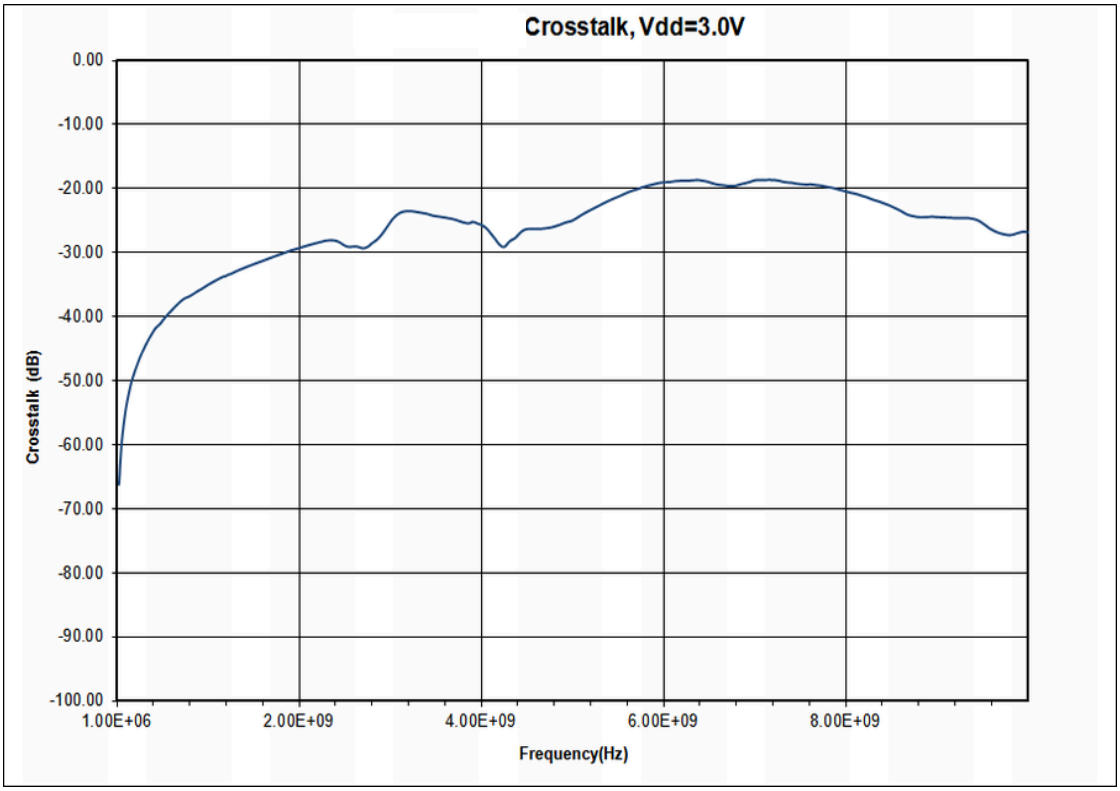


Fig 4. Crosstalk

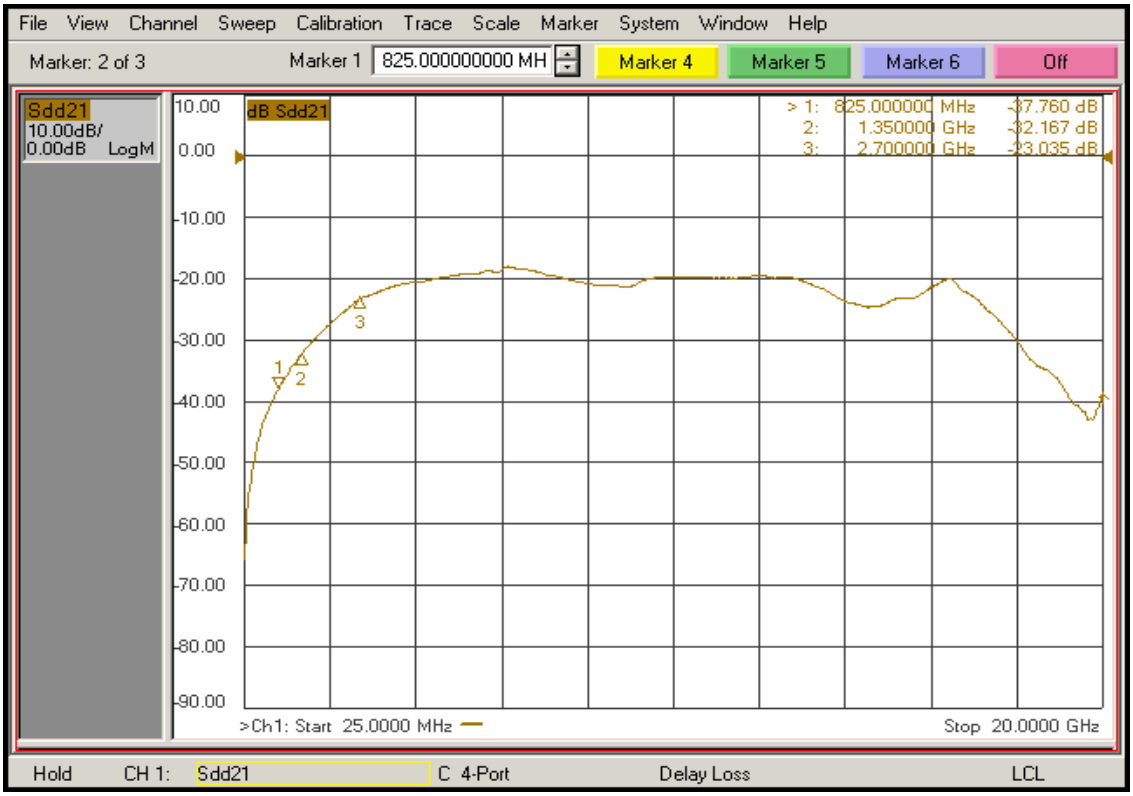


Fig 5. Off Isolation

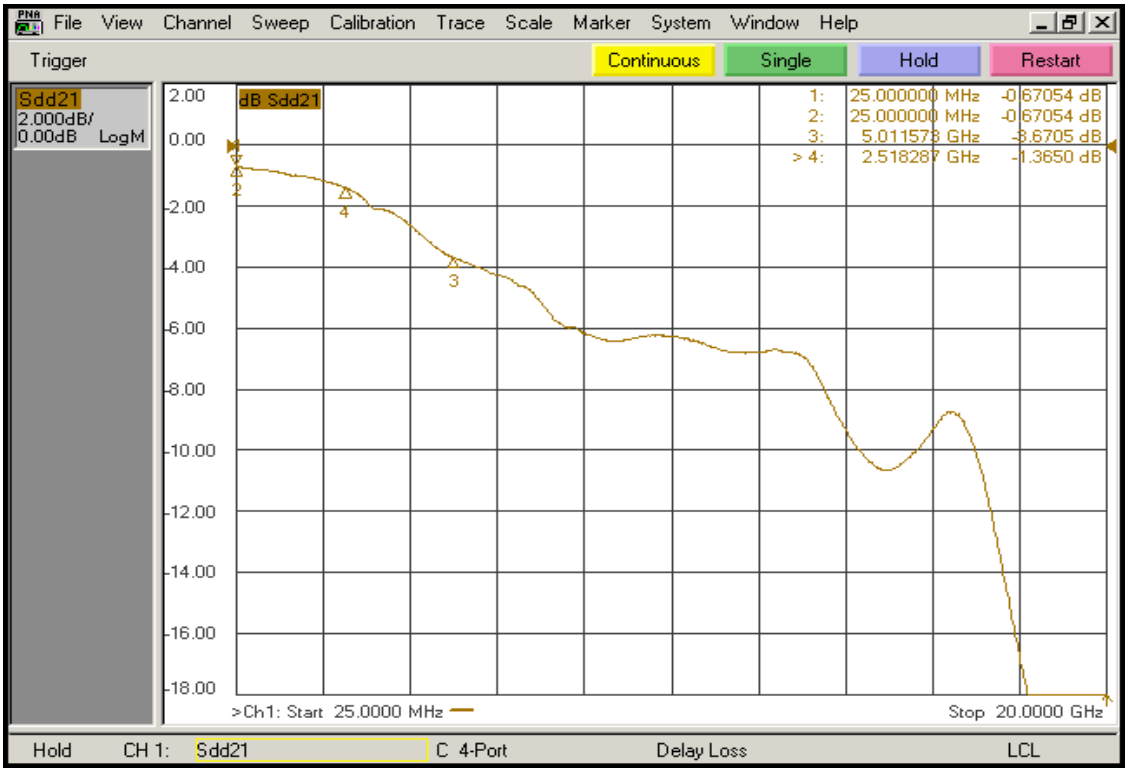


Fig 6. Insertion Loss

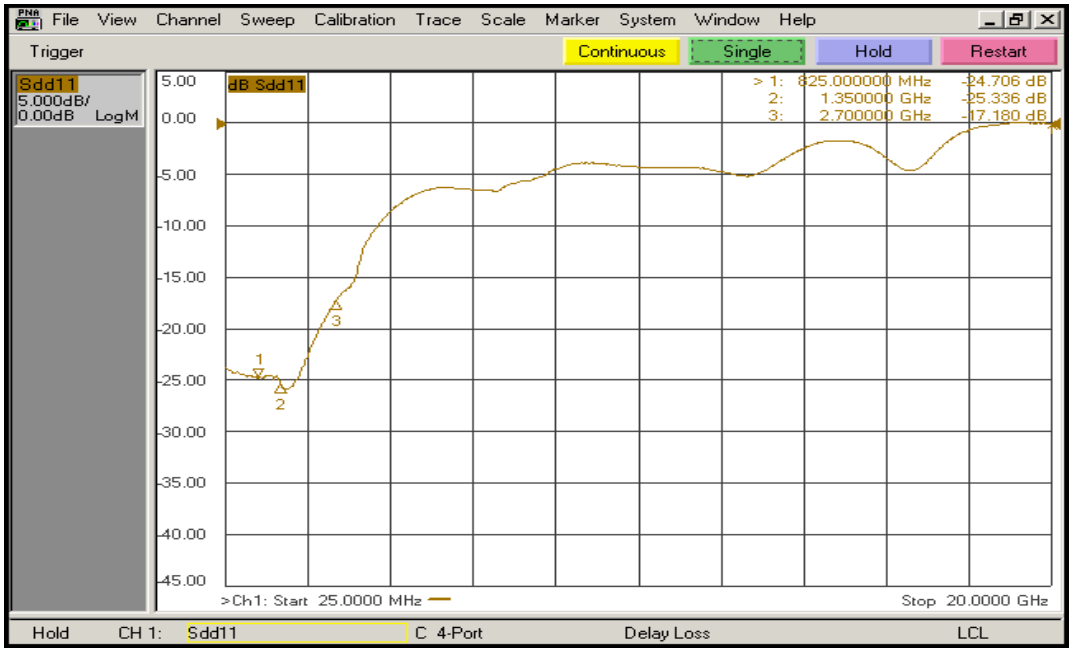


Fig 7. Return Loss

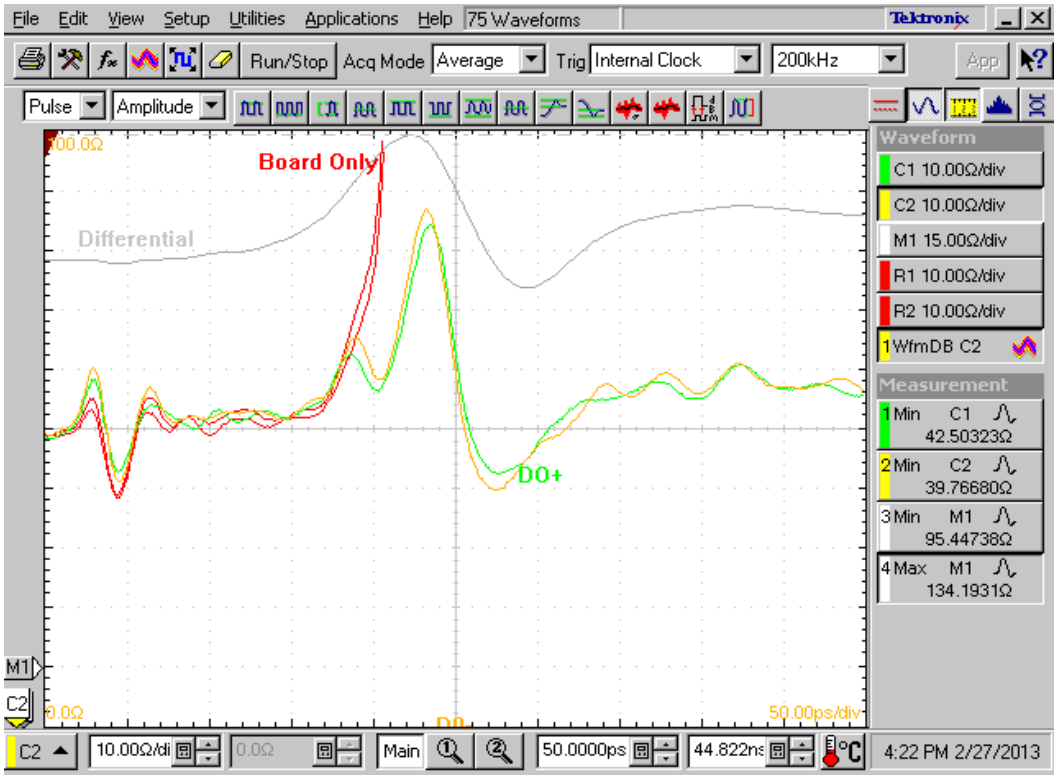
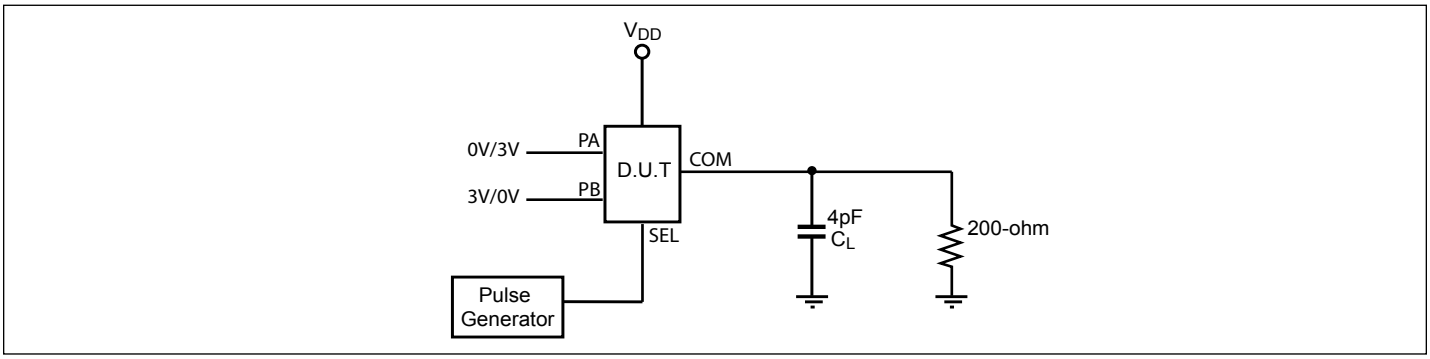


Fig 8. TDR Channel D0, VDD=3.0V, 25C

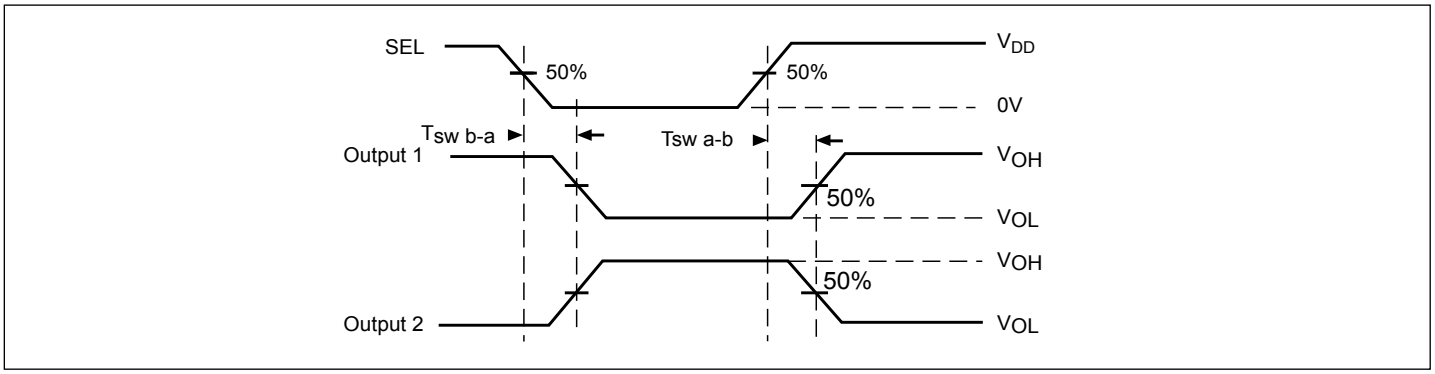
Test Circuit for Electrical Characteristics(1-4)



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 ≤ MHz, Z_O = 50Ω, t_R ≤ 2.5ns, t_F ≤ 2.5ns.
4. The outputs are measured one at a time with one transition per measurement.

Switching Waveforms

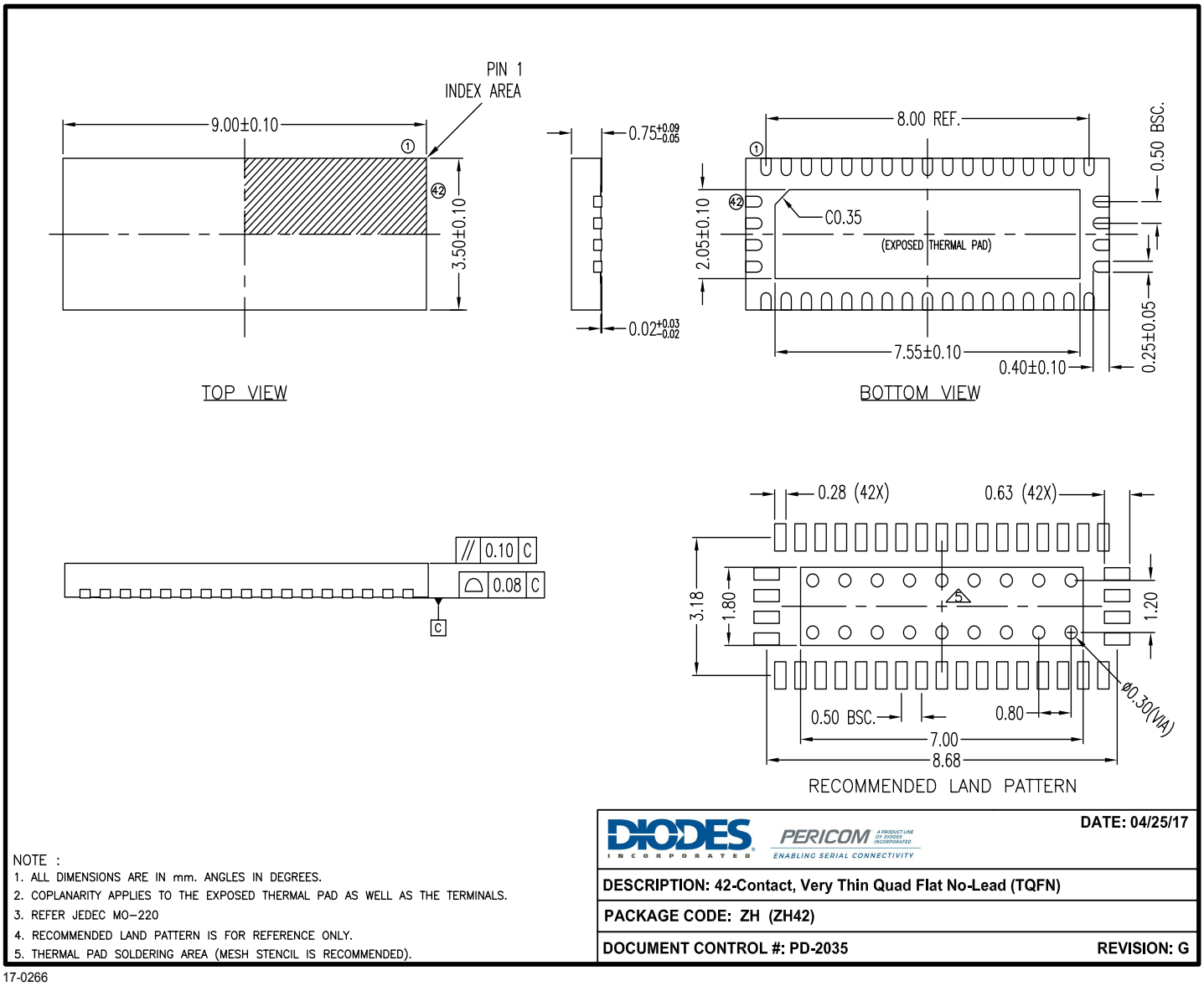


Voltage Waveforms for Select Timing

Test Condition

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

Packaging Mechanical: 42ZH



NOTE :
1. ALL DIMENSIONS ARE IN mm. ANGLES IN DEGREES.
2. COPLANARITY APPLIES TO THE EXPOSED THERMAL PAD AS WELL AS THE TERMINALS.
3. REFER JEDEC MO−220
4. RECOMMENDED LAND PATTERN IS FOR REFERENCE ONLY.
5. THERMAL PAD SOLDERING AREA (MESH STENCIL IS RECOMMENDED).

DATE: 04/25/17

DESCRIPTION: 42-Contact, Very Thin Quad Flat No-Lead (TQFN)

PACKAGE CODE: ZH (ZH42)

DOCUMENT CONTROL #: PD-2035 REVISION: G

17-0266

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
PI3WVR12412ZHEX	ZH	42-contact, Very Thin Quad Flat No-Lead (TQFN) (W24)
PI3WVR12412ZHE+DRX	ZH	42-contact, Very Thin Quad Flat No-Lead (TQFN) (W16)

Notes:

- Thermal characteristics can be found on the company web site at www.diodes.com/design/support/packaging/
- E = Pb-free and Green
- X suffix = Tape/Reel

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