

**PI3WVR31212A**

**DP/HDMI 1:2 De-multiplexer switches**

**Features**

- DP/HDMI 1:2 De-multiplexer switch with 4 high speed differential channel and AUX/DDC, HPD and CAB\_DET signal channels
- One passive output ports for DP1.2 at 5.4Gbps
- One active output port with integrated DP to HDMI re-driver (level shifter) supports HDMI 1.4 at 3.4Gbps
- Pin control mode supports auto port priority selection
- Pin control mode supports port2 with DDC bi-direction buffer switch only
- I2C control mode supports auto port priority selection
- I2C control mode supports port2 with 8 levels equalization and 5 levels pre-emphasis
- I2C control mode supports port2 with either DDC bi-direction buffer switch or DDC passive switch
- Very low operating power when passive port1 is selected
- 3.3V power supply
- 2KV HBM ESD protection for all I/O pins
- Support Type 2 cable ID register
- Packaging:  
60 pin TQFN package (5x9mm, 0.4mm pitch)

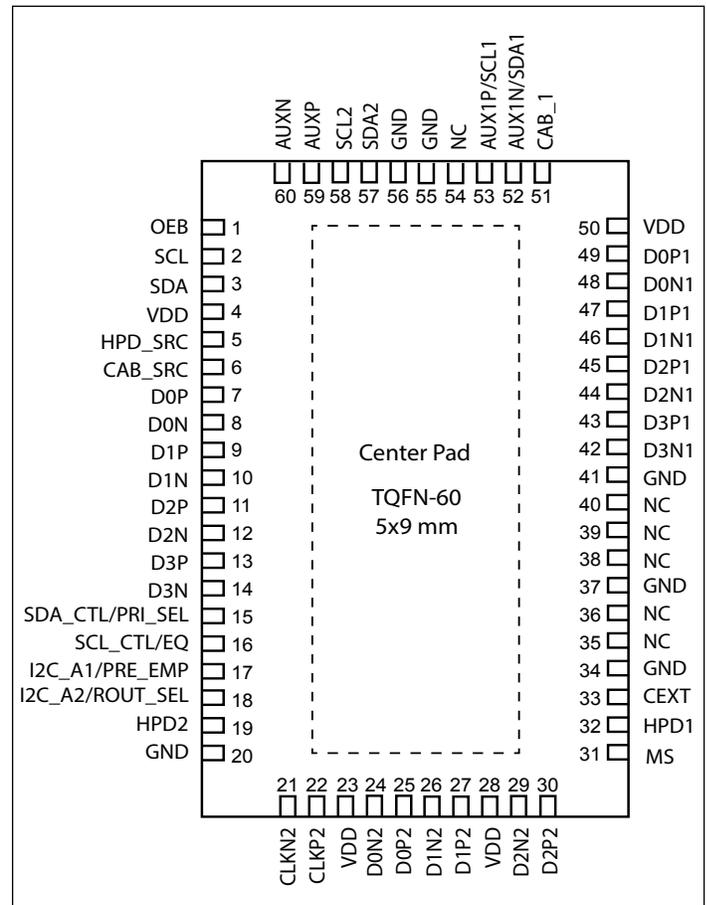
**Description**

PI3WVR31212A has one passive output port1, one active (DP to HDMI) output port2. Passive output supports DP1.2 at 5.4Gbps in I2C mode. Active port2 supports HDMI1.4b at 3.4Gbps. All two output ports support auto port priority selection. Input port accepts DP1.2 and DP++ signals associated with output ports as described above.

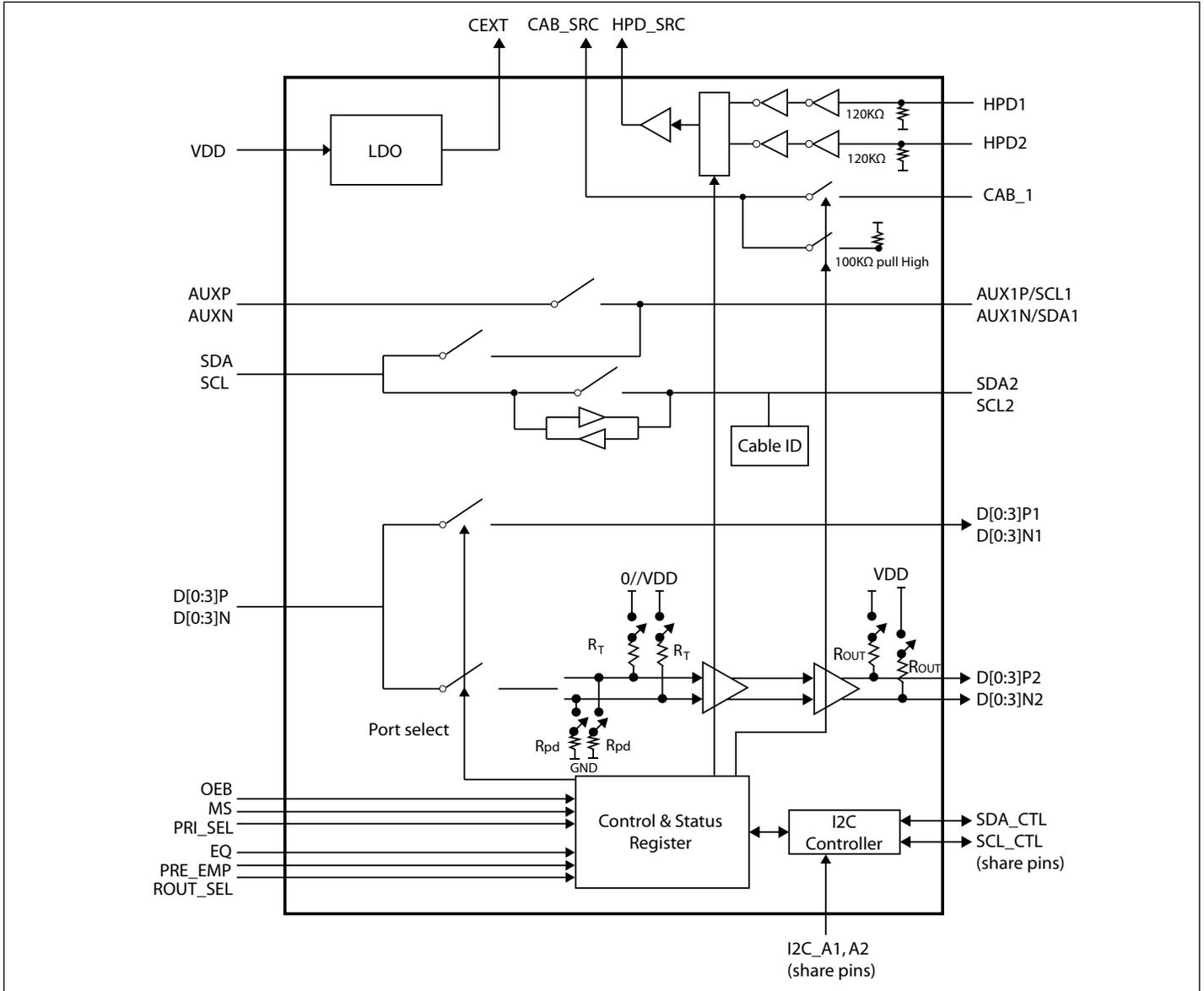
**Application**

- Notebook and dongle

**Pin Configuration: TQFN-60**



**Block Diagram**



### Pin Description

Pin#	Pin Name	Signal Type	Description
7	D0P	IO	4 differential pair input (DP)
9	D1P		
11	D2P		
13	D3P		
8	D0N		
10	D1N		
12	D2N		
14	D3N		
49	D0P1	IO	4 differential pair output (DP) for port 1
47	D1P1		
45	D2P1		
43	D3P1		
48	D0N1		
46	D1N1		
44	D2N1		
42	D3N1		
25	D0P2	IO	4 differential pair output (HDMI) for port 2
27	D1P2		
30	D2P2		
22	CLKP2		
24	D0N2		
26	D1N2		
29	D2N2		
21	CLKN2		
52	AUX1N/SDA1	IO	AUX (DP) or DDC (HDMI) to two ports
53	AUX1P/SCL1		
57	SDA2		
58	SCL2		
60	AUXN	IO	AUX to DP-source
59	AUXP		
3	SDA	IO	DDC to DP-source
2	SCL		
32	HPD1	I	HPD1-2 for port1-2; HPD_SRC to DP-source.
19	HPD2	I	
5	HPD_SRC	O	

Pin#	Pin Name	Signal Type	Description
51 6	CAB_1 CAB_SRC	IO	CAB_1: CAB_DET to port1 CAB_SRC: CAB_DET to DP-source No CAB_DET for HDMI port2
1	OEB	I	OEB=0, device active; OEB=1, device shut down
15	SDA_CTL/PRI_SE	I	MS=0, PRI_SEL selects priority in pin control mode; MS=1, SDA_CTL as SDA in I2C control mode
16	SCL_CTL/EQ	IO	MS=0, EQ selects equalization in pin control mode; MS=1, SCL_CTL as SCL in I2C control mode
17	I2C_A1/PRE_EMP	I	MS=0, PRE_EMP selects Pre-emphasis in pin control mode; MS=1, I2C_A1 as I2C address A1 in I2C control mode
18	I2C_A2/ROUT_SEL	I	MS=0, ROUT_SEL selects source termination in pin control mode; MS=1, I2C_A2 as I2C address A2 in I2C control mode
31	MS	I	Mode Select: MS=0 for pin control mode MS=1 for I2C control mode
33	CEXT	O	Internal LDO bypass capacitance, 4.7uf to GND
4, 23, 28, 50	VDD	Power	3.3V VDD
20, 34, 37, 41, 55, 56, Center Pad	GND	Ground	Bottom GND EPAD
35, 36, 38, 39, 40, 54	NC	NC	Not Connected

### Pin mapping for dual mode DP source DEMUX to DP output

DP mode	HDMI/DVI mode	WVR31212A input pins	WVR31212A port1 output	WVR31212A port2 output
ML_lane	TX2+	D0P	D0P1	D2P2
ML_lane	TX2-	D0N	D0N1	D2N2
ML_lane	TX1+	D1P	D1P1	D1P2
ML_lane	TX1-	D1N	D1N1	D1N2
ML_lane	TX0+	D2P	D2P1	D0P2
ML_lane	TX0-	D2N	D2N1	D0N2
ML_lane	TXC+	D3P	D3P1	CLKP2
ML_lane	TXC-	D3N	D3N1	CLKN2

### Function Description

The MS pin selects I2C or pin control mode.

Pin control mode has only automatic port selection. I2C control mode has automatic port selection.

In auto port selection, when only one HPD high detected, the port with HPD high will be selected. When multiple HPD high detected, the PRI\_SEL pin (priority select) will determine the priority of the 2 ports. See priority selection table

When PRI\_SEL=low or High, the port-priority will be port1-port2 from high to low; when PRI\_SEL=M (open as not connected), the port priority will be port2-por1 from high to low.

When port 1 is selected and CAB\_1 is low as in DP mode, the AUX/DDC channels will work as AUX channels. AUXP shall have 100Kohm external resistor to GND and AUXN shall have 100Kohm external resistor to VDD. The data rate of AUX channels will be >720Mbps. The internal DDC switch will be off.

When port 1 is selected and CAB\_1 is high when DP to HDMI adapter plugged, the AUX/DDC channels will work as DDC channels. The internal DDC channels are on and the AUX channels are off. The input of DDC channels can tolerate 5V input and voltage of DDC to source will be limited about 3.3V or below.

When port 1 is selected (passive ports), port2 with HDMI re-driver will shut down.

When port 2 is selected, the internal DP to HDMI level shifter will be enabled. There will be 3 EQ and 3 Pre-emphasis settings in pin control mode, 8 EQ and 5 Pre-emphasis settings in I2C control mode.

When port 2 is selected, HDMI output can be standard TMDS-open-drain source, as well to be selected with internal source termination as 50 ohm pull up to 3.3V VDD, using ROUT\_SEL pin control or I2C control.

When port 2 is active as DP to HDMP level shifter, the DDC channel can be selected between bi-direction DDC buffer and passive DDC switch in I2C mode.

HPD1, HPD2 are with internal CMOS buffers and can support 3.3V and 5V HPD inputs.

### Squelch Mode

Squelch function will disable HDMI data output (as high impedance) when the voltage and frequency of input clock (TMDS) are below squelch threshold, which will prevent random noise presenting in HDMI data output, thereby prevent noise on sink display. Squelch function will enable-resume HDMI data output when input clock signals are above squelch threshold.

### Truth Table for TMDS port2

EQ – three level pin control

PRE-EMP – three level pin control

EQ	Equalization value
0	1.5dB
open	4.0dB
1	6.5dB

PRE_EMP	TX pre-emphasis
0	0dB
open	1.5dB
1	2.5dB

ROUT\_SEL

ROUT_SEL	Pull-Up Resistors on port2 D[0:2]P2/N2, CLKP2/N2
0	No Pull-up resistors
1	50Ω Pull-up resistors to VDD

MS – three level pin control

MS	Pin mode/type cable ID
0	Pin mode for Type 2 ID
M(0.5*vdd)	Pin mode for Type 1 ID
1	I2C mode

### Truth Table for AUX and DDC

PORT	DP/HDMI	CAB_1	AUXP	AUXN	SCL	SDA
When Port1 Selected	DP Mode	0	AUX1P	AUX1N	Hi-Z	Hi-Z
	DP Mode	1	Hi-Z	Hi-Z	SCL1	SDA1

### Priority Selection Table

PRI_SEL (Priority order)	HPD1	HPD2	HPD_SRC	CAB_SRC	AUXP/AUXN	SDA/SCL
0 or 1	0	0	Hi-Z	Hi-Z	Hi-Z	Hi-Z
0 or 1	1	x	HPD1	CAB1	AUX1P/AUX1N	SDA1/SCL1
0 or 1	0	1	HPD2	High	Hi-Z	SDA2/SCL2
M	0	0	Hi-Z	Hi-Z	Hi-Z	Hi-Z
M	1	0	HPD1	CAB1	AUX1P/AUX1N	SDA1/SCL1
M	x	1	HPD2	High	Hi-Z	SDA2/SCL2

Note: M=internal half VDD when input=HiZ

PRI_SEL (Priority order)	HPD1	HPD2	D0P	D1P	D2P	D3P	D0N	D1N	D2N	D3N
0 or 1	0	0	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z
0 or 1	1	x	D0P1	D1P1	D2P1	D3P1	D0N1	D1N1	D2N1	D3N1
0 or 1	0	1	D2P2	D1P2	D0P2	CLKP2	D2N2	D1N2	D0N2	CLKN2
M	0	0	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z
M	1	0	D0P1	D1P1	D2P1	D3P1	D0N1	D1N1	D2N1	D3N1
M	x	1	D2P2	D1P2	D0P2	CLKP2	D2N2	D1N2	D0N2	CLKN2

Note: M=internal half VDD when input=HiZ

## 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 +4.6V
High Speed Channel Input Voltage (DP Mode).....	-0.5V to 2V
DDC and HPD channels Input Voltage .....	-0.5V to 6V
DC Output Current .....	180mA
Power Dissipation .....	0.6W

**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.

## Electrical Characteristics

### Recommended Operation Conditions

$V_{DD} = 3.3V \pm 10\%$ , Min and Max apply for  $T_A$  between  $-40^\circ C$  to  $85^\circ C$  Typical values are referenced to  $T_A = 25^\circ C$

Parameter	Description	Test Conditions	Min.	Typ.	Max.	Unit
$V_{DD}$	Operating Voltage		3.0	3.3	3.6	V
$I_{DD}$	VDD supply current (Port1 active)	$V_{DD}=3.3V$		1	1.8	mA
	VDD Supply Current (Port2 active)	Output Enable ( open drain 500mv signal-end 0dB pre-emphasis, not including 40mA current to source)		80	100	mA
		Output Enable ( double termination, 500mv signal-end 0dB pre-emphasis, not including 40mA current to source)		160	200	mA
$I_{DDQ}$	VDD Quiescent Supply Current (port2 active w/o TMDS input)	TMDS Output Disable,		3.5	5	mA
Isd1	Supply shut down current when OEB disable (MS=0)	$V_{DD}=3.6V$ , OEB=high		0.1	0.2	mA
Isd2	Supply shut down current when OEB disable (MS=1)	$V_{DD}=3.6V$ , OEB=high		0.6	1.2	mA

**DC Electrical Characteristics for Switching over Operating Range**

Parameter	Description	Test Conditions	Min.	Typ.	Max.	Unit
<b>OEB,MS,ROUT_SEL</b>						
I <sub>IH</sub>	High level digital input current	V <sub>IH</sub> =VDD	-10		40	μA
I <sub>IL</sub>	Low level digital input current	V <sub>IL</sub> = GND	-10		10	μA
V <sub>IH</sub>	High level digital input voltage		2.0			V
V <sub>IL</sub>	Low level digital input voltage		0		0.8	V
<b>HPD_SRC</b>						
V <sub>OL_HPD_SRC</sub>	Buffer Output Low Voltage	I <sub>OL</sub> = 4 mA			0.4	V
V <sub>OH_HPD_SRC</sub>	Buffer Output Low Voltage	I <sub>OH</sub> = 4 mA	2.4			V
<b>HPD_sink</b>						
I <sub>IH</sub>	High level digital input current(1)	V <sub>IH</sub> =VDD	-10		40	μA
I <sub>IL</sub>	Low level digital input current(1)	V <sub>IL</sub> = GND	-10		10	μA
V <sub>IH</sub>	High level digital input voltage	V <sub>DD</sub> =3.3V	2.0			V
V <sub>IL</sub>	Low level digital input voltage		0		0.8	V
<b>CAB</b>						
I <sub>LK</sub>	Input leakage current	Switch is off, Vin=5.5v	-50		50	uA
C <sub>IO</sub>	Input/Output capacitance when-passive switch on			10		pF
R <sub>ON</sub>	Passive Switch resistance	I <sub>O</sub> = 3mA, V <sub>O</sub> = 0.4V		25	50	Ω
V <sub>pass</sub>	Switch Output voltage	V <sub>I</sub> =3.3V, I <sub>I</sub> =100uA	1.5	3.0	3.3	V
CI(source)	Source side CAB capacitance	V <sub>I</sub> peak-peak = 1V, 100 KHz		3.5		pF
CI(sink)	Sink side CAB capacitance when			6.5		pF
<b>SDA/SCL, SDA1/SCL1</b>						
I <sub>LK</sub>	Input leakage current	DDC switch is off, Vin=5.5V	-50		50	uA
C <sub>IO</sub>	Input/Output capacitance when passive switch on	V <sub>I</sub> peak-peak = 1V, 100 KHz		8		pF
R <sub>ON</sub>	Passive Switch resistance	I <sub>O</sub> = 3mA, V <sub>O</sub> = 0.4V		25	50	Ω
V <sub>pass</sub>	Switch Output voltage	V <sub>I</sub> =5.0V, I <sub>I</sub> =100uA V <sub>DD</sub> =3.3V	1.5	2.0	2.5	V
CI(source)	Source side DDC capacitance ( passive switch off. )	V <sub>I</sub> peak-peak = 1V, 100 KHz		2.5		pF
CI(sink)	Sink side DDC capacitance ( pas-sive switch off. )	V <sub>I</sub> peak-peak = 1V, 100 KHz		5		pF
<b>SDA2/SCL2 ( DDC buffer of port2 active)</b>						
V <sub>IH</sub>	High level input voltage	V <sub>DD</sub> =3.3V	2.0			V
V <sub>IL</sub>	Low level input voltage		0		0.8	V
I <sub>LK</sub>	Input leakage current	DDC switch is off, Vin = 5.5V	-10		10	uA

**PI3WVR31212A**

Parameter	Description	Test Conditions	Min.	Typ.	Max.	Unit
I <sub>IL</sub>	Low level input current	V <sub>IL</sub> = 0.2V	-10		10	μA
V <sub>OL</sub>	Low level output voltage	I <sub>OL</sub> = 4mA			0.2	V
I <sub>ILOH</sub>	HIGH-level output leakage current	V <sub>O</sub> =3.6V			10	μA
C <sub>IO</sub>	Input/output capacitance	V <sub>I</sub> = 3 V or 0 V; V <sub>CC</sub> = 3.3 V or 0V		4		pF
<b>SDA/SCL (DDC buffer of port2 active)</b>						
V <sub>IH</sub>	High level input voltage	V <sub>DD</sub> =3.3V	2.0			V
V <sub>IL</sub>	Low level input voltage		0		0.4	V
I <sub>LK</sub>	Input leakage current	DDC switch is off, V <sub>in</sub> = 5.5V	-10		10	uA
I <sub>IL</sub>	Low level input current	V <sub>IL</sub> = 0.2V	-10		10	μA
V <sub>OL</sub>	Low level output voltage	I <sub>OL</sub> = 4mA	0.47	0.52	0.6	V
I <sub>ILOH</sub>	HIGH-level output leakage current	V <sub>O</sub> =3.6V	5		10	μA
C <sub>IO</sub>	Input/output capacitance	V <sub>I</sub> = 3 V or 0 V; V <sub>CC</sub> = 3.3 V or 0V		8		pF
<b>AUXP,AUXN, AUXnP/SCLn, AUXnN/SDAn</b>						
I <sub>LK</sub>	Input leakage current	DDC switch is off, V <sub>in</sub> =5.5V	-50		50	uA
C <sub>IO</sub>	Input/Output capacitance when passive switch on	V <sub>I</sub> peak-peak = 1V, 100 KHz		6		pF
R <sub>ON</sub>	Passive Switch resistance	I <sub>O</sub> = 3mA, V <sub>O</sub> = 0.3V		5		Ω
		I <sub>O</sub> = 3mA, V <sub>O</sub> = 3.0V		10		Ω
V <sub>pass</sub>	Switch Output voltage	V <sub>I</sub> =5.5V, I <sub>I</sub> =100uA V <sub>DD</sub> =3.3V		4.0	4.5	V
CI(source)	Source side capacitance ( passive switch off. )	V <sub>I</sub> peak-peak = 1V, 100 KHz		2.5		pF
CI(sink)	Sink side capacitance ( passive switch off. )	V <sub>I</sub> peak-peak = 1V, 100 KHz		3.5		pF
<b>High Speed Channel (D[0:3]P/N - D[0:3]P1N1)</b>						
V <sub>IK</sub>	Clamp Diode Voltage (HS Channel)	V <sub>DD</sub> = Max., I <sub>IN</sub> = -18mA		-1.6	-1.8	V
I <sub>IH</sub>	Input HIGH Current	V <sub>DD</sub> = Max., V <sub>IN</sub> = V <sub>DD</sub>			±10	μA
I <sub>IL</sub>	Input LOW Current	V <sub>DD</sub> = Max., V <sub>IN</sub> = GND			±10	
R <sub>ON_HS</sub>	On resistance between input to out- put for high speed signals	V <sub>INPUT,cm</sub> = 0V to 1.8V, V <sub>INPUT,diff</sub> < 1.0Vp-p, diff, V <sub>DD</sub> = 3.0V, I <sub>INPUT</sub> = 20mA		8		Ohm

Parameter	Description	Test Conditions	Min.	Typ.	Max.	Unit
<b>High Speed Channel (D[0:3]P/N – D[0:2]P2/N2; CLKP2/N2)</b>						
V <sub>I(open)</sub>	Single-ended input voltage under high impedance input or open input	I <sub>L</sub> =10uA	V <sub>DD</sub> -10		V <sub>DD</sub> +10	mV
R <sub>T</sub>	Input termination resistance	V <sub>IN</sub> =2.9V	45	50	66	ohm
I <sub>OZ</sub>	Leakage current resistance	V <sub>DD</sub> =3.6V, OEB=High		30	100	uA
I <sub>off</sub>	Power off leakage current	V <sub>DD</sub> =0, V <sub>IN</sub> =3.6V	-50		50	uA

### Dynamic Electrical Characteristics over Operating Range

(T<sub>A</sub> = -40° to +85°C, V<sub>DD</sub> = 3.3V ±10%)

Parameter	Description	Test Conditions	Min.	Typ.	Max.	Unit
<b>TMDS Differential Pins</b>						
t <sub>pd</sub>	Propagation delay	V <sub>DD</sub> = 3.3V, R <sub>out</sub> = 50Ω off, open drain, 0dB pre-emphasis			2000	ps
t <sub>r</sub>	Differential output signal rise time (20% - 80%)			120		
t <sub>f</sub>	Differential output signal fall time (20% - 80%)			120		
t <sub>sk(p)</sub>	Pulse skew			15	50	
t <sub>sk(D)</sub>	Intra-pair differential skew			25	50	
t <sub>sk(o)</sub>	Inter-pair differential skew(2)				100	
T <sub>jit_clk(pp)</sub>	Peak-to-peak output jitter CLK residual jitter	Data Input = 3.4 Gbps HDMI data pattern from signal generation, short trace.		15	40	ps
T <sub>jit_dat(pp)</sub>	Peak-to-peak output jitter DATA Residual Jitter	CLK Input = 340 MHz clock		25	50	
t <sub>en</sub>	Enable time				10	us
t <sub>dis</sub>	Disable time				50	

#### SCL,SDA channel, AUX channel, CAB channel : passive switches

t <sub>pd(DDC)</sub>	Propagation delay from SCLn/SDAn to SCL/SDA or SCL/SDA to SCLn/SDAn In passive SW on.	C <sub>L</sub> = 10pF, in passive switch			5	ns
----------------------	---	--	--	--	---	----

#### SCL2,SDA2- SCL,SDA channel : buffers

t <sub>PLH</sub>	LOW-to-HIGH propagation delay	SCL/SDA to SCL2/SDA2	50	100	150	ns
t <sub>PHL</sub>	HIGH-to-LOW propagation delay	SCL/SDA to SCL2/SDA2	10	20	40	ns
t <sub>PLH</sub>	LOW-to-HIGH propagation delay	SCL2/SDA2 to SCL/SDA	50	100	150	ns
t <sub>PHL</sub>	HIGH-to-LOW propagation delay	SCL2/SDA2 to SCL/SDA	10	20	40	ns

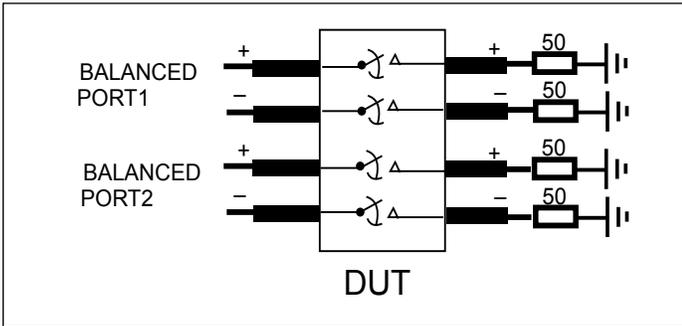
**PI3WVR31212A**

Parameter	Description	Test Conditions	Min.	Typ.	Max.	Unit
<b>Control and Status Pins (HPDn, HPD_SRC)</b>						
tpd(HPD)	Propagation delay (from HPDx to the active port of HPD_SRC, high to low)	CL = 10pF		2	4	us
tsx(HPD)	Switch time (from port select to the latest HPD , manual selection mode)			2	4	us

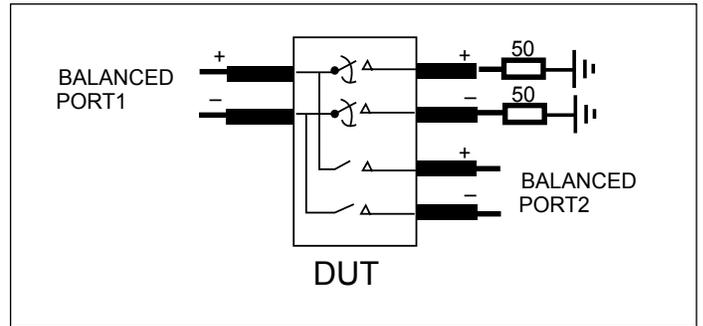
**Dynamic Electrical Characteristics**

Parameter	Description	Test Conditions	Min.	Typ.	Max.	Unit	
<b>High Speed Channel (D[0:3]P/N – D[0:3]P1/N1)</b>							
X <sub>TALK</sub>	Crosstalk on High Speed Channels	See Fig. 1 for Measurement Setup	f= 2.7 GHz		-32	-30	dB
O <sub>IRR</sub>	OFF Isolation on High Speed Channels	See Fig. 2 for Measurement Setup	f= 2.7 GHz		-19	-17	
I <sub>LOSS</sub>	Differential Insertion Loss on High Speed Channels	@2.7GHZ (see figure 3)		-1.7	-1.5		dB
R <sub>loss</sub>	Differential Return Loss on High Speed Channels	@ 2.7GHz (5.4Gbps)			-18.0	-16.0	dB
BW <sub>Dx±</sub>	Bandwidth -3dB for Main high speed path (Dx±)	See figure 3		5.1	5.6		GHz
BW <sub>AUX</sub>	Bandwidth -3dB for AUX	See figure 3		1.2	1.5		GHz
T <sub>startup</sub>	V <sub>DD</sub> valid to channel enable				250		us
T <sub>wakeup</sub>	Enabling output by changing OEB from High to Low				250		us
T <sub>pd</sub>	Propagation delay (input pin to output pin) on all channels				80		ps
t <sub>b-b</sub>	Bit-to-bit skew within the same differential pair of Dx± channels				5	7	ps
t <sub>ch-ch</sub>	Channel-to-channel skew of Dx± channels					35	ps

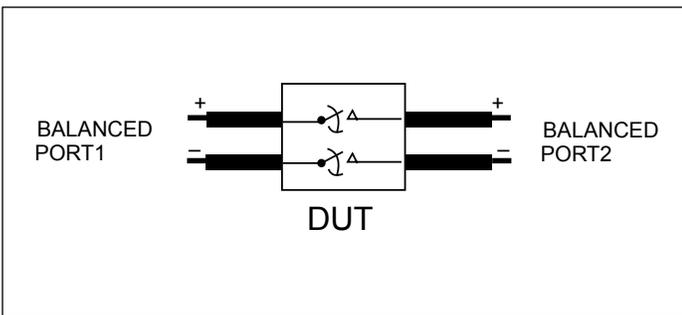
**PI3WVR31212A**



**Fig 1. Crosstalk Setup**



**Fig 2. Off-isolation setup**



**Fig 3. Differential Insertion Loss**

**Differential Off Isolation , Vdd=3.3V, 25C**



**PI3WVR31212A**

**Differential Insertion Loss , Vdd=3.3V, 25C**

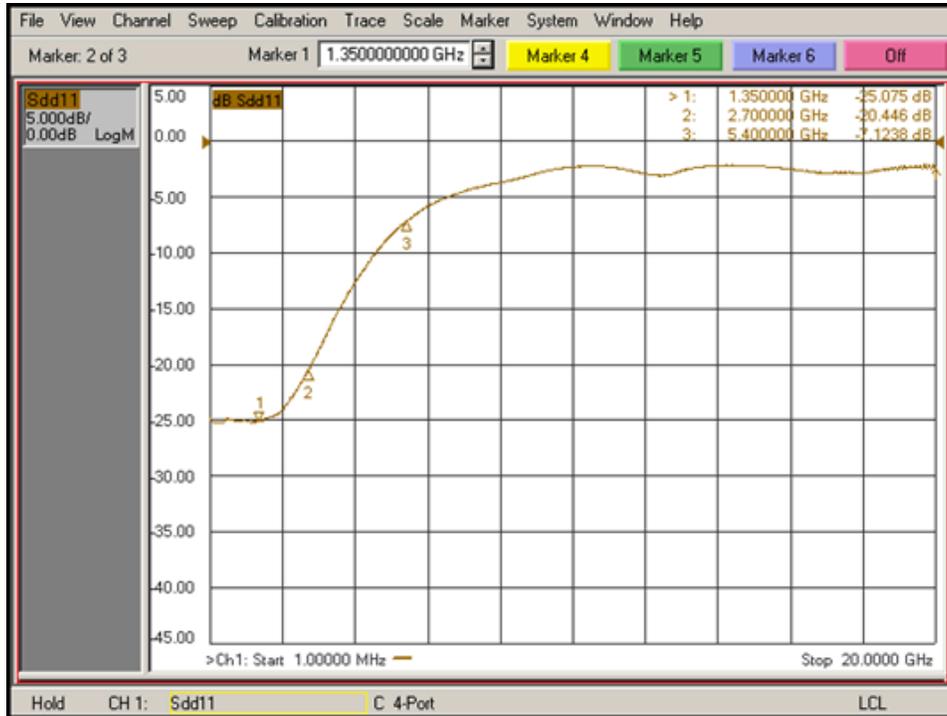


**D0 to D01 Channel**

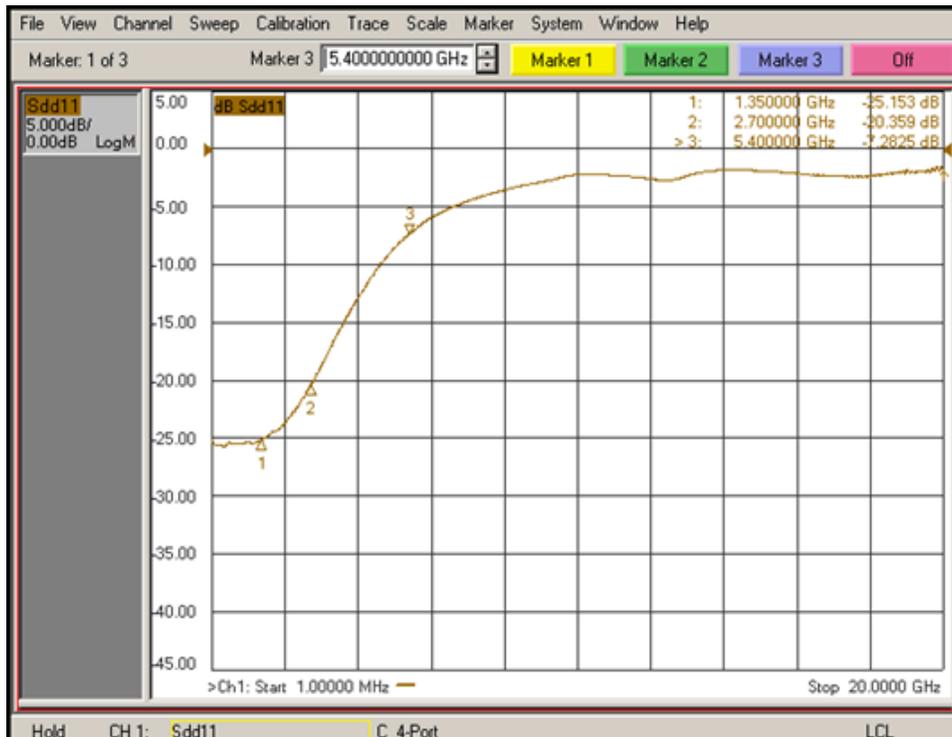


**D0 to D02 Channel**

**Differential Return Loss , Vdd=3.3V, 25C**

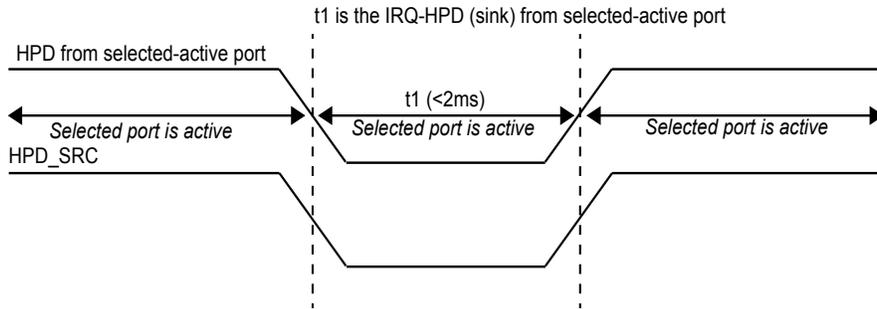


**D0 to D01 Channel**

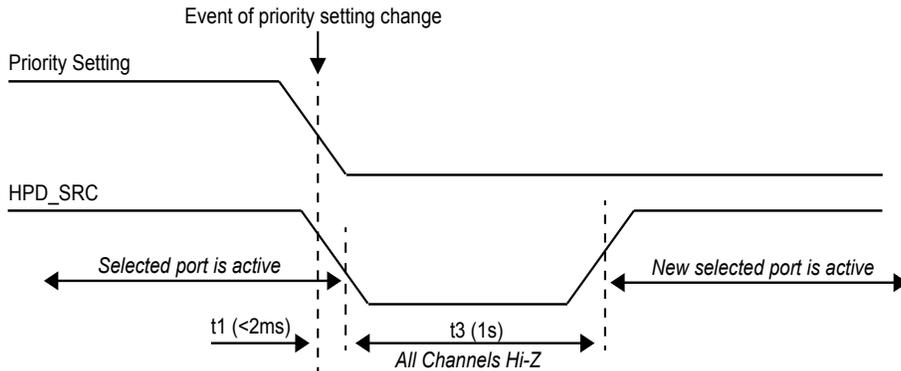


**D0 to D02 Channel**

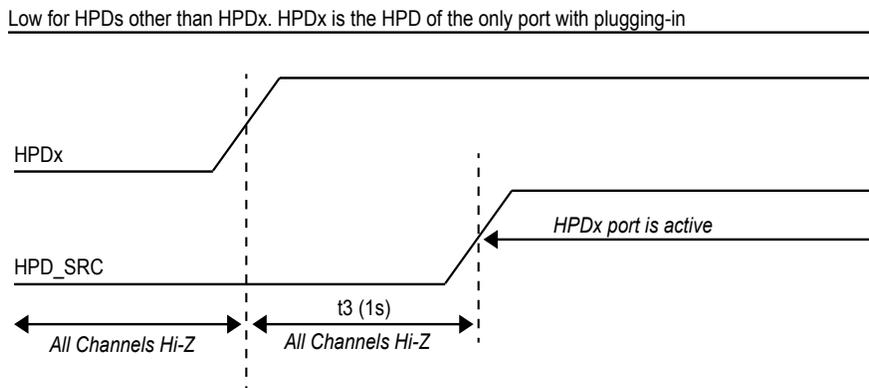
**HPD auto selection timing waveform**



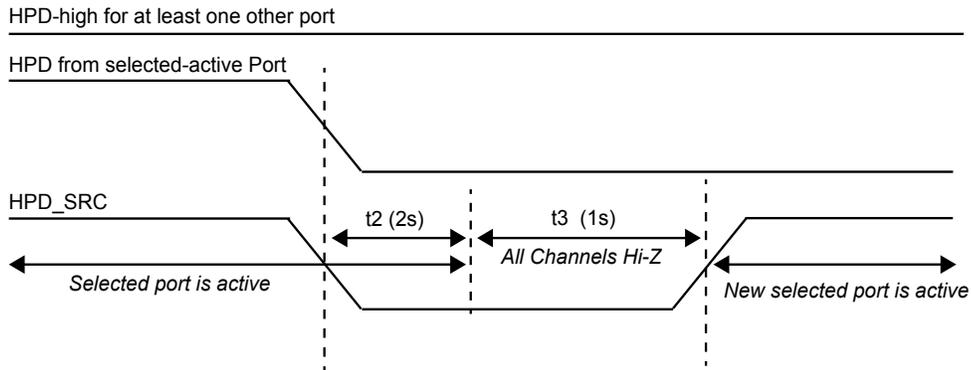
**Fig 4. HPD timing t1. HPD\_SRC low and the active of selected port will follow t1, if t1 further extended less than t2 (2s) when auto switch and manual switch**



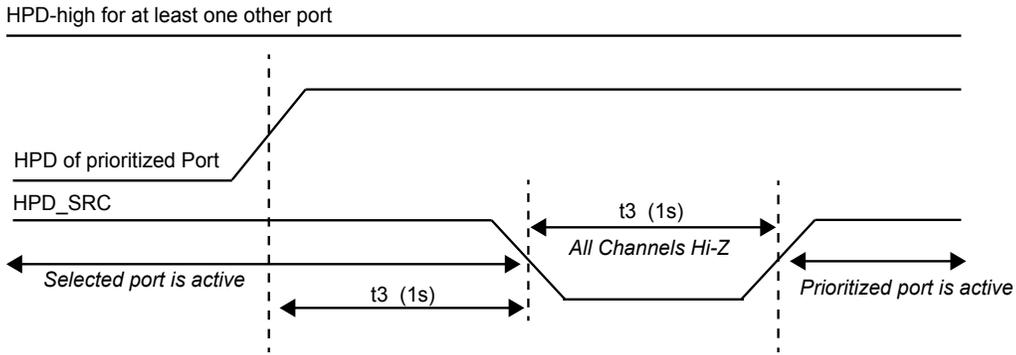
**Fig 5. HPD timing t3. All channels include DP-HDMI data, AUX, DDC, HPD and CAB\_DET when auto switch**



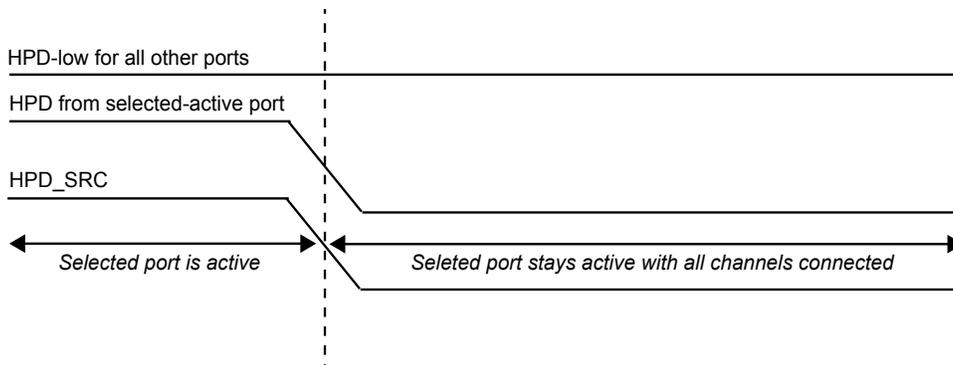
**Fig 6. HPD timing t3 when auto switch**



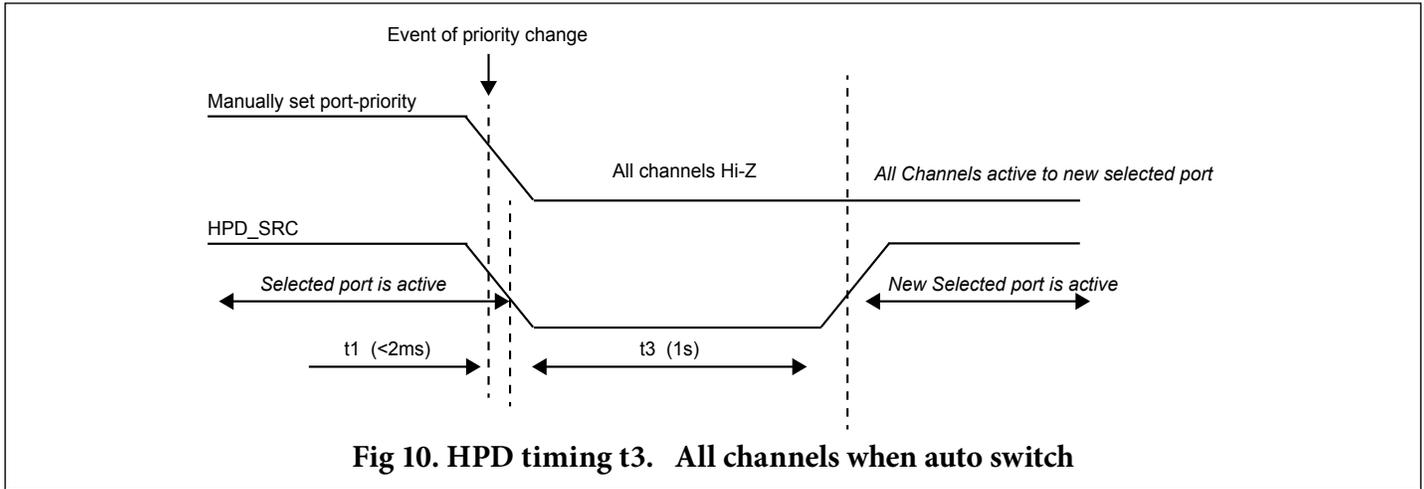
**Fig 7. HPD timing with auto switch**



**Fig 8. HPD timing with auto switch**



**Fig 9. HPD timing when auto switch and manual switch**



Parameter	Test Conditions	Min.	Typ.*	Max.	Unit
<b>HPD auto switching timing</b>					
HPD pulse duration when treated as an IRQ –t1 (Figure 4)				2	ms
Propagation delay of HPDx Desertion –t2 (Figure 7)		1.0	2	3	s
HPD_SRC low duration when the outputs are switched –t3(Figure 5,6,7,8,10); Propagation delay of HPDx assertion (Figure 8)		0.5	1	1.5	s

\*Typical time can be changed by I2C Byte 0x01 bit[2:0], and Byte 0x04 bit3.

**I2C Address Byte**

	b7(MSB)	b6	b5	b4	b3	b2	b1	b0 (R/W)
Address Byte	1	0	1	1	A2	A1	1	1/0*

\* Read; 0:Write, A2 and A1 are two address bits setting

**Data transmission format**

Data is transmitted to the PI3WVR31212A registers using the Write mode as shown in Figure 1. Data is read from the PI3WVR31212A registers using the Read mode as shown in Figure 2.

**Figure 1: I2C control register write condition**



From master to slave      A= acknowledge      A-bar= not acknowledge  
 From slave to master      S= start condition      P= stop condition

**Figure 2: I2c control register read condition**



### I2C Control Register

The I2C control register uses index read or write for byte access.

Offset	Name	Description	Power Up Condition	Type
0x00	CONFIG[7:0]	<p>[7] Reserved to 0</p> <p>[6:5] Port SEL1/SEL0 selection control            00 port 1 (Reserved)            01 all off            10 port 2 (Reserved)            11 Auto selection mode depending on PRI_SEL below</p> <p>[4:2] PRI_SEL priority selection control by HPD<sub>x</sub>            00x port1/port2            010 port1/port2            011 port2/port1            1xx port2/port1</p> <p>[1] DP_HDMI selection control            0=DP input,            1=Reserved</p> <p>[0] Cable ID type selection            0=Type 2 cable ID            1=Type 1 cable ID</p>	0x01	R/W

0x01	RX_SET[7:5] for port2; HPD auto selection time	<p>[7:5] EQ programmable setting</p> <p>000: 1.5 dB 001: 4 dB 010: 6.5 dB 011: 9 dB 100: 11.5 dB 101: 4 dB 110: 16.5 dB 111: 19 dB</p> <p>[4:3] HPD auto selection time source control</p> <p>00: normal 01: -25% 10: +25% 11: test mode</p> <p>[2] HPD auto selection time t3 setting</p> <p>0: 256ms 1: 128ms</p> <p>[1] HPD auto selection time t4 setting</p> <p>0: 1024ms 1: 516ms</p> <p>[0] HPD pulse duration treated as IRQ time t1 setting</p> <p>0: 2ms 1: 4ms</p>	0x00	R/W
------	---	---	------	-----

0x02	TX_SET[7:0] for port2	<p>Output setting for HDMI re-driver/level shifter</p> <p>[7] HDMI output control 0: open drain 1: double termination</p> <p>[6:4] HDMI output Pre-emphasis settings 000: 0dB 001: 1.5dB 010: 2.5dB 011: 3.5dB 100: 6dB</p> <p>[3:2] TMDS output swing setting 00: 500mv as default 01: -10% 10: +10% 11: +20%</p> <p>[1] TMDS output slow rate setting 0: as default 1: +10%</p> <p>[0] DP1 and DP2 port 10Kohm pull low control 0=10Kohm pull low on 1=10Kohm pull low off</p>	0x00	R/W
0x03	Pericom ID	<p>Pericom Vendor Register ID (refer to PCIE clock buffer)</p> <p>[7:4] Vendor ID 0101 [3:0] device revision 0001</p>	0x51	R

**PI3WVR31212A**

0x04	HPD <sub>x</sub> / CAB <sub>x</sub> [6:0] Read only	<p>[7] HPD_SRC output logic function (buffer) 0: HPD_SRC=HPD<sub>x</sub> 1: HPD_SRC=/HPD<sub>x</sub></p> <p>[6] DDC function for port 2 0: Active buffer 1: passive switch</p> <p>[5] Port switching in manual selection 1: disable T3 time pulse when port switching. Port switch immediately 0: Enable T3 time pulse when port switching</p> <p>[4] Reserved</p> <p>[3] HPD2 status as read only</p> <p>[2] Reserved</p> <p>[1] HPD1 status as read only</p> <p>[0] Reserved for HPD1B</p>	0x00	R/W [7:4] R [3:0]
------	---	--	------	----------------------

## Table of ID registers

Data address offset	Data as in spec	Read/White as in spec	Description as in spec	WVR31212A
00h	44h	RO	D	D
01h	50h	RO	P	P
02h	2dh	RO	-	-
03h	48h	RO	H	H
04h	44h	RO	D	D
05h	4dh	RO	M	M
06h	49h	RO	I	I
07h	20h	RO	Space	Space
08h	41h	RO	A	A
09h	44h	RO	D	D
0ah	41h	RO	A	A
0bh	50h	RO	P	P
0ch	54h	RO	T	T
0dh	4fh	RO	O	O
0eh	52h	RO	R	R
0fh	04h	RO	.	.
10h	A0h	RO	Cable Adaptor Identifier	A0h
11h	UD	RO	IEEE OUI 1st byte	00h
12h	UD	RO	IEEE OUI 2nd byte	60h
13h	UD	RO	IEEE OUI third byte	23h
14h	UD	RO	Device Id	50h "P"
15h	UD	RO	Device Id	49h "I"
16h	UD	RO	Device Id	33h "3"
17h	UD	RO	Device Id	57h "W"
18h	UD	RO	Device Id	56h "V"
19h	UD	RO	Device Id	52h "R"
1ah	UD	RO	Hardware (chip) revision 7:4h: major revision 3:0h: minor revision.	00h
1bh	UD	RO	Firmware/software major revision	00h
1ch	UD	RO	Firmware/software minor revision	00h
1dh	UD	RO	Clock rate, specified max 300mhz for HDMI	78h: 300MHz (300/2.5=120=78h)
1eh	0fh	RO	I2C speed control capabilities bit map	0fh

**PI3WVR31212A**

Data address offset	Data as in spec	Read/White as in spec	Description as in spec	WVR31212A
1fh	00h	RW	Reserved data Address at 1fh: 1. DP source reads data address 1fh, ID register returns 00h 2. DP source writes data AAh to data address 1fh, ID register responds ACK or returns 00h.	1fh=00, RW, reserved
20h	00h or 01h	R/W	TMDS output enable or disable. 00h: enabled 01h: disabled (<=10mV Voff) [7:1] Reserved	00h, RW (Not Applicable for PI3WVR31212A) 00h: enabled 01h: disabled (<=10mV Voff) [7:1] Reserved
21h	00h or 01h	R/W	Enables/disables the CEC Isolation Switch.  00h: enabled 01h: disabled [7:1] Reserved	00h, RW (Not Applicable for PI3WVR31212A) 00h: enabled 01h: disabled [7:1] Reserved
22h	UD	R/W	I2C speed control status bit map.  01h: 1Kbps 02h: 5Kbps 04h: 10Kbps 08h: 100Kbps 10h, 20h, 40h and 80h are reserved	08h for 100Khz. (Not Applicable for PI3WVR31212A) For the function specified as: 01h: 1Kbps 02h: 5Kbps 04h: 10Kbps 08h: 100Kbps 10h, 20h, 40h and 80h are reserved
23h-ffh	00h	R/W	Reserved data Address from 23h to ffh: 1. DP source reads data address 23h thru ffh, ID register returns 00h. 2. DP source writes data AAh to data address 23h thru ffh, ID register responds ACK or returns 00h.	23h-ffh=00h, RW, reserved.

**Notes:**

1. DP++ source accesses ID at device address 80h/81h with data offset from 00h-ffh.
2. UD: user dependent.
3. RO: read only.
4. OUI: IEEE Organizationally Unique Identifier.

## ID Access Sequence Specified in DP Interoperability V1.1A

It is suggested that the Source-side cable adaptor have a voltage-level shifter to convert the 5-V HPD signal from a DVI/HDMI Sink Device to +2.25V ~ +3.6V voltage as specified the HPD signal input voltage range of DisplayPort Specification Ver.1.1a.

### DDC Buffer ID of a Source-side HDMI Cable Adaptor

Offset	0	1	2	3	4	5	6	7	8	9	Ah	Bh	Ch	Dh	Eh	Fh
Data	44h	50h	2Dh	48h	44h	4Dh	49h	20h	41h	44h	41h	50h	54h	4Fh	52h	04h

Table below shows the I2C transaction sequence for a Source Device to read the DDC Buffer ID of the Source-side HDMI cable adaptor. I2C write for setting the address offset is optional for a Dual-mode Source Device. The HDMI cable adaptor must acknowledge it when it receives this write operation. The DVI cable adaptor must NACK the I2C transaction to Device Address 80h/81h.

### DDC Buffer ID Access Sequence

Phase	I <sup>2</sup> C Transaction	Transmitting	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	R/W#	Status		
											Master	Slave	
1	Start	Master										Optional	-
2	Write command	Master	1	0	0	0	0	0	0	0	0	Optional	-
3	Acknowledge	Slave										-	Mandatory
4	Word address offset	Master	Word address offset data byte									Optional	-
5	Acknowledge	Slave										-	Mandatory
6	Stop	Master										Optional	-
7	Start	Master										Mandatory	-
8	Read command	Master	1	0	0	0	0	0	0	0	1	Mandatory	-
9	Acknowledge	Slave										-	Mandatory
10	Read data	Slave	Data byte at Offset 0									-	Mandatory
11	Acknowledge	Master										Mandatory	
12	Read data	Slave	Data byte at Offset 1									-	Mandatory
13												-	...
												-	...
40	Read data	Slave	Data byte at Offset 15									-	Mandatory
41	Not acknowledge	Master										Mandatory	-
42	Stop	Master										Mandatory	-

**Note:** if the Slave does not acknowledge during the above transaction sequence, the entire sequence should be retried by the source.

**Packaging Mechanical: ZL60**

SYMBOLS	MIN.	NOM.	MAX.
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A3	0.203 REF.		
b	0.15	0.20	0.25
D	4.90	5.00	5.10
E	8.90	9.00	9.10
e	0.40 BSC		
L	0.30	0.40	0.50
D2	2.90	3.00	3.10
E2	6.90	7.00	7.10

**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 DESIGN IS RECOMMENDED).

**PERICOM**  
Enabling Serial Connectivity

DATE: 04/08/14

DESCRIPTION: 60-Pin, TQFN 5X9mm

PACKAGE CODE: ZL (ZL60)

DOCUMENT CONTROL #: PD-2182

REVISION: -

14-0044

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
PI3WVR31212AZLE	ZL	60-Pin, (TQFN) 5X9mm
PI3WVR31212AZLEX	ZL	60-Pin, (TQFN) 5X9mm, Tape & Reel

Notes:

- Thermal characteristics can be found on the company web site at [www.diodes.com/design/support/packaging/](http://www.diodes.com/design/support/packaging/)
- E = Pb-free and Green
- Adding an X suffix = Tape/Reel

**IMPORTANT NOTICE**

DIODES INCORPORATED MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARDS TO THIS DOCUMENT, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION).

Diodes Incorporated and its subsidiaries reserve the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein. Diodes Incorporated does not assume any liability arising out of the application or use of this document or any product described herein; neither does Diodes Incorporated convey any license under its patent or trademark rights, nor the rights of others. Any Customer or user of this document or products described herein in such applications shall assume all risks of such use and will agree to hold Diodes Incorporated and all the companies whose products are represented on Diodes Incorporated website, harmless against all damages.

Diodes Incorporated does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channel.

Should Customers purchase or use Diodes Incorporated products for any unintended or unauthorized application, Customers shall indemnify and hold Diodes Incorporated and its representatives harmless against all claims, damages, expenses, and attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized application.

Products described herein may be covered by one or more United States, international or foreign patents pending. Product names and markings noted herein may also be covered by one or more United States, international or foreign trademarks.

This document is written in English but may be translated into multiple languages for reference. Only the English version of this document is the final and definitive format released by Diodes Incorporated.

**LIFE SUPPORT**

Diodes Incorporated products are specifically not authorized for use as critical components in life support devices or systems without the express written approval of the Chief Executive Officer of Diodes Incorporated. As used herein:

A. Life support devices or systems are devices or systems which:

1. are intended to implant into the body, or

2. support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in significant injury to the user.

B. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or to affect its safety or effectiveness.

Customers represent that they have all necessary expertise in the safety and regulatory ramifications of their life support devices or systems, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of Diodes Incorporated products in such safety-critical, life support devices or systems, notwithstanding any devices- or systems-related information or support that may be provided by Diodes Incorporated. Further, Customers must fully indemnify Diodes Incorporated and its representatives against any damages arising out of the use of Diodes Incorporated products in such safety-critical, life support devices or systems.

Copyright © 2016, Diodes Incorporated

[www.diodes.com](http://www.diodes.com)