

## PI3AUX221

### AUX/DDC Interface IC

#### Description

The PI3AUX221 is an interface chip between the discrete Graphics Processing Unit (GPU) and the Display Port (DP) connector. The device is ideal for applications that require support of Dual-Mode Display Port. It integrates the support function for Display Data Channel (DDC) in HDMI mode and includes the functions of level translation, mux function, over-voltage protection, back-drive protection and inversion of Hot Plug Detect (HPD). The level translation function allows a wide range of voltage between 1V to 5V. The device eliminates the requirement of many discrete components, and it is available in a space-saving 12-pin ultra-thin 0.65mm high 2x2 mm QFN package.

#### Application(s)

- Dual Mode Display Port in Graphics Cards

#### Features

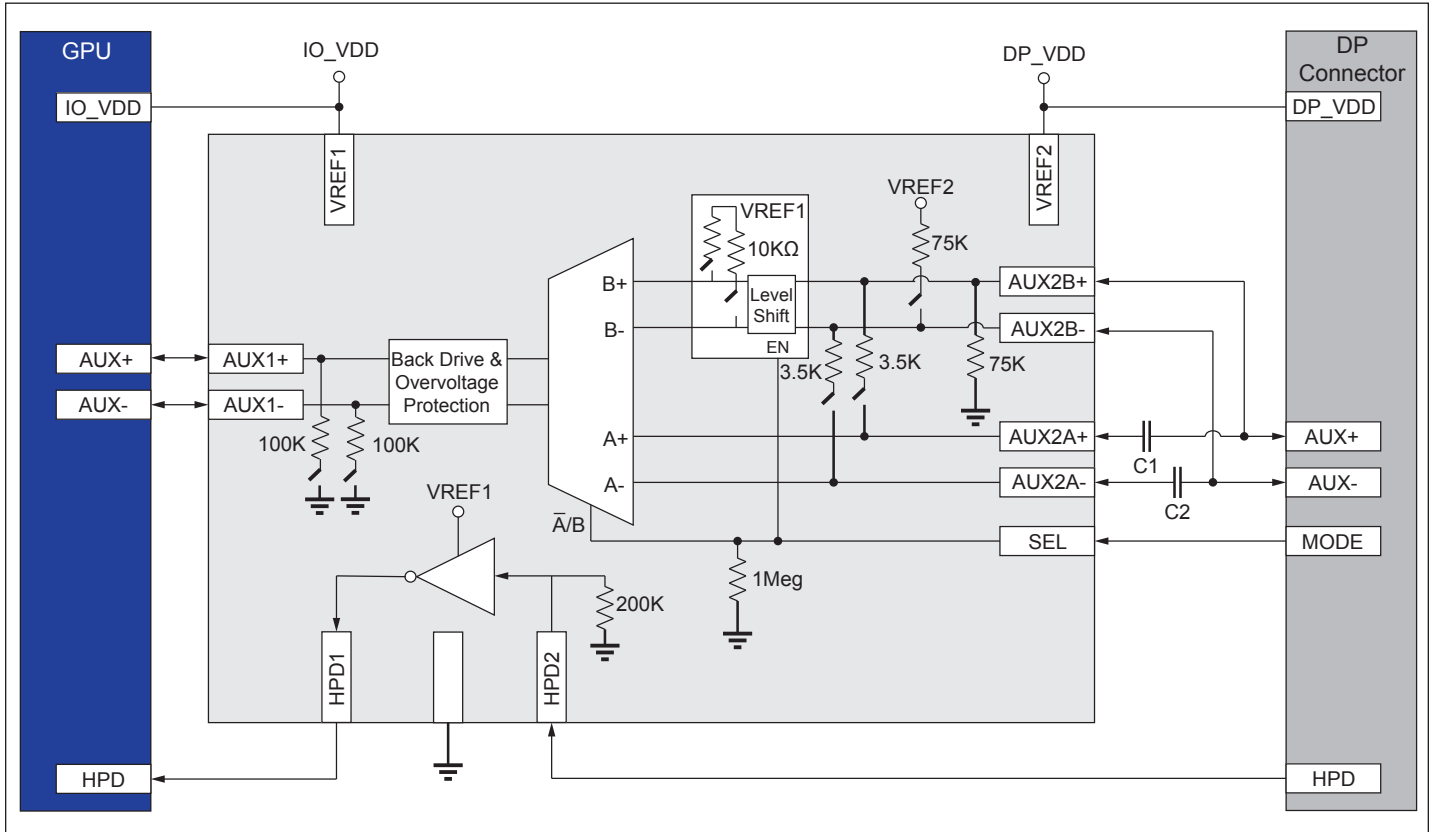
- AC-Coupling of AUX Signal or DC-Level Translated Display Data Channel (DDC) Signal Controlled by the SEL Pin
- Bi-Directional Level Translation of 100KHz DDC Signals
- Inverted Level Translation of HPD Signal from DisplayPort Connector to GPU
- Protection Function to Prevent Signal Propagation Across AUX1 and AUX2A/B when either VREF1 or VREF2 Voltage is Invalid
- Protection Function to Prevent Signal Propagation from HPD2 to HPD1 when VREF1 is Invalid
- Protection on AUX1 from Over-Voltage Condition of AUX2A and AUX2B
- Leakage Current Between VREF1 and VREF2 Limited to 100nA
- 10MHz, -3dB Bandwidth for AUX Switches
- Complies with DisplayPort 2.0
- Complies with HDMI 2.1
- Packaging (Pb-free & Green):
  - 12-Pin UQFN 2x2mm
- Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)
- Halogen and Antimony Free. "Green" Device (Note 3)
- For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/104/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please [contact us](#) or your local Diodes representative.  
<https://www.diodes.com/quality/product-definitions/>

#### Notes:

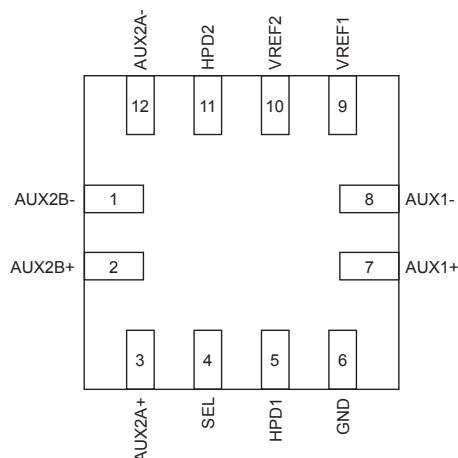
- No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
- See <https://www.diodes.com/quality/lead-free/> for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
- Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

**PI3AUX221**

**Block Diagram**



## Pin Configuration



## Pin Description

Pin Number	Pin Name	Type	Description
1	AUX2B-	I/O	Connector side bi-directional AUX2B- signal.
2	AUX2B+	I/O	Connector side bi-directional AUX2B+ signal.
3	AUX2A+	I/O	Connector side bi-directional AUX2A+ signal
4	SEL	I	AUX2 A/B select input. (Low selects AUX2A, High selects AUX2B)
5	HPD1	O	HPD signal output to GPU.
6	GND	Power	Ground.
7	AUX1+	I/O	GPU side bi-directional AUX1+ signal.
8	AUX1-	I/O	GPU side bi-directional AUX1- signal.
9	VREF1	Power	GPU side reference voltage input.
10	VREF2	Power	Connector side reference voltage input.
11	HPD2	I	HPD signal input from connector.
12	AUX2A-	I/O	Connector side bi-directional AUX2A- signal.

## Maximum Ratings

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

$V_{REF1}$ , $V_{REF2}$ .....	-0.5V to +6.0V
AUX1+, AUX1-, AUX2A+, AUX2A-, AUX2B+, AUX2B- .....	-0.5V to $V_{REF2} + 0.5V$
HPD2, SEL, HPD1 .....	-0.5V to +6.0V
Channel Current .....	$\pm 20mA$
Operation Temperature .....	-40 to +85°C
Storage Temperature .....	-65°C to +150°C
Maximum Junction Temperature, $T_j(max)$ .....	125°C
ESD (HBM) .....	2kV
ESD at $V_{REF2}$ , AUX2A/B+/-, HPD2, SEL (Contact) .....	4kV
ESD at $V_{REF2}$ , AUX2A/B+/-, HPD2, SEL (Air) .....	8kV

### 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.

## Recommended Operating Conditions

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
$V_{REF1}$	GPU reference voltage		1	1.8	5	V
$V_{REF2}$	DP reference voltage		$V_{REF1} + 1$	3.3	5	V
AUX1 $\pm$	AUX1+ or - Single-ended swing	$V_{REF1}$ , $V_{REF2} > \text{or} = 1V$	0		$V_{REF1}$	V
AUX2A $\pm$	AUX2A+ or - Single-ended swing	$V_{REF1}$ , $V_{REF2} > \text{or} = 1V$	0		0.7	V
AUX2B $\pm$	AUX2B+ or - Single-ended swing	$V_{REF1}$ , $V_{REF2} > \text{or} = 1V$	0		$V_{REF2}$	V
HPD2	HPD2 swing	$V_{REF2} > \text{or} = 1V$	0		$V_{REF2}$	V
SEL	SEL swing	$V_{REF2} > \text{or} = 1V$	0		$V_{REF2}$	V
$I_{channel}$	Current to/from AUX1 $\pm$ , AUX2A $\pm$ and AUX2B $\pm$				10	mA

## Electrical Characteristics

$V_{REF1} = 1.8V$ ,  $V_{REF2} = 3.3V$ , Temperature = -40°C to +85°C; unless otherwise specified. Typical values are at Temperature = 25°C.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
$V_{REF1}$ , $V_{REF2}$						
$I_{DD}(V_{REF1})$	Supply current ( $V_{REF1}$ )	SEL = 0, AUX1 $\pm$ , AUX2A/B $\pm$ are floating; SEL = 1, AUX1 $\pm$ , AUX2A $\pm$ are floating, AUX2B $\pm$ are pulled up to 3.3V			40	$\mu A$
$I_{DD}(V_{REF2})$	Supply current ( $V_{REF2}$ )				80	$\mu A$
$I_{leakage}$	Leakage current between $V_{REF1}$ and $V_{REF2}$				100	nA
AUX1, AUX2A, AUX2B						
$R_{AUX1}$	AUX1 $\pm$ pull-down resistance	SEL = 0	60	100	140	K $\Omega$

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Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
	AUX1± pull-up resistance	SEL = 1	6	10	14	KΩ
R <sub>AUX2B</sub>	AUX2B+ pull-down resistance		50	75	100	KΩ
	AUX2B- pull-up resistance	SEL = 0	50	75	100	KΩ
R <sub>onAUX2A</sub>	AUX2A on resistance	SEL = 0, AUX1 = (0, 0.7V), V <sub>REF1</sub> = 1V, V <sub>REF2</sub> = 2V, 10mA into AUX2A			10	Ω
R <sub>onAUX2A_2B</sub>	AUX2A-to-AUX2B on resistance	SEL = 1, AUX2B = 3.3V	2.1	3.5	4.9	KΩ
R <sub>onAUX2B</sub>	AUX2B on resistance	SEL = 1, AUX1 = 0.3 x V <sub>REF1</sub> , V <sub>REF1</sub> = 1V, V <sub>REF2</sub> = 2V, 10mA into AUX2B			5	Ω
R <sub>offAUX2B</sub>	AUX2B off resistance	SEL = 0	10			MΩ
C <sub>onAUX2B</sub>	AUX2B on capacitance	SEL = 1, V <sub>REF2</sub> = 5V, 2.5Vdc 3.5Vpp 100kHz		30		pF
V <sub>CLAMP1</sub>	Clamping voltage at V <sub>AUX1</sub> during OVP	V <sub>AUX2A/B</sub> = 3.3V, R <sub>L</sub> @ V <sub>AUX1</sub> = 10kΩ	0.8 x V <sub>REF1</sub>	V <sub>REF1</sub>	1.2 x V <sub>REF1</sub>	V
<b>SEL</b>						
V <sub>IH</sub>	Logic high input threshold		70% V <sub>REF2</sub>			V
V <sub>IL</sub>	Logic low input threshold				30% V <sub>REF2</sub>	V
R <sub>PD</sub>	Pull-down resistance		600	1000	1400	KΩ
<b>HPD2</b>						
V <sub>IH</sub>	Logic high input threshold		2.0			V
V <sub>IL</sub>	Logic low input threshold				0.8	V
R <sub>PD</sub>	Pull-down resistance		120	200	280	KΩ
<b>HPD1</b>						
V <sub>OH</sub>	Logic high output voltage	I <sub>Source</sub> = 300μA	90% V <sub>REF1</sub>			V
V <sub>OL</sub>	Logic low output voltage	I <sub>Sink</sub> = 300μA			10% V <sub>REF1</sub>	V

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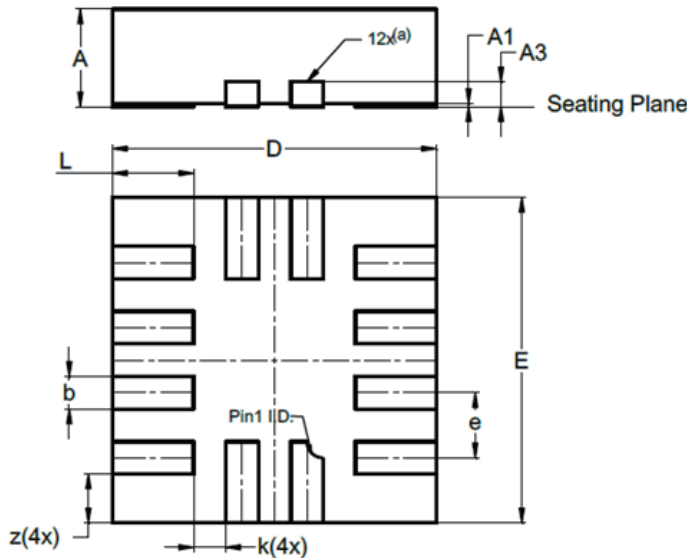
## Part Marking



xK = PI3AUX221ZTAE  
Y: Date Code (Year)  
W: Date Code (Workweek)

## Packaging Mechanical

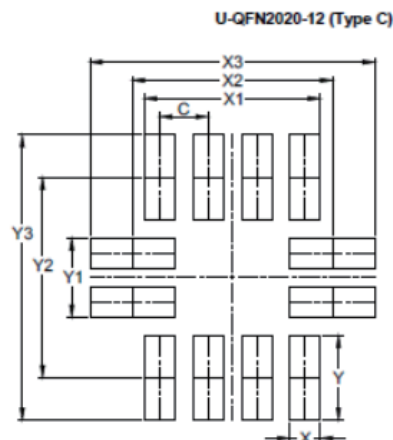
### 12-UQFN (ZTA)



Note (a) Actual shape dependent upon the manufacturing technology used.

U-QFN2020-12 (Type C)			
Dim	Min	Max	Typ
A	0.55	0.65	0.60
A1	0.00	0.05	0.02
A3	--	--	0.152
b	0.15	0.25	0.20
D	1.95	2.05	2.00
E	1.95	2.05	2.00
e	0.40 BSC		
L	0.45	0.55	0.50
k	--	--	0.20
z	--	--	0.30
All Dimensions in mm			

### Suggested Pad Layout



Dimensions	Value (in mm)
C	0.400
X	0.250
X1	1.450
X2	1.650
X3	2.350
Y	0.700
Y1	0.650
Y2	1.650
Y3	2.350

For latest package information:

See <https://www.diodes.com/design/support/packaging/diodes-packaging/diodes-package-outlines-and-pad-layouts/>.

## Ordering Information

Orderable Part Number	Package Code	Package Description
PI3AUX221ZTAEX	ZTA	12-Pin, 2x2mm (UQFN)

### Notes:

1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
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4. E = Pb-free and Green
5. X suffix = Tape/Reel

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