

Features

- V_{REF1} support range from 1V to 5.5V
- V_{REF2} support range from 1.6V to 5.5V
- Support DP_AUX mode or HDMI_DDC mode select function by SEL pin
- Support bi-directional level translation of DDC signals
- Leakage current between V_{REF1} and V_{REF2} limited to 100nA
- Built in V_{REF1} and V_{REF2} Back-drive Protection
- Build in Transient help for AUX2B+/- to V_{REF2} pull up voltage
- Support 2Mbps in DP AUX mode, 100kHz in HDMI_DDC mode
- Support with Display Port 2.0
- Support with HDMI 2.1
- VTQFN 2x2 - 12 Package

General Description

APL3585 is a data selector with a built-in level shifter, which can be used for graphics cards, and can choose between HDMI DDC MODE and DP_AUX MODE through the SEL pin.

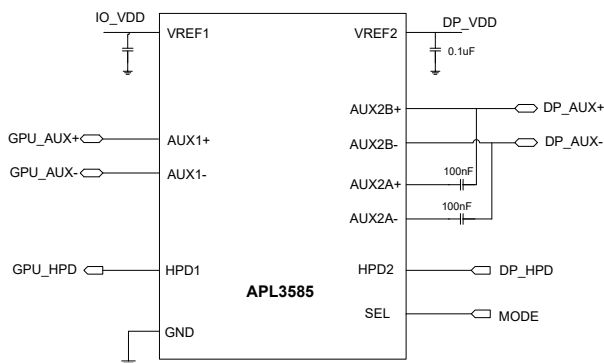
APL3585 has a transient help function in the HDMI DDC MODE, which can meet the I2C rising specifications to help data transmission without distortion.

APL3585 integrates the signal selection application circuit of the Graphics Card, which can reduce the cost and space of the Graphics Card.

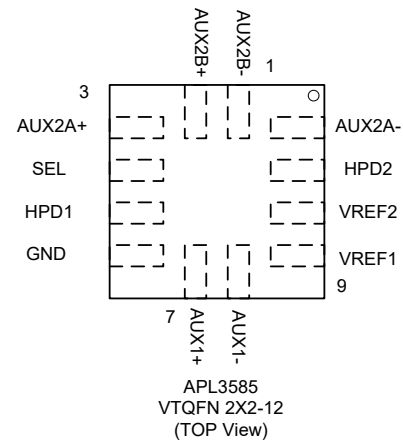
Applications

- Display Port & HDMI AUX Signal Interface SW
- Graphics Card

Simplified Application Circuit



Pin Configuration (Top View)



Ordering and Marking Information

<p>APL3585 □□□—□□□</p> <div style="display: flex; align-items: center;"> <div style="border-left: 1px solid black; border-right: 1px solid black; height: 100px; margin-right: 5px;"></div> <div style="margin-left: 5px;"> <p>Assembly Material</p> <p>Handling Code</p> <p>Temperature Range</p> <p>Package Code</p> <p>Function Code</p> </div> </div>	<p>Package Code QF : VTQFN 2 X 2 - 12</p> <p>Operating Junction Temperature I : - 40 to 85C</p> <p>Handling Code TR : Tape & Reel</p> <p>Assembly Material G : Halogen and Lead Free Device</p>
<div style="display: flex; justify-content: space-between; align-items: center;"> <div>APL3585 QF</div> <div style="border: 1px solid black; padding: 5px; text-align: center;"> 3585 ● X </div> <div>X - Date Code</div> </div>	

Note: ANPEC lead-free products contain molding compounds/die attach materials and 100% matte tin plate termination finish; which are fully compliant with RoHS. ANPEC lead-free products meet or exceed the lead-free requirements of IPC/JEDEC J-STD-020D for MSL classification at lead-free peak reflow temperature. ANPEC defines "Green" to mean lead-free (RoHS compliant) and halogen free (Br or Cl does not exceed 900ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500ppm by weight).

Absolute Maximum Ratings (Note 1)

Symbol	Parameter	Rating	Unit
VREF1, VREF2	power input pin	-0.3 ~ 6	V
-	Other Pins	-0.3 ~ 6	V
T _J	Junction Temperature	150	°C
T _{STG}	Storage Temperature	-65 ~ 150	°C
T _{SDR}	Maximum Lead Soldering Temperature(10 Seconds)	260	°C

Note 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 other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ESD Susceptibility

Symbol	Parameter	Rating	Unit
V _{ESD}	Human Body Mode	4K	V
	Machine Mode (MM)	200	V
	Charge device Mode (CDM)	1K	V

Thermal Characteristics

Symbol	Parameter		Typical Value	Unit
θ _{JA}	Junction-to-Ambient Resistance in free air (Note 2)	VTQFN2x2-12	75	°C/W
θ _{JC}	Junction to Case Resistance in free air (Note 2)	VTQFN2x2-12	13	°C/W

Note 2: θ_{JA} is measured with the component mounted on a high effective thermal conductivity test board in free air.

Recommended Operation Conditions (Note 3)

Symbol	Parameter	Range	Unit
V _{REF1}	VREF1 power input voltage (V _{REF2} ≥ V _{REF1})	1 ~ 5.5	V
V _{REF2}	VREF2 power input voltage (V _{REF1} ≥ 1V)	1.6 ~ 5.5	V
T _A	Ambient Temperature	-40 ~ 85	°C
T _J	Junction Temperature	-40 ~ 125	°C

Note 3: Refer to the typical application circuit.

Electrical Characteristics

Unless otherwise specified, these specifications apply over $V_{REF1}=1.8V$, $V_{REF2}=3.3V$, and $T_A=-40$ to $85^{\circ}C$. Typical values are at $T_A=25^{\circ}C$

Symbol	Parameter	Test condition	APL3585			Unit
			Min.	Typ.	Max.	
V_{REF1}		$V_{REF2} \geq V_{REF1}$	1	1.8	5.5	V
V_{REF1_POR}		$V_{REF2} \geq 1.6V$	0.65	0.8	0.95	V
$V_{REF1_POR_HYS}$		$V_{REF2} \geq 1.6V$	0.05	0.1	0.16	V
IDD1	V_{REF1}	HPD2=0, AUX1,2A,2B N.C.	-	2.4	10	uA
		HPD2= V_{REF2} , AUX1,2A,2B N.C.	-	53	200	uA
V_{REF2}		$V_{REF2} \geq V_{REF1}$	1.6	3.3	5.5	V
V_{REF2_POR}		$V_{REF1} \geq 1V$	1	1.25	1.5	V
$V_{REF2_POR_HYS}$		$V_{REF1} \geq 1V$	0.05	0.12	0.25	V
IDD2	V_{REF2}	HPD2=0, AUX1,2A,2B N.C.	-	0.1	10	uA
		HPD2= V_{REF2} , SEL=0, AUX1,2A,2B N.C.	-	53	200	uA
		HPD2= V_{REF2} , SEL=1, AUX1,2A,2B N.C.	-	95	300	uA
Leakage Current	Between V_{REF1} and V_{REF2}	$V_{REF1}=0V$ or $V_{REF2}=0V$	-	-	100	nA
AUX1	AUX1+ single-ended swing	$V_{REF1} \geq 1V$, $V_{REF2} \geq 1.6V$	0	-	$V_{REF1} + 0.4$	V
	AUX1- single-ended swing	$V_{REF1} \geq 1V$, $V_{REF2} \geq 1.6V$	0	-	$V_{REF1} + 0.4$	V
	AUX1+ , AUX1- Pull-down		60	80	100	k Ω
AUX2A	AUX2A+ single-ended swing	$V_{REF1} \geq 1V$, $V_{REF2} \geq 1.6V$	0	-	V_{AUX1+}	V
	AUX2A- single-ended swing	$V_{REF1} \geq 1V$, $V_{REF2} \geq 1.6V$	0	-	V_{AUX1-}	V
	AUX2A+/- Pull-up to V_{REF2}	SEL = 1 (DDC mode)	60	80	100	k Ω
	Resistance between AUX1 and AUX2A pins	SEL=0, AUX1=(0, 0.7V) $V_{REF1}=1V$, $V_{REF2}=2V$, 10mA into AUX2A	-	-	10	Ω
		SEL=0, AUX1= 0.845V $V_{REF1}=1V$, $V_{REF2}=2V$, 10mA into AUX2A	-	-	10	Ω
		SEL=1	100	-	-	Meg Ω
AUX2B	AUX2B+ single-ended swing	$V_{REF1} \geq 1V$, $V_{REF2} \geq 1.6V$	0	-	V_{REF2}	V
	AUX2B- single-ended swing	$V_{REF1} \geq 1V$, $V_{REF2} \geq 1.6V$	0	-	V_{REF2}	V
	AUX2B+ Pull-down		60	80	100	k Ω
	AUX2B- Pull-up to V_{REF2}		60	80	100	k Ω
	Resistance between AUX1 and AUX2B pins	SEL=0	100	-	-	Meg Ω
		SEL=1, AUX1= 0.3 x V_{REF1} , $V_{REF1}=1V$, $V_{REF2}=2V$, 10mA into AUX2B	-	-	10	Ω
HPD1	Pull-up		28	38	50	k Ω
	V_{OL}	HPD2>2V, external $R_{up}=10k\Omega$ to $V_{REF1}=1.8V$	0	-	10% V_{REF1}	V
	HPD1 V_{REF1} POR	HPD2=2V, $V_{REF2}=0V$, V_{ref1} ramps up until HPD1 < 0.4V	0.6	0.81	0.95	V
	HPD1 V_{REF1} HYS	HPD2=2V, $V_{REF2}=0V$, V_{REF1} ramps down until HPD1>0.4V	-	87	-	mV

Electrical Characteristics (Cont.)

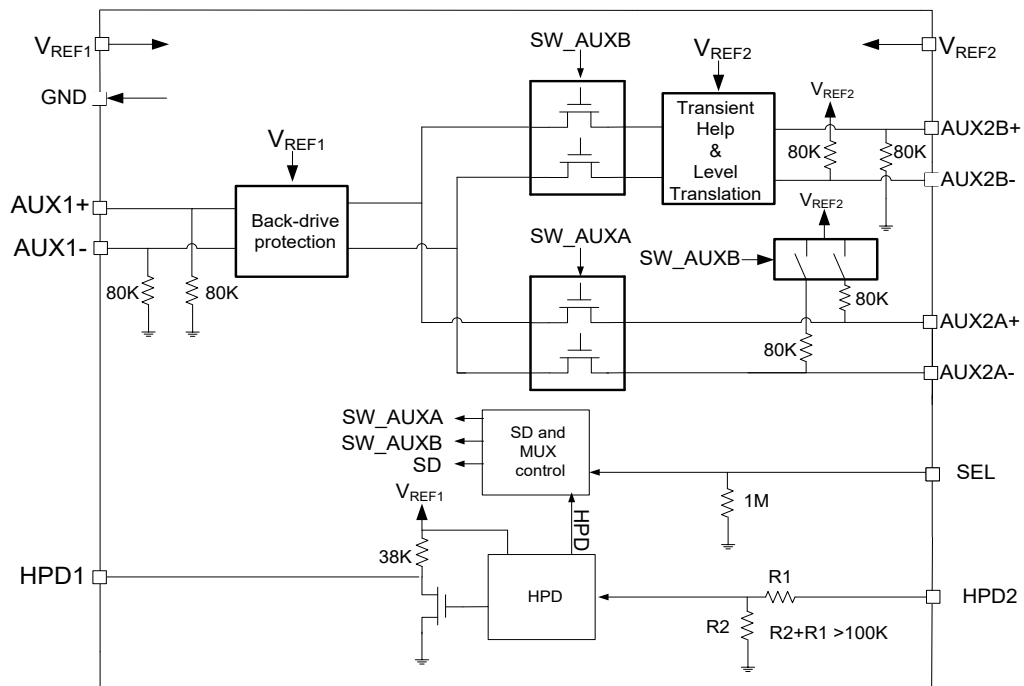
Unless otherwise specified, these specifications apply over $V_{REF1}=1.8V$, $V_{REF2}=3.3V$, and $T_A=-40$ to $85^{\circ}C$. Typical values are at $T_A=25^{\circ}C$

Symbol	Parameter	Test condition	APL3585			Unit
			Min.	Typ.	Max.	
HPD2	V _{IH}	logic High voltage	2	-	5.3	V
	V _{IL}	logic Low voltage	0	-	0.8	V
	Pull-down		100	135	200	kΩ
	Rising edge Delay	HPD2=0 ->2V,Tr=1ns HPD1=VREF1->0.1VREF1, CL=10pF	-	90	200	ns
	falling edge Delay	HPD2=2 ->0V,Tf=1ns HPD1=VREF1->0.9VREF1, CL=10pF	-	1100	2000	ns
	power saving de-bounce time	HPD2> 2V, enter to awake mode	-	0.2	1	ms
		HPD2< 0.8V, enter to standby mode	5	10	20	ms
SEL	V _{IH}	logic High voltage	70% V _{REF2}	-	-	V
	V _{IL}	logic Low voltage	-	-	30% V _{REF2}	V
	Pull-down		0.75	1	1.25	MegΩ
I ² C timing requirements in standard mode (I ² C specification, UM10204 rev.5)						
t _R	Rise time	AUX2B from V _{IL} (0.3V _{REF2}) to V _{IH} (0.7V _{REF2}) base on Cap of DDC line total=800pF	-	-	1000	ns
t _F	Fall time		-	-	300	ns
	C AUX2B	SEL=1 AUX2B+/-=0V Without PCB Parasitic capacitance	-	-	50	pF

Pin Descriptions

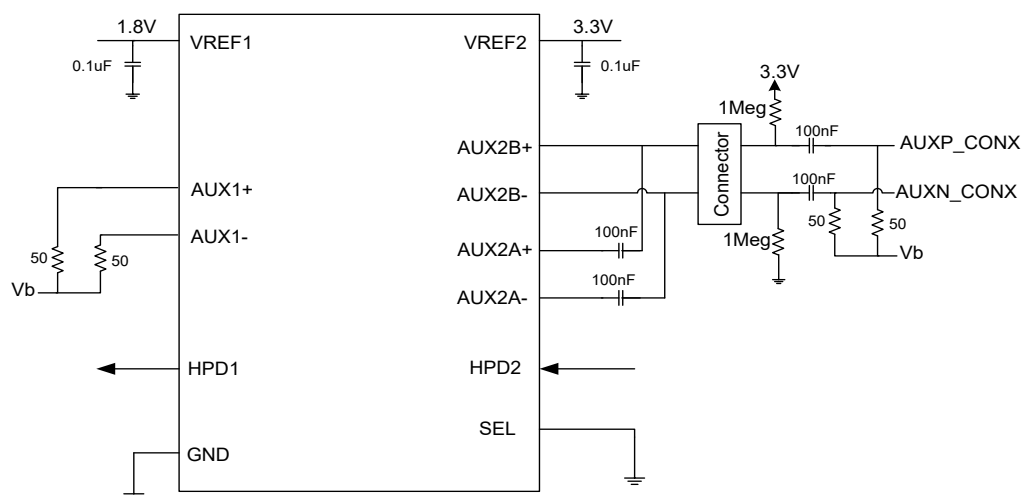
PIN		FUNCTION
NO.	NAME	
TQFN2x2		
1	AUX2B-	Connector side bi-directional AUX2B- signal.
2	AUX2B+	Connector side bi-directional AUX2B+ signal.
3	AUX2A+	Connector side bi-directional AUX2A+ signal
4	SEL	AUX2 A/B select input. (Low selects AUX2A, High selects AUX2B)
5	HPD1	HPD signal output to GPU.
6	GND	Ground.
7	AUX1+	GPU side bi-directional AUX1+ signal.
8	AUX1-	GPU side bi-directional AUX1- signal.
9	V _{REF1}	GPU side reference voltage input.
10	V _{REF2}	Connector side reference voltage input.
11	HPD2	HPD signal input from connector.
12	AUX2A-	Connector side bi-directional AUX2A- signal.

Block Diagram

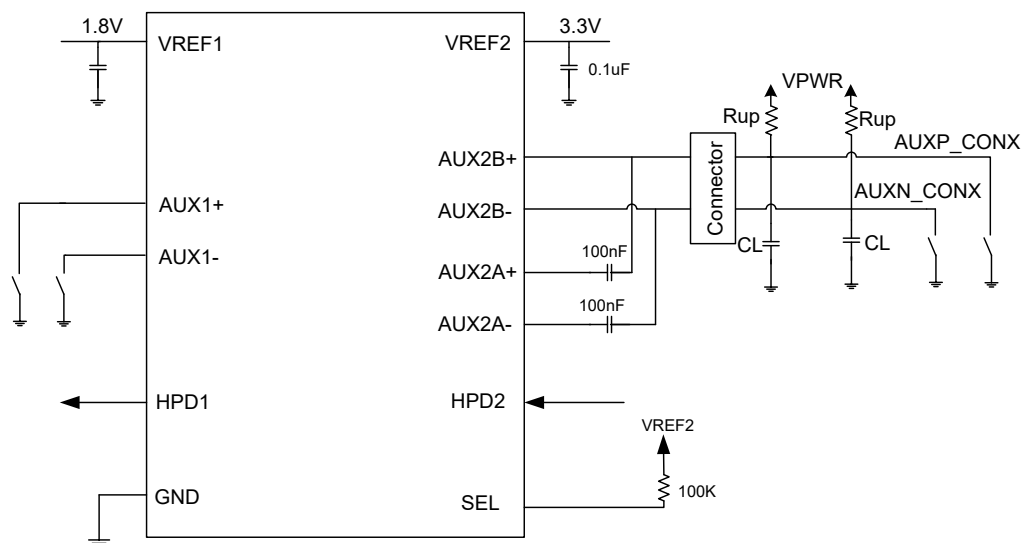


Typical Application Circuit

1. DP_AUX MODE

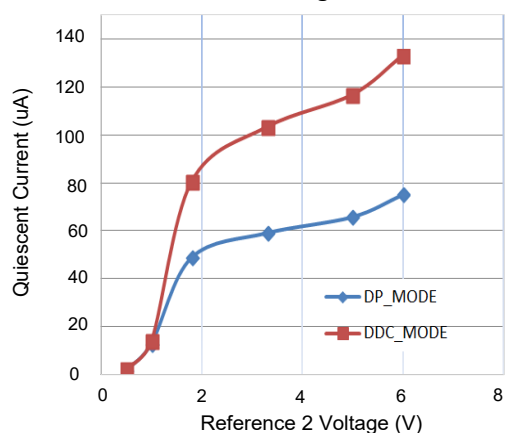


2. HDMI_DDC MODE

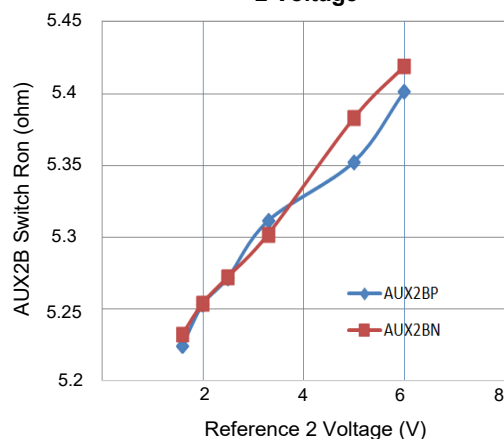


Typical Operating Characteristics

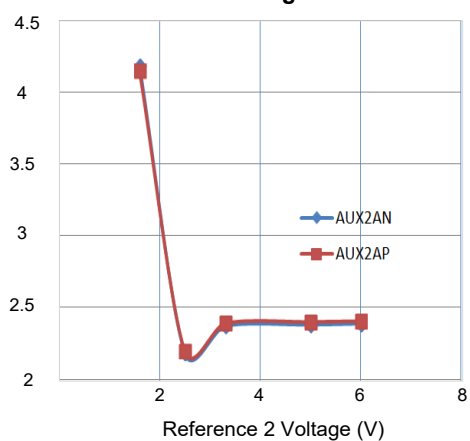
Quiescent Current VS. Reference
2 Voltage



AUX2B Switch Ron VS. Reference
2 Voltage



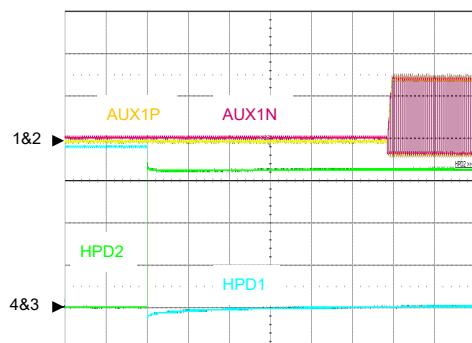
AUX2A Switch Ron VS. Reference
2 Voltage



Operating Waveforms

Refer to the typical application circuit. The test condition is $V_{REF1}=1.8V, V_{REF2}=3.3V, T_A=25^{\circ}C$ unless otherwise specified.

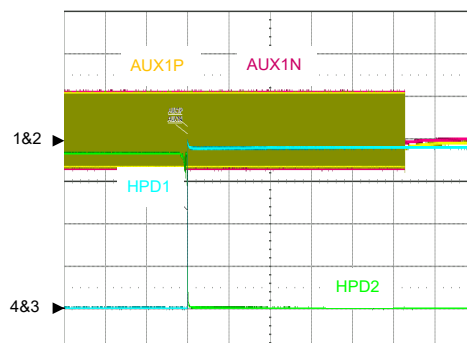
HPD Power On



SEL=Low; DP_AUX Mode

CH1: AUX1P, 0.5V/Div, DC
CH2: AUX1N, 0.5V/Div, DC
CH3: HPD1, 0.5V/Div, DC
CH4: HPD2, 1V/Div, DC
TIME: 20us/Div

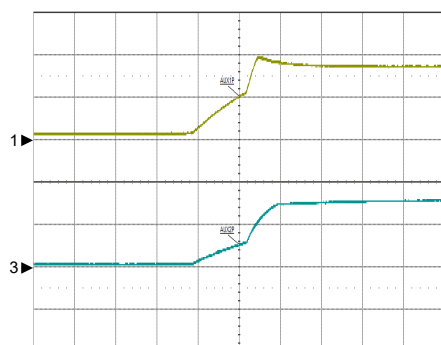
HPD Power Off



SEL=Low; DP_AUX Mode

CH1: AUX1P, 0.5V/Div, DC
CH2: AUX1N, 0.5V/Div, DC
CH3: HPD1, 0.5V/Div, DC
CH4: HPD2, 1V/Div, DC
TIME: 2ms/Div

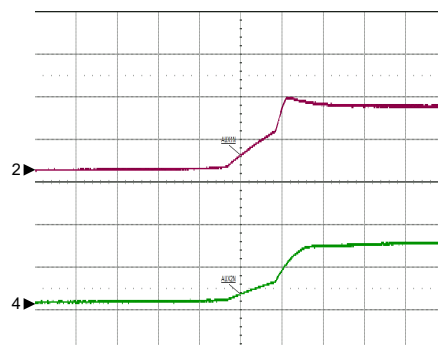
Transient Help Positive



SEL=High ; DDC_HDMI Mode

CH1: AUX1P, 1V/Div, DC
CH3: AUX2P, 2V/Div, DC
TIME: 500ns/Div

Transient Help Negative

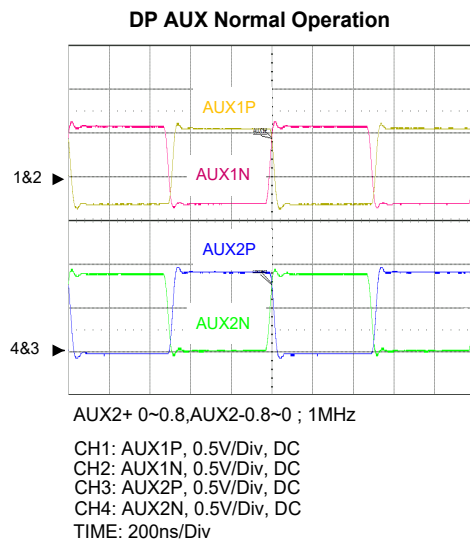


SEL=High ; DDC_HDMI Mode

CH2: AUX1N, 1V/Div, DC
CH4: AUX2N, 2V/Div, DC
TIME: 500ns/Div

Operating Waveforms (Cont.)

Refer to the typical application circuit. The test condition is $V_{REF1}=1.8V$, $V_{REF2}=3.3V$, $T_A=25^{\circ}C$ unless otherwise specified.



Function Descriptions

Data Selector

When the SEL voltage level is V_{REF2} , the IC is in HDMI_DDC mode, AUX2B [+-] pins will lead to AUX1 [+-] pins, and can conduct signals in bi-directional, while AUX2A [+-] is in high impedance.

When the SEL voltage level is GND, the IC is in DP_AUX mode, AUX2A [+-] pins will lead to AUX1 [+-] pins, and can conduct signals in bi-directional, while AUX2B [+-] is in high impedance.

Level Translation

The AUX1/HDMI_DDC Interface IC shall provide bi-directional level translation between V_{REF1} to V_{REF2} levels on AUX2B signal path. The AUX2A signal path does not require level translation as the GPU will be driving CML when this path is selected.

VREF1 and VREF2 Back-drive Protection

When V_{REF1} or V_{REF2} of APL3585 is below the POR threshold, SW_AUXA/B will be turned off.

If V_{REF1} is below the V_{REF1_POR} threshold, HPD1 is pulled up to V_{REF1} .

Hot Plug Detection

When the APL3585 hot plug detection pin HPD2 = H, the IC will be woken up and enter the normal operating mode.

When HPD2 = H, HPD1 = L; and HPD2 = L, HPD1 = H.

Transient Help

In order to make the HDMI_DDC bus comply with I2C timing specifications. In standard mode, as shown in Figure 1, APL3585 has a transient help function. When the signal is transmitted from the GPU to the HDMI_DDC bus, this function can speed up the rise time of AUX2B.

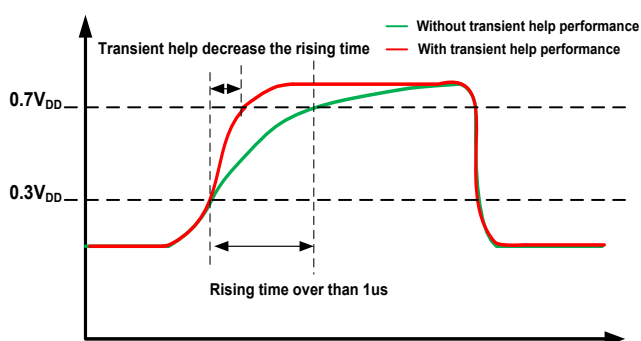
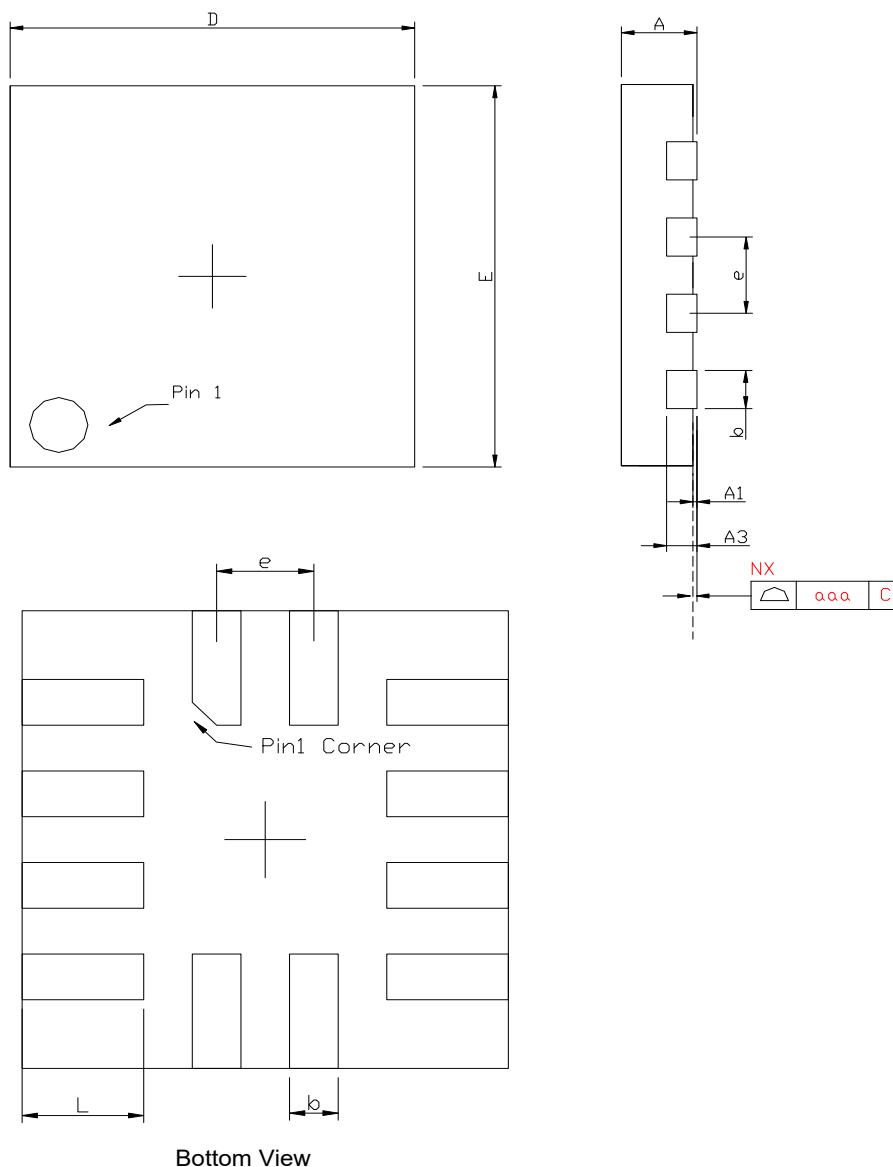


Fig.1 Transient Help pull up signal from 0.3VDD to 0.7VDD in 1us

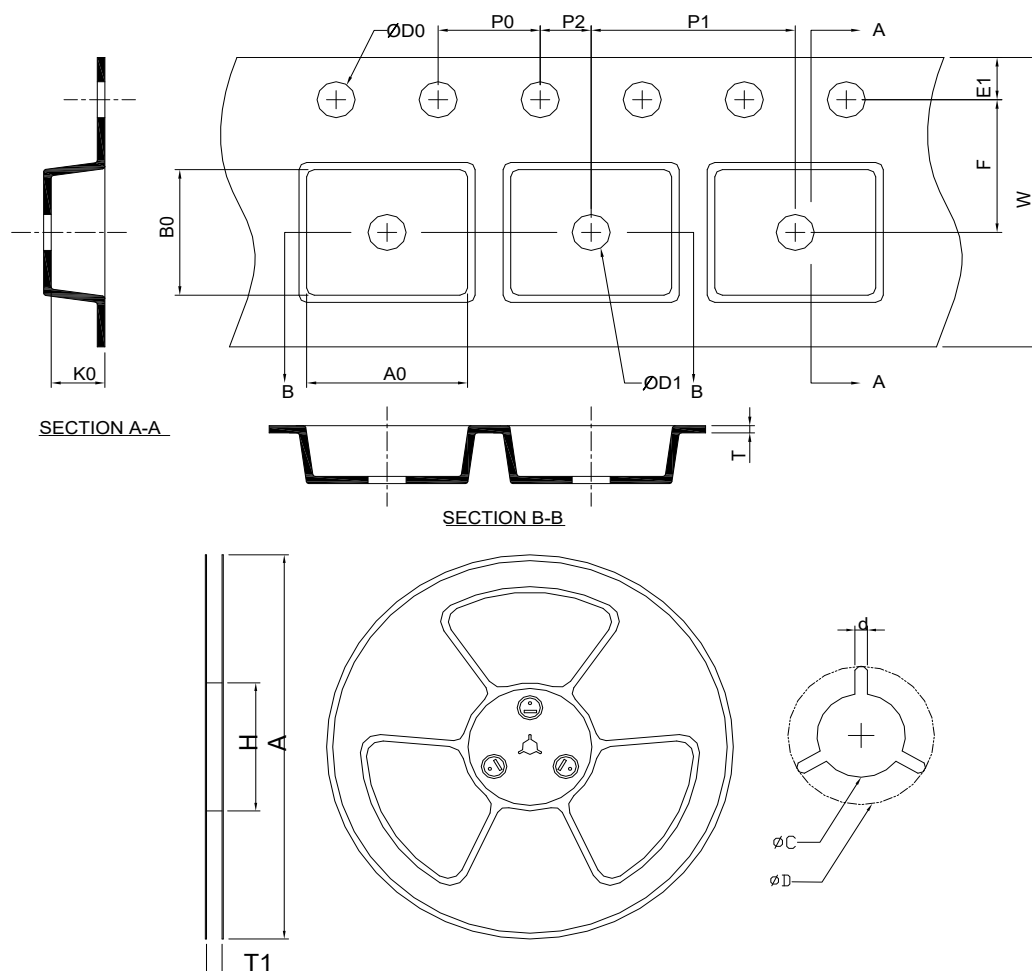
Package Information

VTQFN2x2-12



SYMBOL	VTQFN2*2-12			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	0.50	0.60	0.020	0.024
A1	0.00	0.05	0.000	0.002
A3	0.15 REF		0.006 REF	
b	0.15	0.25	0.006	0.010
D	1.90	2.10	0.075	0.083
E	1.90	2.10	0.075	0.083
e	0.40 BSC		0.016 BSC	
L	0.45	0.55	0.018	0.022
aaa	0.08		0.003	

Carrier Tape & Reel Dimensions



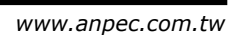
Application	A	H	T1	C	d	D	W	E1	F
VTQFN(2x2)	178.0±2.00	50 MIN.	8.4+2.00 -0.00	13.0+0.50 -0.20	1.5 MIN.	20.2 MIN.	8.0±0.20	1.75±0.10	3.5±0.05
	P0	P1	P2	D0	D1	T	A0	B0	K0
	4.0±0.10	4.0±0.10	2.0±0.05	1.5+0.10 -0.00	1.5 MIN.	0.6+0.00 -0.40	2.20±0.15	2.20±0.15	0.75±0.05

(mm)

Devices Per Unit

Package type	Packing	Quantity
VTQFN(2x2)	Tape & Reel	3000

VTQFN2x2-12



Classification Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Preheat & Soak		
Temperature min (T_{smin})	100 °C	150 °C
Temperature max (T_{smax})	150 °C	200 °C
Time (T_{smin} to T_{smax}) (t_s)	60-120 seconds	60-120 seconds
Average ramp-up rate (T_{smax} to T_p)	3 °C/second max.	3°C/second max.
Liquidous temperature (T_L)	183 °C	217 °C
Time at liquidous (t_L)	60-150 seconds	60-150 seconds
Peak package body Temperature (T_p)*	See Classification Temp in table 1	See Classification Temp in table 2
Time (t_p)** within 5°C of the specified classification temperature (T_c)	20** seconds	30** seconds
Average ramp-down rate (T_p to T_{smax})	6 °C/second max.	6 °C/second max.
Time 25°C to peak temperature	6 minutes max.	8 minutes max.
* Tolerance for peak profile Temperature (T_p) is defined as a supplier minimum and a user maximum.		
** Tolerance for time at peak profile temperature (t_p) is defined as a supplier minimum and a user maximum.		

Table 1. SnPb Eutectic Process – Classification Temperatures (T_c)

Package Thickness	Volume mm ³ <350	Volume mm ³ ≥350
<2.5 mm	235 °C	220 °C
≥2.5 mm	220 °C	220 °C

Table 2. Pb-free Process – Classification Temperatures (T_c)

Package Thickness	Volume mm ³ <350	Volume mm ³ 350-2000	Volume mm ³ >2000
<1.6 mm	260 °C	260 °C	260 °C
1.6 mm – 2.5 mm	260 °C	250 °C	245 °C
≥2.5 mm	250 °C	245 °C	245 °C

Reliability Test Program

Test item	Method	Description
SOLDERABILITY	JESD-22, B102	5 Sec, 245°C
HOLT	JESD-22, A108	1000 Hrs, Bias @ T_j =125°C
PCT	JESD-22, A102	168 Hrs, 100%RH, 2atm, 121°C
TCT	JESD-22, A104	500 Cycles, -65°C~150°C
HBM	MIL-STD-883-3015.7	VHBM ≥ 2KV
MM	JESD-22, A115	VMM ≥ 200V
Latch-Up	JESD 78	10ms, $I_{tr} \geq 100mA$

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