

2.5-V TO 3.3-V HIGH-PERFORMANCE CLOCK BUFFER

FEATURES

- High-Performance 1:10 Clock Driver
- Pin-to-Pin Skew < 100 ps at V_{DD} 3.3 V
- V_{DD} Range = 2.3 V to 3.6 V
- Input Clock Up To 200 MHz (See Figure 7)
- Operating Temperature Range -40°C to 85°C
- Output Enable Glitch Suppression
- Distributes One Clock Input to Two Banks of Five Outputs
- Packaged in 24-Pin TSSOP
- Pin-to-Pin Compatible to the CDCVF2310, Except the R = 22-Ω Series Damping Resistors at Yn

PW PACKAGE (TOP VIEW) GND □□ ☐ CLK 23 \square V_{DD} V_{DD} □ ⊤ V_{DD} 22 1Y0 🗆 21 1Y1 🞞 1Y2 🞞 20 □ 2Y1 ☐ GND GND □ 19 GND □ 18 ☐ GND 1Y3 🗆 17 □ 2Y2 1Y4 🗆 9 16 V_{DD} □ 10 15 \square \vee_{DD} \square V_{DD} 1G □□ 14 2Y4 🔲 12 13 **□** 2G

APPLICATIONS

General-Purpose Applications

DESCRIPTION

The CDCVF310 is a high-performance, low-skew clock buffer that operates up to 200 MHz. Two banks of five outputs each provide low-skew copies of CLK. After power up, the default state of the outputs is low regardless of the state of the control pins. For normal operation, the outputs of bank 1Y[0:4] or 2Y[0:4] can be placed in a low state when the control pins (1G or 2G, respectively) are held low and a negative clock edge is detected on the CLK input. The outputs of bank 1Y[0:4] or 2Y[0:4] can be switched into the buffer mode when the control pins (1G and 2G) are held high and a negative clock edge is detected on the CLK input. The device operates in a 2.5-V and 3.3-V environment. The built-in output enable glitch suppression ensures a synchronized output enable sequence to distribute full period clock signals.

The CDCVF310 is characterized for operation from -40C to 85C.



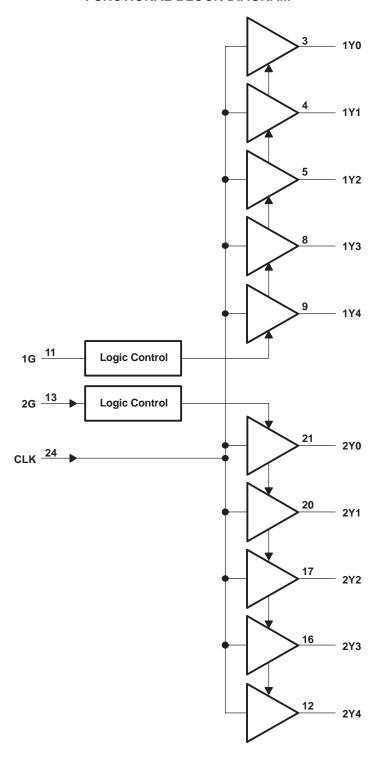
Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.





These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

FUNCTIONAL BLOCK DIAGRAM





FUNCTION TABLE

	INPUT	OUTPUT			
1G	2G	CLK	1Y[0:4]	2Y[0:4]	
L	L	↓	L	L	
Н	L	↓	CLK ⁽¹⁾	L	
L	Н	↓	L	CLK ⁽¹⁾	
Н	Н	↓	CLK ⁽¹⁾	CLK ⁽¹⁾	

(1) After detecting one negative edge on the CLK input, the output follows the input CLK if the control pin is held high.

Terminal Functions

	TERMINAL		DECODIFICAL			
NAME	NO.	I/O	DESCRIPTION			
1G	11	I	Output enable control for 1Y[0:4] outputs. This output enable is active-high, meaning the 1Y[0:4] clock outputs follow the input clock (CLK) if this pin is logic high.			
2G	13	I	Output enable control for 2Y[0:4] outputs. This output enable is active-high, meaning the 2Y[0:4] clock outputs follow the input clock (CLK) if this pin is logic high.			
1Y[0:4]	3, 4, 5, 8, 9	0	Buffered output clocks			
2Y[0:4]	21, 20, 17, 16, 12	0	Buffered output clocks			
CLK	24	I	Input reference frequency			
GND	1, 6, 7, 18, 19		Ground			
V_{DD}	2, 10, 14, 15, 22, 23		DC power supply, 2.3 V – 3.6 V			

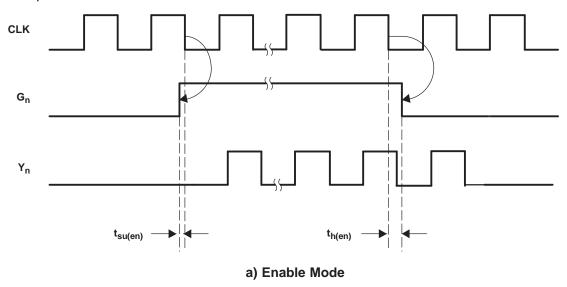


DETAILED DESCRIPTION

Output Enable Glitch Suppression Circuit

The purpose of the glitch suppression circuitry is to ensure the output enable sequence is synchronized with the clock input such that the output buffer is enabled or disabled on the next full period of the input clock (negative edge triggered by the input clock) (see Figure 1).

The G input must fulfill the timing requirements (t_{su}, t_h) according to the Switching Characteristics table for predictable operation.



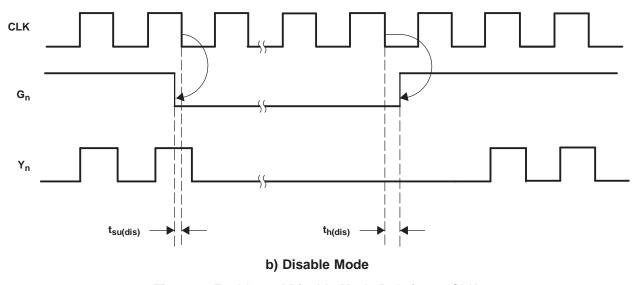


Figure 1. Enable and Disable Mode Relative to CLK



ABSOLUTE MAXIMUM RATINGS

over operating free-air temperature range (unless otherwise noted) (1)

Supply voltage range, V _{DD}	–0.5 V to 4.6 V
Input voltage range, V _I ⁽²⁾⁽³⁾	-0.5 V to V _{DD} + 0.5 V
Output voltage range, V _O ⁽²⁾⁽³⁾	-0.5 V to V _{DD} + 0.5 V
Input clamp current, I_{IK} ($V_I < 0$ or $V_I > V_{DD}$)	±50 mA
Output clamp current, I _{OK} (V _O < 0 or V _O > V _{DD})	±50 mA
Continuous total output current, I _O (V _O = 0 to V _{DD})	±50 mA
Dealisms the week immediates (4). DIM realisms	88°C/W, high K
Package thermal impedance, θ _{JA} ⁽⁴⁾ : PW package	120°C/W, low K
Storage temperature range T _{stg}	−65°C to 150°C

⁽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-rated conditions for extended periods may affect device reliability.

RECOMMENDED OPERATING CONDITIONS (1)

		MIN	NOM	MAX	UNIT
Supply voltage, V _{DD}		2.3	2.5		V
Supply voltage, v _{DD}			3.3	3.6	V
Low lovel input voltage V	V _{DD} = 3 V to 3.6 V			0.8	V
Low-level input voltage, V _{IL}	V_{DD} = 2.3 V to 2.7 V			0.7	V
I Cale Laval Caracteration A	V _{DD} = 3 V to 3.6 V	2	2		V
High-level input voltage, V _{IH}	V_{DD} = 2.3 V to 2.7 V	1.7			V
Input voltage, V _I		0		V_{DD}	V
High lovel output ourrent I	V _{DD} = 3 V to 3.6 V			-12	A
High-level output current, I _{OH}	V _{DD} = 2.3 V to 2.7 V			-6	mA
Low lovel output output	V _{DD} = 3 V to 3.6 V			12	A
Low-level output current, I _{OL}	V _{DD} = 2.3 V to 2.7 V			6	mA
Operating free-air temperature, T	\ \	-40		85	°C

⁽¹⁾ Unused inputs must be held high or low to prevent them from floating.

TIMING REQUIREMENTS

over operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
f _{clk}	Clock frequency	V _{DD} = 2.3 V to 3.6 V, See Figure 7	0		200	MHz

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⁽²⁾ The input and output negative voltage ratings may be exceeded if the input and output clamp-current ratings are observed.

³⁾ This value is limited to 4.6 V maximum.

⁽⁴⁾ The package thermal impedance is calculated in accordance with JESD 51.



ELECTRICAL CHARACTERISTICS

over recommended operating free-air temperature range (unless otherwise noted)(1)

	PARAMETER	TEST CONDITIONS			TYP	MAX	UNIT
V_{IK}	Input voltage	$V_{DD} = 3 V$,	$I_I = -18 \text{ mA}$			-1.2	V
I	Input current	V _I = 0 V or V _{DD}				±5	μΑ
I _{DD} ⁽²⁾	Static device current	$CLK = 0 V \text{ or } V_{DD} = 3.6 V,$	$I_O = 0 \text{ mA}$			80	μΑ
C _I	Input capacitance	$V_{DD} = 2.3 \text{ V to } 3.6 \text{ V},$	$V_I = 0 \text{ V or } V_{DD}$		2.5		pF
Co	Output capacitance	$V_{DD} = 2.3 \text{ V to } 3.6 \text{ V},$	$V_I = 0 V \text{ or } V_{DD}$		2.6		pF
C_{PD}	Power dissipation (3)	$V_{DD} = 2.3 \text{ V to } 3.6 \text{ V},$	$V_I = 0 V \text{ or } V_{DD}$			32	pF

- (1) All typical values are with respect to nominal V_{DD} .
- (2) For dynamic I_{DD} over Frequency see Figure 6.
- (3) This is the formula for the power dissipation calculation.

$$\begin{split} \text{P_tot} &= \text{P_stat} + \text{P_Dyn} + \text{P_Load[W]} \\ \text{P_stat} &= \text{V}_{\text{DD}} \times \text{I}_{\text{DD}} [\text{W}] \\ \text{P_Dyn} &= \text{C_PD} \times \text{V}_{\text{DD}} \times \text{V}_{\text{DD}} \times f [\text{W}] \\ \text{P_Load} &= \text{C_Load} \times \text{V}_{\text{DD}} \times \text{V}_{\text{DD}} \times f \times n [\text{W}] \\ \text{n} &= \text{Number of switching output pins} \end{split}$$

$V_{DD} = 3.3 \text{ V} \pm 0.3 \text{ V}$

PARAMETER		TEST	TEST CONDITIONS			UNIT
		V_{DD} = min to max,	$I_{OH} = -100 \mu A$	V _{DD} - 0.2		
V_{OH}	High-level output voltage	V - 2 V	I _{OH} = -12 mA	2.1		V
		$V_{DD} = 3 V$	$I_{OH} = -6 \text{ mA}$	2.4		
V _{OL} Low-level output voltage	V_{DD} = min to max,	I _{OL} = 100 μA		0.2		
	V 2.V	I _{OL} = 12 mA		0.4	V	
		$V_{DD} = 3 V$	$I_{OL} = 6 \text{ mA}$		0.3	
		$V_{DD} = 3 V$,	V _O = 1 V	-37		
I _{OH}	High-level output current	$V_{DD} = 3.3 \text{ V},$	V _O = 1.65 V		– 57	mA
		$V_{DD} = 3.6 V,$	$V_0 = 3.135 \text{ V}$		-38	
		$V_{DD} = 3 V$,	V _O = 1.95 V	37		
I_{OL}	Low-level output current	$V_{DD} = 3.3 \text{ V},$	V _O = 1.65 V		57	mA
		$V_{DD} = 3.6 \text{ V},$	V _O = 0.4 V		38	

⁽¹⁾ All typical values are with respect to nominal V_{DD} .

$V_{DD} = 2.5 \text{ V} \pm 0.2 \text{ V}$

	PARAMETER	TEST	TEST CONDITIONS			MAX	UNIT
\/	High lovel output voltage	V _{DD} = min to max,	I _{OH} = -100 A	V _{DD} - 0.2			V
V _{OH}	High-level output voltage	$V_{DD} = 2.3 \text{ V}$	$I_{OH} = -6 \text{ mA}$	1.8			V
V Lave lavel autaut valtage	Low lovel output voltage	V_{DD} = min to max,	I _{OL} = 100 A			0.2	V
V _{OL} Low-level output voltage		$V_{DD} = 2.3 \text{ V}$	$I_{OL} = 6 \text{ mA}$			0.4	V
		$V_{DD} = 2.3 V$,	$V_O = 1 V$	-20			
I_{OH}	High-level output current	$V_{DD} = 2.5 V,$	$V_0 = 1.25 \text{ V}$		-36		mA
		$V_{DD} = 2.7 V,$	$V_0 = 2.375 \text{ V}$			-25	
		$V_{DD} = 2.3 V$,	$V_0 = 1.2 \text{ V}$	20			
I_{OL}	Low-level output current	$V_{DD} = 2.5 V,$	$V_0 = 1.25 \text{ V}$		36		mA
		$V_{DD} = 2.7 V,$	$V_0 = 0.3 V$			25	

(1) All typical values are with respect to nominal V_{DD}.



JITTER CHARACTERISTICS

Characterized using CDCVF310 Performance EVM when V_{DD} =3.3 V. Outputs not under test are terminated to 50 Ω .

	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	TINU
	Additional and Street for a formal AVO	12 kHz to 5 MHz, f _{out} = 30.72 MHz		47		fo rmo
^I jitter	Additive phase jitter from input to output 1Y0	12 kHz to 20 MHz, f _{out} = 125 MHz		40		fs rms

SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range (unless otherwise noted)

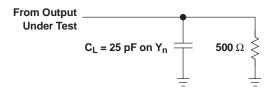
	PARAMETER	TEST CONDITIONS	MIN	TYP ⁽¹⁾	MAX	UNIT
V _{DD} = 3	3.3 V ±0.3 V (see Figure 2)		•			
t _{PLH}	CLK to Yn	(2.8	
t _{PHL}	CLK to Yh	f = 0 MHz to 200 MHz	1		2.8	ns
t _{sk(o)}	Output skew (Ym to Yn) (2) (see Figure 4)			100	150	ps
t _{sk(p)}	Pulse skew (see Figure 5)				250	ps
t _{sk(pp)}	Part-to-part skew				350	ps
t _r	Rise time	$V_0 = 0.4 \text{ V to 2 V}$	1.3		2.7	V/ns
t _f	Fall time	$V_0 = 2 \text{ V to } 0.4 \text{ V}$	1.3		2.7	V/ns
t _{su(en)}	Enable setup time, G_high before CLK \downarrow		0.1			ns
t _{su(dis)}	Disable setup time, G_low before CLK \downarrow		0.1			ns
t _{h(en)}	Enable hold time, G_high after CLK \downarrow		0.4			ns
t _{h(dis)}	Disable hold time, G_low after CLK \downarrow		0.4			ns
$V_{DD} = 2$	2.5 V ±0.2 V (see Figure 2)					
t _{PLH}	CLK to Yn	f = 0 MHz to 200 MHz	1.3		4	ns
t _{PHL}	CER to TII	1 - 0 1011 12 10 200 1011 12	1.3		4	113
t _{sk(o)}	Output skew (Ym to Yn) (2) (see Figure 4)			150	230	ps
t _{sk(p)}	Pulse skew (see Figure 5)				280	ps
t _{sk(pp)}	Part-to-part skew				400	ps
t _r	Rise time	$V_0 = 0.4 \text{ V to } 1.7 \text{ V}$	0.5		1.6	V/ns
t _f	Fall time	$V_0 = 1.7 \text{ V to } 0.4 \text{ V}$	0.5		1.6	V/ns
t _{su(en)}	Enable setup time, G_high before CLK \downarrow		0.1			ns
t _{su(dis)}	Disable setup time, G_low before CLK \downarrow		0.1			ns
t _{h(en)}	Enable hold time, G_high after CLK ↓		0.4			ns
t _{h(dis)}	Disable hold time, G_low after CLK ↓		0.4			ns

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 $[\]begin{array}{ll} \text{(1)} & \text{All typical values are with respect to nominal V_{DD}.} \\ \text{(2)} & \text{The $t_{sk(o)}$ specification is only valid for equal loading of all outputs.} \end{array}$



PARAMETER MEASUREMENT INFORMATION



- A. C_L includes probe and jig capacitance.
- B. All input pulses are supplied by generators having the following characteristics: Clock Frequency \leq 200 MHz, $Z_O = 50$ Ω , $t_r < 1.2$ ns, $t_f < 1.2$ ns.

Figure 2. Test Load Circuit

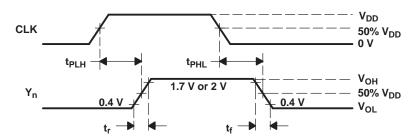


Figure 3. Voltage Waveforms Propagation Delay Times

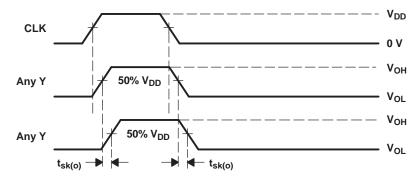


Figure 4. Output Skew

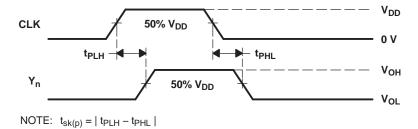
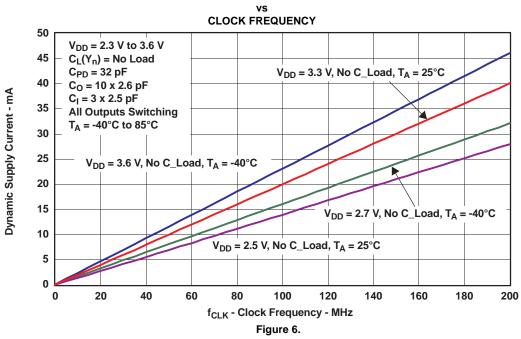


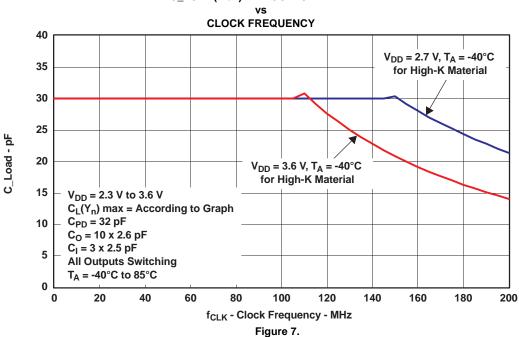
Figure 5. Pulse Skew



DYNAMIC SUPPLY CURRENT



C_LOAD(max) PER OUTPUT PIN Yn







.com 22-Jan-2008

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	e Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
CDCVF310PW	ACTIVE	TSSOP	PW	24	60	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CDCVF310PWG4	ACTIVE	TSSOP	PW	24	60	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CDCVF310PWR	ACTIVE	TSSOP	PW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CDCVF310PWRG4	ACTIVE	TSSOP	PW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

⁽¹⁾ The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

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Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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TAPE AND REEL INFORMATION





A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device		Package Drawing			Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
CDCVF310PWR	TSSOP	PW	24	2000	330.0	16.4	6.95	8.3	1.6	8.0	16.0	Q1





*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CDCVF310PWR	TSSOP	PW	24	2000	346.0	346.0	33.0

PW (R-PDSO-G24)

PLASTIC SMALL OUTLINE



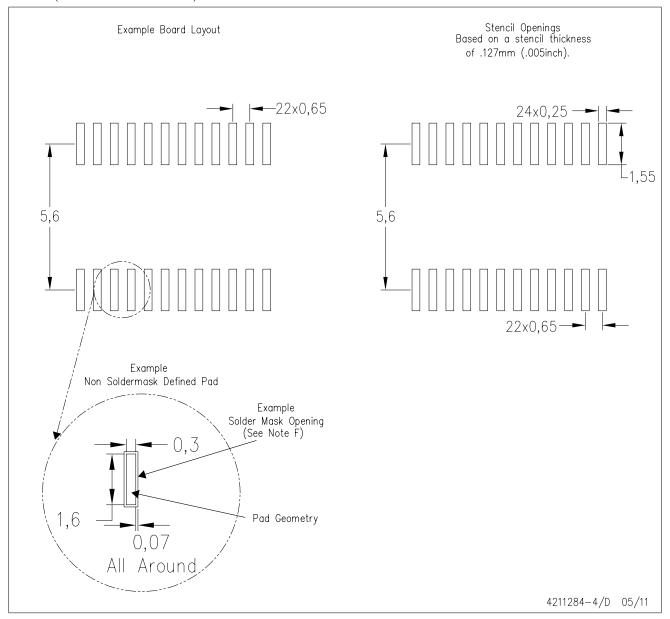
NOTES:

- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M—1994.
- B. This drawing is subject to change without notice.
- Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
- Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
- E. Falls within JEDEC MO-153



PW (R-PDSO-G24)

PLASTIC SMALL OUTLINE



NOTES:

- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Publication IPC-7351 is recommended for alternate design.
- D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
- E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



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