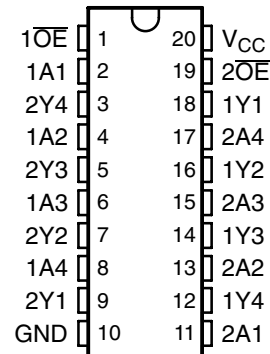


SN74LVC244A-Q1 OCTAL BUFFER/DRIVER WITH 3-STATE OUTPUTS

SCAS790B – DECEMBER 2004 – REVISED JANUARY 2008

- Qualified for Automotive Applications
- Operates From 1.65 V to 3.6 V
- Inputs Accept Voltages to 5.5 V
- Specified From -40°C to 85°C and -40°C to 125°C
- Max t_{pd} of 5.9 ns at 3.3 V
- Typical V_{OLP} (Output Ground Bounce) $<0.8\text{ V}$ at $V_{CC} = 3.3\text{ V}$, $T_A = 25^{\circ}\text{C}$
- Typical V_{OHV} (Output V_{OH} Undershoot) $>2\text{ V}$ at $V_{CC} = 3.3\text{ V}$, $T_A = 25^{\circ}\text{C}$
- Supports Mixed-Mode Signal Operation on All Ports (5-V Input/Output Voltage With 3.3-V V_{CC})
- I_{off} Supports Partial-Power-Down Mode Operation
- Latch-Up Performance Exceeds 250 mA Per JESD 17
- ESD Protection Exceeds JESD 22
 - 2000-V Human-Body Model (A114-A)
 - 200-V Machine Model (A115-A)
 - 1000-V Charged-Device Model (C101)

DW OR PW PACKAGE
(TOP VIEW)



description/ordering information

This octal buffer/line driver is operational at 1.5-V to 3.6-V V_{CC} , but is designed specifically for 1.65-V to 3.6-V V_{CC} operation.

The SN74LVC244A is organized as two 4-bit line drivers with separate output-enable (\overline{OE}) inputs. When \overline{OE} is low, the device passes data from the A inputs to the Y outputs. When \overline{OE} is high, the outputs are in the high-impedance state.

Inputs can be driven from either 3.3-V or 5-V devices. This feature allows the use of this device as a translator in a mixed 3.3-V/5-V system environment.

To ensure the high-impedance state during power up or power down, \overline{OE} should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

This device is fully specified for partial-power-down applications using I_{off} . The I_{off} circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

ORDERING INFORMATION†

T_A	PACKAGE‡		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 125°C	SOIC – DW	Reel of 2000	SN74LVC244AQDWRQ1	LVC244AQ
	TSSOP – PW	Reel of 2000	SN74LVC244AQPWRQ1	LVC244AQ

† For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.

‡ Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.



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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

 **TEXAS
INSTRUMENTS**

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SN74LVC244A-Q1

OCTAL BUFFER/DRIVER

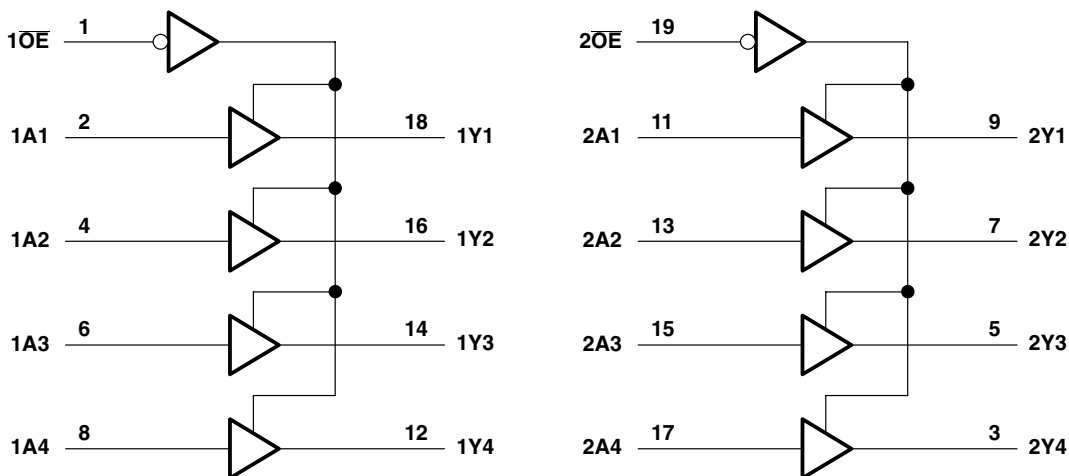
WITH 3-STATE OUTPUTS

SCAS790B – DECEMBER 2004 – REVISED JANUARY 2008

FUNCTION TABLE
(each buffer)

INPUTS		OUTPUT
OE	A	Y
L	H	H
L	L	L
H	X	Z

logic diagram (positive logic)



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)[†]

Supply voltage range, V_{CC}	-0.5 V to 6.5 V
Input voltage range, V_I (see Note 1)	-0.5 V to 6.5 V
Voltage range applied to any output in the high-impedance or power-off state, V_O (see Note 1)	-0.5 V to 6.5 V
Voltage range applied to any output in the high or low state, V_O (see Notes 1 and 2)	-0.5 V to $V_{CC} + 0.5$ V
Input clamp current, I_{IK} ($V_I < 0$)	-50 mA
Output clamp current, I_{OK} ($V_O < 0$)	-50 mA
Continuous output current, I_O	± 50 mA
Continuous current through V_{CC} or GND	± 100 mA
Package thermal impedance, θ_{JA} (see Note 3): DW package	58°C/W
PW package	83°C/W
Storage temperature range, T_{stg}	-65°C to 150°C
Power dissipation, P_{tot} ($T_A = -40^\circ\text{C}$ to 125°C) (see Notes 4 and 5)	500 mW

[†] 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.

- NOTES:
1. The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.
 2. The value of V_{CC} is provided in the recommended operating conditions table.
 3. The package thermal impedance is calculated in accordance with JESD 51-7.
 4. For the DW package, above 70°C the value of P_{tot} derates linearly with 8 mW/K.
 5. For the PW package, above 60°C the value of P_{tot} derates linearly with 5.5 mW/K.

SN74LVC244A-Q1
OCTAL BUFFER/DRIVER
WITH 3-STATE OUTPUTS

SCAS790B – DECEMBER 2004 – REVISED JANUARY 2008

recommended operating conditions (see Note 6)

			T _A = 25°C		–40 TO 85°C		–40 TO 125°C		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
V _{CC}	Supply voltage	Operating	1.65	3.6	1.65	3.6	1.65	3.6	V
		Data retention only	1.5		1.5		1.5		
V _{IH}	High-level input voltage	V _{CC} = 1.65 V to 1.95 V	0.65 × V _{CC}		0.65 × V _{CC}		0.65 × V _{CC}		V
		V _{CC} = 2.3 V to 2.7 V	1.7		1.7		1.7		
		V _{CC} = 2.7 V to 3.6 V	2		2		2		
V _{IL}	Low-level input voltage	V _{CC} = 1.65 V to 1.95 V	0.35 × V _{CC}		0.35 × V _{CC}		0.35 × V _{CC}		V
		V _{CC} = 2.3 V to 2.7 V	0.7		0.7		0.7		
		V _{CC} = 2.7 V to 3.6 V	0.8		0.8		0.8		
V _I	Input voltage	0	5.5	0	5.5	0	5.5	V	
V _O	Output voltage	0	V _{CC}	0	V _{CC}	0	V _{CC}	V	
I _{OH}	High-level output current	V _{CC} = 1.65 V	–4		–4		–4		mA
		V _{CC} = 2.3 V	–8		–8		–8		
		V _{CC} = 2.7 V	–12		–12		–12		
		V _{CC} = 3 V	–24		–24		–24		
I _{OL}	Low-level output current	V _{CC} = 1.65 V	4		4		4		mA
		V _{CC} = 2.3 V	8		8		8		
		V _{CC} = 2.7 V	12		12		12		
		V _{CC} = 3 V	24		24		24		

NOTE 6: All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

SN74LVC244A-Q1

OCTAL BUFFER/DRIVER

WITH 3-STATE OUTPUTS

SCAS790B – DECEMBER 2004 – REVISED JANUARY 2008

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

PARAMETER	TEST CONDITIONS	V _{CC}	T _A = 25°C			-40 TO 85°C		-40 TO 125°C		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V _{OH}	I _{OH} = -100 μA	1.65 V to 3.6 V	V _{CC} - 0.2			V _{CC} - 0.2		V _{CC} - 0.3		V
	I _{OH} = -4 mA	1.65 V	1.29			1.2		1.05		
	I _{OH} = -8 mA	2.3 V	1.9			1.7		1.55		
	I _{OH} = -12 mA	2.7 V	2.2			2.2		2.05		
		3 V	2.4			2.4		2.25		
I _{OH} = -24 mA	3 V	2.3			2.2		2			
V _{OL}	I _{OL} = 100 μA	1.65 V to 3.6 V	0.1			0.2		0.3		V
	I _{OL} = 4 mA	1.65 V	0.24			0.45		0.6		
	I _{OL} = 8 mA	2.3 V	0.3			0.7		0.75		
	I _{OL} = 12 mA	2.7 V	0.4			0.4		0.6		
	I _{OL} = 24 mA	3 V	0.55			0.55		0.8		
I _I	V _I = 5.5 V or GND	3.6 V	±1			±5		±20		μA
I _{off}	V _I or V _O = 5.5 V	0	±1			±10		±20		μA
I _{OZ}	V _O = 0 to 5.5 V	3.6 V	±1			±10		±20		μA
I _{CC}	V _I = V _{CC} or GND	3.6 V	1			10		40		μA
	3.6 V ≤ V _I ≤ 5.5 V†		1			10		40		
ΔI _{CC}	One input at V _{CC} - 0.6 V, Other inputs at V _{CC} or GND	2.7 V to 3.6 V	500			500		5000		μA
C _i	V _I = V _{CC} or GND	3.3 V	4							pF
C _o	V _O = V _{CC} or GND	3.3 V	5.5							pF

† This applies in the disabled state only.



SN74LVC244A-Q1
OCTAL BUFFER/DRIVER
WITH 3-STATE OUTPUTS

SCAS790B – DECEMBER 2004 – REVISED JANUARY 2008

switching characteristics over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V _{CC}	T _A = 25°C			-40 TO 85°C		-40 TO 125°C		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t _{pd}	A	Y	1.5 V		7	14.4		14.9		16.4	ns
			1.8 V ± 0.15 V		5.9	10.4		10.9		12.4	
			2.5 V ± 0.2 V		4.2	7.4		7.9		10	
			2.7 V		4.2	6.7		6.9		8.2	
			3.3 V ± 0.3 V		3.9	5.7		5.9		7.2	
t _{en}	OE	Y	1.5 V		8.3	17.8		18.3		19.8	ns
			1.8 V ± 0.15 V		6.4	12.1		12.6		14.1	
			2.5 V ± 0.2 V		4.6	9.1		9.6		11.7	
			2.7 V		5	8.4		8.6		10.3	
			3.3 V ± 0.3 V		4.5	7.4		7.6		9.4	
t _{dis}	OE	Y	1.5 V		7.2	15.6		16.1		17.6	ns
			1.8 V ± 0.15 V		5.8	11.6		12.1		13.6	
			2.5 V ± 0.2 V		3.7	7.3		7.8		9.9	
			2.7 V		3.8	6.6		6.8		8.6	
			3.3 V ± 0.3 V		3.8	6.3		6.5		8	
t _{sk(o)}			3.3 V ± 0.3 V					1		1.5	ns

operating characteristics, T_A = 25°C

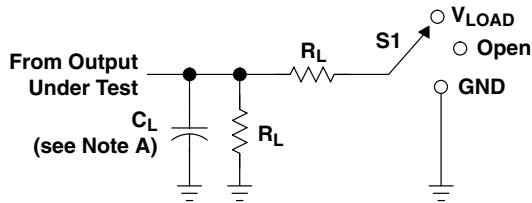
PARAMETER		TEST CONDITIONS	V _{CC}	TYP	UNIT	
C _{pd}	Power dissipation capacitance per buffer/driver	Outputs enabled	f = 10 MHz	1.8 V	43	pF
				2.5 V	43	
				3.3 V	44	
		Outputs disabled	f = 10 MHz	1.8 V	1	
				2.5 V	1	
				3.3 V	2	



SN74LVC244A-Q1 OCTAL BUFFER/DRIVER WITH 3-STATE OUTPUTS

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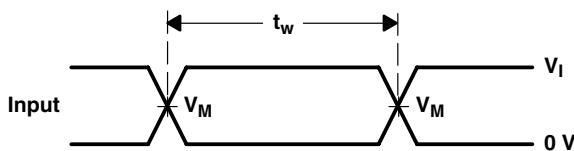
PARAMETER MEASUREMENT INFORMATION



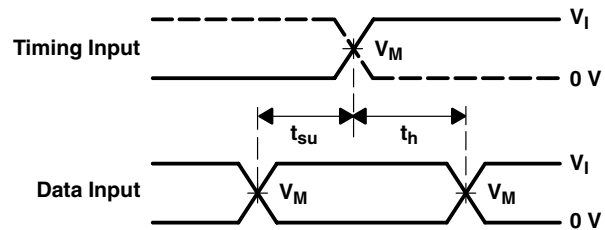
TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	V_{LOAD}
t_{PHZ}/t_{PZH}	GND

LOAD CIRCUIT

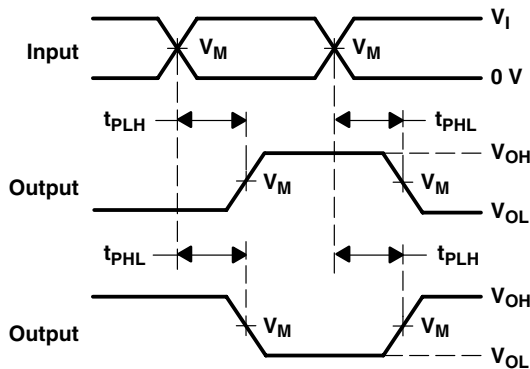
V_{CC}	INPUTS		V_M	V_{LOAD}	C_L	R_L	V_{Δ}
	V_I	t_r/t_f					
1.5 V	V_{CC}	≤ 2 ns	$V_{CC}/2$	$2 \times V_{CC}$	15 pF	2 k Ω	0.1 V
$1.8 V \pm 0.15 V$	V_{CC}	≤ 2 ns	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	1 k Ω	0.15 V
$2.5 V \pm 0.2 V$	V_{CC}	≤ 2 ns	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	500 Ω	0.15 V
2.7 V	2.7 V	≤ 2.5 ns	1.5 V	6 V	50 pF	500 Ω	0.3 V
$3.3 V \pm 0.3 V$	2.7 V	≤ 2.5 ns	1.5 V	6 V	50 pF	500 Ω	0.3 V



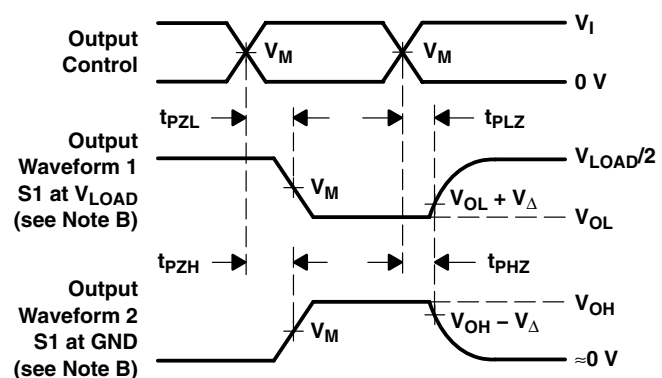
VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
INVERTING AND NONINVERTING OUTPUTS



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES
LOW- AND HIGH-LEVEL ENABLING

- NOTES:
- C_L includes probe and jig capacitance.
 - Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
 - All input pulses are supplied by generators having the following characteristics: $PRR \leq 10$ MHz, $Z_O = 50 \Omega$.
 - The outputs are measured one at a time, with one transition per measurement.
 - t_{PLZ} and t_{PHZ} are the same as t_{dis} .
 - t_{PZL} and t_{PZH} are the same as t_{en} .
 - t_{PLH} and t_{PHL} are the same as t_{pd} .
 - All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
CLVC244AQDWRG4Q1	ACTIVE	SOIC	DW	20	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LVC244AQ	Samples
CLVC244AQPWRG4Q1	ACTIVE	TSSOP	PW	20	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LVC244AQ	Samples
SN74LVC244AQPWRQ1	ACTIVE	TSSOP	PW	20	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LVC244AQ	Samples

(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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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OTHER QUALIFIED VERSIONS OF SN74LVC244A-Q1 :

- Catalog: [SN74LVC244A](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
CLVC244AQDWRG4Q1	SOIC	DW	20	2000	330.0	24.4	10.8	13.3	2.7	12.0	24.0	Q1
CLVC244AQPWRG4Q1	TSSOP	PW	20	2000	330.0	16.4	6.95	7.0	1.4	8.0	16.0	Q1
SN74LVC244AQPWRQ1	TSSOP	PW	20	2000	330.0	16.4	6.95	7.1	1.6	8.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CLVC244AQDWRG4Q1	SOIC	DW	20	2000	367.0	367.0	45.0
CLVC244AQPWRG4Q1	TSSOP	PW	20	2000	356.0	356.0	35.0
SN74LVC244AQPWRQ1	TSSOP	PW	20	2000	356.0	356.0	35.0

EXAMPLE BOARD LAYOUT

PW0020A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



SOLDER MASK DETAILS

4220206/A 02/2017

NOTES: (continued)

- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

PW0020A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 10X

4220206/A 02/2017

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

DW0020A



PACKAGE OUTLINE

SOIC - 2.65 mm max height

SOIC



4220724/A 05/2016

EXAMPLE BOARD LAYOUT

DW0020A

SOIC - 2.65 mm max height

SOIC



LAND PATTERN EXAMPLE
SCALE:6X



SOLDER MASK DETAILS

4220724/A 05/2016

NOTES: (continued)

- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DW0020A

SOIC - 2.65 mm max height

SOIC



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:6X

4220724/A 05/2016

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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