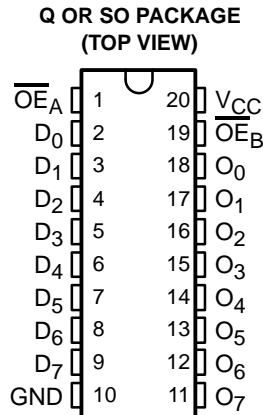


CY74FCT2541T

8-BIT BUFFER/LINE DRIVER WITH 3-STATE OUTPUTS

SCCS041B – SEPTEMBER 1994 – REVISED SEPTEMBER 2001

- Function and Pinout Compatible With FCT and F Logic
- 25-Ω Output Series Resistors to Reduce Transmission-Line Reflection Noise
- Reduced V_{OH} (Typically = 3.3 V) Versions of Equivalent FCT Functions
- Edge-Rate Control Circuitry for Significantly Improved Noise Characteristics
- I_{off} Supports Partial-Power-Down Mode Operation
- ESD Protection Exceeds JESD 22
 - 2000-V Human-Body Model (A114-A)
 - 200-V Machine Model (A115-A)
 - 1000-V Charged-Device Model (C101)
- Matched Rise and Fall Times
- Fully Compatible With TTL Input and Output Logic Levels
- 12-mA Output Sink Current
15-mA Output Source Current
- 3-State Outputs



description

The CY74FCT2541T is an octal buffer and line driver designed to be employed as a memory-address driver, clock driver, and bus-oriented transmitter/receiver. On-chip termination resistors at the outputs reduce system noise caused by reflections. The CY74FCT2541T can replace the CY74FCT541T to reduce noise in an existing design. The speed of the CY74FCT2541T is comparable to bipolar logic counterparts, while reducing power dissipation. Input and output voltage levels allow direct interface with TTL and CMOS devices without external components.

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

TA	PACKAGE†		SPEED (ns)	ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 85°C	QSOP – Q	Tape and reel	4.1	CY74FCT2541CTQCT	FCT2541C
	SOIC – SO	Tube	4.1	CY74FCT2541CTSOC	FCT2541C
		Tape and reel	4.1	CY74FCT2541CTSOCT	
	QSOP – Q	Tape and reel	4.8	CY74FCT2541ATQCT	FCT2541A
	SOIC – SO	Tube	4.8	CY74FCT2541ATSOC	FCT2541A
		Tape and reel	4.8	CY74FCT2541ATSOCT	
	QSOP – Q	Tape and reel	8	CY74FCT2541TQCT	FCT2541
	SOIC – SO	Tube	8	CY74FCT2541TSOC	FCT2541
Tape and reel		8	CY74FCT2541TSOCT		

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.



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 **TEXAS
INSTRUMENTS**

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CY74FCT2541T

8-BIT BUFFER/LINE DRIVER

WITH 3-STATE OUTPUTS

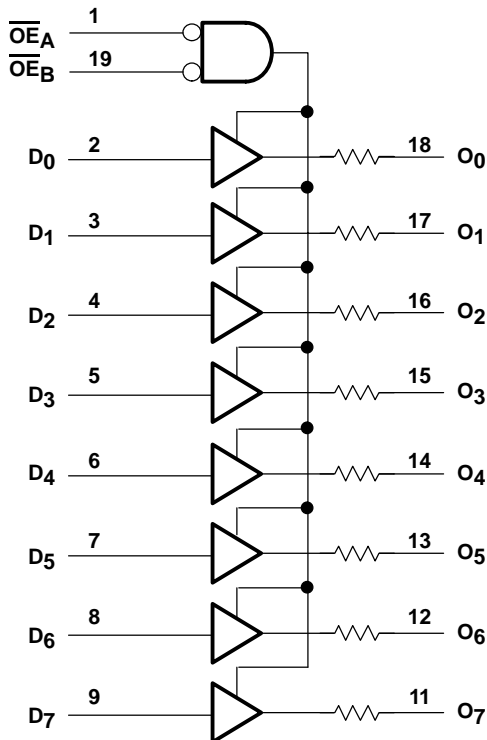
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FUNCTION TABLE

INPUTS			OUTPUT
\overline{OE}_A	\overline{OE}_B	D	
L	L	L	L
L	L	H	H
H	H	X	Z

H = High logic level, L = Low logic level,
X = Don't care, Z = High-impedance state

logic diagram (positive logic)



absolute maximum rating over operating free-air temperature range (unless otherwise noted)†

Supply voltage range to ground potential	-0.5 V to 7 V
DC input voltage range	-0.5 V to 7 V
DC output voltage range	-0.5 V to 7 V
DC output current (maximum sink current/pin)	120 mA
Package thermal impedance, θ_{JA} (see Note 1): Q package	68°C/W
SO package	58°C/W
Ambient temperature range with power applied, T_A	-65°C to 135°C
Storage temperature range, T_{stg}	-65°C to 150°C

† 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.

NOTE 1: The package thermal impedance is calculated in accordance with JESD 51-7.



CY74FCT2541T
8-BIT BUFFER/LINE DRIVER
WITH 3-STATE OUTPUTS

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recommended operating conditions (see Note 2)

		MIN	NOM	MAX	UNIT
V_{CC}	Supply voltage	4.75	5	5.25	V
V_{IH}	High-level input voltage	2			V
V_{IL}	Low-level input voltage			0.8	V
I_{OH}	High-level output current			-15	mA
I_{OL}	Low-level output current			12	mA
T_A	Operating free-air temperature	-40		85	°C

NOTE 2: All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation.

CY74FCT2541T

8-BIT BUFFER/LINE DRIVER

WITH 3-STATE OUTPUTS

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

PARAMETER	TEST CONDITIONS		MIN	TYP†	MAX	UNIT
V _{IK}	V _{CC} = 4.75 V,	I _{IN} = -18 mA		-0.7	-1.2	V
V _{OH}	V _{CC} = 4.75 V,	I _{OH} = -15 mA	2.4	3.3		V
V _{OL}	V _{CC} = 4.75 V,	I _{OL} = 12 mA		0.3	0.55	V
R _{out}	V _{CC} = 4.75 V,	I _{OL} = 12 mA	20	25	40	Ω
V _{hys}	All inputs			0.2		V
I _I	V _{CC} = 5.25 V,	V _{IN} = V _{CC}			5	μA
I _{IH}	V _{CC} = 5.25 V,	V _{IN} = 2.7 V			±1	μA
I _{IL}	V _{CC} = 5.25 V,	V _{IN} = 0.5 V			±1	μA
I _{OZH}	V _{CC} = 5.25 V,	V _{OUT} = 2.7 V			15	μA
I _{OZL}	V _{CC} = 5.25 V,	V _{OUT} = 0.5 V			-15	μA
I _{OS} ‡	V _{CC} = 5.25 V,	V _{OUT} = 0 V	-60	-120	-225	mA
I _{off}	V _{CC} = 0 V,	V _{OUT} = 4.5 V			±1	μA
I _{CC}	V _{CC} = 5.25 V,	V _{IN} ≤ 0.2 V, V _{IN} ≥ V _{CC} - 0.2 V		0.1	0.2	mA
ΔI _{CC}	V _{CC} = 5.25 V, V _{IN} = 3.4 V§, f ₁ = 0, Outputs open			0.5	2	mA
I _{CCD} ¶	V _{CC} = 5.25 V at 50% duty cycle, Outputs open, One bit switching, OE _A = OE _B = GND, V _{IN} ≤ 0.2 V or V _{IN} ≥ V _{CC} - 0.2 V			0.06	0.12	mA/MHz
I _C #	V _{CC} = 5.25 V, Outputs open, OE _A = OE _B = GND	One bit switching at f ₁ = 10 MHz, at 50% duty cycle	V _{IN} ≤ 0.2 V or V _{IN} ≥ V _{CC} - 0.2 V	0.7	1.4	mA
			V _{IN} = 3.4 V or GND	1	2.4	
		Eight bits switching at f ₁ = 2.5 MHz, at 50% duty cycle	V _{IN} ≤ 0.2 V or V _{IN} ≥ V _{CC} - 0.2 V	1.3	2.6	
			V _{IN} = 3.4 V or GND	3.3	10.6	
C _i				5	10	pF
C _o				9	12	pF

† Typical values are at V_{CC} = 5 V, T_A = 25°C.

‡ Not more than one output should be shorted at a time. Duration of short should not exceed one second. The use of high-speed test apparatus and/or sample-and-hold techniques are preferable to minimize internal chip heating and more accurately reflect operational values. Otherwise, prolonged shorting of a high output can raise the chip temperature well above normal and cause invalid readings in other parametric tests. In any sequence of parameter tests, I_{OS} tests should be performed last.

§ Per TTL-driven input (V_{IN} = 3.4 V); all other inputs at V_{CC} or GND

¶ This parameter is derived for use in total power-supply calculations.

I_C = I_{CC} + ΔI_{CC} × D_H × N_T + I_{CCD} (f₀/2 + f₁ × N₁)

Where:

I_C = Total supply current

I_{CC} = Power-supply current with CMOS input levels

ΔI_{CC} = Power-supply current for a TTL high input (V_{IN} = 3.4 V)

D_H = Duty cycle for TTL inputs high

N_T = Number of TTL inputs at D_H

I_{CCD} = Dynamic current caused by an input transition pair (HLH or LHL)

f₀ = Clock frequency for registered devices, otherwise zero

f₁ = Input signal frequency

N₁ = Number of inputs changing at f₁

All currents are in milliamperes and all frequencies are in megahertz.

|| Values for these conditions are examples of the I_{CC} formula.



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switching characteristics over operating free-air temperature range (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	CY74FCT2541T		CY74FCT2541AT		CY74FCT2541CT		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
t _{PLH}	D	O	1.5	8	1.5	4.8	1.5	4.1	ns
t _{PHL}			1.5	8	1.5	4.8	1.5	4.1	
t _{PZH}	\overline{OE}	O	1.5	10	1.5	6.2	1.5	5.8	ns
t _{PZL}			1.5	10	1.5	6.2	1.5	5.8	
t _{PHZ}	\overline{OE}	O	1.5	9.5	1.5	5.6	1.5	5.2	ns
t _{PLZ}			1.5	9.5	1.5	5.6	1.5	5.2	



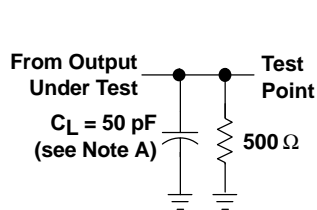
CY74FCT2541T

8-BIT BUFFER/LINE DRIVER

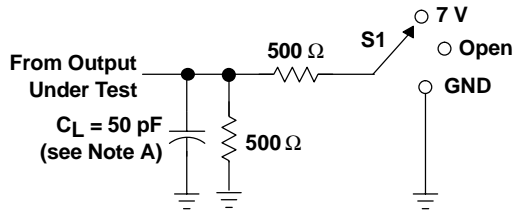
WITH 3-STATE OUTPUTS

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PARAMETER MEASUREMENT INFORMATION

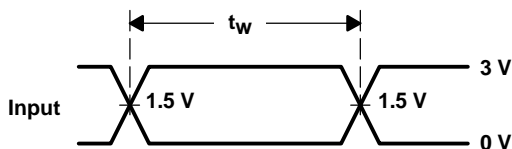


LOAD CIRCUIT FOR TOTEM-POLE OUTPUTS

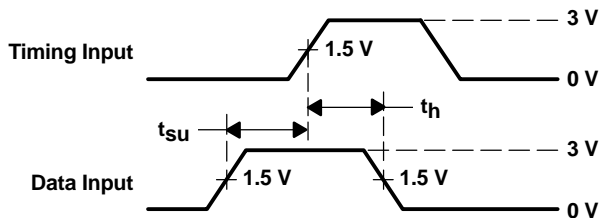


LOAD CIRCUIT FOR 3-STATE OUTPUTS

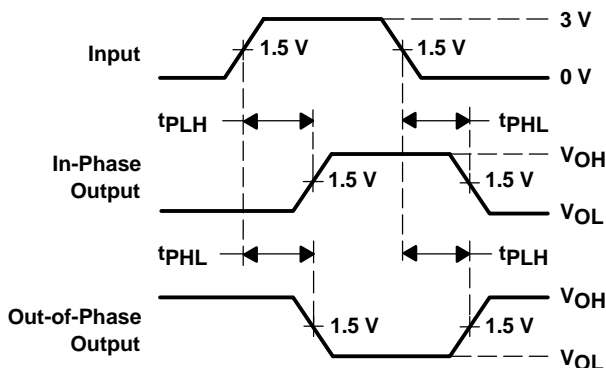
TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	7 V
t_{PHZ}/t_{PZH}	Open



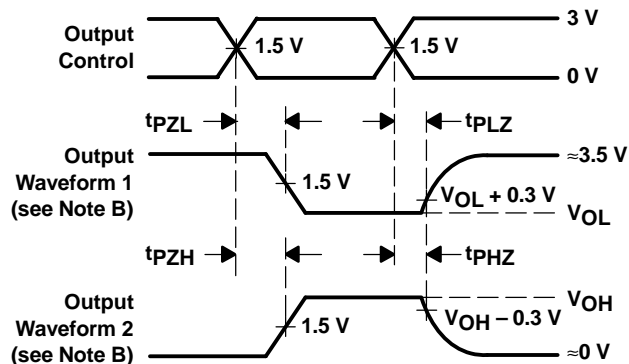
VOLTAGE WAVEFORMS PULSE DURATION



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: A. C_L includes probe and jig capacitance.
 B. 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.
 C. The outputs are measured one at a time with one input transition per measurement.

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
CY74FCT2541ATQCT	ACTIVE	SSOP	DBQ	20	2500	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	FCT2541A	Samples
CY74FCT2541ATQCTE4	ACTIVE	SSOP	DBQ	20	2500	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	FCT2541A	Samples
CY74FCT2541ATSOC	ACTIVE	SOIC	DW	20	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	FCT2541A	Samples
CY74FCT2541CTQCT	ACTIVE	SSOP	DBQ	20	2500	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	FCT2541C	Samples
CY74FCT2541CTSOC	ACTIVE	SOIC	DW	20	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	FCT2541C	Samples
CY74FCT2541TQCT	ACTIVE	SSOP	DBQ	20	2500	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	FCT2541	Samples
CY74FCT2541TQCTE4	ACTIVE	SSOP	DBQ	20	2500	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	FCT2541	Samples
CY74FCT2541TQCTG4	ACTIVE	SSOP	DBQ	20	2500	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	FCT2541	Samples
CY74FCT2541TSOC	ACTIVE	SOIC	DW	20	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	FCT2541	Samples
CY74FCT2541TSOCE4	ACTIVE	SOIC	DW	20	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	FCT2541	Samples
CY74FCT2541TSOCT	ACTIVE	SOIC	DW	20	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	FCT2541	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.

OBSELETE: 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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TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE

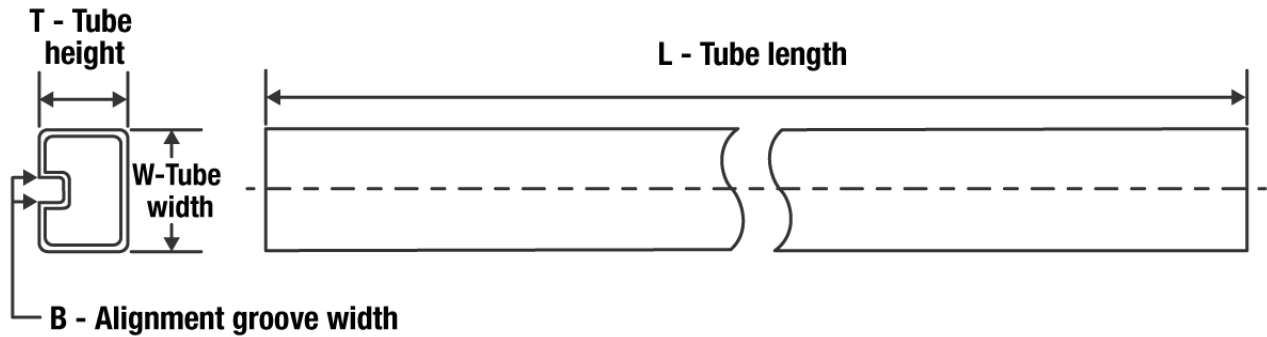

*All dimensions are nominal

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
CY74FCT2541ATQCT	SSOP	DBQ	20	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
CY74FCT2541CTQCT	SSOP	DBQ	20	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
CY74FCT2541TQCT	SSOP	DBQ	20	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
CY74FCT2541TSOCT	SOIC	DW	20	2000	330.0	24.4	10.8	13.3	2.7	12.0	24.0	Q1

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CY74FCT2541ATQCT	SSOP	DBQ	20	2500	853.0	449.0	35.0
CY74FCT2541CTQCT	SSOP	DBQ	20	2500	853.0	449.0	35.0
CY74FCT2541TQCT	SSOP	DBQ	20	2500	853.0	449.0	35.0
CY74FCT2541TSOCT	SOIC	DW	20	2000	367.0	367.0	45.0

TUBE


*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
CY74FCT2541ATSOC	DW	SOIC	20	25	507	12.83	5080	6.6
CY74FCT2541CTSOC	DW	SOIC	20	25	507	12.83	5080	6.6
CY74FCT2541TSOC	DW	SOIC	20	25	507	12.83	5080	6.6
CY74FCT2541TSOCE4	DW	SOIC	20	25	507	12.83	5080	6.6

DW0020A



PACKAGE OUTLINE

SOIC - 2.65 mm max height

SOIC



4220724/A 05/2016

NOTES:

1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.43 mm per side.
5. Reference JEDEC registration MS-013.

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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