LMH0002 SMPTE 292M / 259M Serial Digital Cable Driver

Check for Samples: LMH0002

FEATURES

- **SMPTE 292M, SMPTE 344M and SMPTE 259M Compliant**
- **Supports DVB-ASI at 270 Mbps**
- **Data Rates to 1.485 Gbps**
- **Differential Input**
- **75Ω Differential Output**
- **Selectable Slew Rate**
- **Adjustable Output Amplitude**
- **Single 3.3V Supply Operation**
- **Operating Temperature Range: Commercial 0°C to +70°C (LMH0002MA) or Industrial −40°C to +85°C (LMH0002TMA and LMH0002SQ)**
- **Typical Power Consumption: 125 mW in SD Mode and 149 mW in HD Mode**
- **8–pin SOIC or 16–pin WQFN Package**
- **Replaces the GS1528, GS1528A, or GS1578A**

APPLICATIONS

- **SMPTE 292M, SMPTE 344M, and SMPTE 259M Serial Digital Interfaces**
- **Sonet/SDH and ATM Interfaces**
- **Digital Routers and Switches**
- **Distribution Amplifiers**
- **Buffer Applications**
- **Set Top Boxes**
- **Security Cameras**

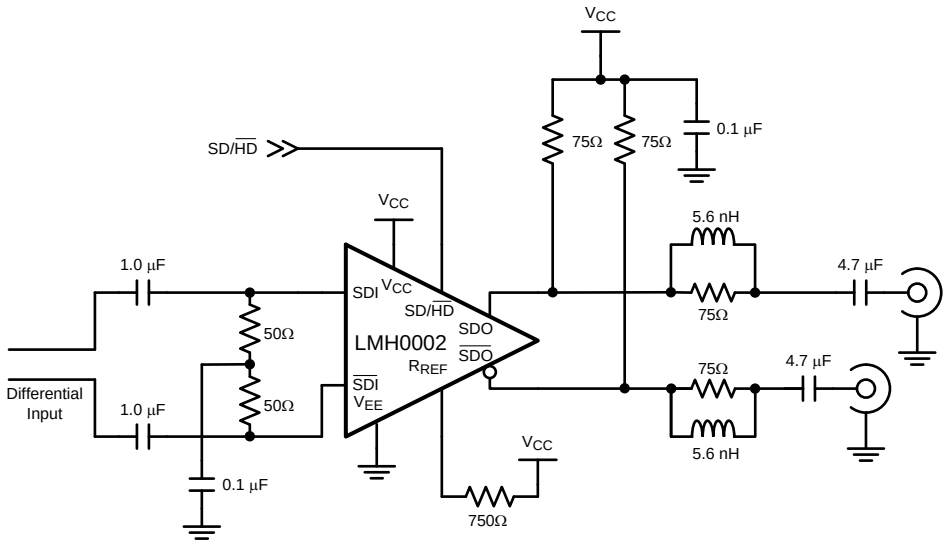
DESCRIPTION

The LMH0002 SMPTE 292M / 259M serial digital cable driver is a monolithic, high-speed cable driver designed for use in SMPTE 292M / 259M serial digital video and ITU-T G.703 serial digital data transmission applications. The LMH0002 drives 75Ω transmission lines (Belden 8281, Belden 1694A or equivalent) at data rates up to 1.485 Gbps.

The LMH0002 provides two selectable slew rates for SMPTE 259M and SMPTE 292M compliance. The output voltage swing is adjustable via a single external resistor.

The LMH0002 is powered from a single 3.3V supply. Power consumption is typically 125 mW in SD mode and 149 mW in HD mode. The LMH0002 is available in an 8-pin SOIC or 16-pin WQFN package.

Typical Application



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.

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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.

Absolute Maximum Ratings(1)

Supply Voltage:	−0.5V to 3.6V
Input Voltage (all inputs)	−0.3V to V_{CC}+0.3V
Output Current	28 mA
Storage Temperature Range	−65°C to +150°C
Junction Temperature	+150°C
Lead Temperature (Soldering 4 Sec)	+260°C
Package Thermal Resistance θ_{JA} 8-pin SOIC θ_{JA} 16-pin WQFN θ_{JC} 8-pin SOIC θ_{JC} 16-pin WQFN	 +160°C/W +78.9°C/W +105°C/W +42.7°C/W
ESD Rating (HBM)	5kV
ESD Rating (MM)	250V

(1) "Absolute Maximum Ratings" are those parameter values beyond which the life and operation of the device cannot be ensured. The stating herein of these maximums shall not be construed to imply that the device can or should be operated at or beyond these values. The table of Electrical Characteristics specifies acceptable device operating conditions.

Recommended Operating Conditions

Supply Voltage (V_{CC} – V_{EE}):	3.3V ±5%
Operating Free Air Temperature (T_A) LMH0002MA LMH0002TMA and LMH0002SQ	 0°C to +70°C −40°C to +85°C

DC Electrical Characteristics

Over Supply Voltage and Operating Temperature ranges, unless otherwise specified(1)(2).

Symbol	Parameter	Conditions	Reference	Min	Typ	Max	Units
V_{CMIN}	Input Common Mode Voltage		SDI, $\overline{SDI}$	1.6 + V_{SDI}/2		V_{CC} – V_{SDI}/2	V
V_{SDI}	Input Voltage Swing	Differential		100		2000	mV_{P-P}
V_{CMOUT}	Output Common Mode Voltage		SDO, $\overline{SDO}$		V_{CC} – V_{SDO}		V
V_{SDO}	Output Voltage Swing	Single-ended, 75Ω load, R_{REF} = 750Ω 1%		750	800	850	mV_{P-P}
		Single-ended, 75Ω load, R_{REF} = 590Ω 1%		900	1000	1100	mV_{P-P}
	SD/$\overline{HD}$ Input Voltage	Min for SD	SD/$\overline{HD}$	2.4			V
		Max for HD				0.8	V
	SD/$\overline{HD}$ Input Current				3.7		µA
I_{CC}	Supply Current	SD/$\overline{HD}$ = 0(3)			45	49	mA
		SD/$\overline{HD}$ = 1(3)			38	43	mA

(1) Current flow into device pins is defined as positive. Current flow out of device pins is defined as negative. All voltages are stated referenced to V_{EE} = 0 Volts.
(2) Typical values are stated for V_{CC} = +3.3V and T_A = +25°C.
(3) Maximum I_{CC} is measured at V_{CC} = +3.465V and T_A = +70°C.

AC Electrical Characteristics

Over Supply Voltage and Operating Temperature ranges, unless otherwise specified(1).

Symbol	Parameter	Conditions	Reference	Min	Typ	Max	Units
DR_{SDI}	Input Data Rate	(2)	SDI, $\overline{SDI}$			1485	Mbps
t_{jit}	Additive Jitter	1.485 Gbps	SDO, $\overline{SDO}$		26		ps_{P-P}
		270 Mbps			18		ps_{P-P}
t_r,t_f	Output Rise Time, Fall Time	SD/$\overline{HD}$ = 0, 20% – 80%,(3)			120	220	ps
		SD/$\overline{HD}$ = 1, 20% – 80%		400	560	800	ps
	Mismatch in Rise/Fall Time	(2)				30	ps
	Duty Cycle Distortion	SD/$\overline{HD}$ = 0, (2)				30	ps
		SD/$\overline{HD}$ = 1, (2)				100	ps
t_{OS}	Output Overshoot	(2)				8	%
RL_{SDO}	Output Return Loss	(4)		15	20		dB

(1) Typical values are stated for V_{CC} = +3.3V and T_A = +25°C.
(2) Specification is ensured by characterization.
(3) Specification is ensured by characterization and verified by test.
(4) Output return loss is dependent on board design. The LMH0002 meets this specification on the SD002 evaluation board from 5MHz to 1.5GHz.

CONNECTION DIAGRAM

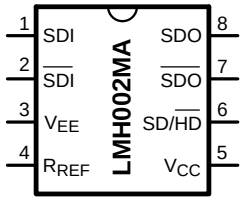


Figure 1. 8-Pin SOIC
See D Package

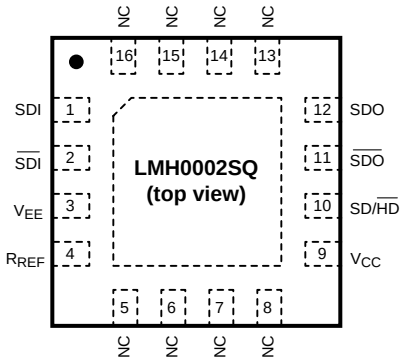


Figure 2. 16-Pin WQFN
See RUM0016A Package

Table 1. PIN DESCRIPTIONS

SOIC Pin #	WQFN Pin #	Name	Description
1	1	SDI	Serial data true input.
2	2	$\overline{SDI}$	Serial data complement input.
3	3	V_{EE}	Negative power supply (ground).
4	4	R_{REF}	Output driver level control. Connect a resistor to V_{CC} to set output voltage swing.
5	9	V_{CC}	Positive power supply (+3.3V).
6	10	SD/$\overline{HD}$	Output slew rate control. Output rise/fall time complies with SMPTE 292M when low and SMPTE 259M when high.
7	11	$\overline{SDO}$	Serial data complement output.
8	12	SDO	Serial data true output.
—	5, 6, 7, 8, 13, 14, 15, 16	NC	No connect.
—	DAP	V_{EE}	Connect exposed DAP to negative power supply (ground).

APPLICATION INFORMATION

Device Operation

INPUT INTERFACING

The LMH0002 accepts either differential or single-ended input. The inputs are self-biased, allowing for simple AC or DC coupling. DC-coupled inputs must be kept within the specified common-mode range. SDI and $\overline{SDI}$ are self-biased at approximately 2.1V with V_{CC} = 3.3V. Figure 3 shows the differential input stage for SDI and $\overline{SDI}$.

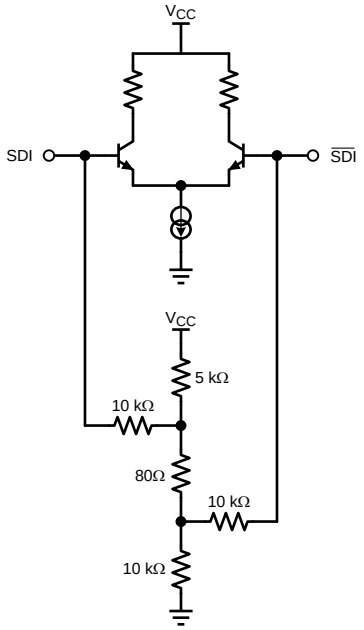


Figure 3. Differential Input Stage for SDI and $\overline{SDI}$.

OUTPUT INTERFACING

The LMH0002 uses current mode outputs. Single-ended output levels are 800 mV_{P-P} into 75Ω AC-coupled coaxial cable (with R_{REF} = 750Ω). Output level is controlled by the value of the R_{REF} resistor connected between the R_{REF} pin and V_{CC}.

The R_{REF} resistor should be placed as close as possible to the R_{REF} pin. In addition, the copper in the plane layers below the R_{REF} network should be removed to minimize parasitic capacitance.

OUTPUT SLEW RATE CONTROL

The LMH0002 output rise and fall times are selectable for either SMPTE 259M or SMPTE 292M compliance via the SD/$\overline{HD}$ pin. For slower rise and fall times, or SMPTE 259M compliance, SD/$\overline{HD}$ is set high. For faster rise and fall times, or SMPTE 292M compliance, SD/$\overline{HD}$ is set low.

REPLACING THE GENNUM GS1528, GS1528A, and GS1578A

The LMH0002MA is form-fit-function compatible with the Gennum GS1528 and GS1528A. The LMH0002SQ is form-fit-function compatible with the Gennum GS1578A.

REVISION HISTORY

Changes from Revision D (April 2013) to Revision E	Page
• Changed layout of National Data Sheet to TI format	5

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
LMH0002MA/NOPB	Active	Production	SOIC (D) | 8	95 | TUBE	Yes	SN	Level-1-260C-UNLIM	-40 to 85	L002
LMH0002MA/NOPB.A	Active	Production	SOIC (D) | 8	95 | TUBE	Yes	SN	Level-1-260C-UNLIM	-40 to 85	L002
LMH0002MAX/NOPB	Active	Production	SOIC (D) | 8	2500 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	L002
LMH0002MAX/NOPB.A	Active	Production	SOIC (D) | 8	2500 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	L002
LMH0002SQ/NOPB	Active	Production	WQFN (RUM) | 16	1000 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-	L002
LMH0002SQ/NOPB.A	Active	Production	WQFN (RUM) | 16	1000 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	L002
LMH0002SQE/NOPB	Active	Production	WQFN (RUM) | 16	250 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-	L002
LMH0002SQE/NOPB.A	Active	Production	WQFN (RUM) | 16	250 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	L002
LMH0002TMA/NOPB	Active	Production	SOIC (D) | 8	95 | TUBE	Yes	SN	Level-1-260C-UNLIM	-40 to 85	L002T
LMH0002TMA/NOPB.A	Active	Production	SOIC (D) | 8	95 | TUBE	Yes	SN	Level-1-260C-UNLIM	-40 to 85	L002T
LMH0002TMAX/NOPB	Active	Production	SOIC (D) | 8	2500 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	L002T
LMH0002TMAX/NOPB.A	Active	Production	SOIC (D) | 8	2500 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	L002T

(1) **Status:** For more details on status, see our product life cycle.

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

(4) **Lead finish/Ball material:** Parts 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.

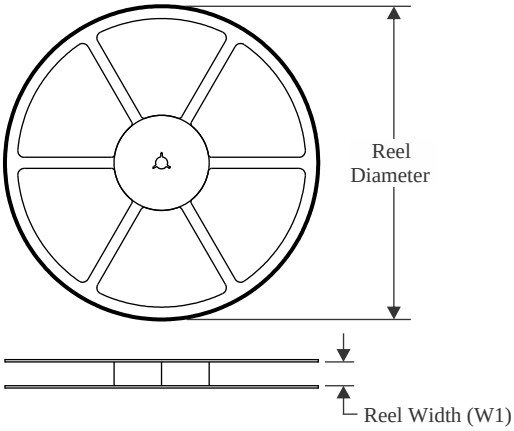
(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

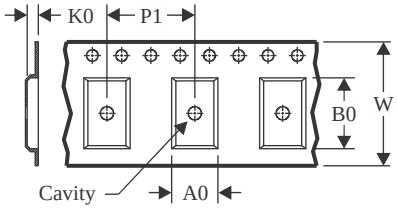
Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

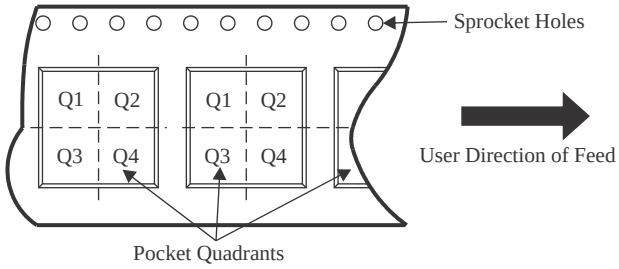


TAPE DIMENSIONS



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

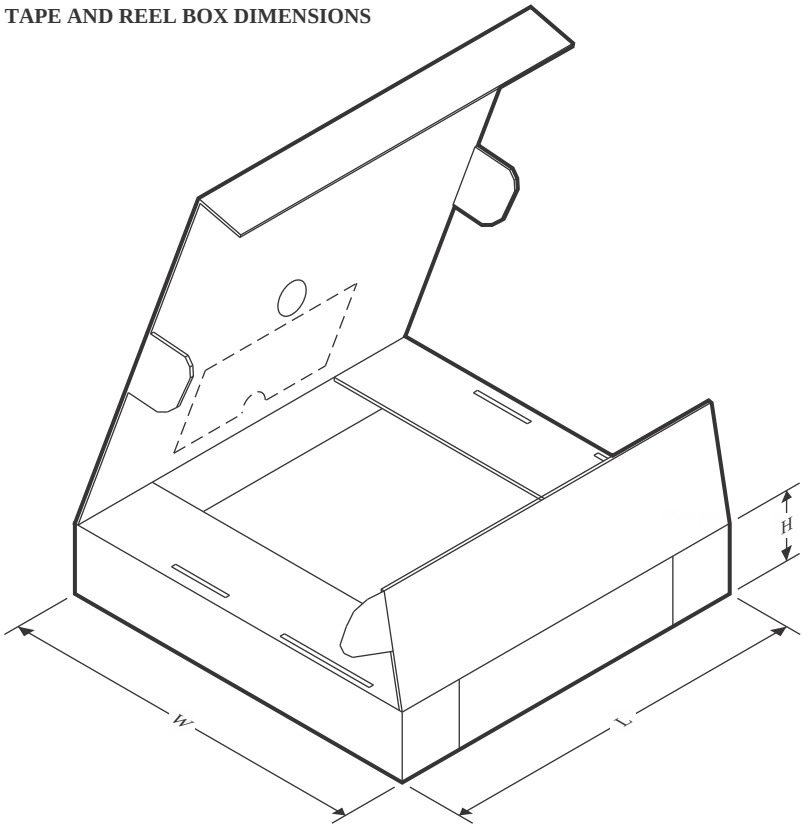
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
LMH0002MAX/NOPB	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1
LMH0002SQ/NOPB	WQFN	RUM	16	1000	177.8	12.4	4.3	4.3	1.3	8.0	12.0	Q1
LMH0002SQE/NOPB	WQFN	RUM	16	250	177.8	12.4	4.3	4.3	1.3	8.0	12.0	Q1
LMH0002TMAX/NOPB	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1

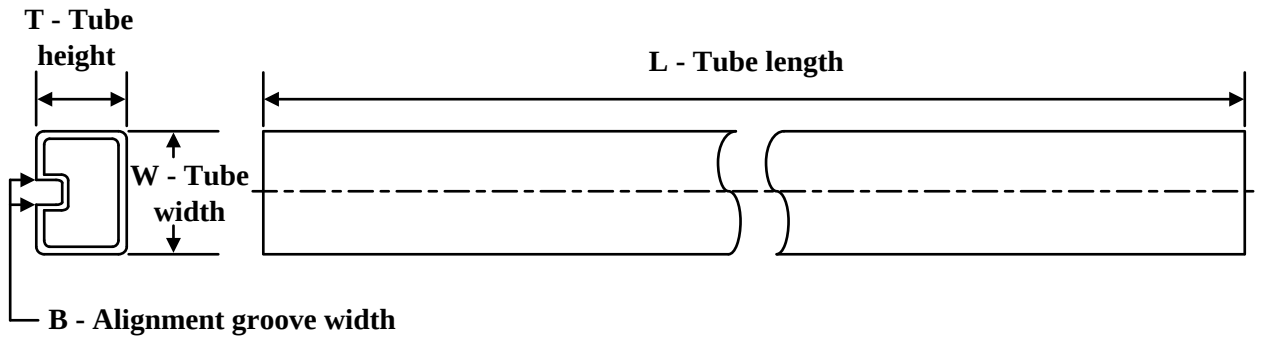
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LMH0002MAX/NOPB	SOIC	D	8	2500	367.0	367.0	35.0
LMH0002SQ/NOPB	WQFN	RUM	16	1000	208.0	191.0	35.0
LMH0002SQE/NOPB	WQFN	RUM	16	250	208.0	191.0	35.0
LMH0002TMAX/NOPB	SOIC	D	8	2500	367.0	367.0	35.0

TUBE



*All dimensions are nominal

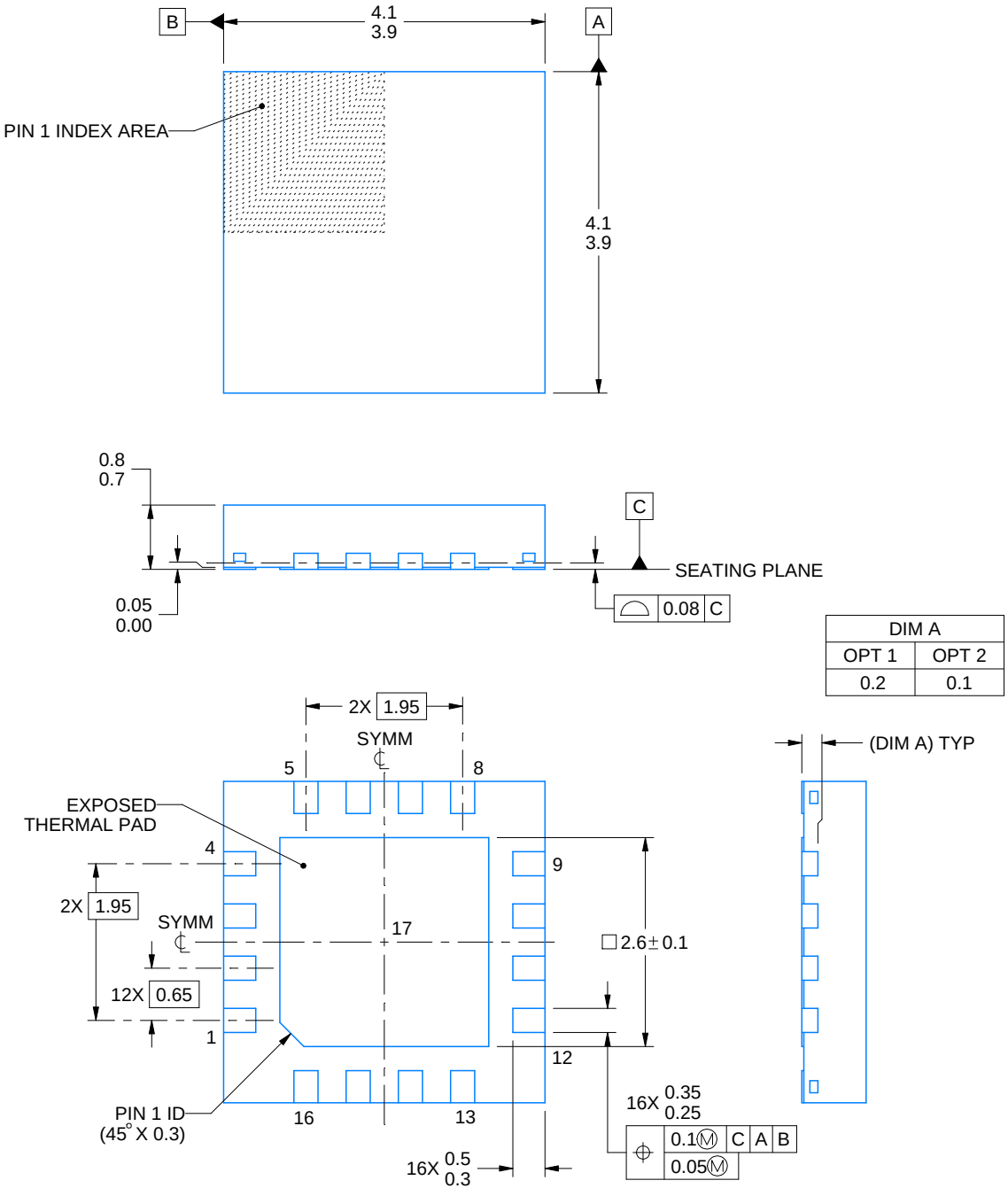
Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
LMH0002MA/NOPB	D	SOIC	8	95	495	8	4064	3.05
LMH0002MA/NOPB.A	D	SOIC	8	95	495	8	4064	3.05
LMH0002TMA/NOPB	D	SOIC	8	95	495	8	4064	3.05
LMH0002TMA/NOPB.A	D	SOIC	8	95	495	8	4064	3.05

RUM0016A

PACKAGE OUTLINE

WQFN - 0.8 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



NOTES:

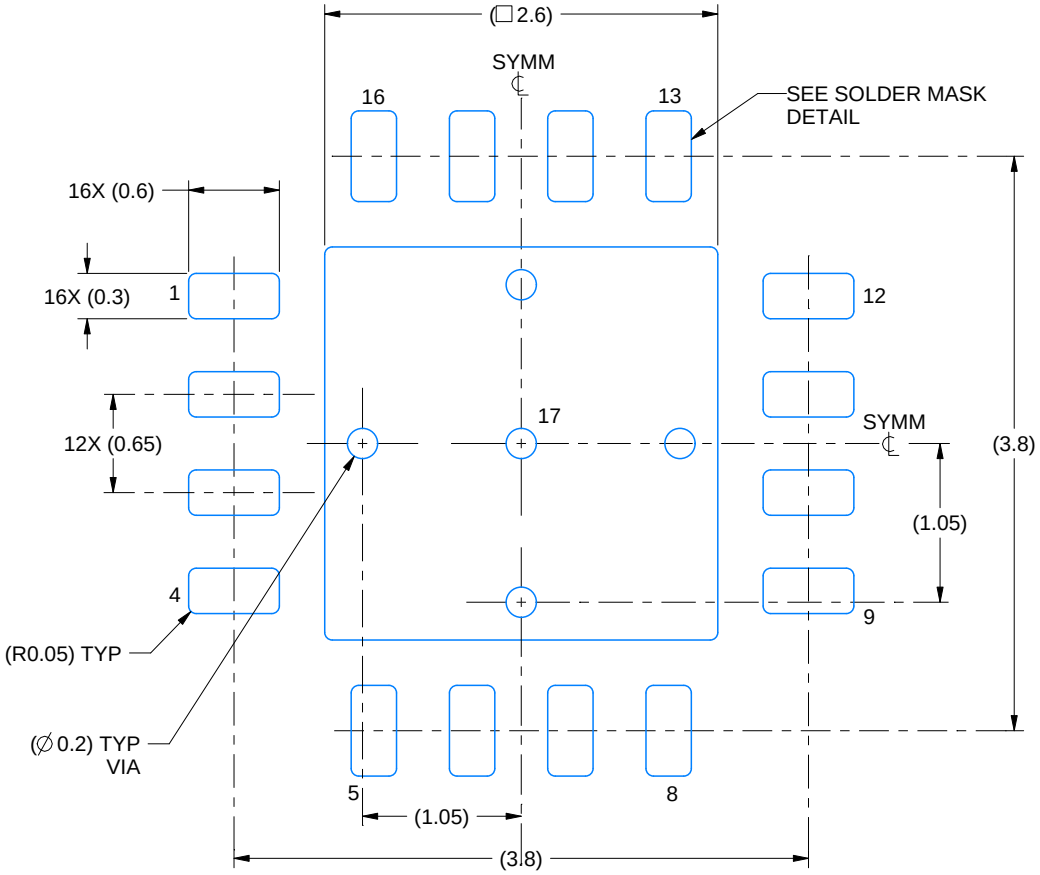
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

EXAMPLE BOARD LAYOUT

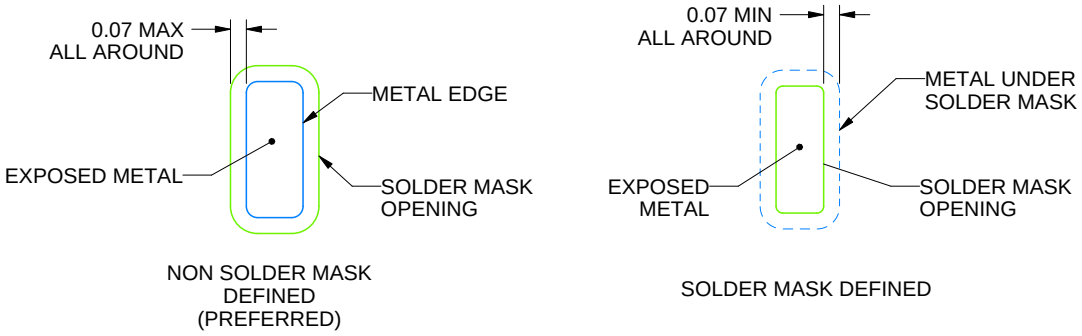
RUM0016A

WQFN - 0.8 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 20X

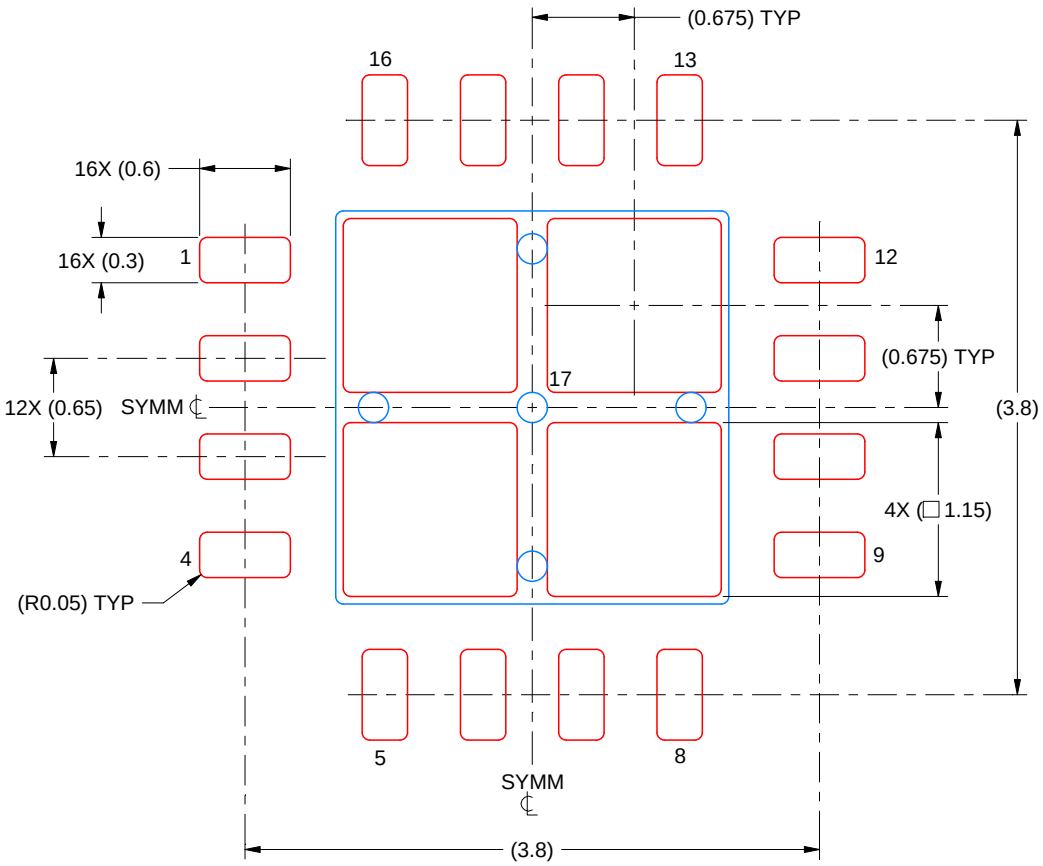


SOLDER MASK DETAILS

4214998/A 11/2021

NOTES: (continued)

4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.



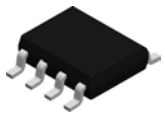
SOLDER PASTE EXAMPLE
BASED ON 0.125 MM THICK STENCIL
SCALE: 20X

EXPOSED PAD 17
78% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE

4214998/A 11/2021

NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

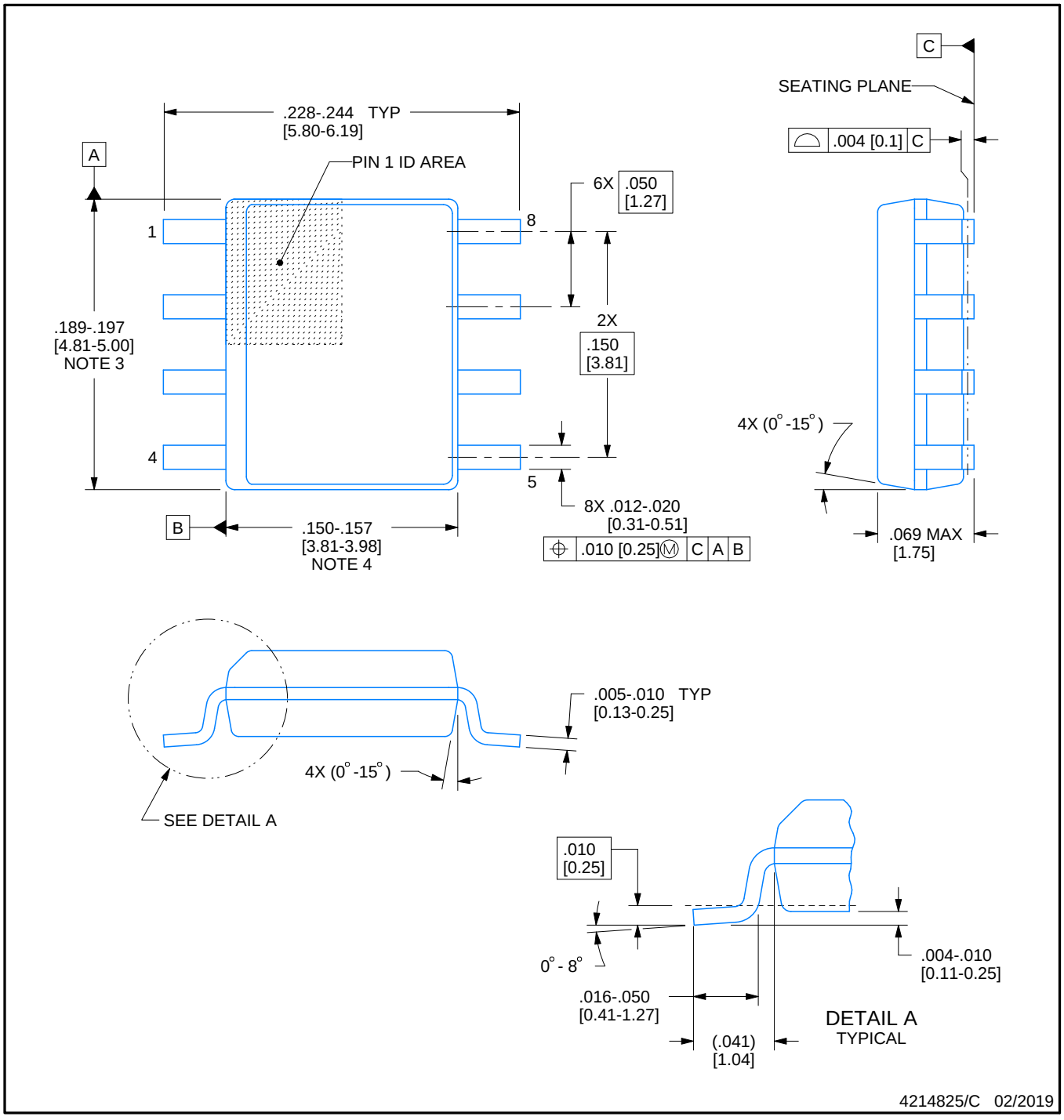


PACKAGE OUTLINE

D0008A

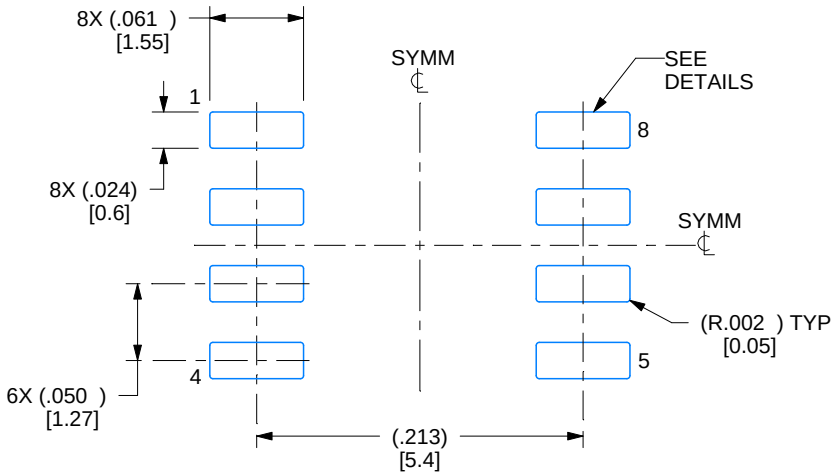
SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT

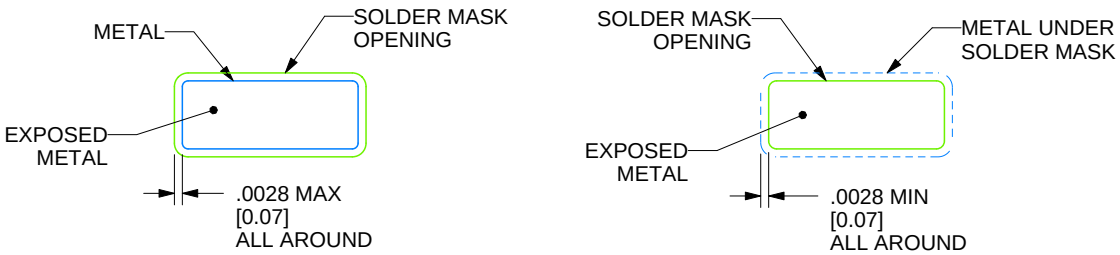


NOTES:

1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. 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 .006 [0.15] per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:8X



SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

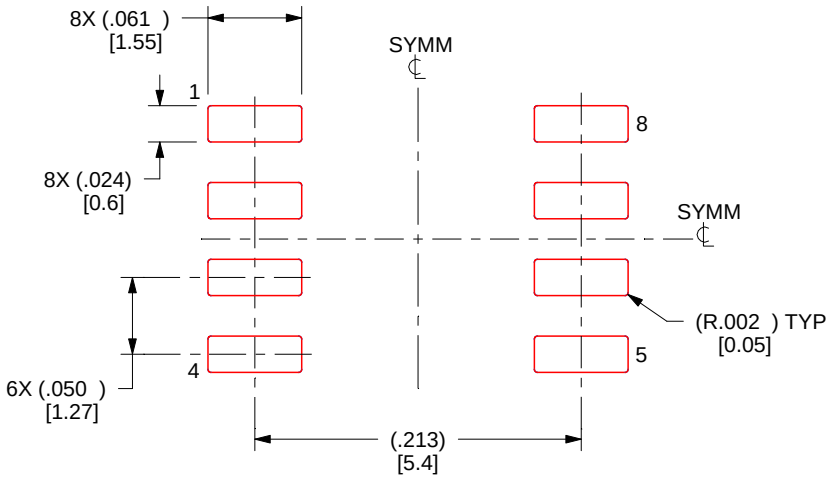
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE
BASED ON .005 INCH [0.125 MM] THICK STENCIL
SCALE:8X

4214825/C 02/2019

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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