

SN74LVC240A-Q1 Automotive Octal Buffer/Driver with 3-State Outputs

1 Features

- AEC-Q100 qualified for automotive applications:
 - Device temperature grade 1: -40°C to +125°C
 - Device HBM ESD classification level 2
 - Device CDM ESD classification level C4B
- Operating range from 1.65V to 3.6V
- Over-voltage tolerant inputs support up to 5.5V independent of V_{CC}
- Supports [partial-power-down](#) with back drive protection (I_{off})
- High push-pull output drive strength:
 - $\pm 24\text{mA}$ at 3.3V
 - $\pm 8\text{mA}$ at 2.3V
 - $\pm 4\text{mA}$ at 1.65V
- Latch-up performance exceeds 100mA per JESD78 and AEC-Q100-004

2 Applications

- [Drive an indicator LED](#)
- [Level-shift using open-drain outputs](#)

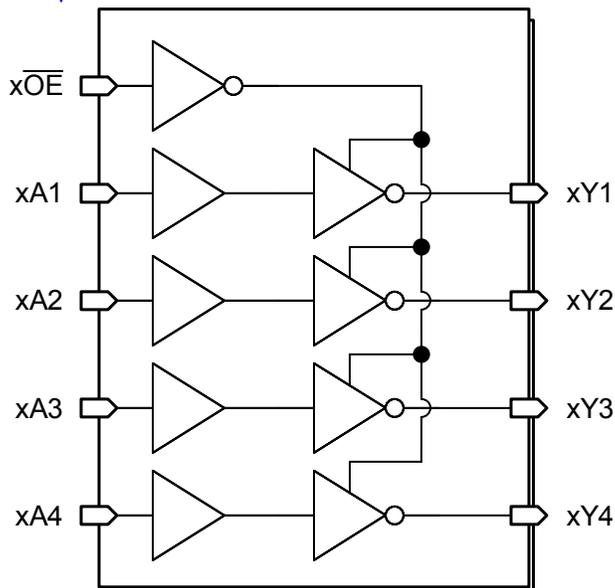
3 Description

The SN74LVC240A-Q1 is an octal buffer with 3-state outputs. The device is configured into two banks of four drivers, each controlled by an output enable pin.

Package Information

PART NUMBER	PACKAGE ⁽¹⁾	PACKAGE SIZE ⁽²⁾	BODY SIZE ⁽³⁾
SN74LVC240A-Q1	PW (TSSOP, 20)	6.5mm × 6.4mm	6.5mm × 4.4mm
	DGS (VSSOP, 20)	5.1mm × 4.9mm	5.1mm × 3.0mm
	RKS (VQFN, 20)	4.5mm × 2.5mm	4.5mm × 2.5mm

- (1) For more information, see [Mechanical, Packaging, and Orderable Information](#).
- (2) The package size (length × width) is a nominal value and includes pins, where applicable.
- (3) The body size (length × width) is a nominal value and does not include pins.



Functional Block Diagram



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4 Pin Configuration and Functions

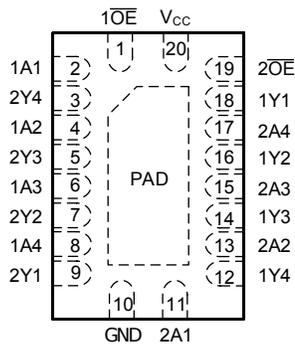


Figure 4-1. SN74LVC240A-Q1 RKS Package (Top View)

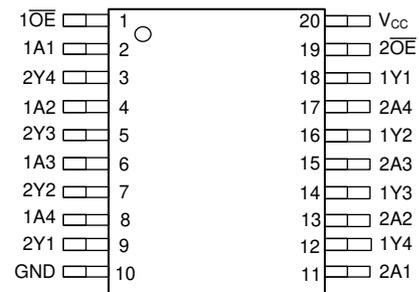


Figure 4-2. SN74LVC240A-Q1 PW, DGS Package (Top View)

Pin Functions

PIN		TYPE ⁽¹⁾	DESCRIPTION
NAME	NO.		
A1	2	I	Bank 1, channel 1 input
A2	3	O	Bank 2, channel 4 output
A3	4	I	Bank 1, channel 2 input
A4	5	O	Bank 2, channel 3 output
A5	6	I	Bank 1, channel 3 input
A6	7	O	Bank 2, channel 2 output
A7	8	I	Bank 1, channel 4 input
A8	9	O	Bank 2, channel 1 output
GND	10	G	Ground
OE1	1	I	Bank 1, output enable, active low
OE2	19	I	Bank 2, output enable, active low
Thermal Pad ⁽²⁾		—	The thermal pad can be connected to GND or left floating. Do not connect to any other signal or supply.
V _{CC}	20	P	Positive supply
Y1	18	O	Bank 1, channel 1 output
Y2	17	I	Bank 2, channel 4 input
Y3	16	O	Bank 1, channel 2 output
Y4	15	I	Bank 2, channel 3 input
Y5	14	O	Bank 1, channel 3 output
Y6	13	I	Bank 2, channel 2 input
Y7	12	O	Bank 1, channel 4 output
Y8	11	I	Bank 2, channel 1 input

(1) Signal Types: I = Input, O = Output, G = Ground, P = Power.

(2) RKS package only.

5 Specifications

5.1 Absolute Maximum Ratings

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

		MIN	MAX	UNIT
V _{CC}	Supply voltage range	-0.5	6.5	V
V _I	Input voltage range ⁽²⁾	-0.5	6.5	V
V _O	Output voltage range ⁽²⁾	-0.5	V _{CC} + 0.5	V
V _O	Output voltage range -- open-drain output only ⁽²⁾	-0.5	6.5	V
I _{IK}	Input clamp current	V _I < 0V		-50 mA
I _{OK}	Output clamp current	V _O < 0V		-50 mA
I _O	Continuous output current		±50	mA
I _O	Continuous output current through V _{CC} or GND		±100	mA
T _J	Junction temperature	-65	150	°C
T _{stg}	Storage temperature	-65	150	°C

- (1) Operation outside the *Absolute Maximum Ratings* may cause permanent device damage. Absolute maximum ratings do not imply functional operation of the device at these or any other conditions beyond those listed under *Recommended Operating Conditions*. If briefly operating outside the *Recommended Operating Conditions* but within the *Absolute Maximum Ratings*, the device may not sustain damage, but it may not be fully functional. Operating the device in this manner may affect device reliability, functionality, performance, and shorten the device lifetime.
- (2) The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

5.2 ESD Ratings

		VALUE	UNIT
V _(ESD)	Electrostatic discharge	Human body model (HBM), per AEC Q100-002 HBM ESD Classification Level 2 ⁽¹⁾	±2000
		Charged device model (CDM), per AEC Q100-011 CDM ESD Classification Level C4B	±1000

- (1) AEC Q100-002 indicate that HBM stressing shall be in accordance with the ANSI/ESDA/JEDEC JS-001 specification.

5.3 Recommended Operating Conditions

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

Specifications	Description	Condition	MIN	MAX	UNIT
V _{CC}	Supply voltage	Operating	1.65	3.6	V
		Functional	1.2		
V _I	Input voltage			5.5	V
V _O	Output voltage	(High or low state)		V _{CC}	V
V _O	Output voltage	3-state	0	5.5	V
V _{IH}	High-level input voltage	V _{CC} = 1.65V to 1.95V	0.65x V _{CC}		V
		V _{CC} = 2.3V to 2.7V	1.7		
		V _{CC} = 2.7V to 3.6V	2		
V _{IL}	Low-Level input voltage	V _{CC} = 1.65V to 1.95V	0.35x V _{CC}		V
		V _{CC} = 2.3V to 2.7V	0.7		
		V _{CC} = 2.7V to 3.6V	0.8		
I _{OH}	High-level output current	V _{CC} = 1.8V	-4		mA
		V _{CC} = 2.3V	-8		
		V _{CC} = 2.7V	-12		
		V _{CC} = 3V	-24		
I _{OL}	Low-level output current	V _{CC} = 1.8V	4		mA
		V _{CC} = 2.3V	8		
		V _{CC} = 2.7V	12		
		V _{CC} = 3V	24		
Δt/Δv	Input transition rise or fall rate			10	ns/V
T _A	Operating free-air temperature		-40	125	°C

5.4 Thermal Information

PACKAGE	PINS	THERMAL METRIC ⁽¹⁾						UNIT
		R _{θJA}	R _{θJC(top)}	R _{θJB}	Ψ _{JT}	Ψ _{JB}	R _{θJC(bot)}	
PW (TSSOP, 20)	20	120.3	62.5	82.4	16.0	81.5	N/A	°C/W
DGS (VSSOP, 20)	20	129.9	72.4	86.1	18.6	85.8	N/A	°C/W
RKS (VQFN, 20)	20	87.2	93.4	59.8	24.9	59.6	44.3	°C/W

(1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics](#) application note.

5.5 Electrical Characteristics

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

PARAMETER	TEST CONDITIONS	V _{CC}	T _A = 25°C			-40°C to 125°C			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
V _{OH}	I _{OH} = -100µA	1.65V to 3.6V	V _{CC} - 0.2			V _{CC} - 0.2			V
	I _{OH} = -4mA	1.65V	1.29			1.2			
	I _{OH} = -8mA	2.3V	1.9			1.75			
	I _{OH} = -12mA	2.7V	2.2			2.2			
	I _{OH} = -24mA	3V	2.4			2.4			
V _{OL}	I _{OH} = 100µA	1.65V to 3.6V				0.1			V
	I _{OH} = 4mA	1.65V				0.24			
	I _{OH} = 8mA	2.3V				0.3			
	I _{OH} = 12mA	2.7V				0.4			
	I _{OH} = 24mA	3V				0.35			
I _I	V _I = V _{CC} or GND	3.6V				±1			µA
I _{OFF}	V _I or V _O = V _{CC}	0V				±1			µA
I _{OZ}	V _O = V _{CC} or GND	3.6V				±1			µA
I _{CC}	V _I = V _{CC} or GND, I _O = 0	3.6V				1			µA
ΔI _{CC}	One input at V _{CC} - 0.6V, other inputs at V _{CC} or GND	2.7V to 3.6V				500			µA
C _I	V _I = V _{CC} or GND	3.3V				4.9			pF
C _O	V _O = V _{CC} or GND	3.3V				6.3			pF

5.6 Switching Characteristics

over operating free-air temperature range; typical values measured at T_A = 25°C (unless otherwise noted). See *Parameter Measurement Information*

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	V _{CC}	T _A = 25°C			-40°C to 125°C			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
t _{pd}	A	Y	C _L = 30pF	1.8V ± 0.15V	7.3			8			ns
				2.5V ± 0.2V	4.5			5.1			
			C _L = 50pF	2.7V	4.6			5.4			
				3.3V ± 0.3V	4.1			4.6			
t _{en}	OE	Y	C _L = 30pF	1.8V ± 0.15V	8.8			9.8			ns
				2.5V ± 0.2V	5.7			6.4			
			C _L = 50pF	2.7V	6.2			7			
				3.3V ± 0.3V	5.3			6			
t _{dis}	OE	Y	C _L = 30pF	1.8V ± 0.15V	9.5			10.9			ns
				2.5V ± 0.2V	5.5			6.6			
			C _L = 50pF	2.7V	5.7			6.7			
				3.3V ± 0.3V	5.5			6.2			
t _{sk(o)}				3.3V ± 0.3V	0.4			0.4			ns

over operating free-air temperature range; typical values measured at $T_A = 25^\circ\text{C}$ (unless otherwise noted). See *Parameter Measurement Information*

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	V_{CC}	$T_A = 25^\circ\text{C}$			$-40^\circ\text{C to } 125^\circ\text{C}$			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
C_{PD}		Outputs Enabled	$f = 10\text{MHz}$	1.8V		13.5				pF	
				2.5V		14.1					
				3.3V		14.5					
		Outputs Disabled	$f = 10\text{MHz}$	1.8V		1.3					
				2.5V		1.4					
				3.3V		1.6					

5.7 Typical Characteristics

$T_A = 25^\circ\text{C}$ (unless otherwise noted)

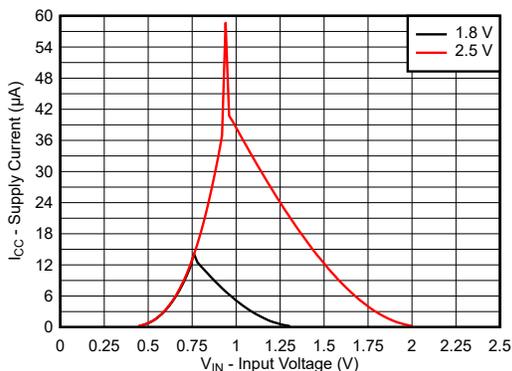


Figure 5-1. Supply Current Across Input Voltage 1.8V and 2.5V Supply

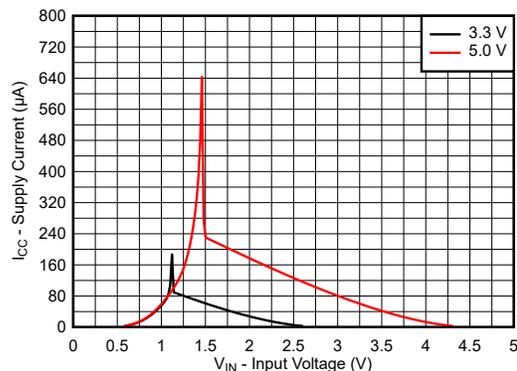


Figure 5-2. Supply Current Across Input Voltage 3.3V and 5.0V Supply

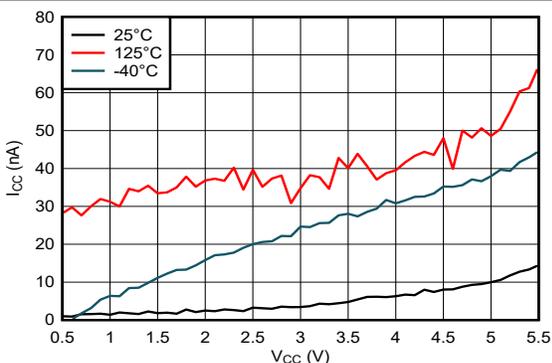


Figure 5-3. Supply Current Across Supply Voltage

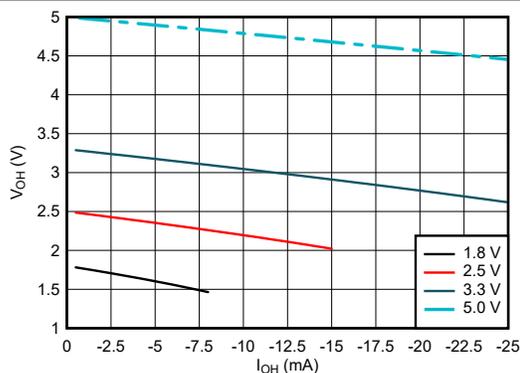


Figure 5-4. Output Voltage vs Current in HIGH State

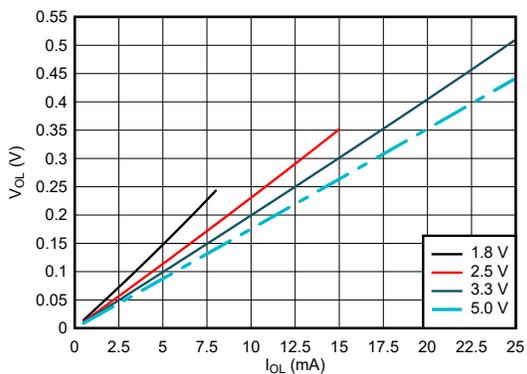


Figure 5-5. Output Voltage vs Current in LOW State

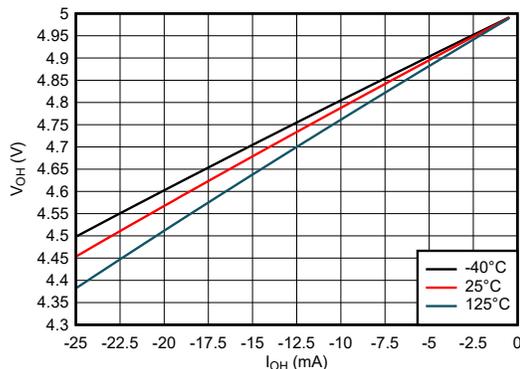


Figure 5-6. Output Voltage vs Current in HIGH State; 5V Supply

5.7 Typical Characteristics (continued)

$T_A = 25^\circ\text{C}$ (unless otherwise noted)

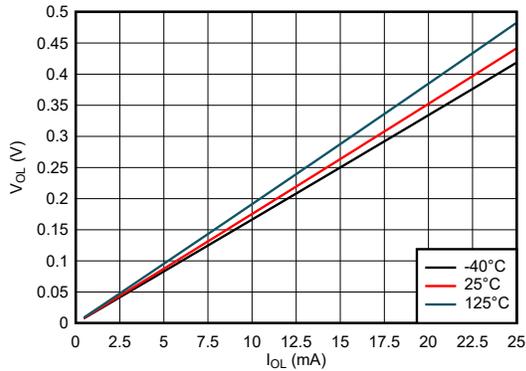


Figure 5-7. Output Voltage vs Current in LOW State; 5V Supply

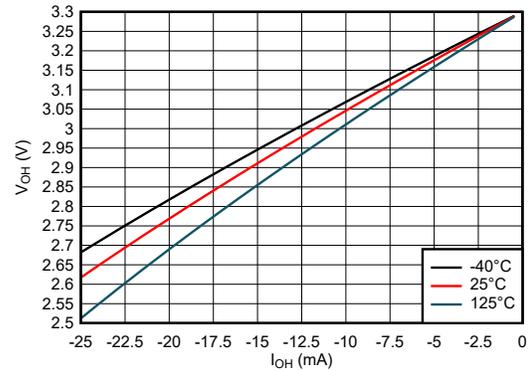


Figure 5-8. Output Voltage vs Current in HIGH State; 3.3V Supply

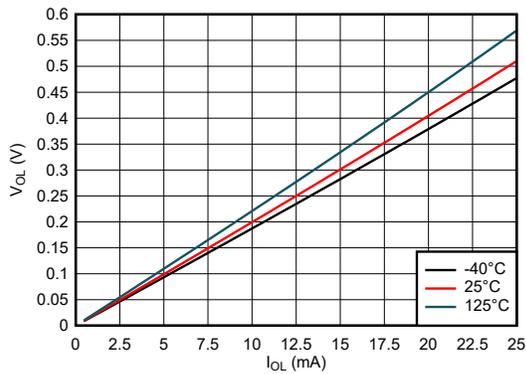


Figure 5-9. Output Voltage vs Current in LOW State; 3.3V Supply

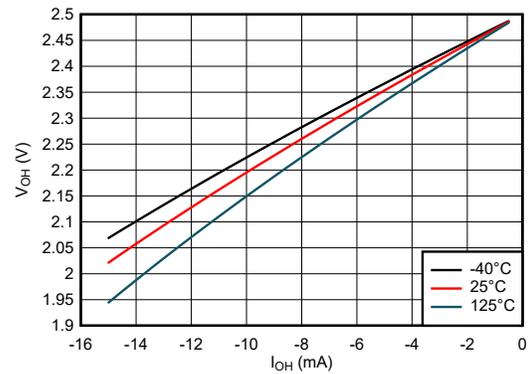


Figure 5-10. Output Voltage vs Current in HIGH State; 2.5V Supply

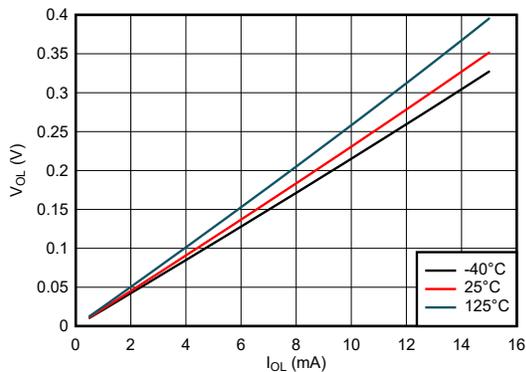


Figure 5-11. Output Voltage vs Current in LOW State; 2.5V Supply

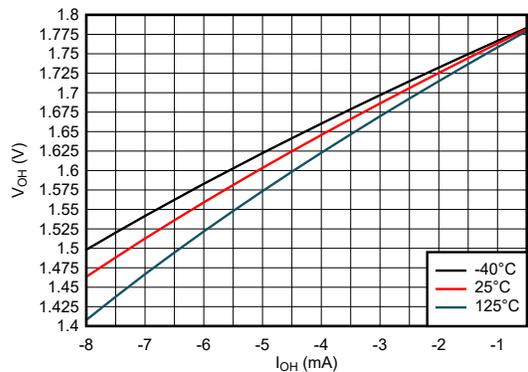


Figure 5-12. Output Voltage vs Current in HIGH State; 1.8V Supply

5.7 Typical Characteristics (continued)

T_A = 25°C (unless otherwise noted)

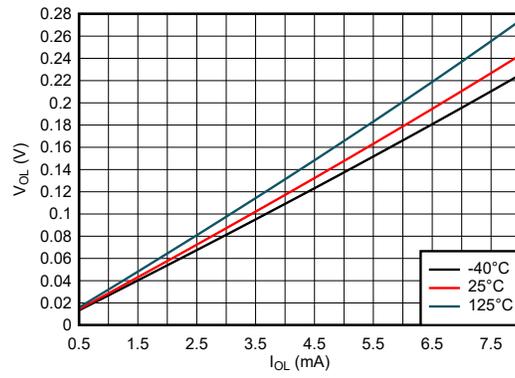


Figure 5-13. Output Voltage vs Current in LOW State; 1.8V Supply

6 Parameter Measurement Information

Phase relationships between waveforms are chosen arbitrarily for the examples listed in the following table. All input pulses are supplied by generators having the following characteristics: PRR ≤ 1MHz, Z_O = 50Ω, t_r ≤ 2.5ns.

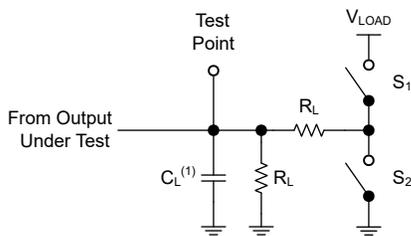
The outputs are measured individually with one input transition per measurement.

Table 6-1. 3-State Outputs

TEST	S1	S2
t _{PLH} , t _{PHL}	OPEN	OPEN
t _{PLZ} , t _{PZL}	CLOSED	OPEN
t _{PHZ} , t _{PZH}	OPEN	CLOSED

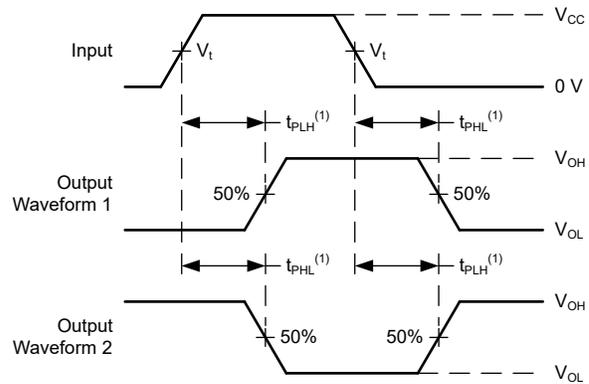
Table 6-2. 3-State or Open-Drain Outputs

V _{CC}	V _t	R _L	C _L	ΔV	V _{LOAD}
1.8V ± 0.15V	V _{CC} /2	1kΩ	30pF	0.15V	2×V _{CC}
2.5V ± 0.2V	V _{CC} /2	500Ω	30pF	0.15V	2×V _{CC}
2.7V	1.5V	500Ω	50pF	0.3V	6V
3.3V ± 0.3V	1.5V	500Ω	50pF	0.3V	6V



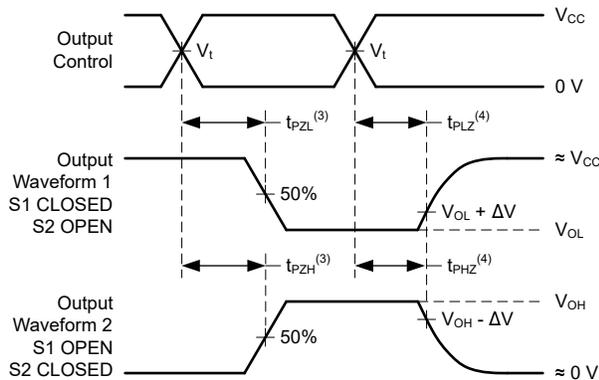
(1) C_L includes probe and test-fixture capacitance.

Figure 6-1. Load Circuit for 3-State Outputs



(1) The greater between t_{PLH} and t_{PHL} is the same as t_{pd}.

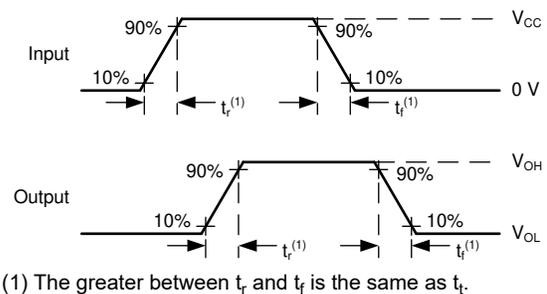
Figure 6-2. Voltage Waveforms Propagation Delays



(1) The greater between t_{PZL} and t_{PZH} is the same as t_{en}.

(2) The greater between t_{PLZ} and t_{PHZ} is the same as t_{dis}.

Figure 6-3. Voltage Waveforms Propagation Delays



(1) The greater between t_r and t_f is the same as t_t.

Figure 6-4. Voltage Waveforms, Input and Output Transition Times

7 Detailed Description

7.1 Overview

The SN74LVC240A-Q1 contains 8 individual high speed CMOS inverters with Schmitt-trigger inputs and 3-state outputs.

Each inverter performs the Boolean logic function $xY_n = \overline{xA_n}$, with x being the bank number and n being the channel number.

Each output enable (\overline{xOE}) controls four inverters. When the \overline{xOE} pin is in the low state, the outputs of all inverters in the bank x are enabled. When the \overline{xOE} pin is in the high state, the outputs of all inverters in the bank x are disabled. All disabled output are placed into the high-impedance state.

To confirm the high-impedance state during power up or power down, both \overline{OE} pins must be tied to V_{CC} through a pull-up resistor; the minimum value of the resistor is determined by the current sinking capability of the driver and the leakage of the pin as defined in the *Electrical Characteristics* table.

7.2 Functional Block Diagram

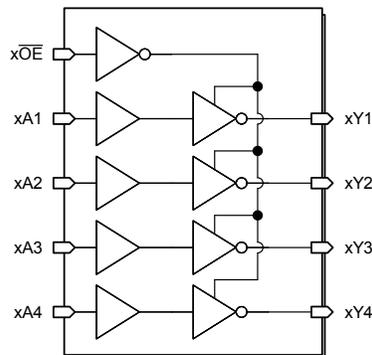


Figure 7-1. Logic Diagram (Positive Logic) for SN74LVC240A-Q1

7.3 Feature Description

7.3.1 Balanced CMOS 3-State Outputs

This device includes balanced CMOS 3-state outputs: driving high, driving low, and high impedance. The term *balanced* indicates that the device can sink and source similar currents. The drive capability of this device can create fast edges into light loads, so consider routing and load conditions to prevent ringing. Additionally, the outputs of this device can drive larger currents than the device can sustain without damage. Limit the output power of the device to avoid damage from overcurrent. The electrical and thermal limits defined in the *Absolute Maximum Ratings* must be followed at all times.

When placed into the high-impedance state, the output does not source or sink current except minor leakage current as defined in the *Electrical Characteristics* table. In the high-impedance state, the device does not control the output voltage. The output current is dependent on external factors. A floating node is a node that has no other drivers connected, and the voltage is unknown. A pull-up or pull-down resistor can be connected to the output to provide a known voltage at the output while the device is in the high-impedance state. The value of the resistor depends on multiple factors, including parasitic capacitance and power consumption limitations. Typically, a 10kΩ resistor meets these requirements.

Leave unused 3-state CMOS outputs disconnected.

7.3.2 Partial Power Down (I_{off})

This device includes circuitry to disable all outputs when the supply pin is held at 0V. When disabled, the outputs neither source nor sink current, regardless of the input voltages. The amount of leakage current at each output is defined by the I_{off} specification in the *Electrical Characteristics* table.

7.3.3 Standard CMOS Inputs

This device includes standard CMOS inputs. Standard CMOS inputs are high impedance and are typically modeled as a resistor in parallel with the input capacitance given in the *Electrical Characteristics*. The worst case resistance is calculated with the maximum input voltage, given in the *Absolute Maximum Ratings*, and the maximum input leakage current, given in the *Electrical Characteristics*, using Ohm's law ($R = V \div I$).

Standard CMOS inputs require that input signals transition between valid logic states quickly, as defined by the input transition time or rate in the *Recommended Operating Conditions* table. Failing to meet this specification results in excessive power consumption and can cause oscillations. See more details in *Implications of Slow or Floating CMOS Inputs*.

Do not leave standard CMOS inputs floating at any time during operation. Terminate unused inputs at V_{CC} or GND. If a system does not always drive an input, consider adding a pull-up or pull-down resistor to provide a valid input voltage. The resistor value depends on multiple factors; a 10k Ω resistor, however, is recommended and typically meets all requirements.

7.3.4 Clamp Diode Structure

Figure 7-2 shows the inputs and outputs to this device have negative clamping diodes only.

CAUTION

Voltages beyond the values specified in the *Absolute Maximum Ratings* table can cause damage to the device. The input and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.

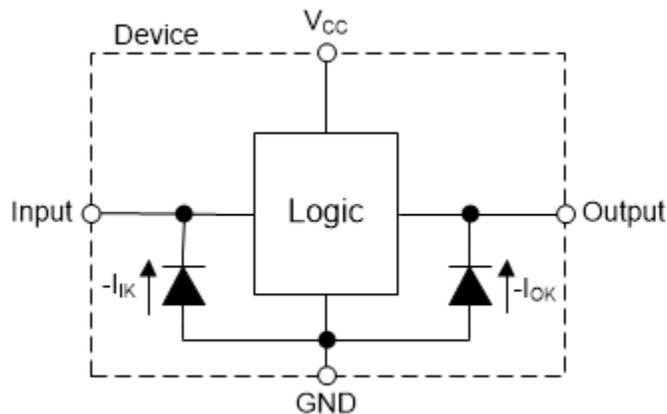


Figure 7-2. Electrical Placement of Clamping Diodes for Each Input and Output

7.4 Device Functional Modes

Table 7-1 lists the functional modes of the SN74LVC240A-Q1.

Table 7-1. Function Table

INPUTS ⁽¹⁾		OUTPUTS
\overline{OE}	A	Y
L	L	H
L	H	L
H	X	Z

(1) H = High Voltage Level, L = Low Voltage Level, X = Do Not Care, Z = High-Impedance State

8 Application and Implementation

Note

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes, as well as validating and testing their design implementation to confirm system functionality.

8.1 Application Information

The SN74LVC240A-Q1 can be used to drive signals over relatively long traces or transmission lines. A series damping resistor placed in series with the transmitter's output can be used to reduce ringing caused by impedance mismatches between the driver, transmission line, and receiver. The figure in the *Application Curve* section shows the received signal with three separate resistor values. Just a small amount of resistance can make a significant impact on signal integrity in this type of application.

8.2 Typical Application

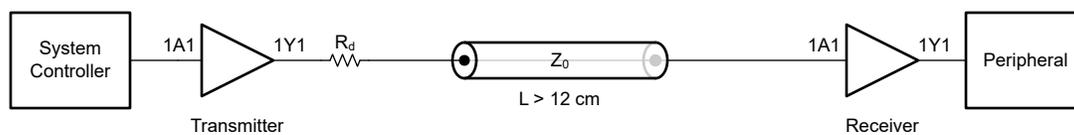


Figure 8-1. Typical Application Block Diagram

8.2.1 Design Requirements

The SN74LVC240A-Q1 device uses CMOS technology and has balanced output drive. Take care to avoid bus contention because it can drive currents that would exceed maximum limits.

The SN74LVC240A-Q1 allows switching control of analog and digital signals with a digital control signal. All input signals should remain as close to either 0V or V_{CC} as possible for optimal operation.

8.2.1.1 Power Considerations

Verify that the desired supply voltage is within the range specified in the *Electrical Characteristics*. The supply voltage sets the device electrical characteristics of the device, as described in the *Electrical Characteristics* section.

The positive voltage supply must be capable of sourcing current equal to the total current to be sourced by all outputs of the SN74LVC240A-Q1 plus the maximum static supply current, I_{CC} , listed in the *Electrical Characteristics*, and any transient current required for switching. The logic device can only source as much current that is provided by the positive supply source. Verify that the maximum total current through V_{CC} listed in the *Absolute Maximum Ratings* is not exceeded.

The ground must be capable of sinking current equal to the total current to be sunk by all outputs of the SN74LVC240A-Q1 plus the maximum supply current, I_{CC} , listed in the *Electrical Characteristics*, and any transient current required for switching. The logic device can only sink as much current that can be sunk into the ground connection. Verify that the maximum total current through GND listed in the *Absolute Maximum Ratings* is not exceeded.

The SN74LVC240A-Q1 can drive a load with a total capacitance less than or equal to 50pF while still meeting all of the datasheet specifications. Larger capacitive loads can be applied; however, do not exceed 50pF.

The SN74LVC240A-Q1 can drive a load with total resistance described by $R_L \geq V_O / I_O$, with the output voltage and current defined in the *Electrical Characteristics* table with V_{OH} and V_{OL} . When outputting in the HIGH state, the output voltage in the equation is defined as the difference between the measured output voltage and the supply voltage at the V_{CC} pin.

Total power consumption can be calculated using the information provided in the [CMOS Power Consumption and Cpd Calculation application note](#).

Thermal increase can be calculated using the information provided in the [Thermal Characteristics of Standard Linear and Logic \(SLL\) Packages and Devices application note](#).

CAUTION

The maximum junction temperature, $T_{J(max)}$ listed in the *Absolute Maximum Ratings*, is an additional limitation to prevent damage to the device. Do not violate any values listed in the *Absolute Maximum Ratings*. These limits are provided to prevent damage to the device.

8.2.1.2 Input Considerations

Input signals must cross $V_{IL(max)}$ to be considered a logic LOW, and $V_{IH(min)}$ to be considered a logic HIGH. Do not exceed the maximum input voltage range found in the *Absolute Maximum Ratings*.

Unused inputs must be terminated to either V_{CC} or ground. The unused inputs can be directly terminated if the input is completely unused, or the inputs can be connected with a pullup or pulldown resistor if the input is used sometimes, but not always. A pullup resistor is used for a default state of HIGH, and a pulldown resistor is used for a default state of LOW. The drive current of the controller, leakage current into the SN74LVC240A-Q1 (as specified in the *Electrical Characteristics*), and the desired input transition rate limits the resistor size. A 10k Ω resistor value is often used due to these factors.

The SN74LVC240A-Q1 has CMOS inputs and thus requires fast input transitions to operate correctly, as defined in the *Electrical Characteristics* table. Slow input transitions can cause oscillations, additional power consumption, and reduction in device reliability.

Refer to the *Feature Description* for additional information regarding the inputs for this device.

8.2.1.3 Output Considerations

The positive supply voltage is used to produce the output HIGH voltage. Drawing current from the output decreases the output voltage as specified by the V_{OH} specification in the *Electrical Characteristics*. The ground voltage is used to produce the output LOW voltage. Sinking current into the output increases the output voltage as specified by the V_{OL} specification in the *Electrical Characteristics*.

Push-pull outputs that can be in opposite states, even for a very short time period, must never be connected directly together. This can cause excessive current and damage to the device.

Two channels within the same device with the same input signals can be connected in parallel for additional output drive strength.

Unused outputs can be left floating. Do not connect outputs directly to V_{CC} or ground.

Refer to the *Feature Description* section for additional information regarding the outputs for this device.

8.2.2 Detailed Design Procedure

1. Recommended input conditions:
 - For rise time and fall time specifications, see $\Delta t/\Delta v$ in the *Recommended Operating Conditions* table.
 - For specified high and low levels, see V_{IH} and V_{IL} in the *Recommended Operating Conditions* table.
 - Inputs and outputs are overvoltage tolerant and can therefore go as high as 5.5V at any valid V_{CC} .
2. Recommended output conditions:
 - Load currents not exceeding $\pm 50\text{mA}$.
3. Frequency selection criterion:
 - The effects of frequency upon the device's power consumption should be studied in the [CMOS Power Consumption and CPD Calculation application note](#).
 - Added trace resistance and capacitance can reduce maximum frequency capability; follow the layout practices listed in the *Layout* section.

8.2.3 Application Curves

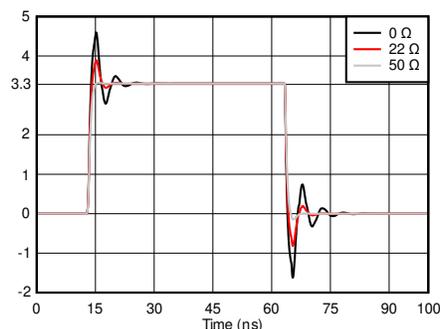


Figure 8-2. Simulated Signal Integrity at the Receiver With Different Damping Resistor (R_d) Values

8.3 Power Supply Recommendations

The power supply can be any voltage between the minimum and maximum supply voltage rating listed in the *Recommended Operating Conditions*.

Verify that each V_{CC} terminal has a good bypass capacitor to prevent power disturbance. For the SN74LVC240A-Q1, a $0.1\mu\text{F}$ bypass capacitor is recommended. To reject different frequencies of noise, use multiple bypass capacitors in parallel. Capacitors with values of $0.1\mu\text{F}$ and $1\mu\text{F}$ are commonly used in parallel.

8.4 Layout

8.4.1 Layout Guidelines

- Bypass capacitor placement
 - Place near the positive supply terminal of the device
 - Provide an electrically short ground return path
 - Use wide traces to minimize impedance
 - Keep the device, capacitors, and traces on the same side of the board whenever possible
- Signal trace geometry
 - 8mil to 12mil trace width
 - Lengths less than 12cm to minimize transmission line effects
 - Avoid 90° corners for signal traces
 - Use an unbroken ground plane below signal traces
 - Flood fill areas around signal traces with ground
 - Parallel traces must be separated by at least 3x dielectric thickness
 - For traces longer than 12cm
 - Use impedance controlled traces
 - Source-terminate using a series damping resistor near the output
 - Avoid branches; buffer each signal that must branch separately

8.4.2 Layout Example

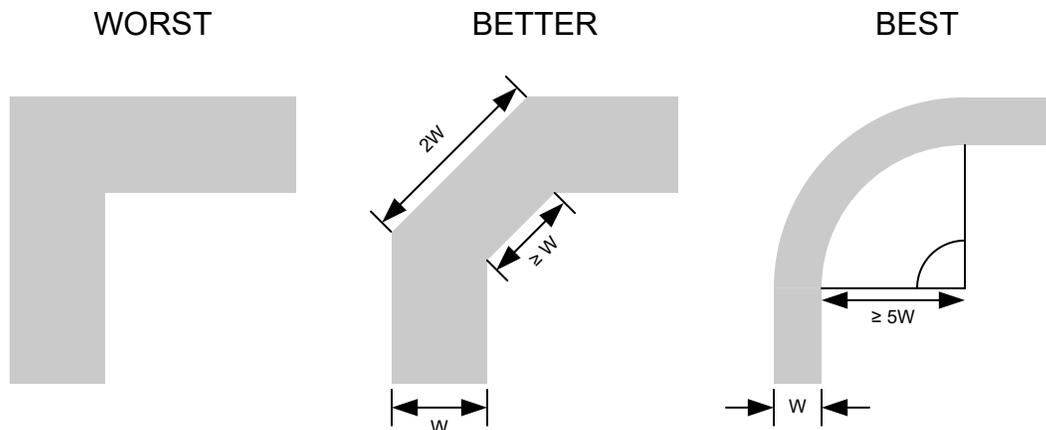


Figure 8-3. Example Trace Corners for Improved Signal Integrity

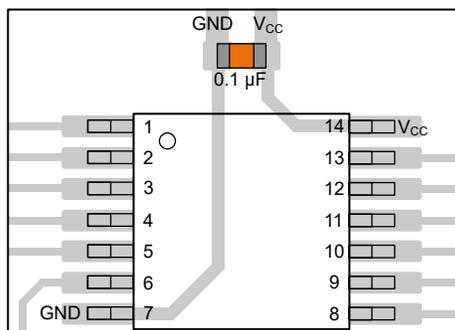


Figure 8-4. Example Bypass Capacitor Placement for TSSOP and Similar Packages

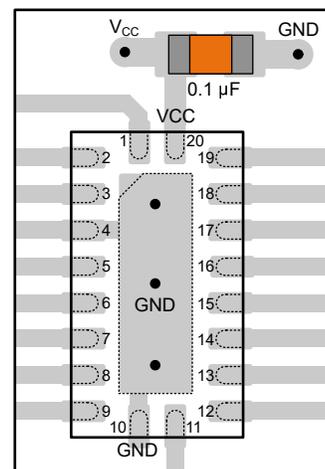


Figure 8-5. Example Bypass Capacitor Placement for WQFN and Similar Packages

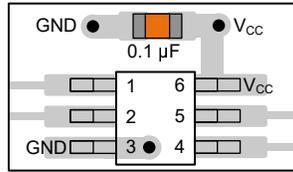


Figure 8-6. Example Bypass Capacitor Placement for SOT, SC70 and Similar Packages

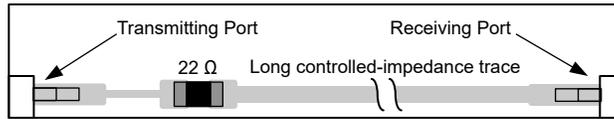


Figure 8-7. Example Damping Resistor Placement for Improved Signal Integrity

9 Device and Documentation Support

TI offers an extensive line of development tools. Tools and software to evaluate the performance of the device, generate code, and develop solutions are listed below.

9.1 Documentation Support

9.1.1 Related Documentation

For related documentation, see the following:

- Texas Instruments, [CMOS Power Consumption and \$C_{pd}\$ Calculation application note](#)
- Texas Instruments, [Designing With Logic application note](#)
- Texas Instruments, [Thermal Characteristics of Standard Linear and Logic \(SLL\) Packages and Devices application note](#)

9.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Notifications* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

9.3 Support Resources

TI E2E™ [support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

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9.4 Trademarks

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9.5 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

9.6 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

10 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

DATE	REVISION	NOTES
March 2026	*	Initial Release

11 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

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)
SN74LVC240ADGSRQ1	Active	Production	VSSOP (DGS) 20	5000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	C240Q
SN74LVC240APWRQ1	Active	Production	TSSOP (PW) 20	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LVC240AQ

(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.

Important Information and Disclaimer:The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

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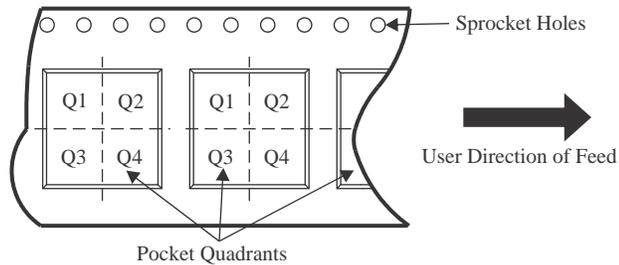
OTHER QUALIFIED VERSIONS OF SN74LVC240A-Q1 :

- Catalog : [SN74LVC240A](#)

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
SN74LVC240ADGSRQ1	VSSOP	DGS	20	5000	330.0	16.4	5.4	5.4	1.45	8.0	16.0	Q1
SN74LVC240APWRQ1	TSSOP	PW	20	3000	330.0	16.4	6.95	7.0	1.4	8.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

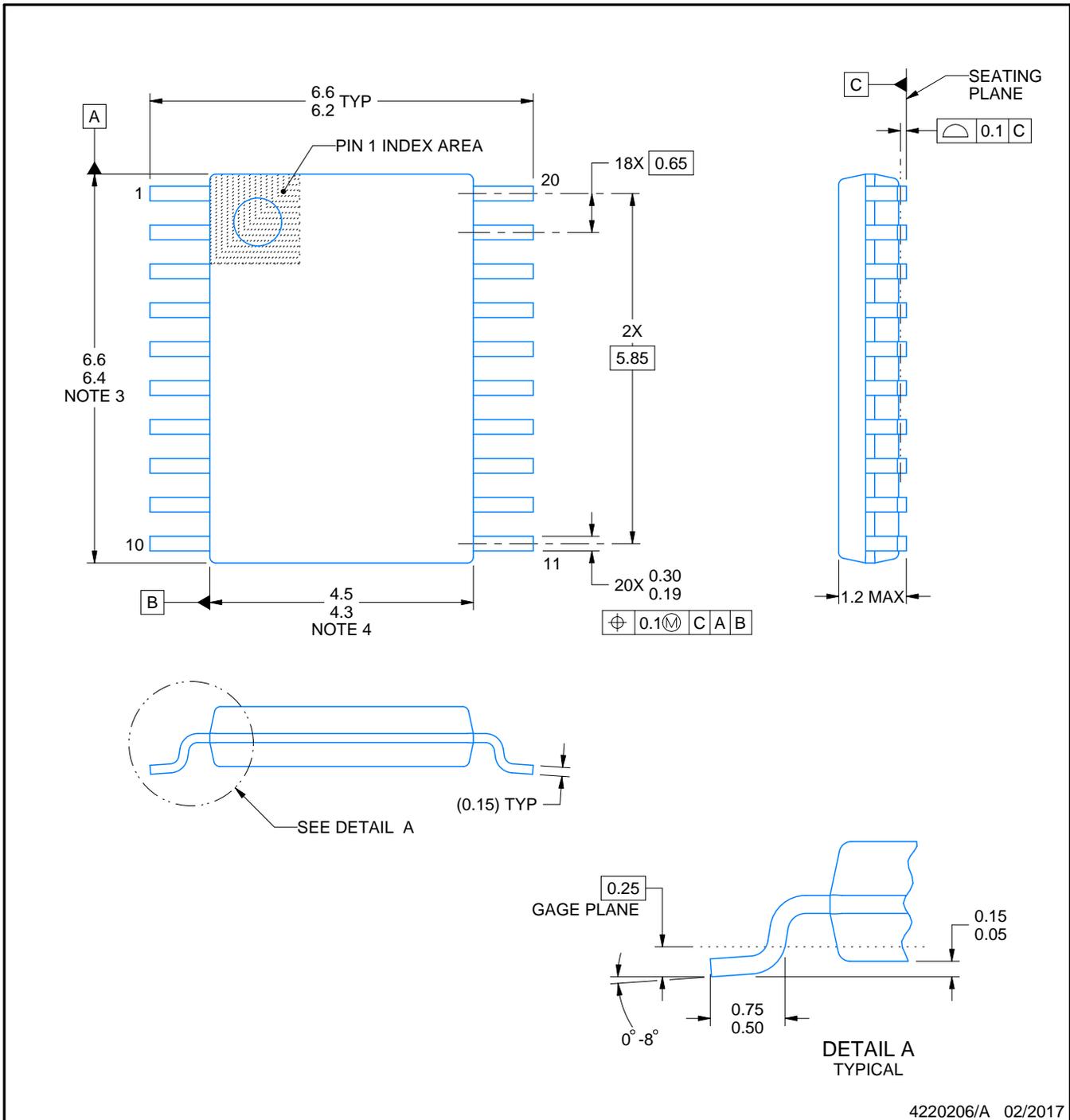
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74LVC240ADGSRQ1	VSSOP	DGS	20	5000	353.0	353.0	32.0
SN74LVC240APWRQ1	TSSOP	PW	20	3000	353.0	353.0	32.0

PW0020A



PACKAGE OUTLINE
TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



4220206/A 02/2017

NOTES:

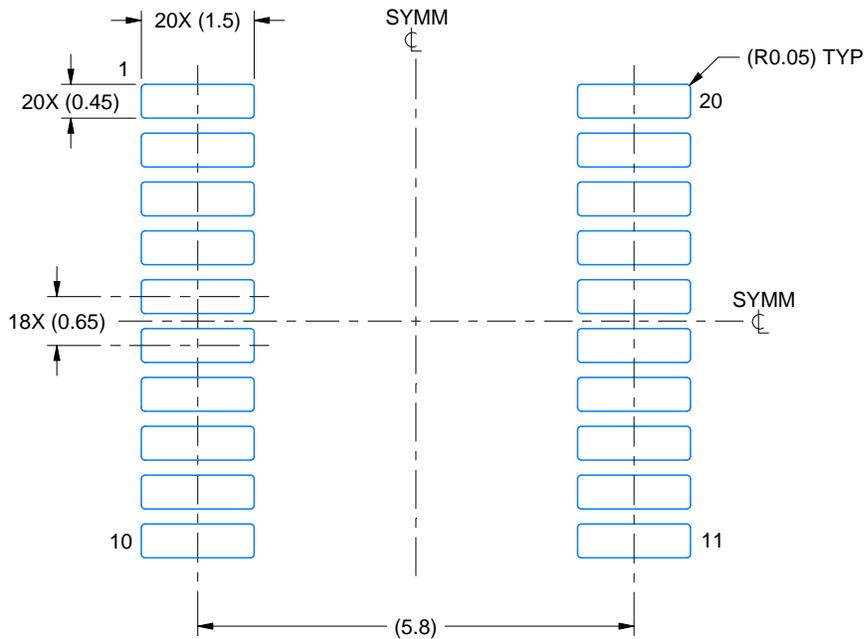
- All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
- This drawing is subject to change without notice.
- This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
- This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
- Reference JEDEC registration MO-153.

EXAMPLE BOARD LAYOUT

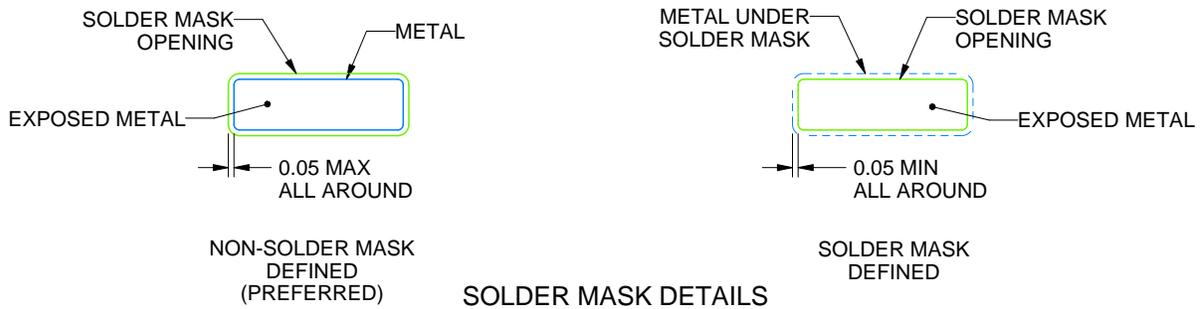
PW0020A

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)

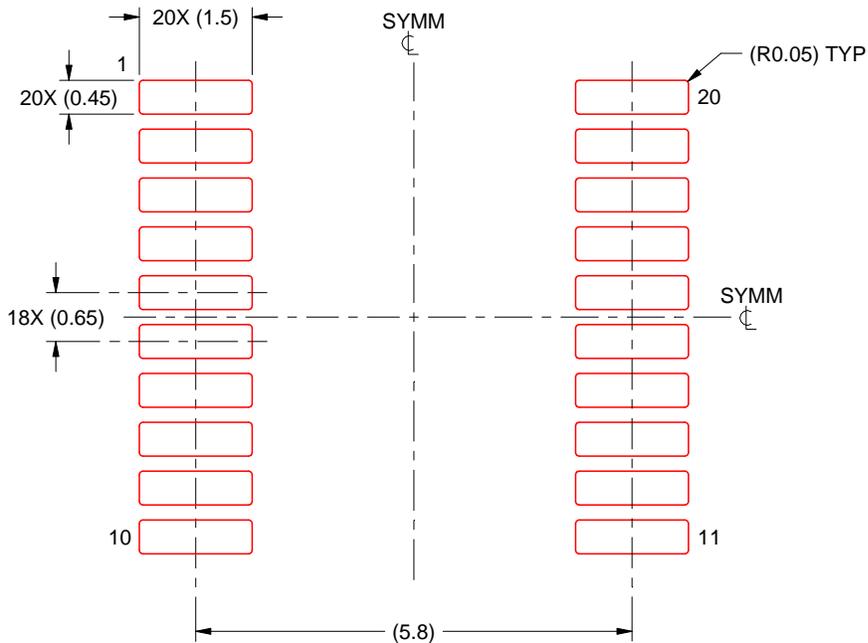
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

PW0020A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE

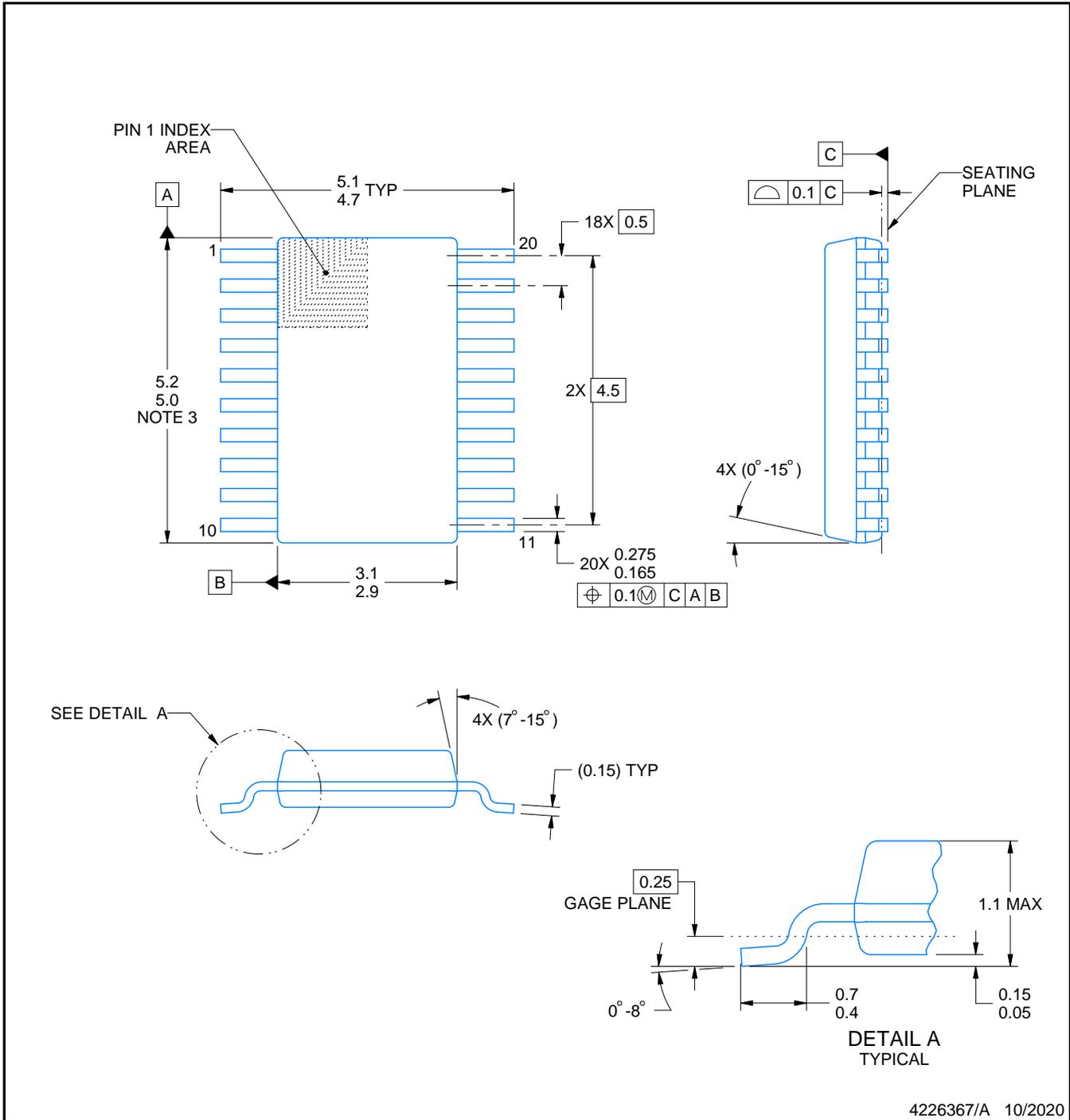


SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 10X

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.



NOTES:

PowerPAD is a trademark of Texas Instruments.

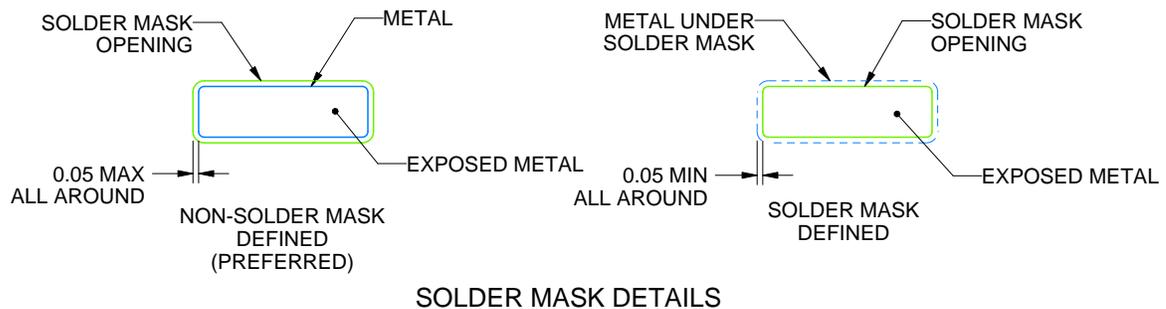
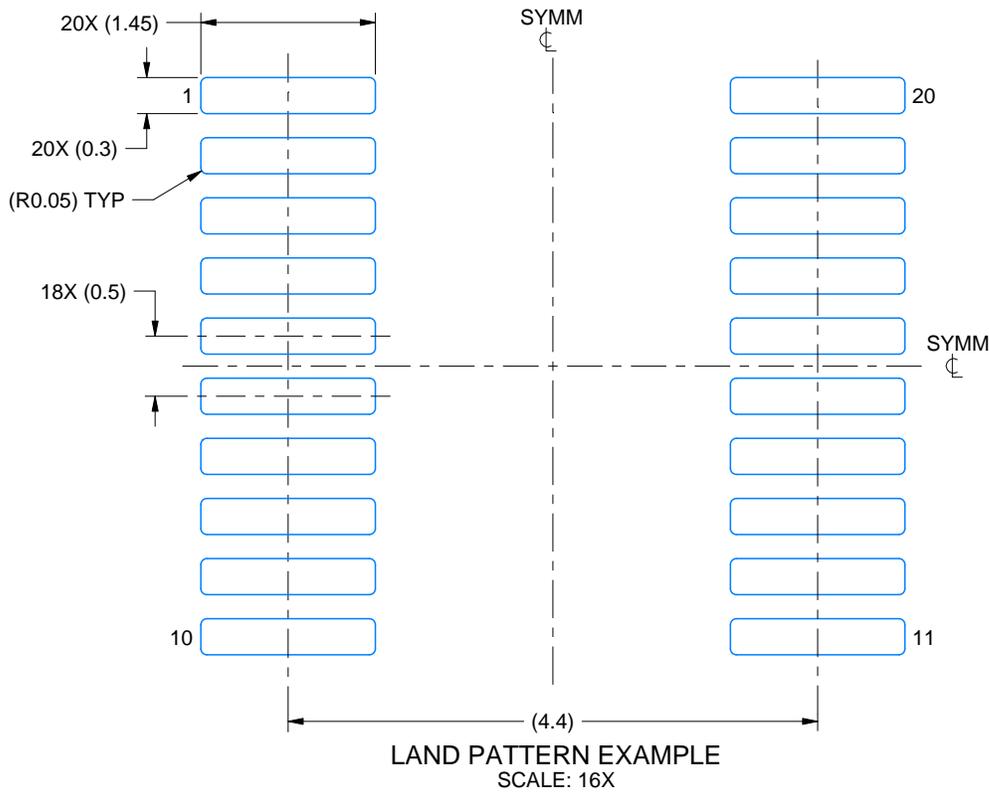
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. No JEDEC registration as of September 2020.
5. Features may differ or may not be present.

EXAMPLE BOARD LAYOUT

DGS0020A

VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



4226367/A 10/2020

NOTES: (continued)

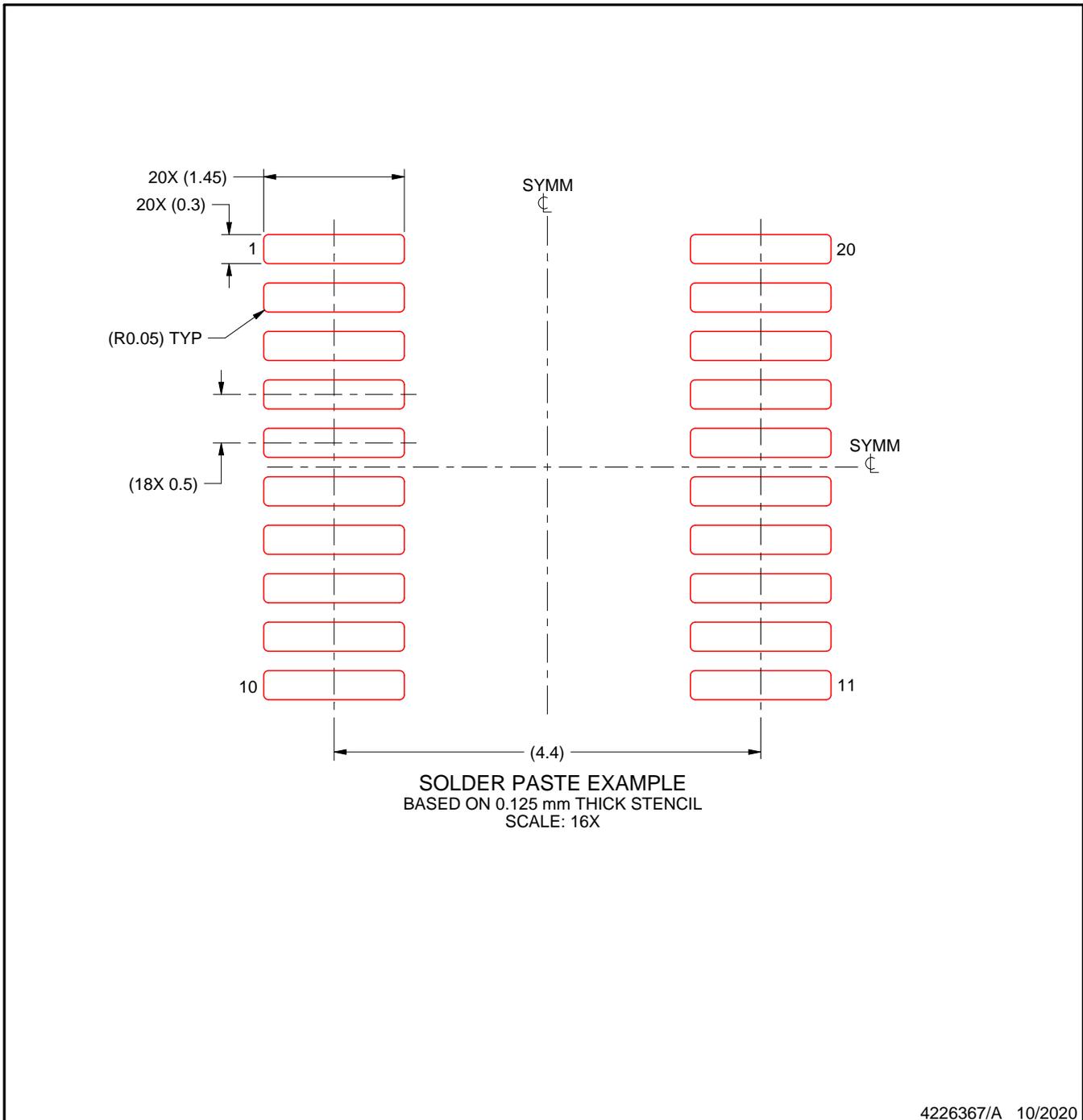
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
8. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature numbers SLMA002 (www.ti.com/lit/slma002) and SLMA004 (www.ti.com/lit/slma004).
9. Size of metal pad may vary due to creepage requirement.
10. Vias are optional depending on application, refer to device data sheet. It is recommended that vias under paste be filled, plugged or tented.

EXAMPLE STENCIL DESIGN

DGS0020A

VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



NOTES: (continued)

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

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