SN74AUP1G57 Low-Power Configurable Multiple-Function Gate

1 Features

- Available in the Texas Instruments NanoStar™ Packages
- Low Static-Power Consumption (I_{CC} = 0.9 μA Maximum)
- Low Dynamic-Power Consumption (C_{pd} = 4.3 pF Typical at 3.3 V)
- Low Input Capacitance (C_i = 1.5 pF Typical)
- Low Noise – Overshoot and Undershoot <10% of V_{CC}
- I_{off} Supports Partial-Power-Down Mode Operation
- Includes Schmitt-Trigger Inputs
- Wide Operating V_{CC} Range of 0.8 V to 3.6 V
- Optimized for 3.3-V Operation
- 3.6-V I/O Tolerant to Support Mixed-Mode Signal Operation
- t_{pd} = 5.3 ns Maximum at 3.3 V
- Suitable for Point-to-Point Applications
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Performance Tested Per JESD 22
  - 2000-V Human-Body Model (A114-B, Class II)
  - 1000-V Charged-Device Model (C101)

2 Applications

- Active Noise Cancellation (ANC)
- Barcode Scanners
- Blood Pressure Monitors
- CPAP Machines
- Cable Solutions
- E-Books
- Embedded PCs
- Field Transmitter: Temperature or Pressure Sensors
- HVAC: Heating, Ventilating, and Air Conditioning
- Network-Attached Storage (NAS)
- Server Motherboard and PSU
- Software Defined Radio (SDR)
- TV: High-Definition (HDTV), LCD, and Digital
- Video Communications Systems

3 Description

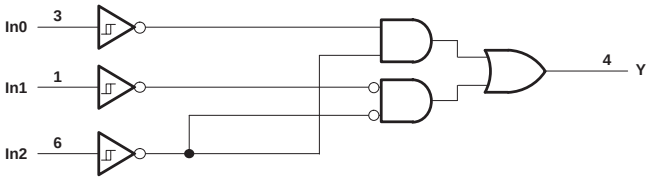
The SN74AUP1G57 device features configurable multiple functions. The output state is determined by eight patterns of 3-bit input. The user can choose the logic functions AND, OR, NAND, NOR, XNOR, inverter, and noninverter. All inputs can be connected to V_{CC} or GND.

Device Information(1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
SN74AUP1G57YFP	DSBGA (6)	1.16 x 0.76 mm
SN74AUP1G57YZP	DSBGA (6)	1.388 x 0.888 mm
SN74AUP1G57DRY	SON (6)	1.00 x 1.45 mm
SN74AUP1G57DSF	SON (6)	1.00 x 1.00 mm
SN74AUP1G57DBV	SOT-23 (6)	2.80 x 2.90 mm
SN74AUP1G57DCK	SC70 (6)	2.10 x 2.00 mm
SN74AUP1G57DRL	SOT (6)	1.60 x 1.60 mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

Functional Block Diagram (Positive Logic)



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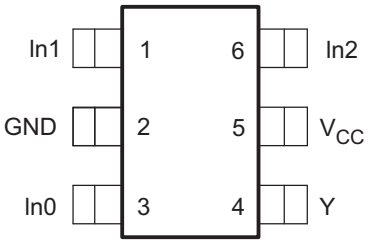
4 Revision History

Changes from Revision I (May 2010) to Revision J **Page**

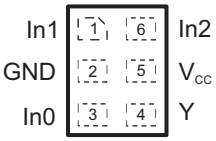
- Added *Pin Configuration and Functions* section, *ESD Ratings* table, *Feature Description* section, *Device Functional Modes*, *Application and Implementation* section, *Power Supply Recommendations* section, *Layout* section, *Device and Documentation Support* section, and *Mechanical, Packaging, and Orderable Information* section ... 1

5 Pin Configuration and Functions

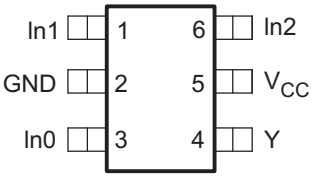
DBV Package
6-Pin SOT-23
Top View



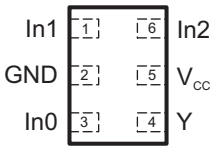
DRY Package
6-Pin SON
Top View



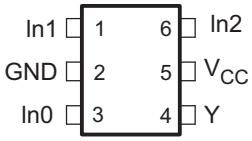
DCK Package
6-Pin SC70
Top View



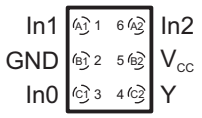
DSF Package
6-Pin SON
Top View



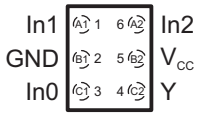
DRL Package
6-Pin SOT
Top View



YFP Package
6-Pin DSBGA
Top View



YZP Package
6-Pin DSBGA
Top View



Pin Functions

PIN			I/O	DESCRIPTION
NAME	SOT-23, SC70, SOT	DSBGA		
In1	1	A1	I	Logic input 1
GND	2	B1	—	Ground
In0	3	C1	I	Logic input 0
Y	4	C2	O	Logic output
V_{CC}	5	B2	—	Power
In2	6	A2	I	Logic input 2

6 Specifications

6.1 Absolute Maximum Ratings

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

			MIN	MAX	UNIT
V_{CC}	Supply voltage		–0.5	4.6	V
V_I	Input voltage(2)		–0.5	4.6	V
V_O	Voltage applied to any output in the high-impedance or power-off state(2)		–0.5	4.6	V
V_O	Output voltage in the high or low state(2)		–0.5	V_{CC} + 0.5	V
I_{IK}	Input clamp current	V_I < 0		–50	mA
I_{OK}	Output clamp current	V_O < 0		–50	mA
I_O	Continuous output current			±20	mA
	Continuous current through V_{CC} or GND			±50	mA
T_J	Junction temperature			150	°C
T_{stg}	Storage temperature		–65	150	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) The input negative-voltage and output voltage ratings may be exceeded if the input and output current ratings are observed.

6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001(1)	2000	V
		Charged-device model (CDM), per JEDEC specification JESD22-C101(2)	1000	

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

6.3 Recommended Operating Conditions

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

			MIN	MAX	UNIT
V_{CC}	Supply voltage		0.8	3.6	V
V_I	Input voltage		0	3.6	V
V_O	Output voltage		0	V_{CC}	V
I_{OH}	High-level output current	V_{CC} = 0.8 V		–20	μA
		V_{CC} = 1.1 V		–1.1	mA
		V_{CC} = 1.4 V		–1.7	
		V_{CC} = 1.65		–1.9	
		V_{CC} = 2.3 V		–3.1	
		V_{CC} = 3 V		–4	
I_{OL}	Low-level output current	V_{CC} = 0.8 V		20	μA
		V_{CC} = 1.1 V		1.1	mA
		V_{CC} = 1.4 V		1.7	
		V_{CC} = 1.65 V		1.9	
		V_{CC} = 2.3 V		3.1	
		V_{CC} = 3 V		4	
T_A	Operating free-air temperature		–40	85	°C

(1) All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. See the TI application report *Implications of Slow or Floating CMOS Inputs*, SCBA004.

6.4 Thermal Information

THERMAL METRIC[1]		SN74AUP1G57						UNIT
		DBV (SOT-23)	DCK (SC70)	DRL (SOT)	DSF (SON)	DRY (SON)	YFP/YZP (DSBGA)	
		6 PINS	6 PINS	6 PINS	6 PINS	6 PINS	6 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	165	259	142	300	234	123	°C/W

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report, SPRA953.

6.5 Electrical Characteristics

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

PARAMETER	TEST CONDITIONS	V_{CC}	T_A = 25°C			T_A = –40°C to 85°C		UNIT
			MIN	TYP	MAX	MIN	MAX	
V_{T+} Positive-going input threshold voltage		0.8 V	0.3		0.6	0.3	0.6	V
		1.1 V	0.53		0.9	0.53	0.9	
		1.4 V	0.74		1.11	0.74	1.11	
		1.65 V	0.91		1.29	0.91	1.29	
		2.3 V	1.37		1.77	1.37	1.77	
		3 V	1.88		2.29	1.88	2.29	
V_{T-} Negative-going input threshold voltage		0.8 V	0.1		0.6	0.1	0.6	V
		1.1 V	0.26		0.65	0.26	0.65	
		1.4 V	0.39		0.75	0.39	0.75	
		1.65 V	0.47		0.84	0.47	0.84	
		2.3 V	0.69		1.04	0.69	1.04	
		3 V	0.88		1.24	0.88	1.24	
ΔV_T Hysteresis ($V_{T+} - V_{T-}$)		0.8 V	0.07		0.5	0.07	0.5	V
		1.1 V	0.08		0.46	0.08	0.46	
		1.4 V	0.18		0.56	0.18	0.56	
		1.65 V	0.27		0.66	0.27	0.66	
		2.3 V	0.53		0.92	0.53	0.92	
		3 V	0.79		1.31	0.79	1.31	
V_{OH}	I_{OH} = –20 µA	0.8 V to 3.6 V	V_{CC} – 0.1			V_{CC} – 0.1		V
	I_{OH} = –1.1 mA	1.1 V	0.75 × V_{CC}			0.7 × V_{CC}		
	I_{OH} = –1.7 mA	1.4 V	1.11			1.03		
	I_{OH} = –1.9 mA	1.65 V	1.32			1.3		
	I_{OH} = –2.3 mA	2.3 V	2.05			1.97		
	I_{OH} = –3.1 mA		1.9			1.85		
	I_{OH} = –2.7 mA	3 V	2.72			2.67		
	I_{OH} = –4 mA		2.6			2.55		
V_{OL}	I_{OL} = 20 µA	0.8 V to 3.6 V			0.1		0.1	V
	I_{OL} = 1.1 mA	1.1 V			0.3 × V_{CC}		0.3 × V_{CC}	
	I_{OL} = 1.7 mA	1.4 V			0.31		0.37	
	I_{OL} = 1.9 mA	1.65 V			0.31		0.35	
	I_{OL} = 2.3 mA	2.3 V			0.31		0.33	
	I_{OL} = 3.1 mA				0.44		0.45	
	I_{OL} = 2.7 mA	3 V			0.31		0.33	
	I_{OL} = 4 mA				0.44		0.45	
I_I (all inputs)	V_I = GND to 3.6 V	0 V to 3.6 V			0.1		0.5	µA
I_{off}	V_I or V_O = 0 V to 3.6 V	0 V			0.2		0.6	µA

Electrical Characteristics (continued)

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

PARAMETER	TEST CONDITIONS	V_{CC}	T_A = 25°C			T_A = –40°C to 85°C		UNIT
			MIN	TYP	MAX	MIN	MAX	
ΔI_{off}	V_I or V_O = 0 V to 3.6 V	0 V to 0.2 V			0.2		0.6	µA
I_{CC}	V_I = GND or (V_{CC} to 3.6 V), I_O = 0	0.8 V to 3.6 V			0.5		0.9	µA
ΔI_{CC}	V_I = V_{CC} – 0.6 V(1), I_O = 0	3.3 V			40		50	µA
C_i	V_I = V_{CC} or GND	0 V		1.5				pF
		3.6 V		1.5				
C_o	V_O = GND	0 V		3				pF

(1) One input at V_{CC} – 0.6 V, other inputs at V_{CC} or GND.

6.6 Switching Characteristics, C_L = 5 pF

over recommended operating free-air temperature range, C_L = 5 pF (unless otherwise noted) (see Figure 2 and Figure 3)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC}	T_A = 25°C			T_A = –40°C to 85°C		UNIT
				MIN	TYP	MAX	MIN	MAX	
t_{pd}	In0, In1, or In2	Y	0.8 V		28.6				ns
			1.2 V ± 0.1 V	2.6	9.5	13.6	2.1	17.1	
			1.5 V ± 0.1 V	1.9	6.4	9.1	1.4	11.1	
			1.8 V ± 0.15 V	1.4	5.2	7.1	0.9	8.9	
			2.5 V ± 0.2 V	1.1	3.6	5.3	0.6	6.3	
			3.3 V ± 0.3 V	1	2.9	4.4	0.5	5.3	

6.7 Switching Characteristics, C_L = 10 pF

over recommended operating free-air temperature range, C_L = 10 pF (unless otherwise noted) (see Figure 2 and Figure 3)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC}	T_A = 25°C			T_A = –40°C to 85°C		UNIT
				MIN	TYP	MAX	MIN	MAX	
t_{pd}	In0, In1, or In2	Y	0.8 V		32.8				ns
			1.2 V ± 0.1 V	2.6	11	15.1	2.1	18.1	
			1.5 V ± 0.1 V	1.9	7.4	10.3	1.4	12.4	
			1.8 V ± 0.15 V	1.4	6	8.1	0.9	10	
			2.5 V ± 0.2 V	1.1	4.3	6.1	0.6	7.3	
			3.3 V ± 0.3 V	1	3.5	5.1	0.5	6.1	

6.8 Switching Characteristics, C_L = 15 pF

over recommended operating free-air temperature range, C_L = 15 pF (unless otherwise noted) (see Figure 2 and Figure 3)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC}	T_A = 25°C			T_A = –40°C to 85°C		UNIT
				MIN	TYP	MAX	MIN	MAX	
t_{pd}	In0, In1, or In2	Y	0.8 V		37				ns
			1.2 V ± 0.1 V	3.6	12.3	16.8	3.1	20.1	
			1.5 V ± 0.1 V	2.8	8.3	11.4	2.3	13.7	
			1.8 V ± 0.15 V	2.1	6.7	9	1.6	11.1	
			2.5 V ± 0.2 V	1.7	4.9	6.8	1.2	8.1	
			3.3 V ± 0.3 V	1.5	3.9	5.6	1	6.7	

6.9 Switching Characteristics, C_L = 30 pF

over recommended operating free-air temperature range, C_L = 30 pF (unless otherwise noted) (see Figure 2 and Figure 3)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC}	T_A = 25°C			T_A = –40°C to 85°C		UNIT
				MIN	TYP	MAX	MIN	MAX	
t_{pd}	In0, In1, or In2	Y	0.8 V		49.3				ns
			1.2 V ± 0.1 V	5	15.7	21.4	4.5	26.5	
			1.5 V ± 0.1 V	3.9	10.8	14.4	3.4	17.4	
			1.8 V ± 0.15 V	3.1	8.8	11.4	2.6	14	
			2.5 V ± 0.2 V	2.6	6.4	8.4	2.1	10.1	
			3.3 V ± 0.3 V	2.3	5.3	7	1.8	8.4	

6.10 Operating Characteristics

T_A = 25°C

PARAMETER		TEST CONDITIONS	V_{CC}	TYP	UNIT
C_{pd}	Power dissipation capacitance	f = 10 MHz	0.8 V	4	pF
			1.2 V ± 0.1 V	4	
			1.5 V ± 0.1 V	4	
			1.8 V ± 0.15 V	4	
			2.5 V ± 0.2 V	4.1	
			3.3 V ± 0.3 V	4.3	

6.11 Typical Characteristics

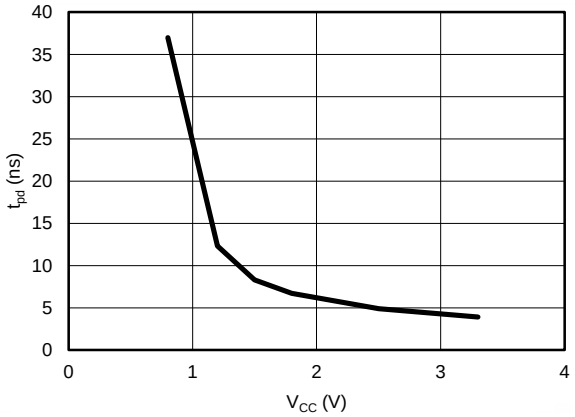
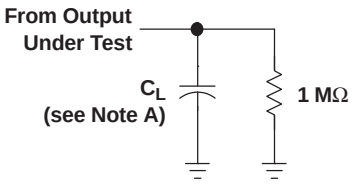


Figure 1. t_{pd} vs V_{CC}, 15-pF Load

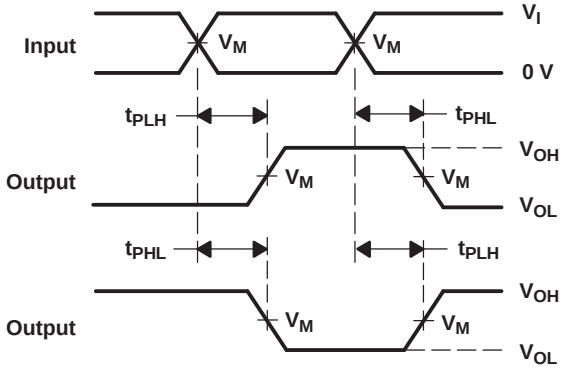
7 Parameter Measurement Information

7.1 Propagation Delays, Setup and Hold Times, and Pulse Duration

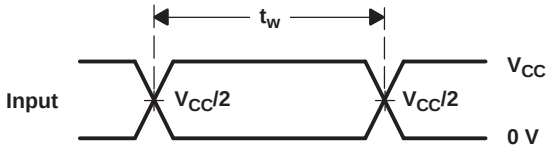


LOAD CIRCUIT

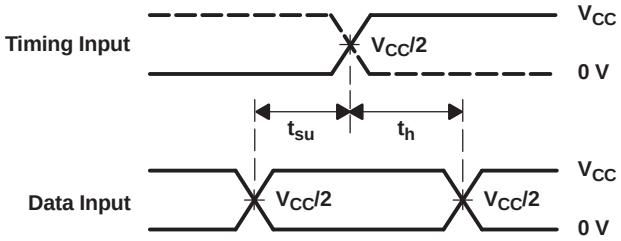
	V_{CC} = 0.8 V	V_{CC} = 1.2 V ± 0.1 V	V_{CC} = 1.5 V ± 0.1 V	V_{CC} = 1.8 V ± 0.15 V	V_{CC} = 2.5 V ± 0.2 V	V_{CC} = 3.3 V ± 0.3 V
C_L	5, 10, 15, 30 pF	5, 10, 15, 30 pF	5, 10, 15, 30 pF	5, 10, 15, 30 pF	5, 10, 15, 30 pF	5, 10, 15, 30 pF
V_M	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$
V_I	V_{CC}	V_{CC}	V_{CC}	V_{CC}	V_{CC}	V_{CC}



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
INVERTING AND NONINVERTING OUTPUTS



VOLTAGE WAVEFORMS
PULSE DURATION

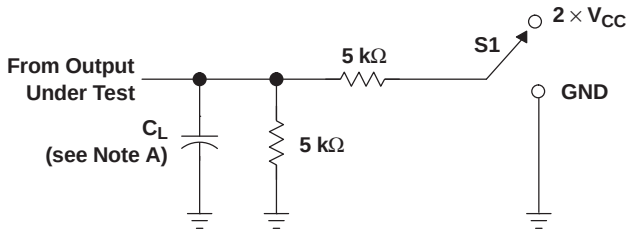


VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES

NOTES: A. C_L includes probe and jig capacitance.
B. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, Z_O = 50 Ω, slew rate ≥ 1 V/ns.
C. The outputs are measured one at a time, with one transition per measurement.
D. t_{PLH} and t_{PHL} are the same as t_{pd}.
E. All parameters and waveforms are not applicable to all devices.

Figure 2. Load Circuit and Voltage Waveforms

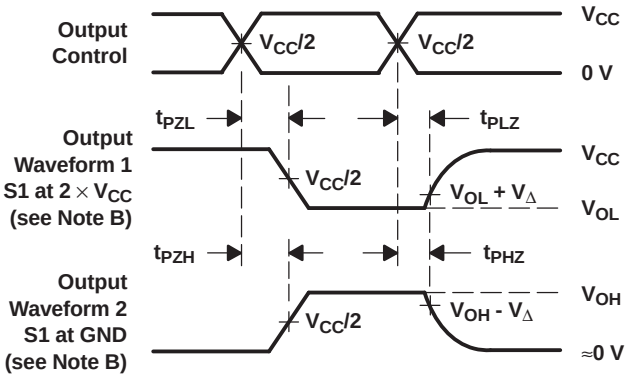
7.2 Enable and Disable Times



TEST	S1
t_{PLZ}/t_{PZL} t_{PHZ}/t_{PZH}	$2 \times V_{CC}$ GND

LOAD CIRCUIT

	V_{CC} = 0.8 V	V_{CC} = 1.2 V ± 0.1 V	V_{CC} = 1.5 V ± 0.1 V	V_{CC} = 1.8 V ± 0.15 V	V_{CC} = 2.5 V ± 0.2 V	V_{CC} = 3.3 V ± 0.3 V
C_L	5, 10, 15, 30 pF	5, 10, 15, 30 pF	5, 10, 15, 30 pF	5, 10, 15, 30 pF	5, 10, 15, 30 pF	5, 10, 15, 30 pF
V_M	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$
V_I	V_{CC}	V_{CC}	V_{CC}	V_{CC}	V_{CC}	V_{CC}
V_Δ	0.1 V	0.1 V	0.1 V	0.15 V	0.15 V	0.3 V



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. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, Z_O = 50 Ω, slew rate ≥ 1 V/ns.
D. The outputs are measured one at a time, with one transition per measurement.
E. t_{PLZ} and t_{PHZ} are the same as t_{dis}.
F. t_{PZL} and t_{PZH} are the same as t_{en}.
G. All parameters and waveforms are not applicable to all devices.

Figure 3. Load Circuit and Voltage Waveforms

8 Detailed Description

8.1 Overview

The AUP family is TI's premier solution to the low-power needs of the industry in battery-powered portable applications. This family ensures a very low static and dynamic power consumption across the entire V_{CC} range of 0.8 V to 3.6 V, resulting in an increased battery life. This product also maintains excellent signal integrity, which produces very low undershoot and overshoot characteristics.

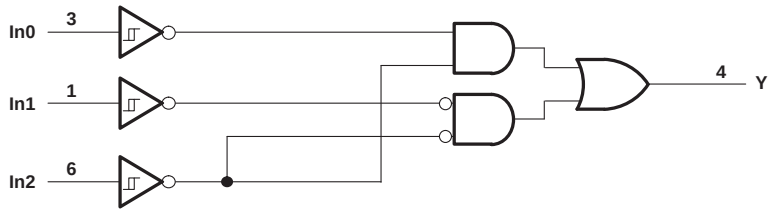
The SN74AUP1G57 features configurable multiple functions. The output state is determined by eight patterns of 3-bit input. The user can choose the logic functions AND, OR, NAND, NOR, XNOR, inverter, and noninverter. All inputs can be connected to V_{CC} or GND.

The device functions as an independent gate with Schmitt-trigger inputs, which allow for slow input transition and better switching noise immunity at the input.

NanoStar package technology is a major breakthrough in IC packaging concepts, using the die as the package.

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.

8.2 Functional Block Diagram



8.3 Feature Description

This part is available in the TI NanoStar package. It has low static-power consumption with I_{CC} = 0.9 µA maximum and low dynamic power consumption (C_{pd} = 4.3 pF, Typical at 3.3 V).

The inputs have low capacitance, with typical C_i = 1.5 pF.

This part has low noise, with overshoot and undershoot less than 10% of V_{CC}.

This part supports partial-power-down mode operation. When this part is powered down (V_{CC} = 0 V), the leakage current into the device is characterized by I_{off}.

Schmitt-trigger inputs provide hysterisis and consistency in V_{IH} / V_{IL}.

It has a wide operating V_{CC} range of 0.8 V to 3.6 V, and has been optimized for 3.3-V operation.

3.6-V I/O tolerant to support mixed-mode signal operation.

It has a low propagation delay of 5.3 ns at 3.3 V.

It is suitable for point-to-point applications.

8.4 Device Functional Modes

Table 1 lists all the functional modes of the SN74AUP1G57.

Table 1. Function Table

INPUTS			OUTPUT
In2	In1	In0	Y
L	L	L	H
L	L	H	L
L	H	L	H

Table 1. Function Table (continued)

INPUTS			OUTPUT Y
In2	In1	In0	
L	H	H	L
H	L	L	L
H	L	H	L
H	H	L	H
H	H	H	H

8.4.1 Logic Configurations

Table 2 lists all the logic functions of the SN74AUP1G57.

Table 2. Function Selection Table

LOGIC FUNCTION	FIGURE NO.
2-input AND	Figure 4
2-input AND with both inputs inverted	Figure 7
2-input NAND with inverted input	Figure 5, Figure 6
2-input OR with inverted input	Figure 5, Figure 6
2-input NOR	Figure 7
2-input NOR with both inputs inverted	Figure 4
2-input XNOR	Figure 8

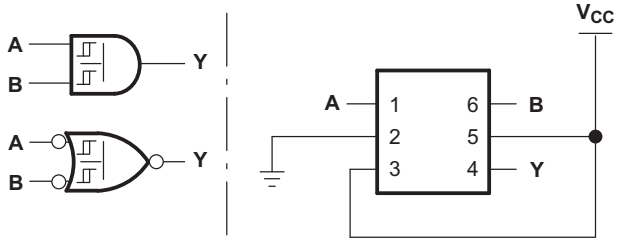


Figure 4. 2-Input AND Gate

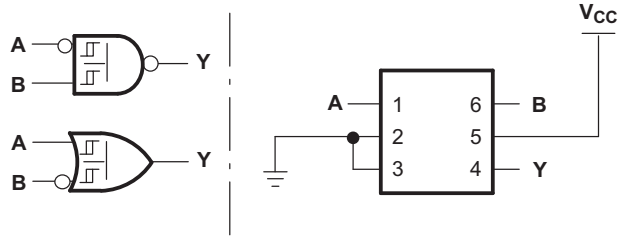


Figure 5. 2-Input NAND Gate With Inverted A Input

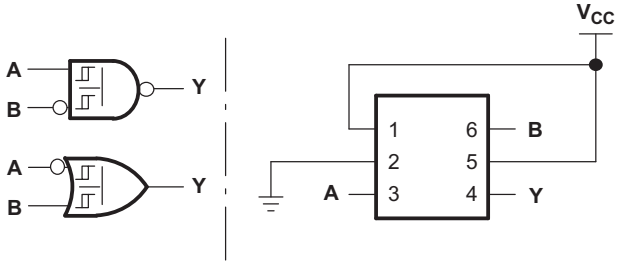


Figure 6. 2-Input NAND Gate With Inverted B Input

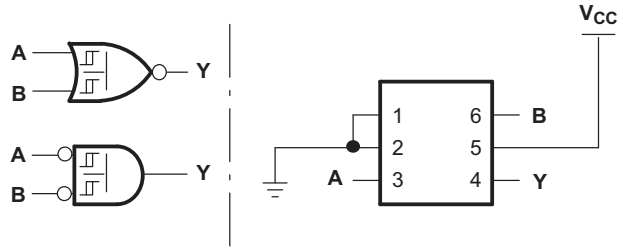


Figure 7. 2-Input NOR Gate

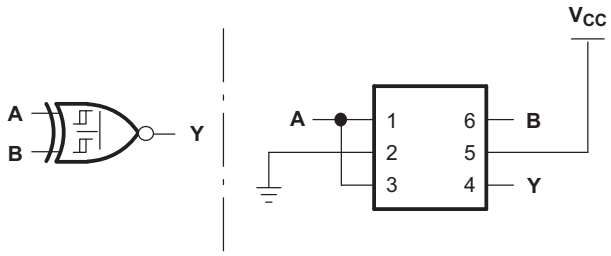


Figure 8. 2-Input XNOR Gate

9 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. Customers should validate and test their design implementation to confirm system functionality.

9.1 Application Information

The SN74AUP1G57 features configurable multiple functions. The output state is determined by eight patterns of 3-bit input. The user can choose the logic functions AND, NAND, NOR, XNOR, inverter, and noninverter. All inputs can be connected to V_{CC} or GND.

This part can be used in any application where an equivalent single gate would work. The biggest benefit to this part is that it can be used for multiple functions on the same board, reducing the total number of part numbers to be used.

9.2 Typical Application

This application shows how the SN74AUP1G57 can be configured to work as an AND logic gate. This part can The capacitor shown is 0.1 uF and should be placed as close as possible to the part.

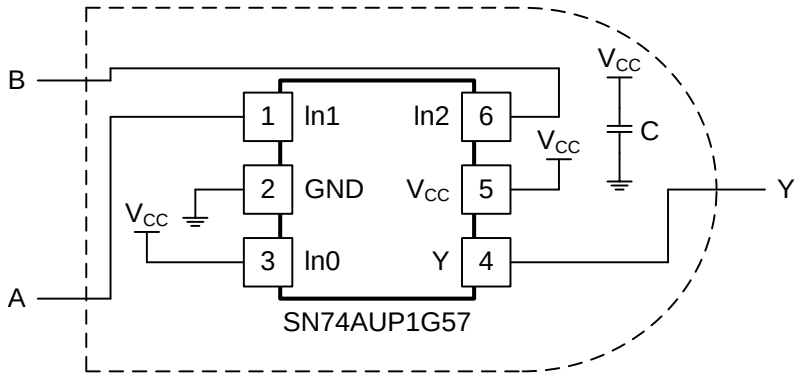


Figure 9. Schematic for AND Gate Configuration of SN74AUP1G57

9.2.1 Design Requirements

This 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.

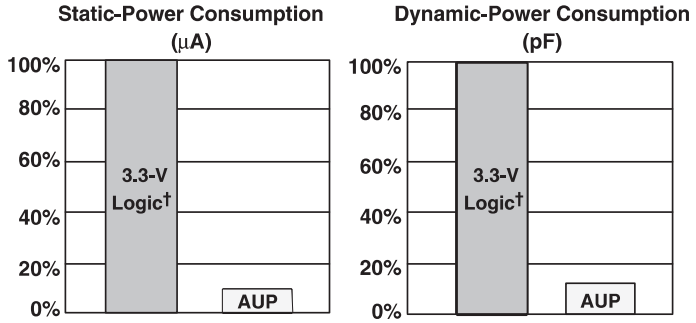
9.2.2 Detailed Design Procedure

1. Recommended Input conditions
   - Rise time and fall time specs. See (Δt/ΔV) in *Recommended Operating Conditions*
   - Specified high and low levels. See (V_{IH} and V_{IL}) in *Recommended Operating Conditions*
   - Inputs are overvoltage tolerant allowing them to go as high as 4.6 V at any valid V_{CC}
2. Recommend output conditions
   - Load currents should not exceed 20 mA on the output and 50 mA total for the part
   - Outputs should not be pulled above V_{CC} + 0.5 V.

Typical Application (continued)

9.2.3 Application Curve

The AUP family of single gate logic makes excellent translators for the new lower voltage microprocessors that typically are powered from 0.8 V to 1.2 V. They can drop the voltage of peripheral drivers and accessories that are still powered by 3.3 V to the new microcontroller power levels.



† Single, dual, and triple gates.

Figure 10. AUP – The Lowest-Power Family

10 Power Supply Recommendations

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

Each V_{CC} terminal should have a good bypass capacitor to prevent power disturbance. For devices with a single supply, a 0.1-μF bypass capacitor is recommended. If there are multiple pins labeled V_{CC}, then a 0.01-μF or 0.022-μF capacitor is recommended for each V_{CC} because the V_{CC} pins will be tied together internally. For devices with dual supply pins operating at different voltages, for example V_{CC} and V_{DD}, a 0.1-μF bypass capacitor is recommended for each supply pin. It is acceptable to parallel multiple bypass capacitors to reject different frequencies of noise. 0.1-μF and 1-μF capacitors are commonly used in parallel. The bypass capacitor should be installed as close to the power terminal as possible for best results.

11 Layout

11.1 Layout Guidelines

Reflections and matching are closely related to the loop antenna theory but are different enough to be discussed separately from the theory. When a PCB trace turns a corner at a 90° angle, a reflection can occur. A reflection occurs primarily because of the change of width of the trace. At the apex of the turn, the trace width increases to 1.414 times the width. This increase upsets the transmission-line characteristics, especially the distributed capacitance and self–inductance of the trace which results in the reflection. Not all PCB traces can be straight and therefore some traces must turn corners. Figure 11 shows progressively better techniques of rounding corners. Only the last example (BEST) maintains constant trace width and minimizes reflections.

11.2 Layout Example

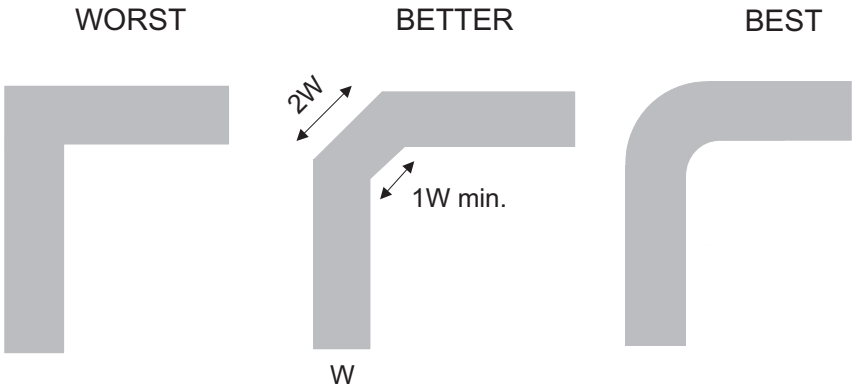


Figure 11. Trace Example

12 Device and Documentation Support

12.1 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

TI E2E™ Online Community ***TI's Engineer-to-Engineer (E2E) Community.*** Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

Design Support ***TI's Design Support*** Quickly find helpful E2E forums along with design support tools and contact information for technical support.

12.2 Trademarks

NanoStar, E2E are trademarks of Texas Instruments.
All other trademarks are the property of their respective owners.

12.3 Electrostatic Discharge Caution

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.

12.4 Glossary

SLYZ022 — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

13 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 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
SN74AUP1G57DBVR	ACTIVE	SOT-23	DBV	6	3000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	HA7R	Samples
SN74AUP1G57DBVT	ACTIVE	SOT-23	DBV	6	250	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	HA7R	Samples
SN74AUP1G57DCKR	ACTIVE	SC70	DCK	6	3000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	HHR	Samples
SN74AUP1G57DCKRE4	ACTIVE	SC70	DCK	6	3000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	HHR	Samples
SN74AUP1G57DCKT	ACTIVE	SC70	DCK	6	250	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	HHR	Samples
SN74AUP1G57DRLR	ACTIVE	SOT-5X3	DRL	6	4000	RoHS & Green	NIPDAU | NIPDAUAG	Level-1-260C-UNLIM	-40 to 85	(HH7, HHR)	Samples
SN74AUP1G57DRLRG4	ACTIVE	SOT-5X3	DRL	6	4000	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 85	(HH7, HHR)	Samples
SN74AUP1G57DRYR	ACTIVE	SON	DRY	6	5000	RoHS & Green	NIPDAU | NIPDAUAG	Level-1-260C-UNLIM	-40 to 85	HH	Samples
SN74AUP1G57DSFR	ACTIVE	SON	DSF	6	5000	RoHS & Green	NIPDAU | NIPDAUAG	Level-1-260C-UNLIM	-40 to 85	HH	Samples
SN74AUP1G57YFPR	ACTIVE	DSBGA	YFP	6	3000	RoHS & Green	SNAGCU	Level-1-260C-UNLIM		HHN	Samples
SN74AUP1G57YZPR	ACTIVE	DSBGA	YZP	6	3000	RoHS & Green	SNAGCU	Level-1-260C-UNLIM	-40 to 85	HHN	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.

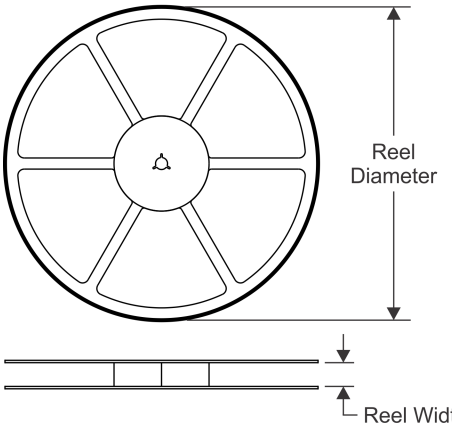
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(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.

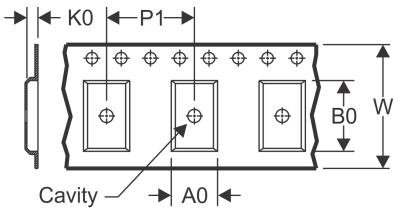
(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

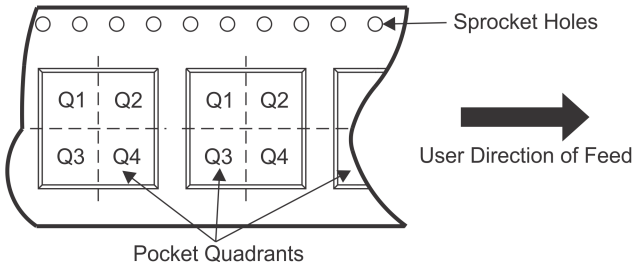


TAPE DIMENSIONS



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

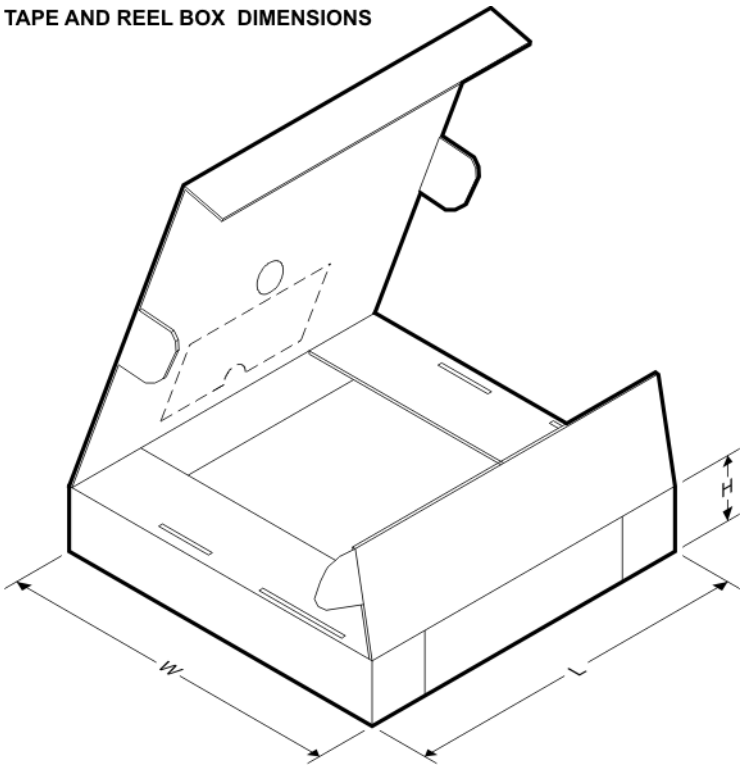
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
SN74AUP1G57DBVR	SOT-23	DBV	6	3000	180.0	8.4	3.23	3.17	1.37	4.0	8.0	Q3
SN74AUP1G57DBVT	SOT-23	DBV	6	250	180.0	8.4	3.23	3.17	1.37	4.0	8.0	Q3
SN74AUP1G57DCKR	SC70	DCK	6	3000	180.0	8.4	2.41	2.41	1.2	4.0	8.0	Q3
SN74AUP1G57DCKT	SC70	DCK	6	250	180.0	8.4	2.41	2.41	1.2	4.0	8.0	Q3
SN74AUP1G57DRLR	SOT-5X3	DRL	6	4000	180.0	8.4	1.98	1.78	0.69	4.0	8.0	Q3
SN74AUP1G57DRLR	SOT-5X3	DRL	6	4000	180.0	9.5	1.78	1.78	0.69	4.0	8.0	Q3
SN74AUP1G57DRYR	SON	DRY	6	5000	180.0	9.5	1.15	1.6	0.75	4.0	8.0	Q1
SN74AUP1G57DSFR	SON	DSF	6	5000	180.0	9.5	1.16	1.16	0.5	4.0	8.0	Q2
SN74AUP1G57YFPR	DSBGA	YFP	6	3000	178.0	9.2	0.89	1.29	0.62	4.0	8.0	Q1
SN74AUP1G57YZPR	DSBGA	YZP	6	3000	178.0	9.2	1.02	1.52	0.63	4.0	8.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

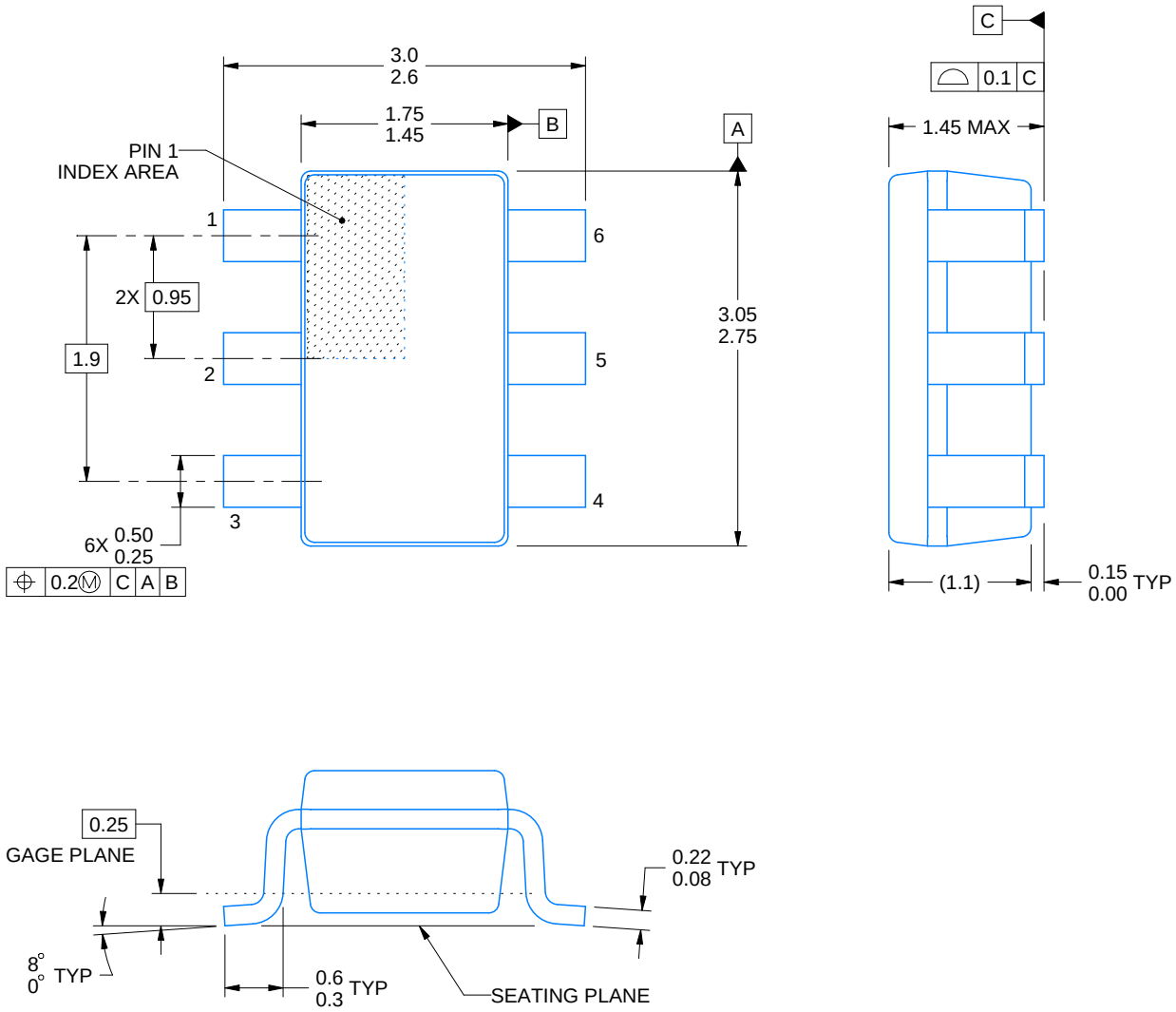
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74AUP1G57DBVR	SOT-23	DBV	6	3000	202.0	201.0	28.0
SN74AUP1G57DBVT	SOT-23	DBV	6	250	202.0	201.0	28.0
SN74AUP1G57DCKR	SC70	DCK	6	3000	202.0	201.0	28.0
SN74AUP1G57DCKT	SC70	DCK	6	250	202.0	201.0	28.0
SN74AUP1G57DRLR	SOT-5X3	DRL	6	4000	202.0	201.0	28.0
SN74AUP1G57DRLR	SOT-5X3	DRL	6	4000	184.0	184.0	19.0
SN74AUP1G57DRYR	SON	DRY	6	5000	184.0	184.0	19.0
SN74AUP1G57DSFR	SON	DSF	6	5000	184.0	184.0	19.0
SN74AUP1G57YFPR	DSBGA	YFP	6	3000	220.0	220.0	35.0
SN74AUP1G57YZPR	DSBGA	YZP	6	3000	220.0	220.0	35.0

PACKAGE OUTLINE

DBV0006A

SOT-23 - 1.45 mm max height

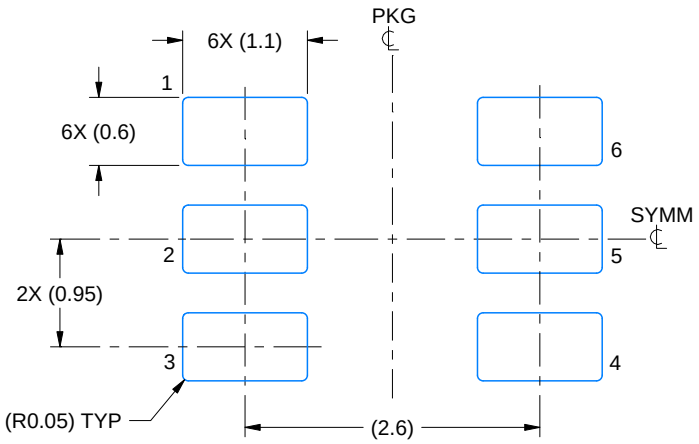
SMALL OUTLINE TRANSISTOR



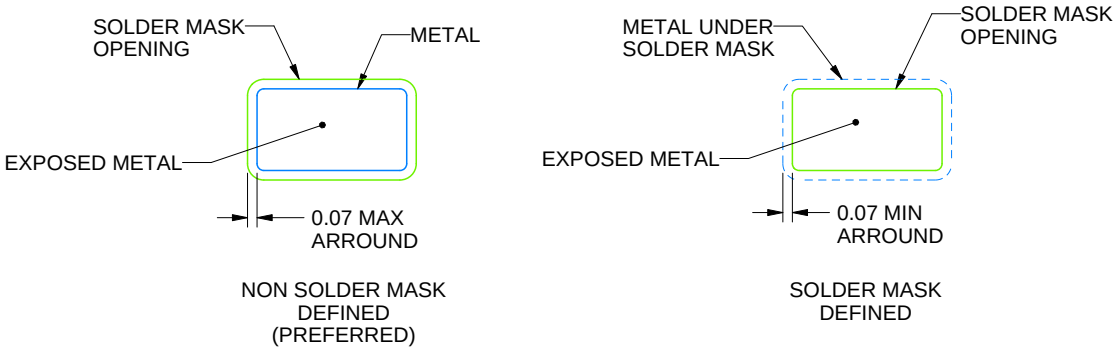
4214840/B 03/2018

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. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
4. Leads 1,2,3 may be wider than leads 4,5,6 for package orientation.
5. Refernce JEDEC MO-178.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:15X

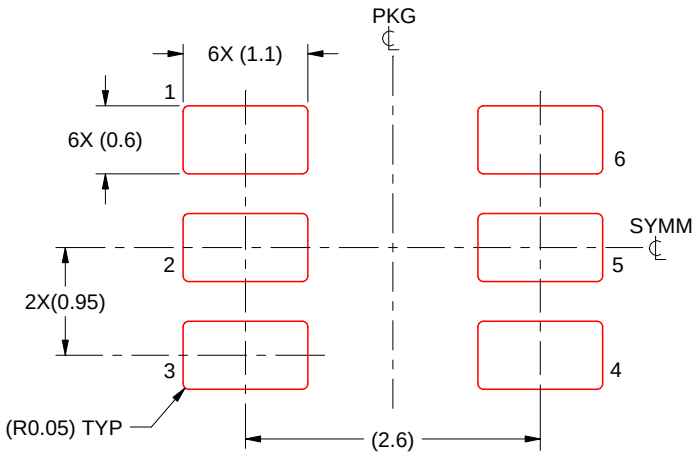


SOLDER MASK DETAILS

4214840/B 03/2018

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.



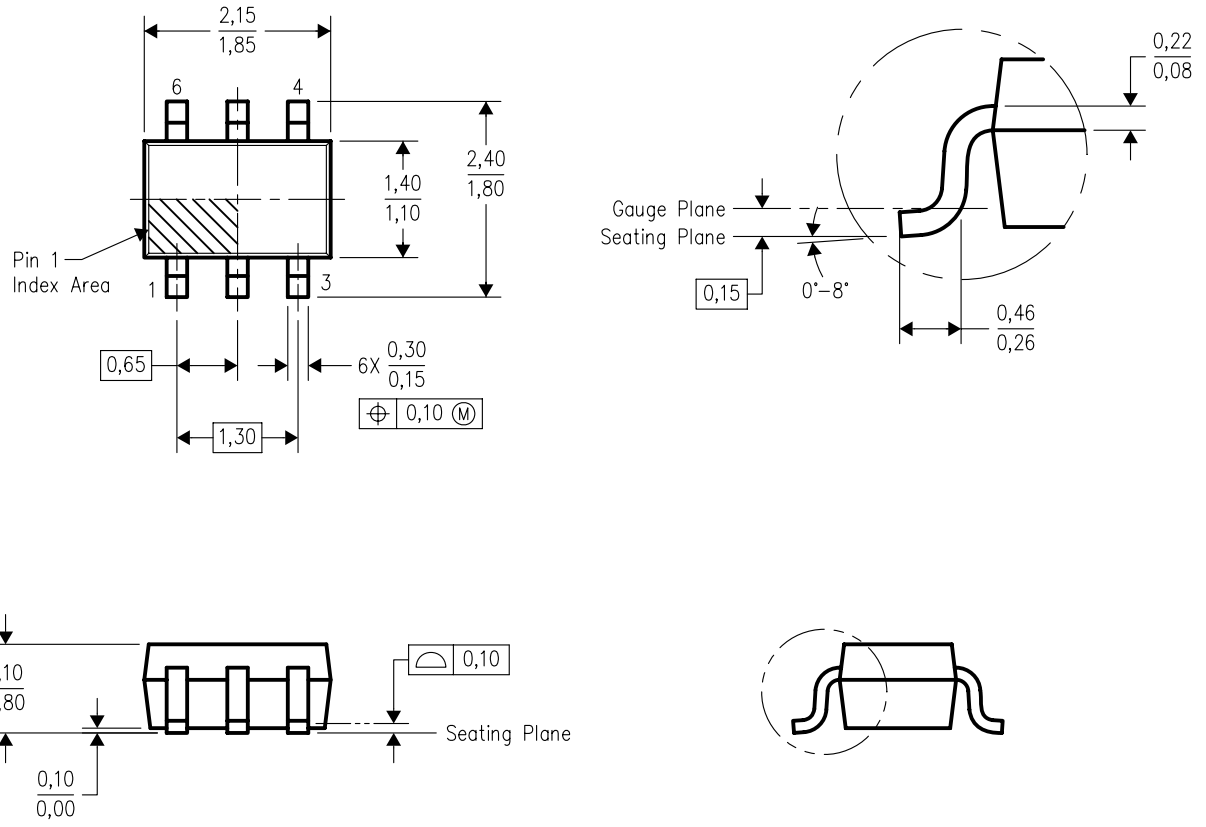
SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:15X

4214840/B 03/2018

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.

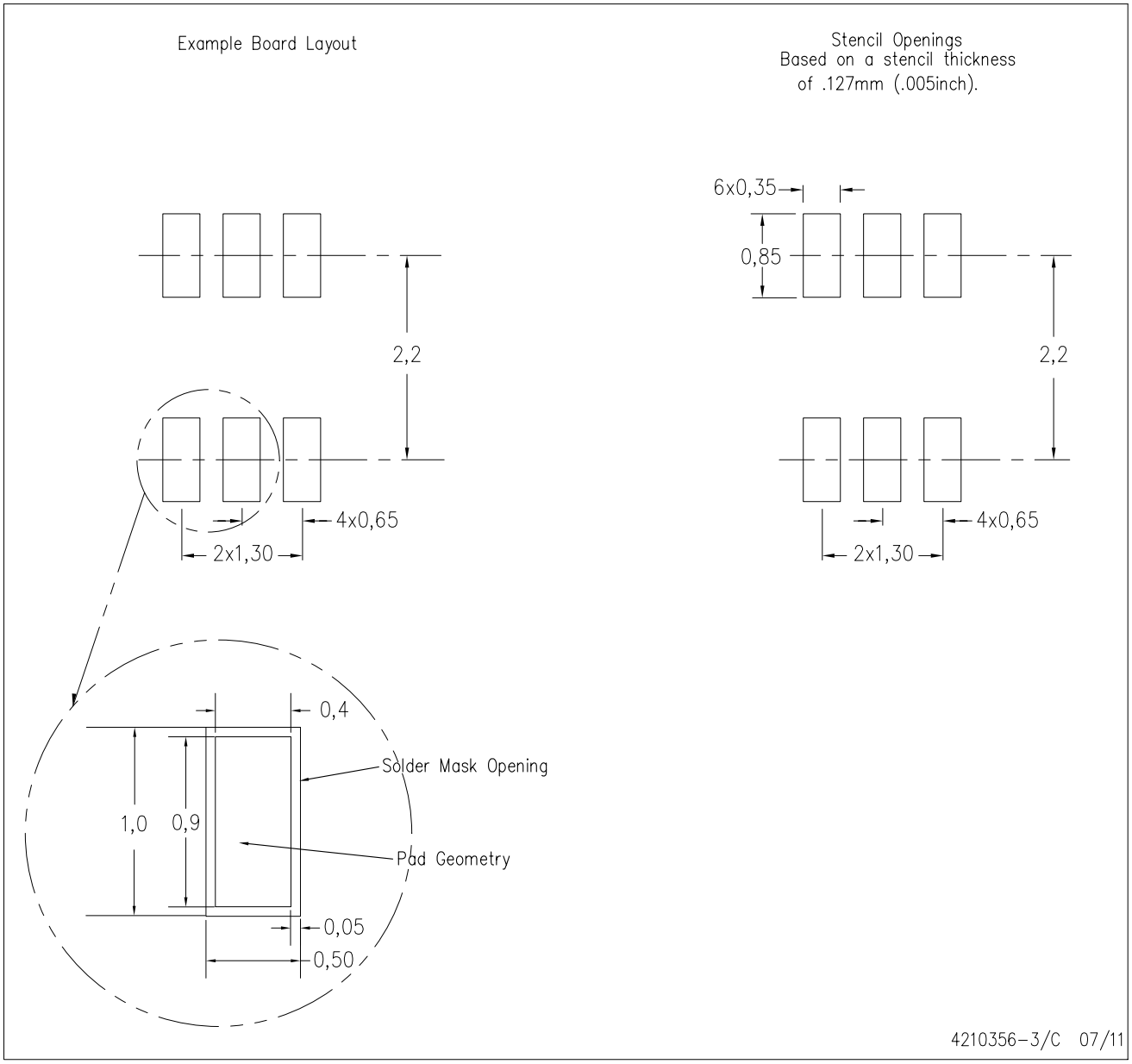
DCK (R–PDSO–G6) PLASTIC SMALL–OUTLINE PACKAGE



4093553–4/G 01/2007

NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
D. Falls within JEDEC MO–203 variation AB.

DCK (R–PDSO–G6) PLASTIC SMALL OUTLINE



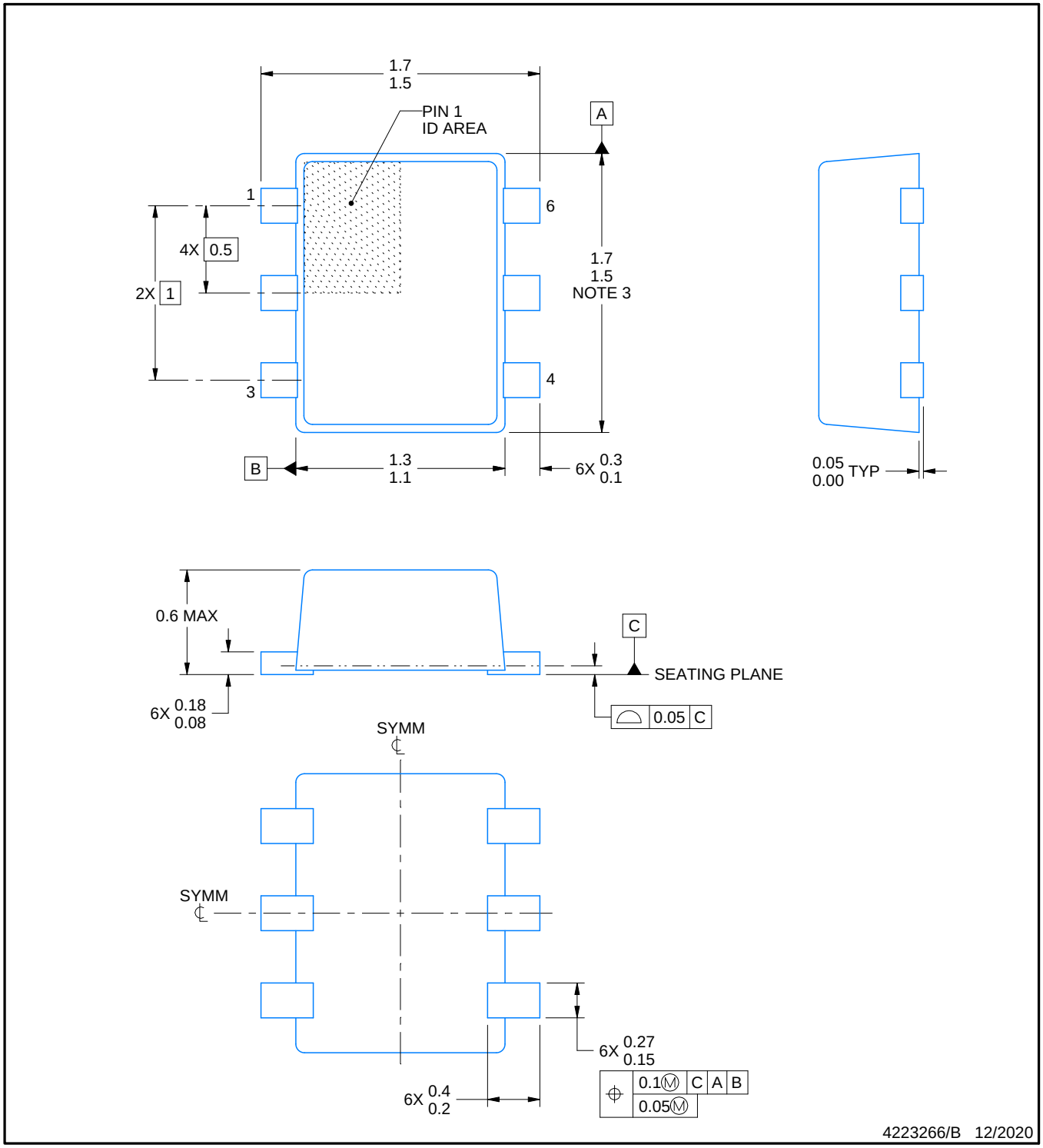
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
D. Publication IPC–7351 is recommended for alternate designs.
E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC–7525 for other stencil recommendations.

PACKAGE OUTLINE

DRL0006A

SOT - 0.6 mm max height

PLASTIC SMALL OUTLINE



NOTES:

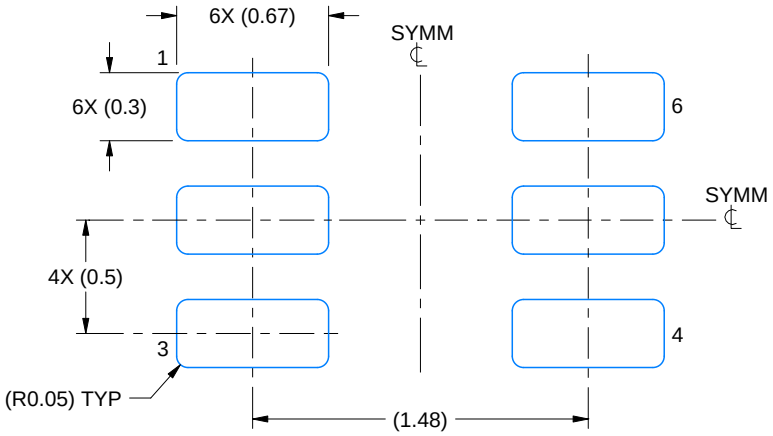
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. Reference JEDEC registration MO-293 Variation UAAD

EXAMPLE BOARD LAYOUT

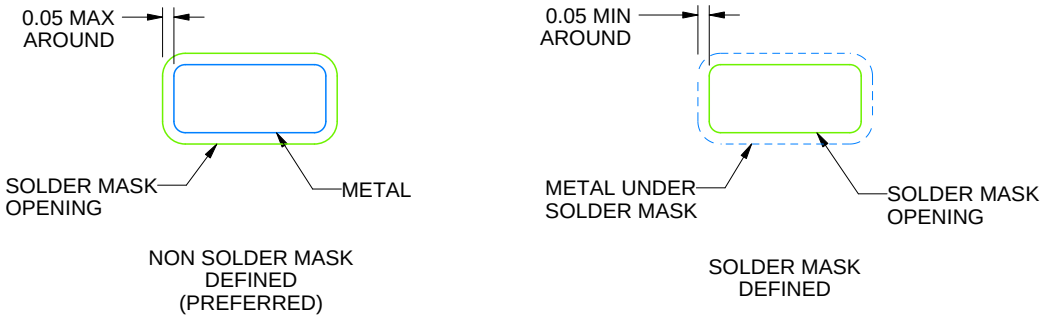
DRL0006A

SOT - 0.6 mm max height

PLASTIC SMALL OUTLINE



LAND PATTERN EXAMPLE
SCALE:30X

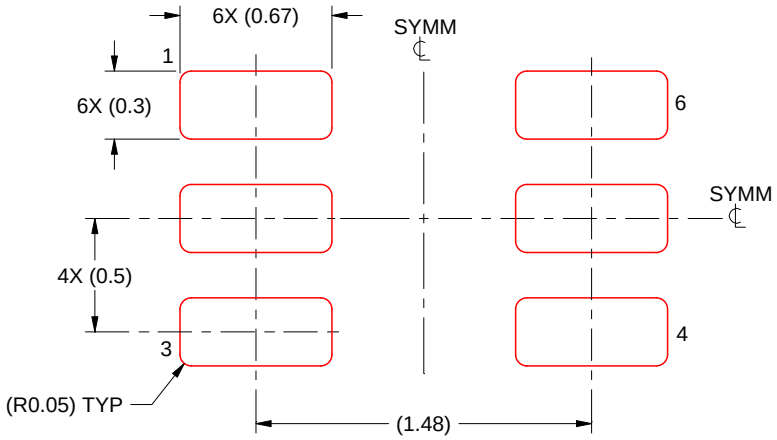


SOLDERMASK DETAILS

4223266/B 12/2020

NOTES: (continued)

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



SOLDER PASTE EXAMPLE
BASED ON 0.1 mm THICK STENCIL
SCALE:30X

4223266/B 12/2020

NOTES: (continued)

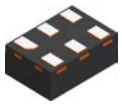
7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
8. Board assembly site may have different recommendations for stencil design.

DRY 6 USON - 0.6 mm max height

PLASTIC SMALL OUTLINE - NO LEAD

Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

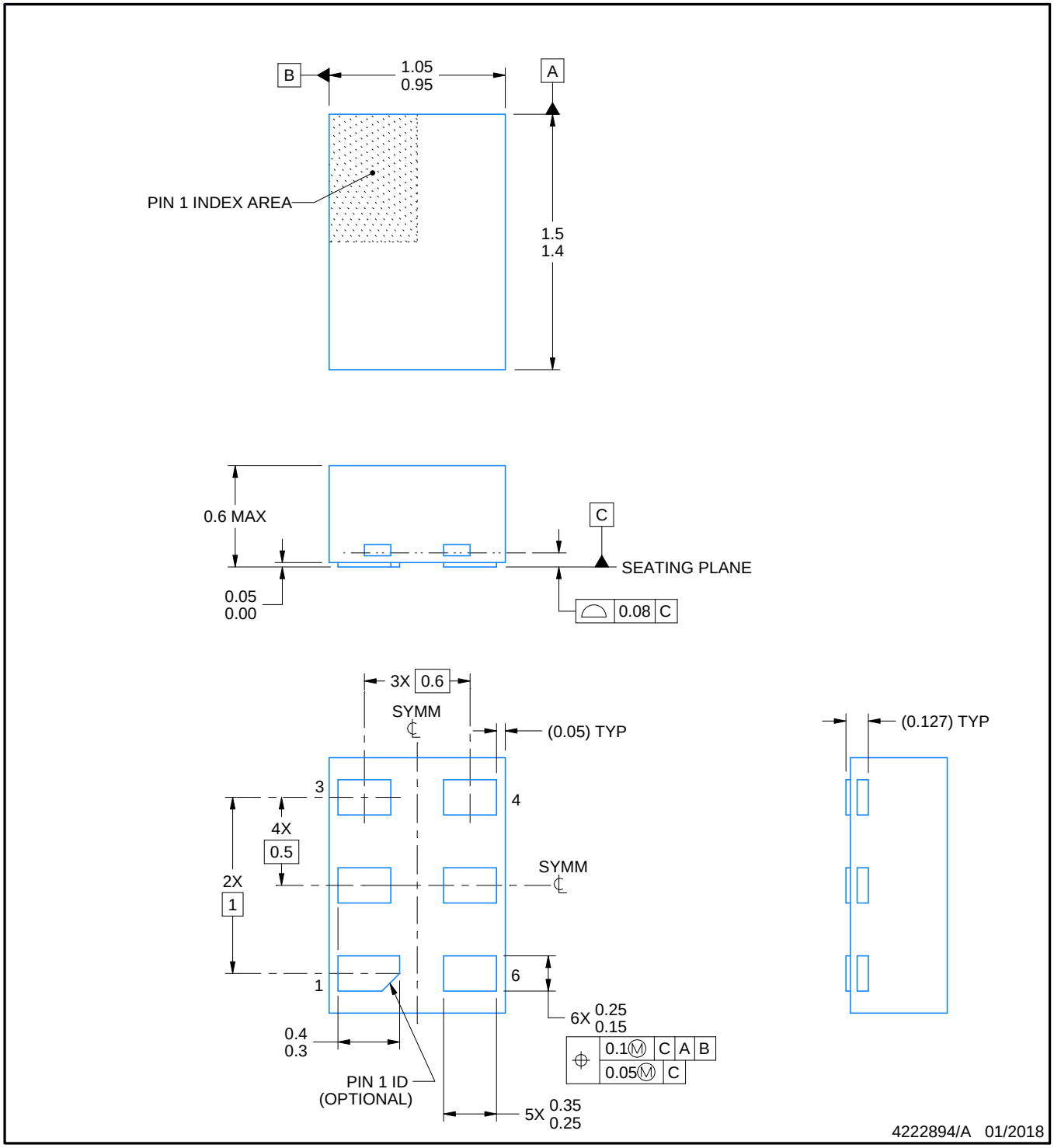
DRY0006A



PACKAGE OUTLINE

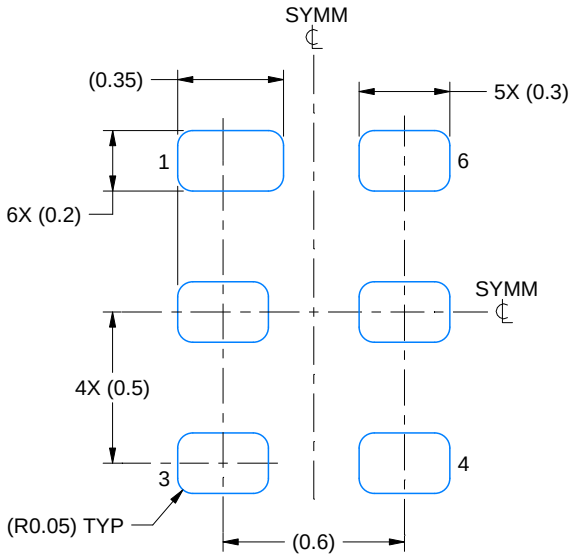
USON - 0.6 mm max height

PLASTIC SMALL OUTLINE - NO LEAD

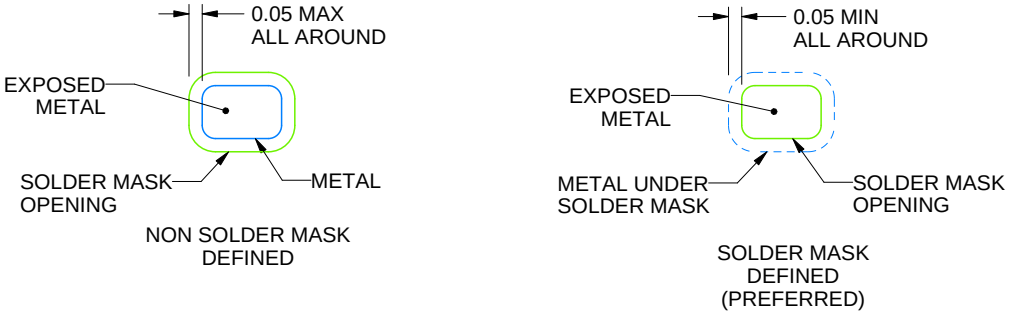


NOTES:

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.



LAND PATTERN EXAMPLE
1:1 RATIO WITH PKG SOLDER PADS
EXPOSED METAL SHOWN
SCALE:40X



SOLDER MASK DETAILS

4222894/A 01/2018

NOTES: (continued)

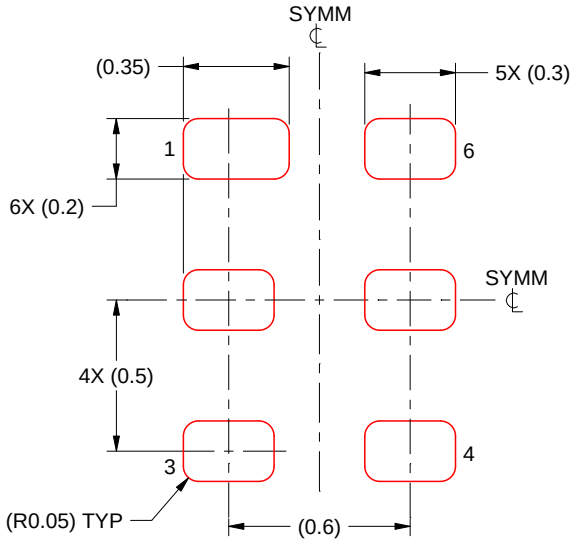
3. For more information, see QFN/SON PCB application report in literature No. SLUA271 (www.ti.com/lit/slua271).

EXAMPLE STENCIL DESIGN

DRY0006A

USON - 0.6 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.075 - 0.1 mm THICK STENCIL
SCALE:40X

4222894/A 01/2018

NOTES: (continued)

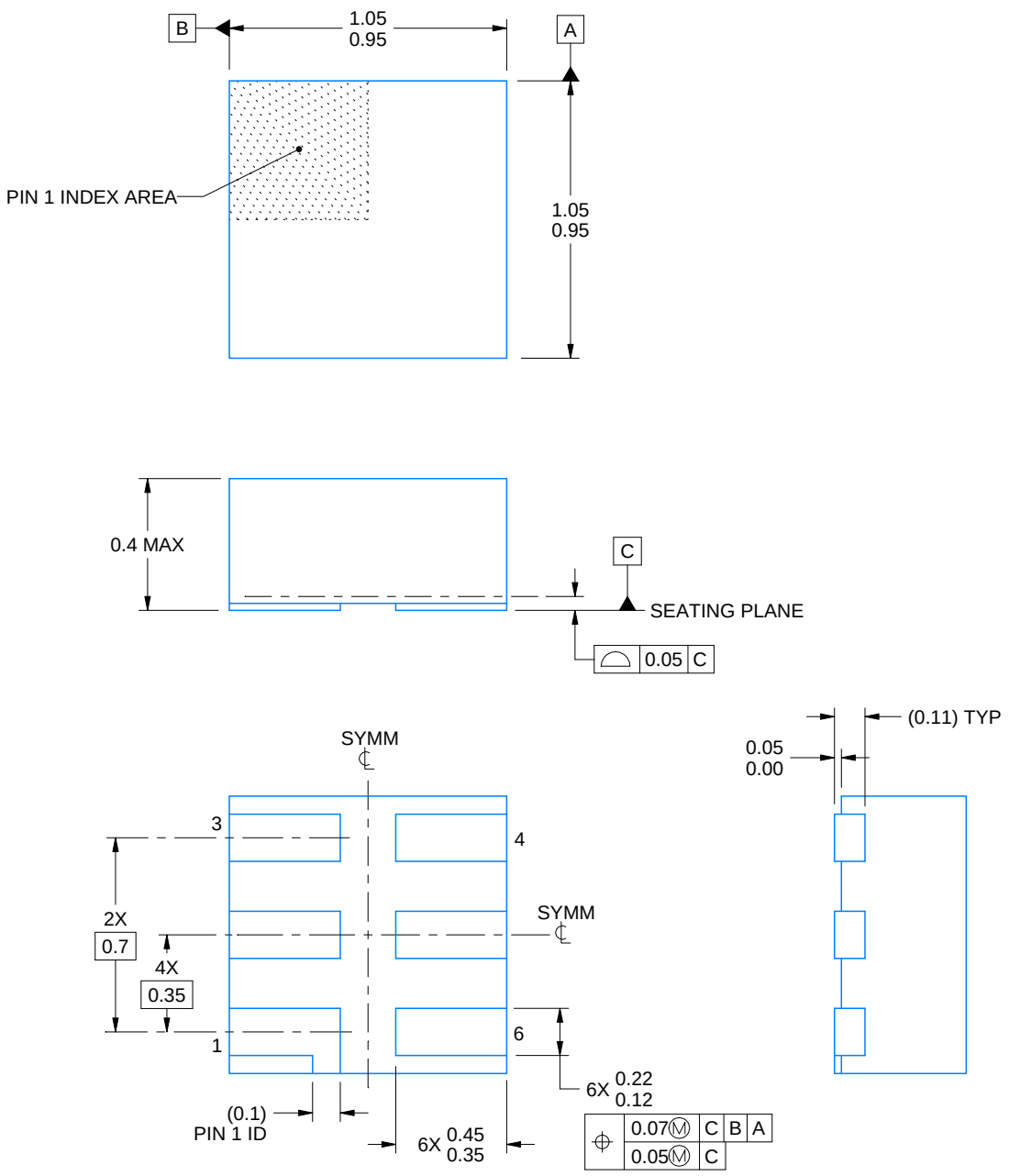
4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

PACKAGE OUTLINE

DSF0006A

X2SON - 0.4 mm max height

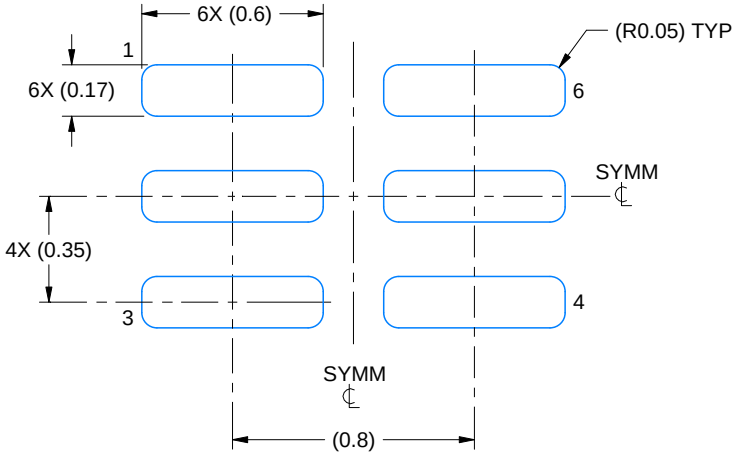
PLASTIC SMALL OUTLINE - NO LEAD



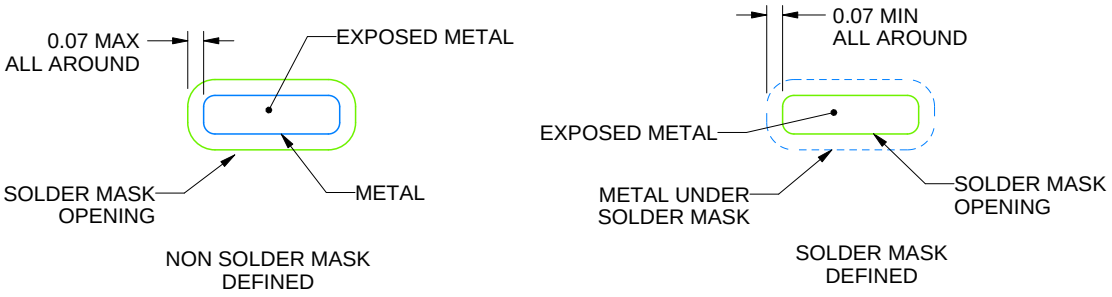
4220597/A 06/2017

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. Reference JEDEC registration MO-287, variation X2AAF.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:40X



SOLDER MASK DETAILS

4220597/A 06/2017

NOTES: (continued)

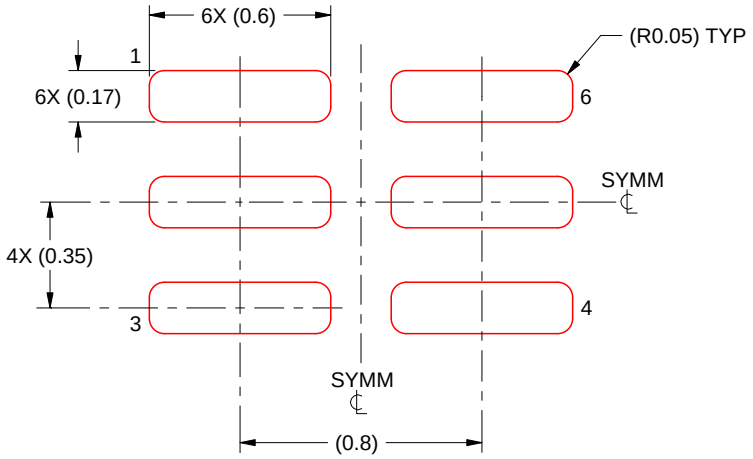
4. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).

EXAMPLE STENCIL DESIGN

DSF0006A

X2SON - 0.4 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE
SCALE:40X

4220597/A 06/2017

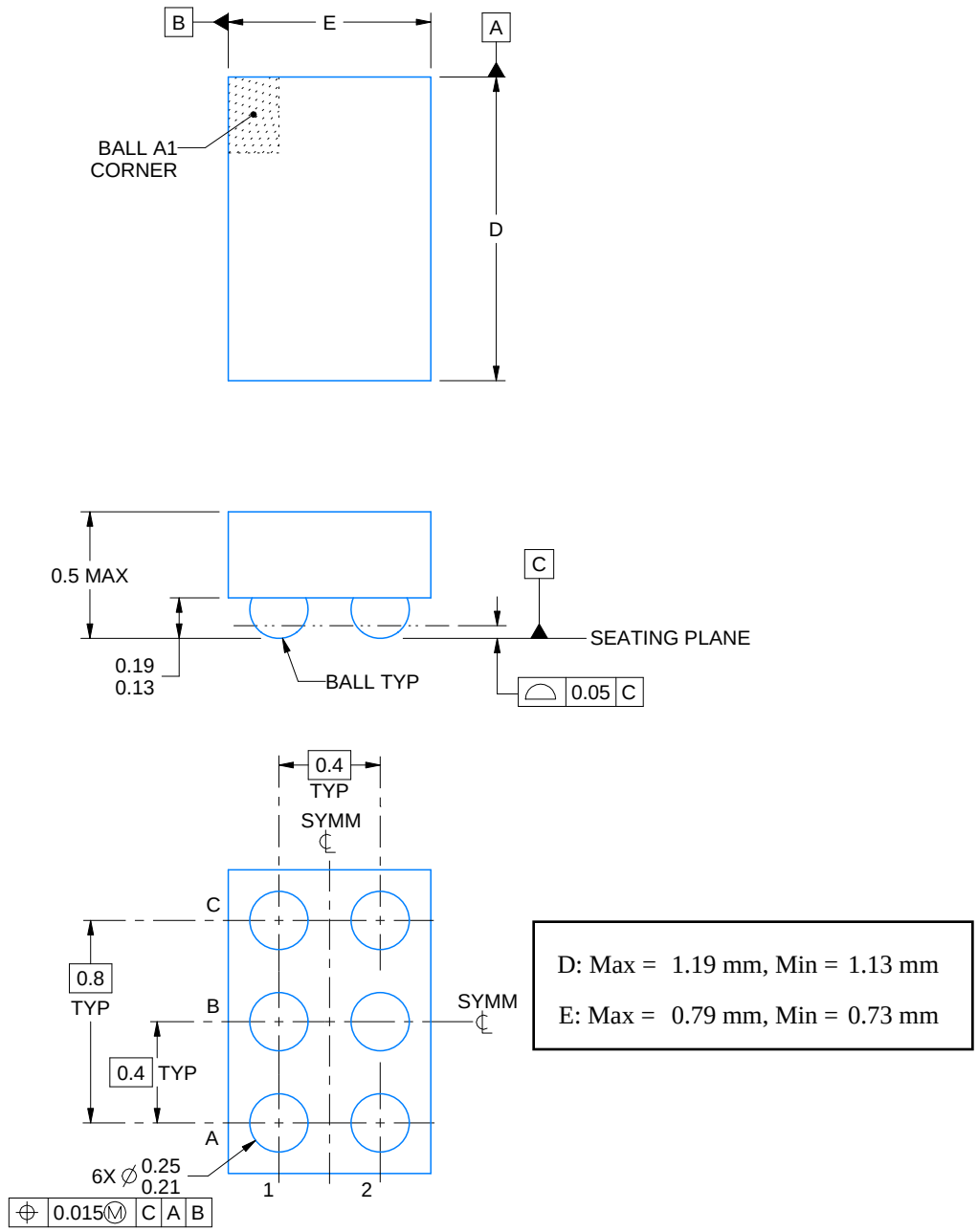
4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

PACKAGE OUTLINE

YFP0006

DSBGA - 0.5 mm max height

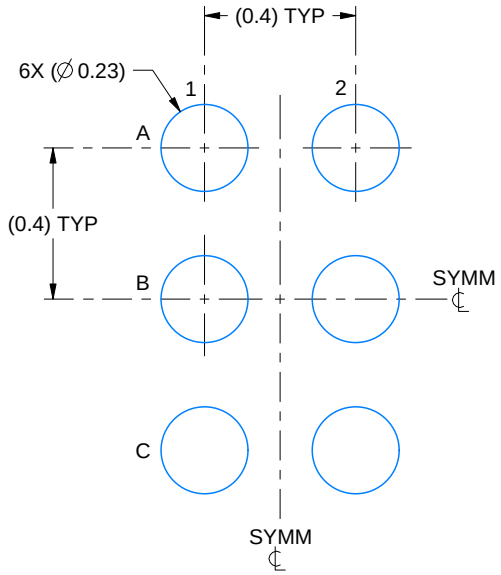
DIE SIZE BALL GRID ARRAY



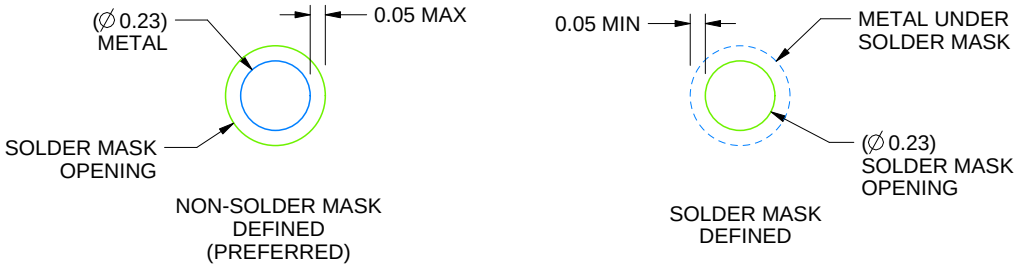
4223410/A 11/2016

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.



LAND PATTERN EXAMPLE
SCALE:50X

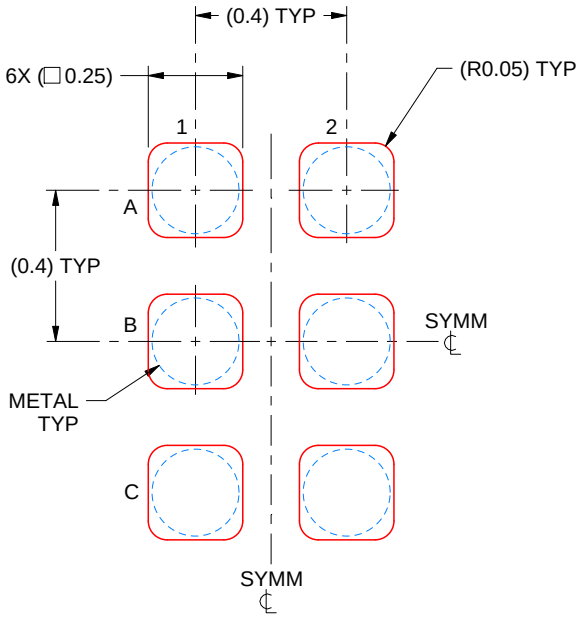


SOLDER MASK DETAILS
NOT TO SCALE

4223410/A 11/2016

NOTES: (continued)

3. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints.
   For more information, see Texas Instruments literature number SNVA009 (www.ti.com/lit/snva009).



SOLDER PASTE EXAMPLE
BASED ON 0.1 mm THICK STENCIL
SCALE:50X

4223410/A 11/2016

NOTES: (continued)

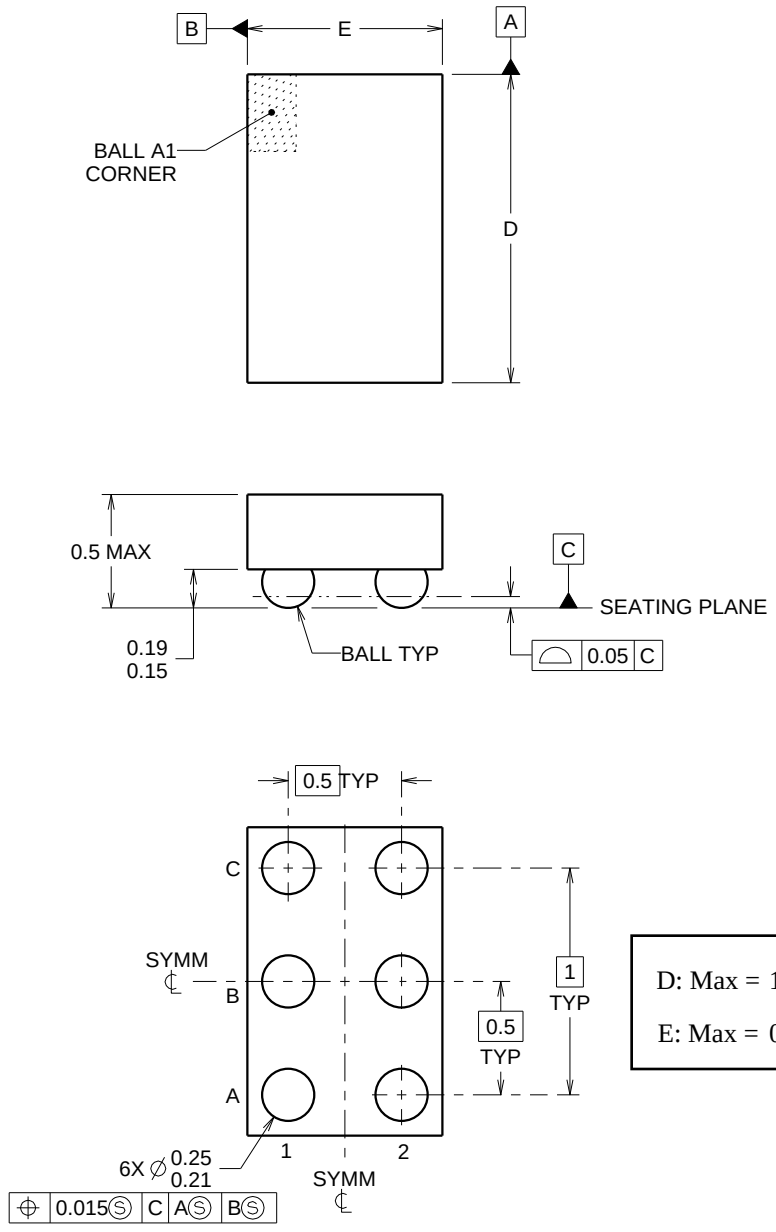
4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release.

PACKAGE OUTLINE

YZP0006

DSBGA - 0.5 mm max height

DIE SIZE BALL GRID ARRAY



D: Max = 1.418 mm, Min =1.358 mm

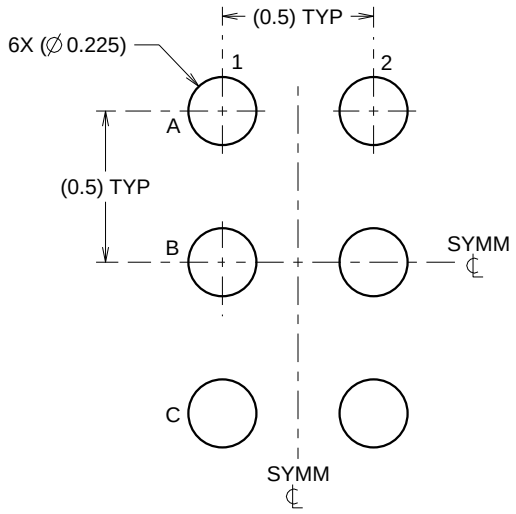
E: Max = 0.918 mm, Min =0.858 mm

4219524/A 06/2014

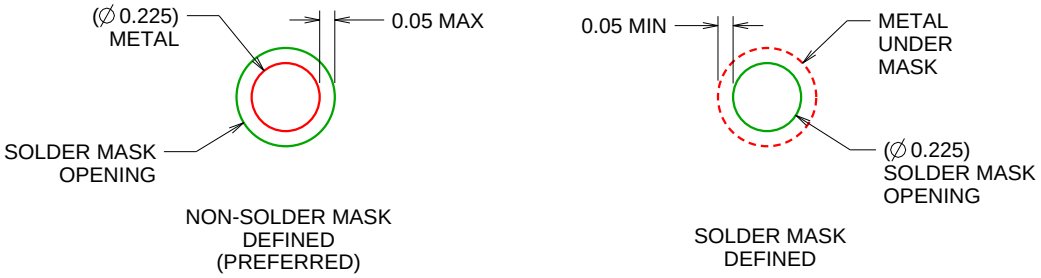
NOTES:

NanoFree 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. NanoFree™ package configuration.



LAND PATTERN EXAMPLE
SCALE:40X

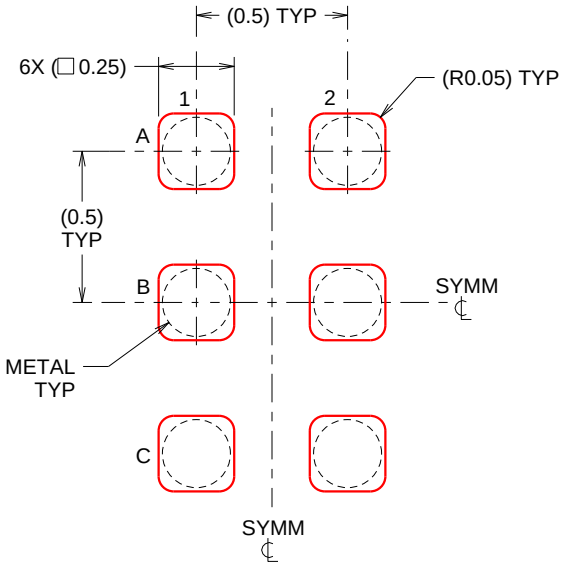


SOLDER MASK DETAILS
NOT TO SCALE

4219524/A 06/2014

NOTES: (continued)

4. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. For more information, see Texas Instruments literature number SBVA017 (www.ti.com/lit/sbva017).



SOLDER PASTE EXAMPLE
BASED ON 0.1 mm THICK STENCIL
SCALE:40X

4219524/A 06/2014

NOTES: (continued)

5. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release.

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