

# SN74AHCT1G125-Q1 Automotive Single Bus Buffer Gate with 3-State Output

## 1 Features

- Qualified for automotive applications
- Operating range of 3 V to 5.5 V
- Max  $t_{pd}$  of 6 ns at 5 V
- Low power consumption, 10- $\mu$ A Max  $I_{CC}$
- $\pm 8$ -mA output drive at 5 V
- Inputs are TTL-Voltage compatible

## 2 Applications

- [Enable or disable a digital signal](#)
- [Controlling an indicator LED](#)
- [Translation between communication modules and system controllers](#)

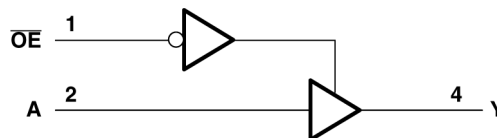
## 3 Description

The SN74AHCT1G125-Q1 is a single bus buffer gate/line driver with 3-state output. The output is disabled when the output-enable ( $\overline{OE}$ ) input is high. When  $\overline{OE}$  is low, true data is passed from the A input to the Y output.

### Package Information

PART NUMBER	PACKAGE <sup>(1)</sup>	PACKAGE SIZE <sup>(2)</sup>	BODY SIZE <sup>(3)</sup>
SN74AHCT1G125-Q1	DBV (SOT-23, 5)	2.8 mm × 2.8 mm	2.9 mm × 1.6 mm
	DCK (SC70, 5)	2.0 mm × 2.1 mm	2 mm × 1.25 mm
	DTX (X2SON, 5)	1.1 mm × 0.85	0.85 mm × 1.1 mm

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



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## 4 Revision History

Changes from Revision C (July 2023) to Revision D (October 2023)	Page
• Added <i>Applications</i> section.....	1
• Added DBV and DTX packages to <i>Package Information</i> table.....	1
• Added DBV and DTX packages to <i>Pin Configuration and Functions</i> section.....	3
• Updated R $\theta$ JA values: DBV = 278.0, DTX = 184.7, all values in °C/W .....	5
• Added <i>Application and Implementation</i> section.....	9

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Changes from Revision B (January 2008) to Revision C (July 2023)	Page
• Added <i>Package Information</i> table, <i>Pin Functions</i> table, <i>ESD Ratings</i> table, <i>Thermal Information</i> table, <i>Device Functional Modes</i> , <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section.....	1
• Updated thermal values for DCK package from R $\theta$ JA = 252 to 293.4, all values in °C/W .....	5

## 5 Pin Configuration and Functions

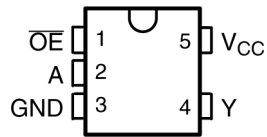


Figure 5-1. DBV Package, 5-Pin SOT-23; DCK Package (Top View)



Figure 5-2. DTX Package, 5-Pin X2SON (Top View)

Table 5-1. Pin Functions

PIN		TYPE <sup>(1)</sup>	DESCRIPTION
NO.	NAME		
1	$\overline{OE}$	I	Output Enable
2	A	I	Input A
3	GND	—	Ground Pin
4	Y	O	Output Y
5	V <sub>CC</sub>	—	Power Pin

(1) Signal Types: I = Input, O = Output, I/O = Input or Output

## 6 Specifications

### 6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

		MIN	MAX	UNIT
V <sub>CC</sub>	Supply voltage range	-0.5	7	V
V <sub>I</sub> <sup>(2)</sup>	Input voltage range	-0.5	7	V
V <sub>O</sub> <sup>(2)</sup>	Output voltage range	-0.5	V <sub>CC</sub> + 0.5	V
I <sub>IK</sub>	Input clamp current	(V <sub>I</sub> < 0)	-20	mA
I <sub>OK</sub>	Output clamp current	(V <sub>O</sub> < 0 or V <sub>O</sub> > V <sub>CC</sub> )	±20	mA
I <sub>O</sub>	Continuous output current	(V <sub>O</sub> = 0 to V <sub>CC</sub> )	±25	mA
	Continuous current through V <sub>CC</sub> or GND		±50	mA
T <sub>stg</sub>	Storage temperature range	-65	150	°C

- (1) Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

### 6.2 ESD Ratings

		VALUE	UNIT
V <sub>(ESD)</sub>	Electrostatic discharge	Human body model (HBM), per AEC Q100-002 <sup>(1)</sup>	±2000 V

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

### 6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

		MIN	MAX	UNIT
V <sub>CC</sub>	Supply voltage	3	5.5	V
V <sub>IH</sub>	High-level input voltage	V <sub>CC</sub> = 3.0 V	1.4	V
		V <sub>CC</sub> = 4.5 V to 5.5 V	2	
V <sub>IL</sub>	Low-level input voltage	V <sub>CC</sub> = 3.0 V	0.53	V
		V <sub>CC</sub> = 4.5 V to 5.5 V	0.8	
V <sub>I</sub>	Input voltage	0	5.5	V
V <sub>O</sub>	Output voltage	0	V <sub>CC</sub>	V
I <sub>OH</sub>	High-level output current		-8	mA
I <sub>OL</sub>	Low-level output current		8	mA
Δt/Δv	Input transition rise or fall rate		20	ns/V
T <sub>A</sub>	Operating free-air temperature	-40	125	°C

- (1) All unused inputs of the device must be held at V<sub>CC</sub> or GND for specified device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

## 6.4 Thermal Information

THERMAL METRIC <sup>(1)</sup>	SN74AHCT1G125-Q1			UNIT
	DBV (SOT-23)	DCK (SC-70)	DTX (X2SON)	
	5	5	5	
R <sub>θJA</sub> Junction-to-ambient thermal resistance	278.0	293.4	184.7	°C/W

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

## 6.5 Electrical Characteristics

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

PARAMETER	TEST CONDITIONS	V <sub>CC</sub>	T <sub>A</sub> = 25°C			MIN	MAX	UNIT
			MIN	TYP	MAX			
V <sub>OH</sub>	I <sub>OH</sub> = -50 μA	3 V	2.9	3		2.9	V	
		4.5 V	4.4	4.5		4.4		
	I <sub>OH</sub> = -4 mA	3 V	2.58			2.34		
		4.5 V	3.94			3.66		
V <sub>OL</sub>	I <sub>OL</sub> = 50 μA	3 V and 4.5 V	0.1			0.1	V	
	I <sub>OL</sub> = 4 mA	3 V	0.36			0.52		
	I <sub>OL</sub> = 8 mA	4.5 V	0.36			0.52		
I <sub>I</sub>	V <sub>I</sub> = 5.5 V or GND	0 V to 5.5 V	±0.1			±1	μA	
I <sub>OZ</sub>	V <sub>O</sub> = V <sub>CC</sub> or GND	5.5 V	±0.25			±2.5	μA	
I <sub>CC</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0, $\overline{OE}$ high or low	3 V and 5.5 V	1			10	μA	
ΔI <sub>CC</sub> <sup>(1)</sup>	One input at 3.4 V, Other input at V <sub>CC</sub> or GND	5.5 V	1.35			1.5	mA	
C <sub>i</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	5 V	4	10		10	pF	
C <sub>o</sub>	V <sub>O</sub> = V <sub>CC</sub> or GND	5 V	10				pF	

(1) This is the increase in supply current for each input at one of the specified TTL voltage levels, rather than 0 V or V<sub>CC</sub>.

## 6.6 Switching Characteristics, $V_{CC} = 3\text{ V} \pm 0.3\text{ V}$

over recommended operating free-air temperature range,  $V_{CC} = 3\text{ V} \pm 0.3\text{ V}$  (unless otherwise noted) (see [Load Circuit and Voltage Waveforms](#))

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	$T_A = 25^\circ\text{C}$			MIN	MAX	UNIT
				MIN	TYP	MAX			
$t_{PLH}$	A	Y	$C_L = 15\text{ pF}$		5.6	8		12	ns
$t_{PHL}$					5.6	8		12	
$t_{PZH}$	$\overline{OE}$	Y	$C_L = 15\text{ pF}$		5.4	8		11.5	ns
$t_{PZL}$					5.4	8		11.5	
$t_{PHZ}$	$\overline{OE}$	Y	$C_L = 15\text{ pF}$		6.5	9.7		14.5	ns
$t_{PLZ}$					6.5	9.7		14.5	
$t_{PLH}$	A	Y	$C_L = 50\text{ pF}$		8.1	11.5		16	ns
$t_{PHL}$					8.1	11.5		16	
$t_{PZH}$	$\overline{OE}$	Y	$C_L = 50\text{ pF}$		7.9	11.5		15	ns
$t_{PZL}$					7.9	11.5		15	
$t_{PHZ}$	$\overline{OE}$	Y	$C_L = 50\text{ pF}$		8	13.2		18	ns
$t_{PLZ}$					8	13.2		18	

## 6.7 Switching Characteristics, $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$

over recommended operating free-air temperature range,  $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$  (unless otherwise noted) (see [Load Circuit and Voltage Waveforms](#))

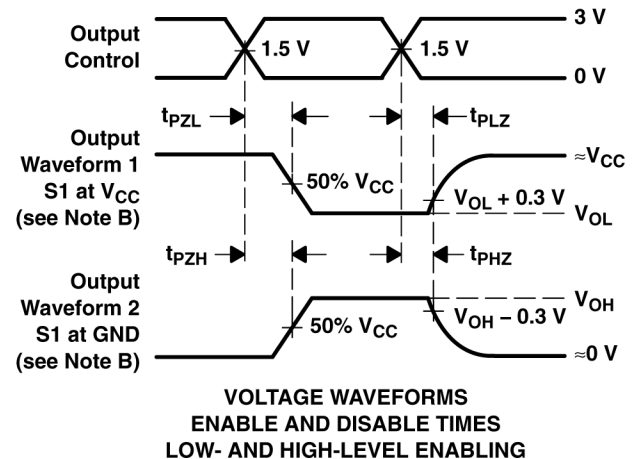
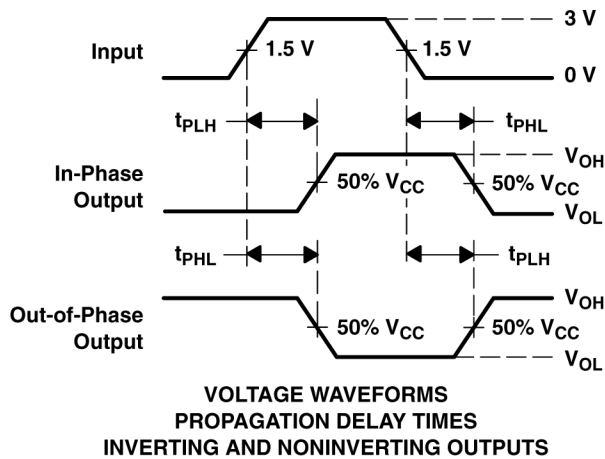
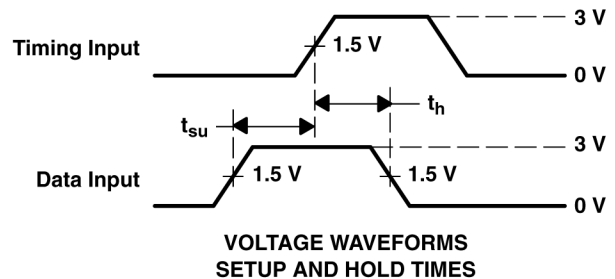
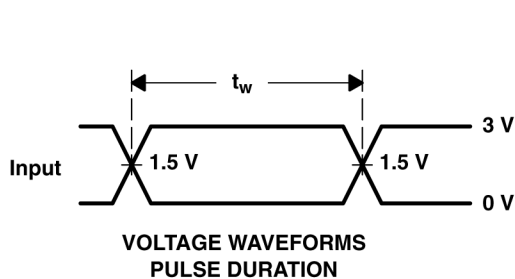
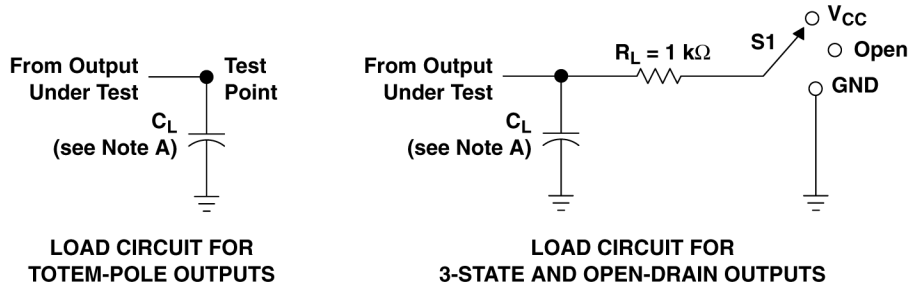
PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	$T_A = 25^\circ\text{C}$			MIN	MAX	UNIT
				MIN	TYP	MAX			
$t_{PLH}$	A	Y	$C_L = 15\text{ pF}$		3.8	5.5		8.5	ns
$t_{PHL}$					3.8	5.5		8.5	
$t_{PZH}$	$\overline{OE}$	Y	$C_L = 15\text{ pF}$		3.6	5.1		7.5	ns
$t_{PZL}$					3.6	5.1		7.5	
$t_{PHZ}$	$\overline{OE}$	Y	$C_L = 15\text{ pF}$		4.8	6.8		10	ns
$t_{PLZ}$					4.8	6.8		10	
$t_{PLH}$	A	Y	$C_L = 50\text{ pF}$		5.3	7.5		10.5	ns
$t_{PHL}$					5.3	7.5		10.5	
$t_{PZH}$	$\overline{OE}$	Y	$C_L = 50\text{ pF}$		5.1	7.1		9.5	ns
$t_{PZL}$					5.1	7.1		9.5	
$t_{PHZ}$	$\overline{OE}$	Y	$C_L = 50\text{ pF}$		7	8.8		12	ns
$t_{PLZ}$					7	8.8		12	

## 6.8 Operating Characteristics

$V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

PARAMETER	TEST CONDITIONS	TYP	UNIT
$C_{pd}$ Power dissipation capacitance	No load, $f = 1\text{ MHz}$	14	pF

## 7 Parameter Measurement Information



- 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:  $PRR \leq 1$  MHz,  $Z_O = 50 \Omega$ ,  $t_r \leq 3$  ns,  $t_f \leq 3$  ns.
- D. The outputs are measured one at a time with one input transition per measurement.
- E. All parameters and waveforms are not applicable to all devices.

**Figure 7-1. Load Circuit and Voltage Waveforms**

TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	$V_{CC}$
$t_{PHZ}/t_{PZH}$	GND
Open Drain	$V_{CC}$

## 8 Detailed Description

### 8.1 Overview

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

### 8.2 Functional Block Diagram

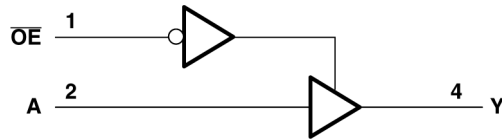


Figure 8-1. Logic Diagram (Positive Logic)

### 8.3 Device Functional Modes

Table 8-1. Function Table

INPUTS		OUTPUT
$\overline{OE}$	A	Y
L	H	H
L	L	L
H	X	Z



## 9 Application and Implementation

### Note

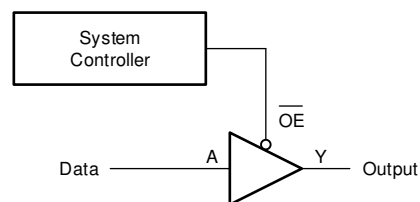
Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes, as well as validating and testing their design implementation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

### 9.1 Application Information

In this application, three 2-input AND gates are combined to produce a 4-input AND gate function as shown in [Figure 9-1](#). The fourth gate can be used for another application in the system, or the inputs can be grounded and the channel left unused.

The SN74AHCT1G125-Q1 is used to directly control the  $\overline{\text{RESET}}$  pin of a motor controller. The controller requires four input signals to all be HIGH before being enabled, and should be disabled in the event that any one signal goes LOW. The 4-input AND gate function combines the four individual reset signals into a single active-low reset signal.

### 9.2 Typical Application



**Figure 9-1. Typical Application Block Diagram**

### 9.3 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. A 0.1- $\mu\text{F}$  capacitor is recommended for this device. It is acceptable to parallel multiple bypass capacitors to reject different frequencies of noise. The 0.1- $\mu\text{F}$  and 1- $\mu\text{F}$  capacitors are commonly used in parallel. The bypass capacitor should be installed as close to the power terminal as possible for best results, as shown in the following layout example.

### 9.4 Layout

#### 9.4.1 Layout Guidelines

When using multiple-input and multiple-channel logic devices, inputs must never be left floating. In many cases, functions or parts of functions of digital logic devices are unused (for example, when only two inputs of a triple-input AND gate are used or only 3 of the 4 buffer gates are used). Such unused input pins must not be left unconnected because the undefined voltages at the outside connections result in undefined operational states. All unused inputs of digital logic devices must be connected to a logic high or logic low voltage, as defined by the input voltage specifications, to prevent them from floating. The logic level that must be applied to any particular unused input depends on the function of the device. Generally, the inputs are tied to GND or  $V_{CC}$ , whichever makes more sense for the logic function or is more convenient.

### 9.4.2 Layout Example

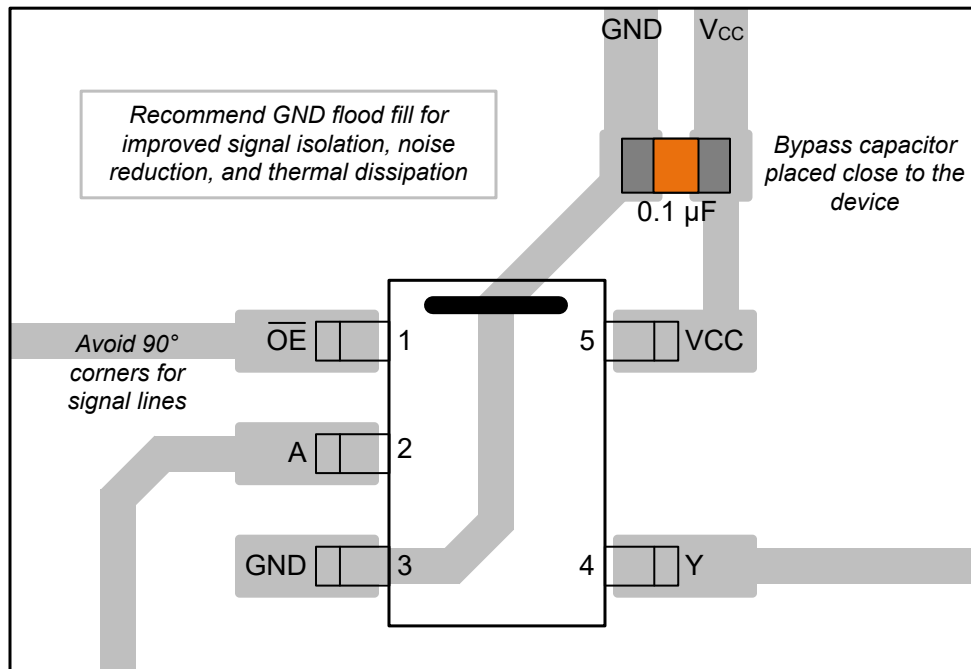


Figure 9-2. Example Layout for the SN74AHCT1G125-Q1

## 10 Device and Documentation Support

### 10.1 Documentation Support (Analog)

#### 10.1.1 Related Documentation

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

**Table 10-1. Related Links**

PARTS	PRODUCT FOLDER	SAMPLE & BUY	TECHNICAL DOCUMENTS	TOOLS & SOFTWARE	SUPPORT & COMMUNITY
SN74AHCT1G125-Q1	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>

#### 10.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](http://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.

#### 10.3 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.

Linked content is 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](#).

#### 10.4 Trademarks

TI E2E™ is a trademark of Texas Instruments.  
All trademarks are the property of their respective owners.

#### 10.5 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.

#### 10.6 Glossary

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

## 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 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
CAHCT1G125QDCKRG4Q	ACTIVE	SC70	DCK	5	3000	RoHS & Green	Call TI   NIPDAU	Level-1-260C-UNLIM	-40 to 125	BMS	Samples
CAHCT1G125QDCKRQ1	ACTIVE	SC70	DCK	5	3000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	BMS	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.

**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.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**OTHER QUALIFIED VERSIONS OF SN74AHCT1G125-Q1 :**

- Catalog : [SN74AHCT1G125](#)

## NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

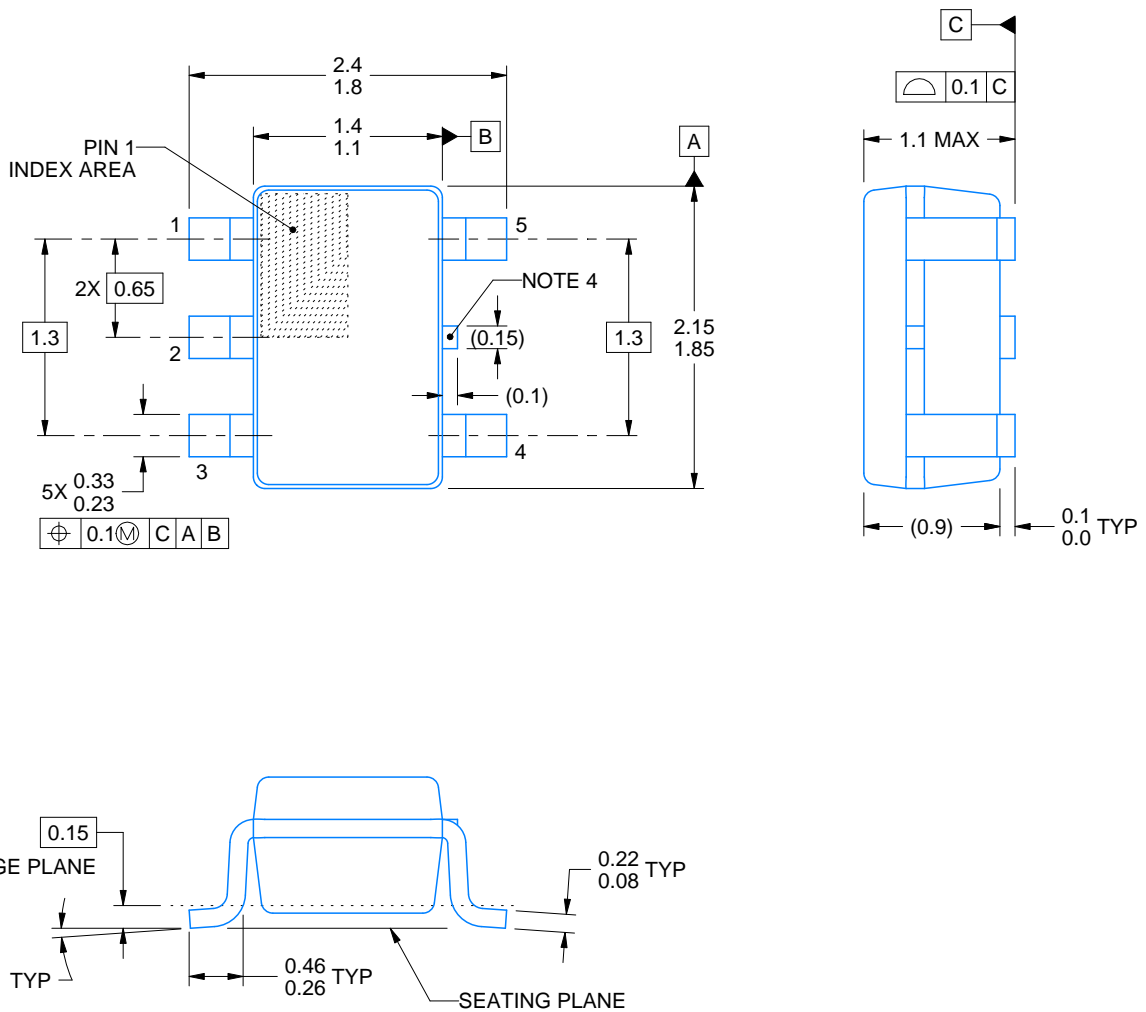
DCK0005A



# PACKAGE OUTLINE

SOT - 1.1 max height

SMALL OUTLINE TRANSISTOR



4214834/C 03/2023

NOTES:

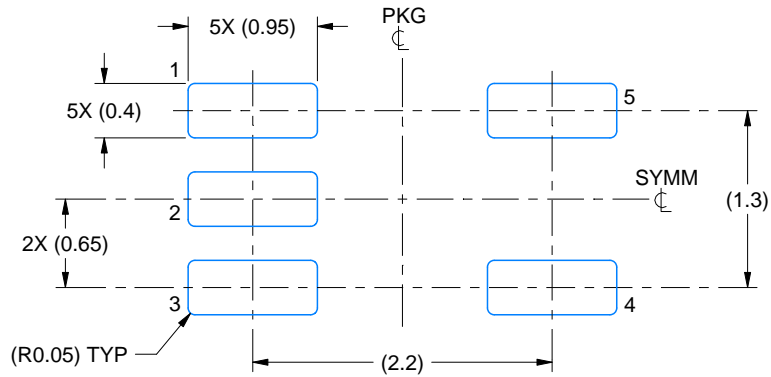
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC MO-203.
4. Support pin may differ or may not be present.

# EXAMPLE BOARD LAYOUT

DCK0005A

SOT - 1.1 max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:18X



SOLDER MASK DETAILS

4214834/C 03/2023

NOTES: (continued)

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

# EXAMPLE STENCIL DESIGN

DCK0005A

SOT - 1.1 max height

SMALL OUTLINE TRANSISTOR



SOLDER PASTE EXAMPLE  
BASED ON 0.125 THICK STENCIL  
SCALE:18X

4214834/C 03/2023

NOTES: (continued)

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



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