

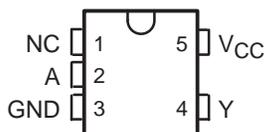
SN74AUP1G06

LOW-POWER SINGLE INVERTER BUFFER/DRIVER WITH OPEN-DRAIN OUTPUTS

SCES590 – JULY 2004

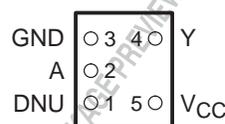
- Available in the Texas Instruments NanoStar™ and NanoFree™ Packages
- Low Static-Power Consumption; $I_{CC} = 0.9 \mu\text{A Max}$
- Low Dynamic-Power Consumption; $C_{pd} = 1 \text{ pF Typ at } 3.3 \text{ V}$
- Low Input Capacitance; $C_i = 1.5 \text{ pF Typ}$
- Low Noise – Overshoot and Undershoot $<10\%$ of V_{CC}
- I_{off} Supports Partial-Power-Down Mode Operation
- Input Hysteresis Allows Slow Input Transition and Better Switching Noise Immunity at the Input ($V_{hys} = 250 \text{ mV Typ at } 3.3 \text{ V}$)
- 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
- $t_{pd} = 3.6 \text{ ns Max at } 3.3 \text{ V}$
- 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)
 - 200-V Machine Model (A115-A)
 - 1000-V Charged-Device Model (C101)
- ESD Protection Exceeds $\pm 5000 \text{ V}$ With Human-Body Model

DBV OR DCK PACKAGE
(TOP VIEW)



NC – No internal connection

YEP OR YZP PACKAGE
(BOTTOM VIEW)



DNU – Do not use

description/ordering information

The AUP family is TI's premier solution to the industry's low power needs 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 (see Figures 1 and 2).

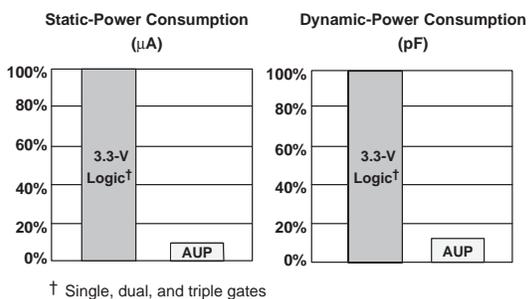


Figure 1. AUP – The Lowest-Power Family

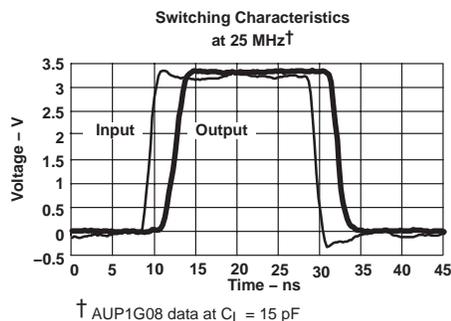


Figure 2. Excellent Signal Integrity

The output of this single inverter buffer/driver is open drain, and can be connected to other open-drain outputs to implement active-low wired-OR or active-high wired-AND functions.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

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LOW-POWER SINGLE INVERTER BUFFER/DRIVER WITH OPEN-DRAIN OUTPUTS

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description/ordering information (continued)

NanoStar™ and NanoFree™ 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.

ORDERING INFORMATION

TA	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING‡
-40°C to 85°C	NanoStar™ – WCSP (DSBGA) 0.23-mm Large Bump – YEP	Reel of 3000	SN74AUP1G06YEPR	___HT_
	NanoFree™ – WCSP (DSBGA) 0.23-mm Large Bump – YZP (Pb-free)		SN74AUP1G06YZPR	
	SOT (SOT-23) – DBV	Reel of 3000	SN74AUP1G06DBVR	H06_
		Reel of 250	SN74AUP1G06DBVT	
	SOT (SC-70) – DCK	Reel of 3000	SN74AUP1G06DCKR	HT_
		Reel of 250	SN74AUP1G06DCKT	

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

‡ DBV/DCK: The actual top-side marking has one additional character that designates the assembly/test site.

YEP/YZP: The actual top-side marking has three preceding characters to denote year, month, and sequence code, and one following character to designate the assembly/test site. Pin 1 identifier indicates solder-bump composition (1 = SnPb, • = Pb-free).

FUNCTION TABLE

INPUT A	OUTPUT Y
H	L
L	H

logic diagram (positive logic)



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

Supply voltage range, V_{CC}	–0.5 V to 4.6 V
Input voltage range, V_I (see Note 1)	–0.5 V to 4.6 V
Voltage range applied to any output in the high-impedance or power-off state, V_O (see Note 1)	–0.5 V to 4.6 V
Output voltage range in the high or low state, V_O (see Note 1)	–0.5 V to $V_{CC} + 0.5$ V
Input clamp current, I_{IK} ($V_I < 0$)	–50 mA
Output clamp current, I_{OK} ($V_O < 0$)	–50 mA
Continuous output current, I_O	±20 mA
Continuous current through V_{CC} or GND	±50 mA
Package thermal impedance, θ_{JA} (see Note 2): DBV package	206°C/W
DCK package	252°C/W
YEP/YZP package	132°C/W
Storage temperature range, T_{stg}	–65°C to 150°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES: 1. The input negative-voltage and output voltage ratings may be exceeded if the input and output current ratings are observed.
2. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions (see Note 3)

		MIN	MAX	UNIT	
V_{CC}	Supply voltage	0.8	3.6	V	
V_{IH}	High-level input voltage	$V_{CC} = 0.8$ V	V_{CC}	V	
		$V_{CC} = 1.1$ V to 1.95 V	$0.65 \times V_{CC}$		
		$V_{CC} = 2.3$ V to 2.7 V	1.6		
		$V_{CC} = 3$ V to 3.6 V	2		
V_{IL}	Low-level input voltage	$V_{CC} = 0.8$ V	0	V	
		$V_{CC} = 1.1$ V to 1.95 V	$0.35 \times V_{CC}$		
		$V_{CC} = 2.3$ V to 2.7 V	0.7		
		$V_{CC} = 3$ V to 3.6 V	0.9		
V_I	Input voltage	0	3.6	V	
V_O	Output voltage	0	3.6	V	
I_{OL}^\ddagger	Low-level output current	$V_{CC} = 0.8$ V	20	mA	
		$V_{CC} = 1.1$ V	1.1		
		$V_{CC} = 1.4$ V	1.7		
		$V_{CC} = 1.65$ V	1.9		
		$V_{CC} = 2.3$ V	3.1		
		$V_{CC} = 3$ V	4		
$\Delta t/\Delta v$	Input transition rise or fall rate	$V_{CC} = 0.8$ V to 3.6 V		200	ns/V
T_A	Operating free-air temperature	–40	85	°C	

‡ Defined by the signal integrity requirements and design-goal priorities

NOTE 3: All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.



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electrical characteristics over recommended 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 _{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 A input	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
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, 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	1.7					
C _o	V _O = GND	0 V	1.7					pF

switching characteristics over recommended operating free-air temperature range, C_L = 5 pF (unless otherwise noted) (see Figures 3 and 4)

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}	A	Y	0.8 V	12.4					ns
			1.2 V ± 0.1 V	2.7	12	9.9	2	12.8	
			1.5 V ± 0.1 V	2.1	3.5	6.2	1.5	7.6	
			1.8 V ± 0.15 V	2.1	3.1	4.7	1.2	5.9	
			2.5 V ± 0.2 V	1.4	2.2	3.2	1	3.9	
			3.3 V ± 0.3 V	1.3	2.2	3.3	0.8	3.6	

switching characteristics over recommended operating free-air temperature range, C_L = 10 pF (unless otherwise noted) (see Figures 3 and 4)

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}	A	Y	0.8 V	15.1					ns
			1.2 V ± 0.1 V	3.6	12	11.2	2.7	14.1	
			1.5 V ± 0.1 V	2.9	4.3	7	2.2	8.6	
			1.8 V ± 0.15 V	2.7	3.9	5.4	1.8	6.7	
			2.5 V ± 0.2 V	2.1	2.9	3.8	1.4	4.5	
			3.3 V ± 0.3 V	1.7	3	4.5	1.2	4.9	



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LOW-POWER SINGLE INVERTER BUFFER/DRIVER WITH OPEN-DRAIN OUTPUTS

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switching characteristics over recommended operating free-air temperature range, $C_L = 15 \text{ pF}$ (unless otherwise noted) (see Figures 3 and 4)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC}	$T_A = 25^\circ\text{C}$			$T_A = -40^\circ\text{C}$ TO 85°C		UNIT
				MIN	TYP	MAX	MIN	MAX	
t_{pd}	A	Y	0.8 V	17.4					ns
			$1.2 \text{ V} \pm 0.1 \text{ V}$	4.9	12	12.2	3.4	15.2	
			$1.5 \text{ V} \pm 0.1 \text{ V}$	3.5	5	7.7	2.7	9.4	
			$1.8 \text{ V} \pm 0.15 \text{ V}$	3.2	4.8	6.6	2.2	7.3	
			$2.5 \text{ V} \pm 0.2 \text{ V}$	2.5	3.5	4.5	1.7	5.1	
			$3.3 \text{ V} \pm 0.3 \text{ V}$	2	3.8	6	1.5	6.5	

switching characteristics over recommended operating free-air temperature range, $C_L = 30 \text{ pF}$ (unless otherwise noted) (see Figures 3 and 4)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC}	$T_A = 25^\circ\text{C}$			$T_A = -40^\circ\text{C}$ TO 85°C		UNIT
				MIN	TYP	MAX	MIN	MAX	
t_{pd}	A	Y	0.8 V	25.3					ns
			$1.2 \text{ V} \pm 0.1 \text{ V}$	7.6	12	16	5.6	19.3	
			$1.5 \text{ V} \pm 0.1 \text{ V}$	5.9	7.6	10.1	4.3	12	
			$1.8 \text{ V} \pm 0.15 \text{ V}$	4.8	7.4	10.7	3.6	11	
			$2.5 \text{ V} \pm 0.2 \text{ V}$	3.7	5.4	7.1	2.8	7.8	
			$3.3 \text{ V} \pm 0.3 \text{ V}$	3.2	6.5	10.5	2.5	10.8	

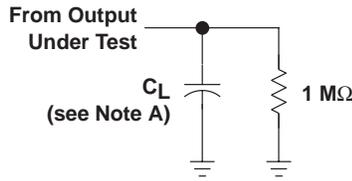
operating characteristics, $T_A = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS	V_{CC}	TYP	UNIT
C_{pd}	Power dissipation capacitance	$f = 10 \text{ MHz}$	0.8 V	1	pF
			$1.2 \text{ V} \pm 0.1 \text{ V}$	1	
			$1.5 \text{ V} \pm 0.1 \text{ V}$	1	
			$1.8 \text{ V} \pm 0.15 \text{ V}$	1	
			$2.5 \text{ V} \pm 0.2 \text{ V}$	1	
			$3.3 \text{ V} \pm 0.3 \text{ V}$	1	

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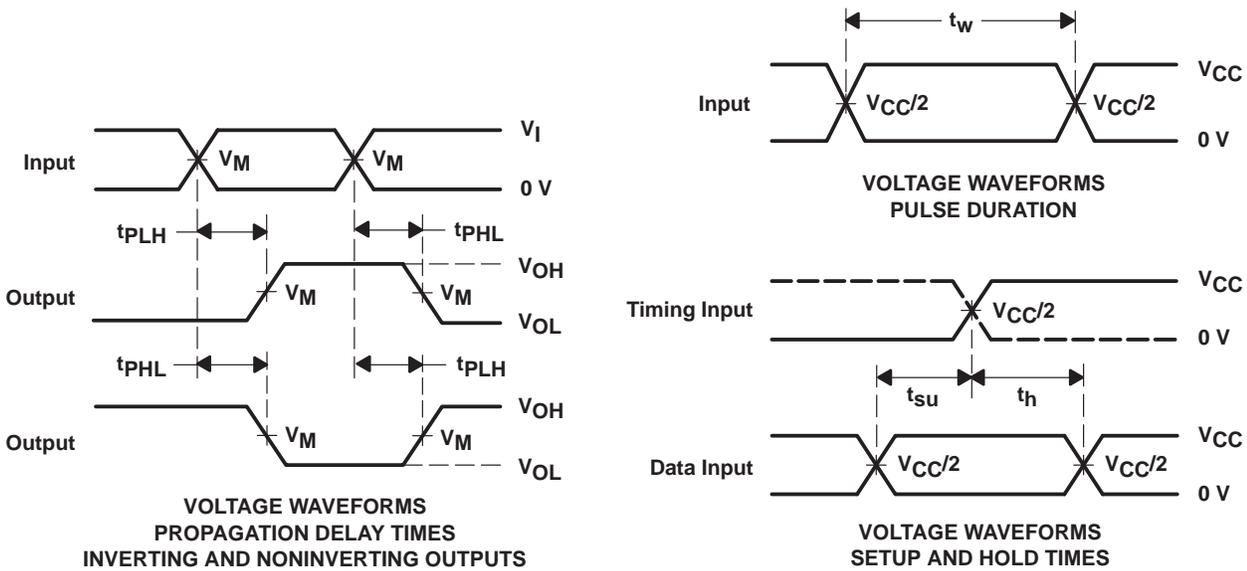
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PARAMETER MEASUREMENT INFORMATION
(Propagation Delays, Setup and Hold Times, and Pulse Width)



LOAD CIRCUIT

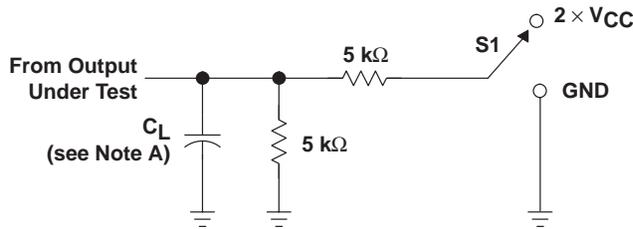
	$V_{CC} = 0.8\text{ V}$	$V_{CC} = 1.2\text{ V}$ $\pm 0.1\text{ V}$	$V_{CC} = 1.5\text{ V}$ $\pm 0.1\text{ V}$	$V_{CC} = 1.8\text{ V}$ $\pm 0.15\text{ V}$	$V_{CC} = 2.5\text{ V}$ $\pm 0.2\text{ V}$	$V_{CC} = 3.3\text{ V}$ $\pm 0.3\text{ V}$
C_L	5, 10, 15, 30 pF	5, 10, 15, 30 pF	5, 10, 15, 30 pF	5, 10, 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}



- NOTES: A. C_L includes probe and jig capacitance.
 B. All input pulses are supplied by generators having the following characteristics: $PRR \leq 10\text{ MHz}$, $Z_O = 50\ \Omega$, $t_r/t_f = 3\text{ ns}$.
 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 3. Load Circuit and Voltage Waveforms

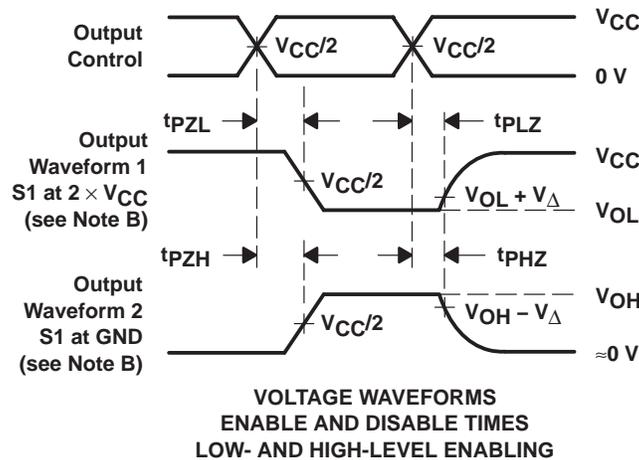
PARAMETER MEASUREMENT INFORMATION
(Enable and Disable Times)



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

LOAD CIRCUIT

	$V_{CC} = 0.8 \text{ V}$	$V_{CC} = 1.2 \text{ V}$ $\pm 0.1 \text{ V}$	$V_{CC} = 1.5 \text{ V}$ $\pm 0.1 \text{ V}$	$V_{CC} = 1.8 \text{ V}$ $\pm 0.15 \text{ V}$	$V_{CC} = 2.5 \text{ V}$ $\pm 0.2 \text{ V}$	$V_{CC} = 3.3 \text{ V}$ $\pm 0.3 \text{ V}$
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



- 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 $\leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r/t_f = 3 \text{ ns}$.
 - 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 4. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
SN74AUP1G06DBVR	ACTIVE	SOT-23	DBV	5	3000	Pb-Free (RoHS)	CU NIPDAU	Level-1-260C-UNLIM
SN74AUP1G06DBVRE4	ACTIVE	SOT-23	DBV	5	3000	Pb-Free (RoHS)	CU NIPDAU	Level-1-260C-UNLIM
SN74AUP1G06DBVT	ACTIVE	SOT-23	DBV	5	250	Pb-Free (RoHS)	CU NIPDAU	Level-1-260C-UNLIM
SN74AUP1G06DBVTE4	ACTIVE	SOT-23	DBV	5	250	Pb-Free (RoHS)	CU NIPDAU	Level-1-260C-UNLIM
SN74AUP1G06DCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AUP1G06DCKRE4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AUP1G06DCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AUP1G06DCKTE4	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

⁽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⁾ Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS) or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

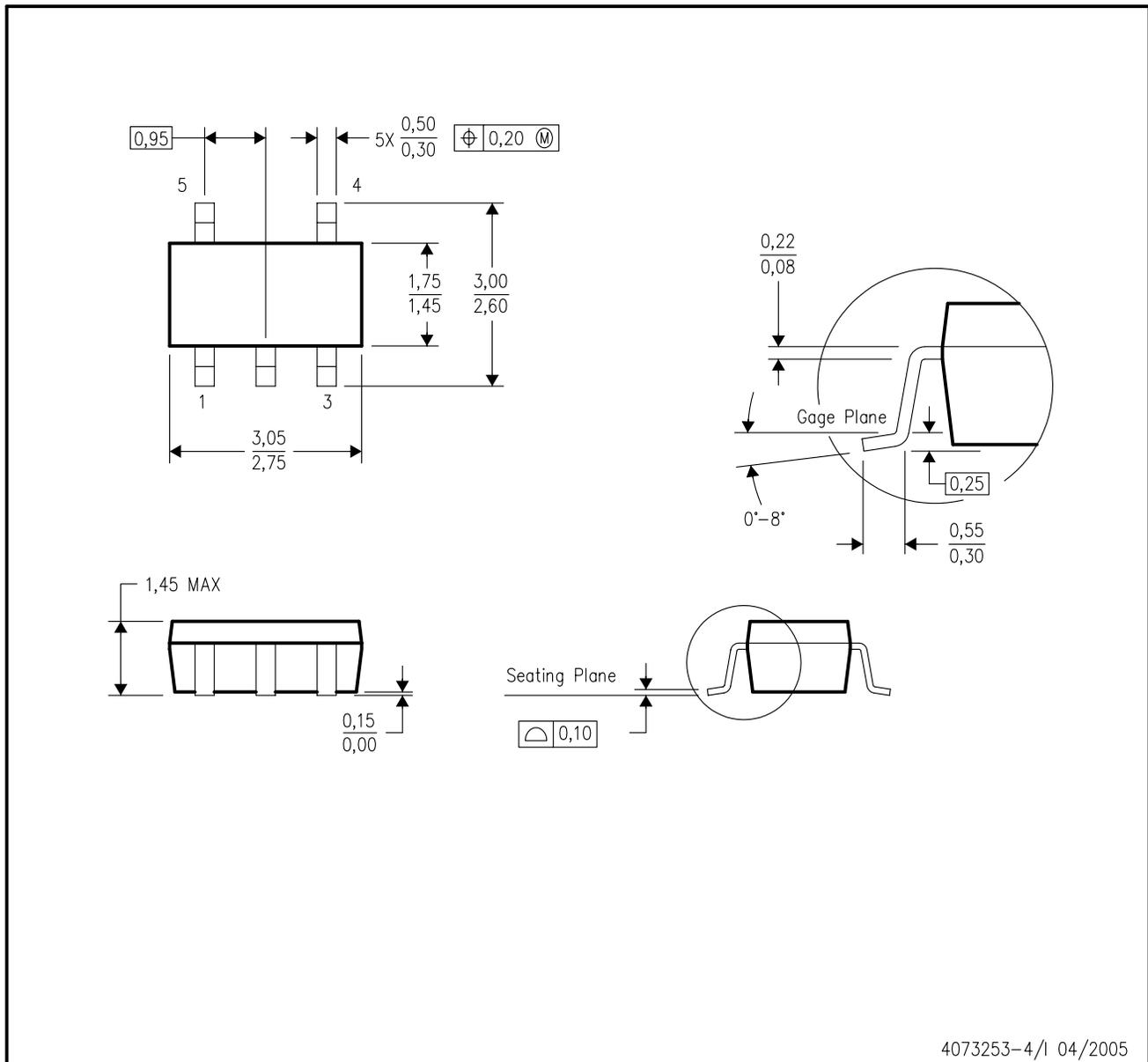
⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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DBV (R-PDSO-G5)

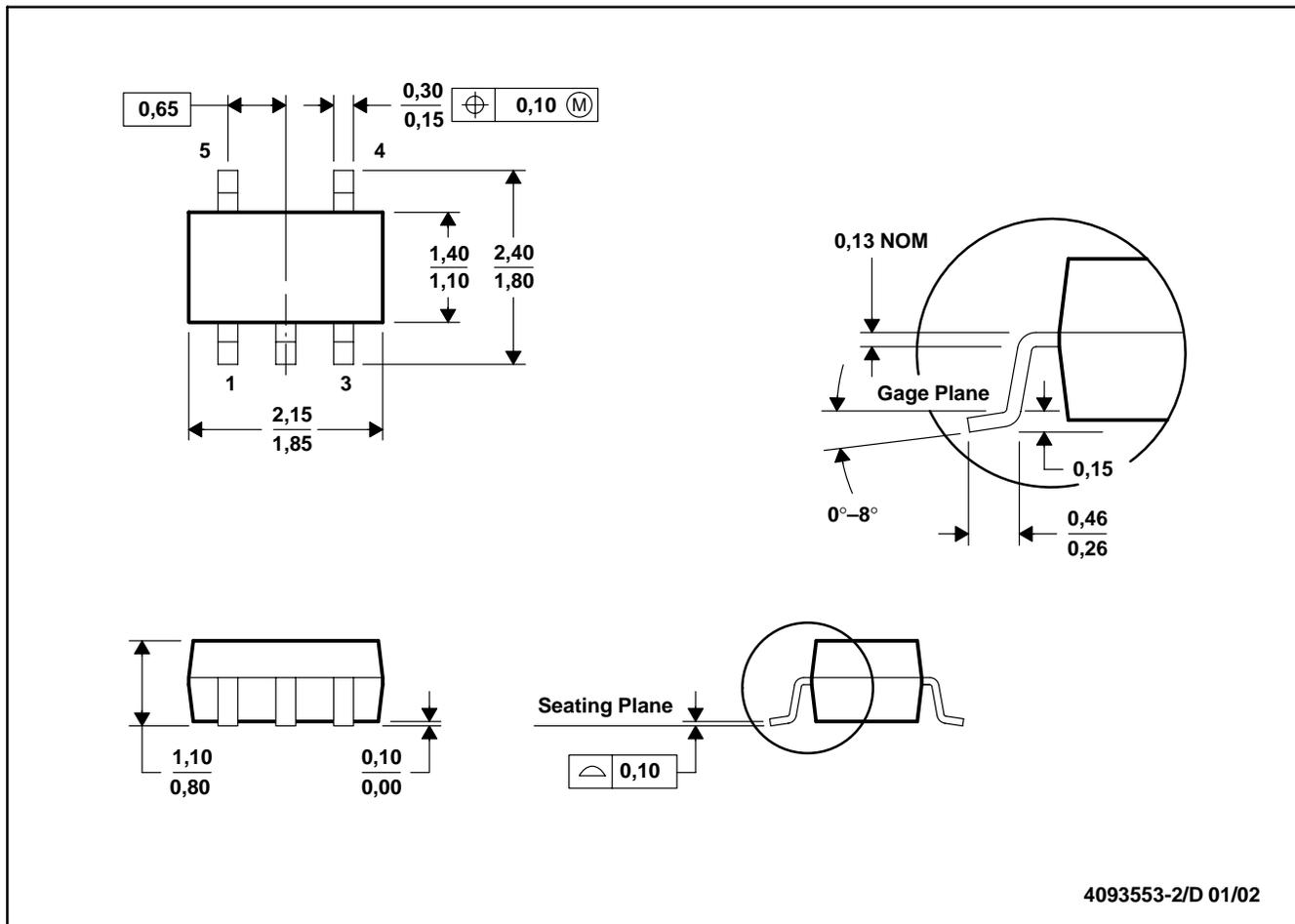
PLASTIC SMALL-OUTLINE PACKAGE



- 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.
 - D. Falls within JEDEC MO-178 Variation AA.

DCK (R-PDSO-G5)

PLASTIC SMALL-OUTLINE PACKAGE



- 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.
 D. Falls within JEDEC MO-203

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