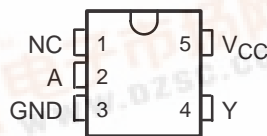


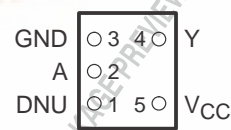
- Available in the Texas Instruments NanoStar™ and NanoFree™ Packages
- Low Static-Power Consumption; $I_{CC} = 0.9\text{-}\mu\text{A Max}$
- Low Dynamic-Power Consumption; $C_{pd} = 4.1\text{ pF Typical at } 3.3\text{ V}$
- Low Input Capacitance; $C_i = 1.5\text{ pF Typical}$
- Low Noise – Overshoot and Undershoot <math><10\%</math> 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 ($V_{hys} = 250\text{ mV Typical at } 3.3\text{ V}$)
- 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
- $t_{pd} = 3.9\text{ ns Max at } 3.3\text{ V}$
- 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, DCK, OR DRL PACKAGE (TOP VIEW)



NC – No internal connection

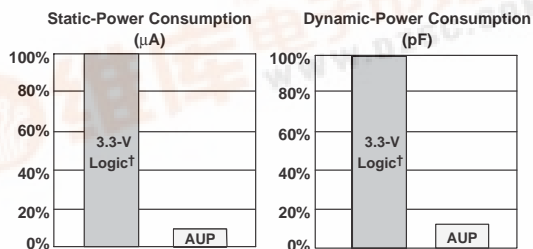
YEP OR YZP PACKAGE (BOTTOM VIEW)



DNU – Do not use

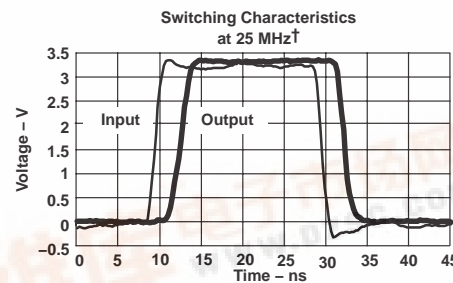
description/ordering information

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).



† Single, dual, and triple gates.

Figure 1. AUP—The Lowest-Power Family



† AUP1G08 data at $C_L = 15\text{ pF}$.

Figure 2. Excellent Signal Integrity

This single inverter gate performs the Boolean function $Y = \bar{A}$.

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

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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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

SN74AUP1G04

LOW-POWER SINGLE INVERTER GATE

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description/ordering information (continued)

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

T _A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING‡
-40°C to 85°C	NanoStar™ – WCSP (DSBGA) 0.23-mm Large Bump – YEP	Tape and reel	SN74AUP1G04YEPR	---HC_
	NanoFree™ – WCSP (DSBGA) 0.23-mm Large Bump – YZP (Pb-free)	Tape and reel	SN74AUP1G04YZPR	
	SOT (SOT-23) – DBV	Tape and reel	SN74AUP1G04DBVR	H04_
	SOT (SC-70) – DCK	Tape and reel	SN74AUP1G04DCKR	HC_
	SOT (SOT-533) – DRL	Reel of 4000	SN74AUP1G04DRLR	PREVIEW

† 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)



SN74AUP1G04

LOW-POWER SINGLE INVERTER GATE

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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 × 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 × 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	V _{CC}	V	
I _{OH} †	High-level output current	V _{CC} = 0.8 V	-20	μA	
		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		
I _{OL} †	Low-level output current	V _{CC} = 0.8 V	20	μA	
		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		
Δt/Δv	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.

SN74AUP1G04

LOW-POWER SINGLE INVERTER GATE

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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 _{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	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			1.5				
C _o		V _O = GND	0 V			2.5			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	15.6					ns
			1.2 V ± 0.1 V	3.3	5.9	10.8	2.1	13.5	
			1.5 V ± 0.1 V	2.5	4.2	7	1.6	8.8	
			1.8 V ± 0.15 V	2.2	3.4	5.9	1.4	7	
			2.5 V ± 0.2 V	1.7	2.5	4	1.3	4.9	
			3.3 V ± 0.3 V	1.4	2.1	3.2	1.2	3.9	

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LOW-POWER SINGLE INVERTER GATE

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switching characteristics over recommended operating free-air temperature range, $C_L = 10\text{ pF}$ (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	17.7					ns
			1.2 V \pm 0.1 V	3.9	6.9	12.2	3.1	15	
			1.5 V \pm 0.1 V	3	5	8.1	2.5	9.9	
			1.8 V \pm 0.15 V	2.6	4	6.9	2.1	7.9	
			2.5 V \pm 0.2 V	2.1	3	4.6	1.7	5.6	
			3.3 V \pm 0.3 V	1.8	2.5	3.8	1.5	4.5	

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	19.5					ns
			1.2 V \pm 0.1 V	4.7	7.8	13	3.8	15.9	
			1.5 V \pm 0.1 V	3.7	5.6	8.6	3.1	10.6	
			1.8 V \pm 0.15 V	3.2	4.6	7.4	2.6	8.5	
			2.5 V \pm 0.2 V	2.5	3.5	5.1	2.1	6.1	
			3.3 V \pm 0.3 V	2.2	2.9	4.2	1.9	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	25.4					ns
			1.2 V \pm 0.1 V	6.8	10.4	16	6.1	19	
			1.5 V \pm 0.1 V	5.3	7.6	10.8	4.8	12.9	
			1.8 V \pm 0.15 V	4.6	6.3	9.2	4.1	10.5	
			2.5 V \pm 0.2 V	3.6	4.8	6.5	3.3	7.6	
			3.3 V \pm 0.3 V	3.2	4	5.4	2.9	6.2	

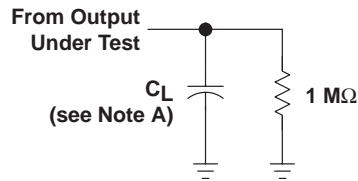
operating characteristics, $T_A = 25^\circ\text{C}$

PARAMETER	TEST CONDITIONS	V_{CC}	TYP	UNIT
C_{pd} Power dissipation capacitance	$f = 10\text{ MHz}$	0.8 V	3.9	pF
		1.2 V \pm 0.1 V	3.9	
		1.5 V \pm 0.1 V	3.9	
		1.8 V \pm 0.15 V	3.9	
		2.5 V \pm 0.2 V	3.9	
		3.3 V \pm 0.3 V	4.1	

SN74AUP1G04 LOW-POWER SINGLE INVERTER GATE

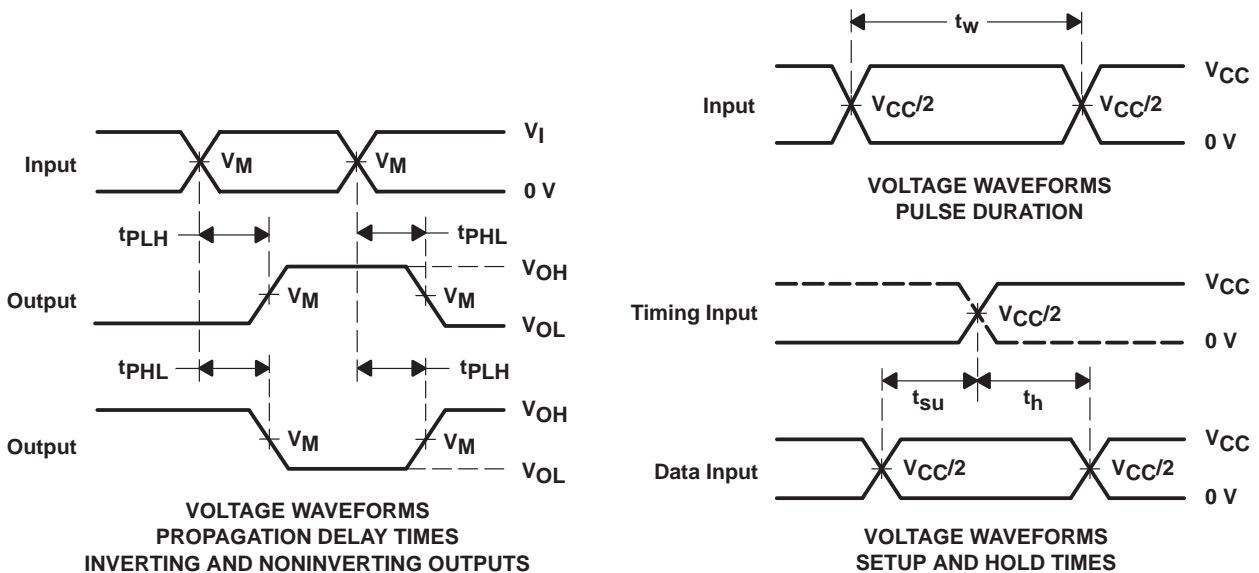
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PARAMETER MEASUREMENT INFORMATION (Propagation Delays, Setup and Hold Times, and Pulse Width)



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}



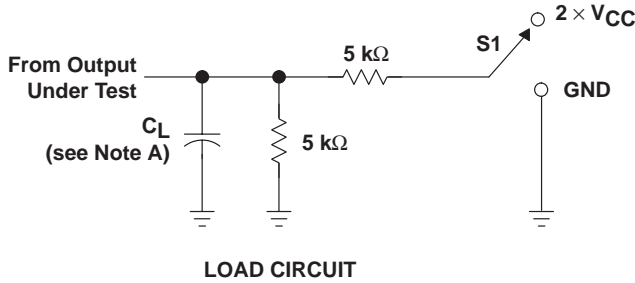
- NOTES: A. C_L includes probe and jig capacitance.
 B. All input pulses are supplied by generators having the following characteristics: $PRR \leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r/t_f = 3 \text{ ns}$.
 C. The outputs are measured one at a time, with one transition per measurement.
 D. t_{PLH} 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

SN74AUP1G04 LOW-POWER SINGLE INVERTER GATE

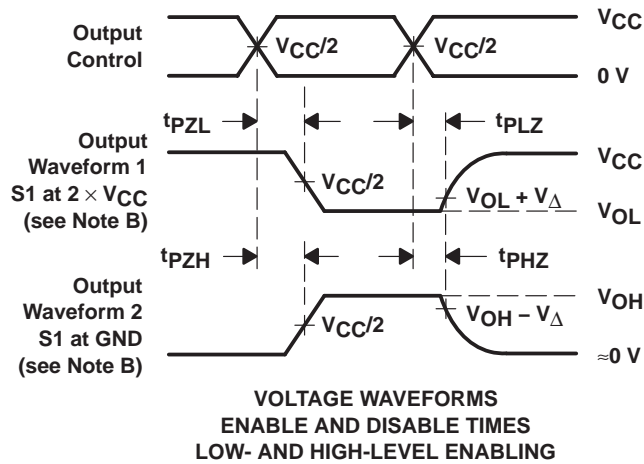
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PARAMETER MEASUREMENT INFORMATION (Enable and Disable Times)



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

	$V_{CC} = 0.8 \text{ V}$	$V_{CC} = 1.2 \text{ V}$ $\pm 0.1 \text{ V}$	$V_{CC} = 1.5 \text{ V}$ $\pm 0.1 \text{ V}$	$V_{CC} = 1.8 \text{ V}$ $\pm 0.15 \text{ V}$	$V_{CC} = 2.5 \text{ V}$ $\pm 0.2 \text{ V}$	$V_{CC} = 3.3 \text{ V}$ $\pm 0.3 \text{ V}$
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:
- C_L includes probe and jig capacitance.
 - 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.
 - All input pulses are supplied by generators having the following characteristics: PRR $\leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r/t_f = 3 \text{ ns}$.
 - The outputs are measured one at a time, with one transition per measurement.
 - t_{PLZ} and t_{PHZ} are the same as t_{dis} .
 - t_{PZL} and t_{PZH} are the same as t_{en} .
 - 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⁾
SN74AUP1G04DBVR	ACTIVE	SOT-23	DBV	5	3000	Pb-Free (RoHS)	CU NIPDAU	Level-1-260C-UNLIM
SN74AUP1G04DBVT	ACTIVE	SOT-23	DBV	5	250	Pb-Free (RoHS)	CU NIPDAU	Level-1-260C-UNLIM
SN74AUP1G04DCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AUP1G04DCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AUP1G04DRLR	ACTIVE	SOP	DRL	5	4000	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.

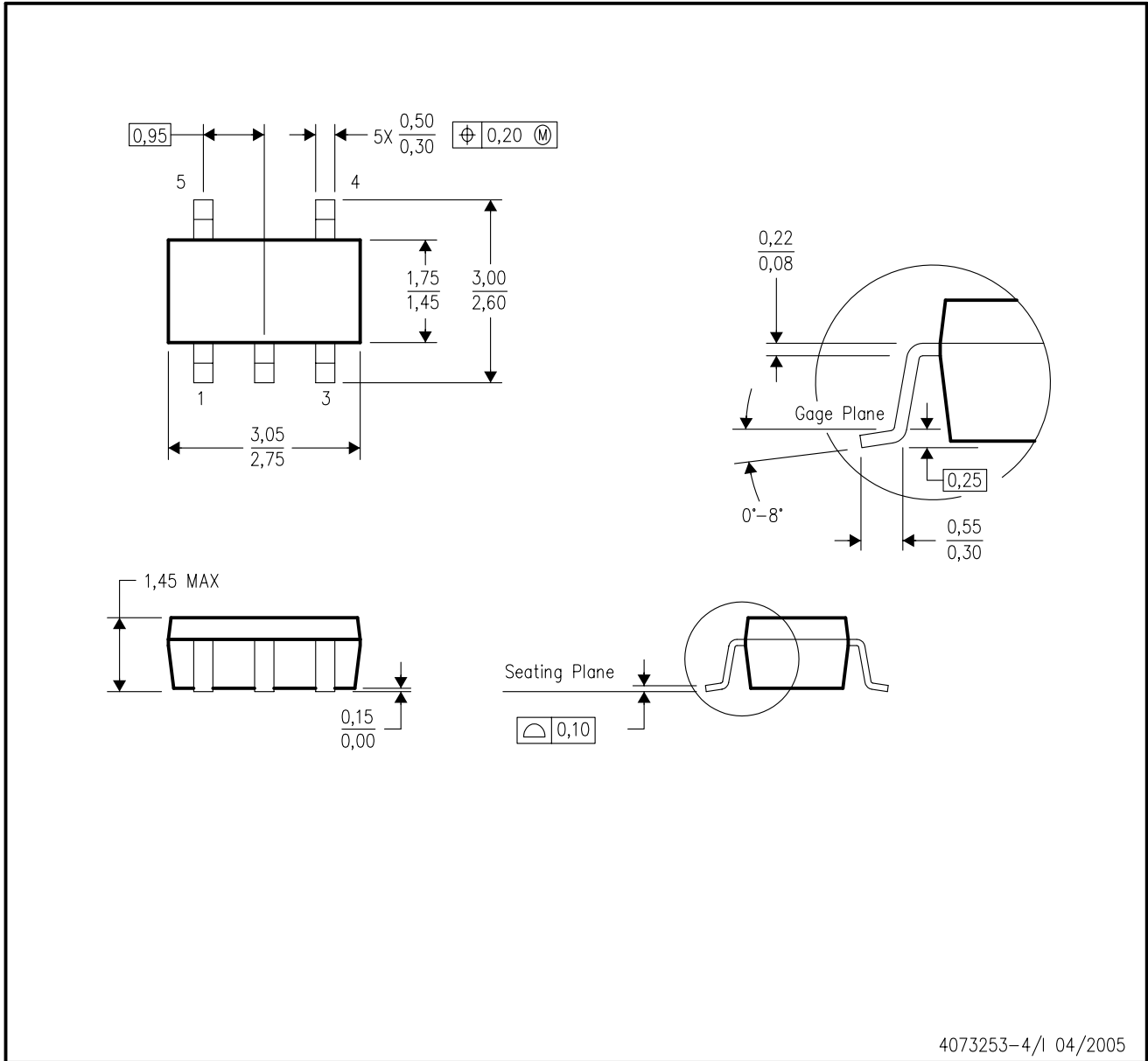
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MECHANICAL DATA

DBV (R-PDSO-G5)

PLASTIC SMALL-OUTLINE PACKAGE



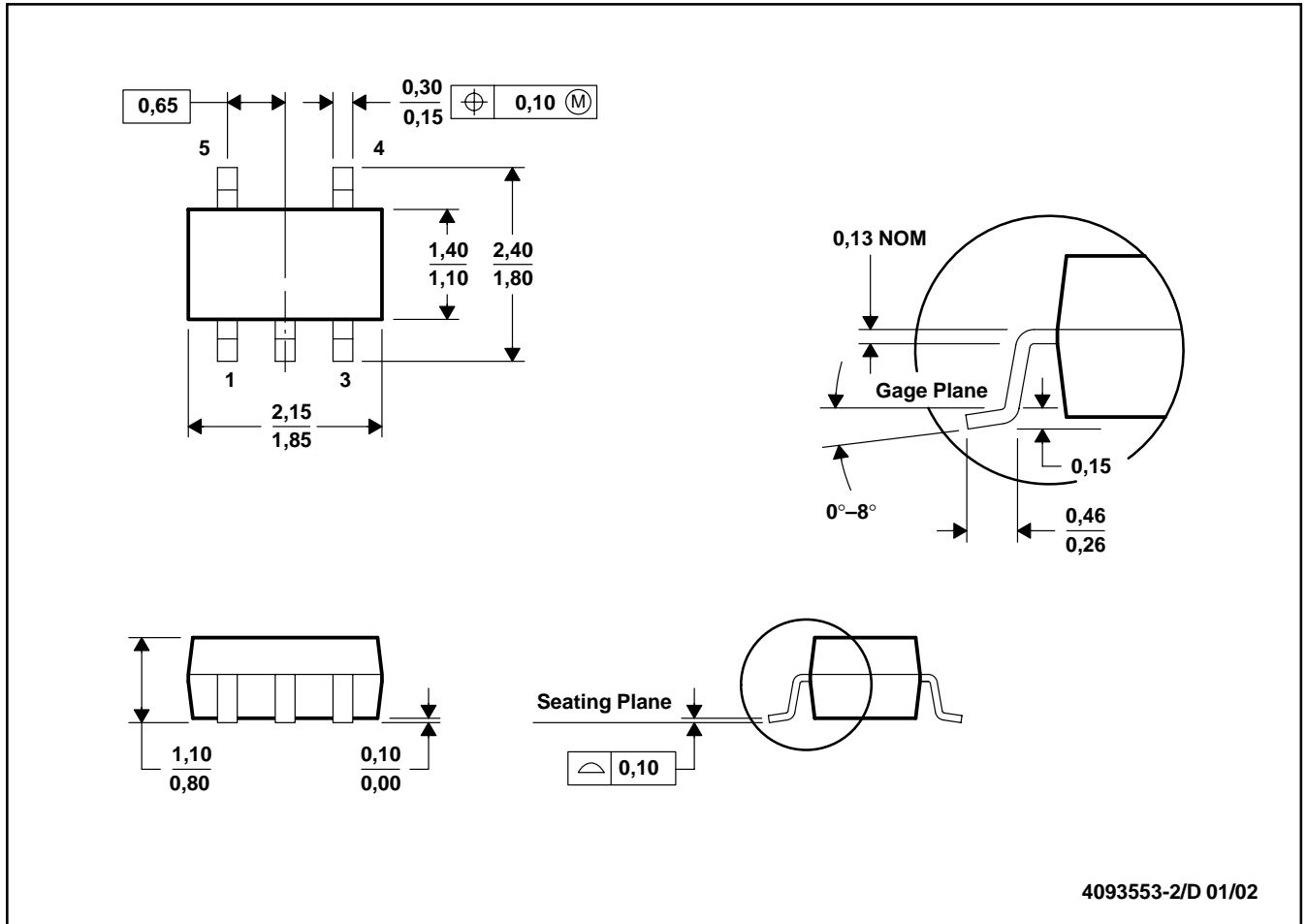
- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion.
 - D. Falls within JEDEC MO-178 Variation AA.

MECHANICAL DATA

MPDS025C – FEBRUARY 1997 – REVISED FEBRUARY 2002

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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