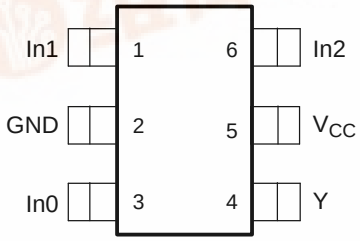
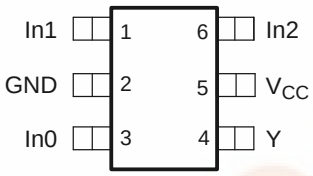
FEATURES

- Available in the Texas Instruments NanoStar™ and NanoFree™ Packages
- Supports 5-V V_{CC} Operation
- Inputs Accept Voltages to 5.5 V
- Max t_{pd} of 6.3 ns at 3.3 V
- Low Power Consumption, 10-μA Max I_{CC}
- ±24-mA Output Drive at 3.3 V
- I_{off} Supports Partial-Power-Down Mode Operation
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
  - 2000-V Human-Body Model (A114-A)
  - 200-V Machine Model (A115-A)
  - 1000-V Charged-Device Model (C101)

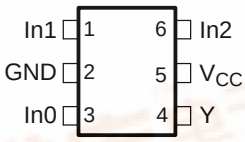
DBV PACKAGE (TOP VIEW)



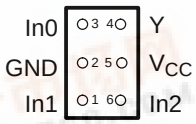
DCK PACKAGE (TOP VIEW)



DRL PACKAGE (TOP VIEW)



YEA, YEP, YZA, OR YZP PACKAGE (BOTTOM VIEW)



See mechanical drawings for dimensions.

DESCRIPTION/ORDERING INFORMATION

This configurable multiple-function gate is designed for 1.65-V to 5.5-V V_{CC} operation.

The SN74LVC1G98 features configurable multiple functions. The output state is determined by eight patterns of 3-bit input. The user can choose the logic functions MUX, AND, OR, NAND, NOR, inverter, and noninverter. All inputs can be connected to V_{CC} or GND.

ORDERING INFORMATION

T_A	PACKAGE(1)		ORDERABLE PART NUMBER	TOP-SIDE MARKING(2)
–40°C to 85°C	NanoStar™ – WCSP (DSBGA) 0.17-mm Small Bump – YEA	Reel of 3000	SN74LVC1G98YEAR	_ _ _CW_
	NanoFree™ – WCSP (DSBGA) 0.17-mm Small Bump – YZA (Pb-free)		SN74LVC1G98YZAR	
	NanoStar™ – WCSP (DSBGA) 0.23-mm Large Bump – YEP		SN74LVC1G98YEPR	
	NanoFree™ – WCSP (DSBGA) 0.23-mm Large Bump – YZP (Pb-free)		SN74LVC1G98YZPR	
	SOT (SOT-23) – DBV	Reel of 3000	SN74LVC1G98DBVR	C98_
		Reel of 250	SN74LVC1G98DBVT	
	SOT (SC-70) – DCK	Reel of 3000	SN74LVC1G98DCKR	CW_
		Reel of 250	SN74LVC1G98DCKT	
	SOT (SOT-553) – DRL	Reel of 4000	SN74LVC1G98DRLR	CW_

(1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.
(2) DBV/DCK/DRL: The actual top-side marking has one additional character that designates the assembly/test site. YEA/YZA, 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).

DESCRIPTION/ORDERING INFORMATION (CONTINUED)

This device functions as an independent gate, but because of Schmitt action, it may have different input threshold levels for positive-going (V_{T+}) and negative-going (V_{T-}) signals.

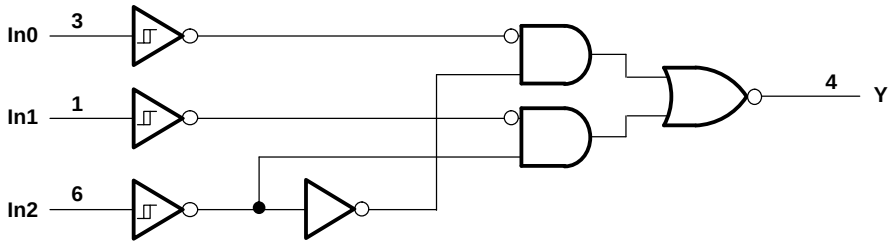
NanoStar™ and NanoFree™ package technology is a major breakthrough in IC packaging concepts, using the die as the package.

This device is fully specified for partial-power-down applications using I_{off}. The Ioff circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

FUNCTION TABLE

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

LOGIC DIAGRAM (POSITIVE LOGIC)



FUNCTION SELECTION TABLE

LOGIC FUNCTION	FIGURE NO.
2-to-1 data selector with inverted output	1
2-input NAND gate	2
2-input NOR gate with one inverted input	3
2-input AND gate with one inverted input	3
2-input NAND gate with one inverted input	4
2-input OR gate with one inverted input	4
2-input NOR gate	5
Noninverted buffer	6
Inverter	7

LOGIC CONFIGURATIONS

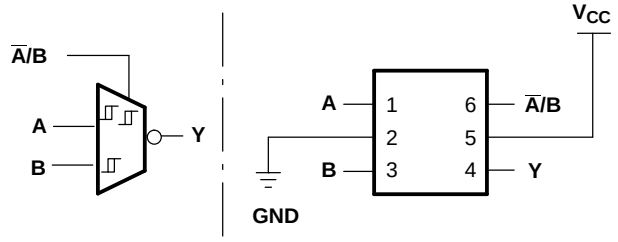


Figure 1. 2-to-1 Data Selector With Inverted Output

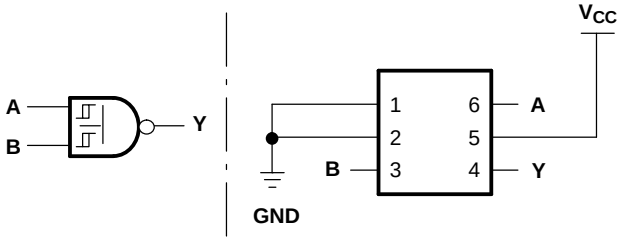


Figure 2. 2-Input NAND Gate

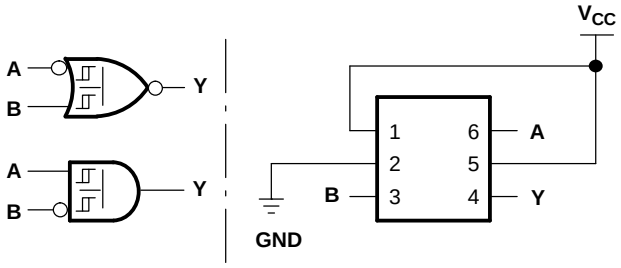


Figure 3. 2-Input NOR Gate With One Inverted Input
2-Input AND Gate With One Inverted Input

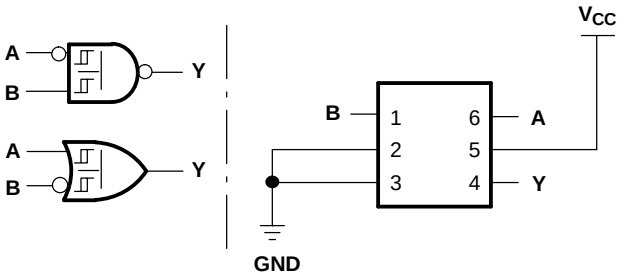


Figure 4. 2-Input NAND Gate With One Inverted Input
2-Input OR Gate With One Inverted Input

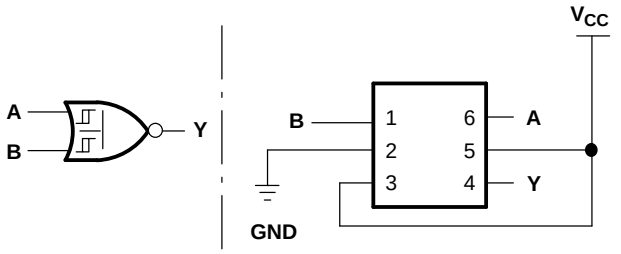


Figure 5. 2-Input NOR Gate

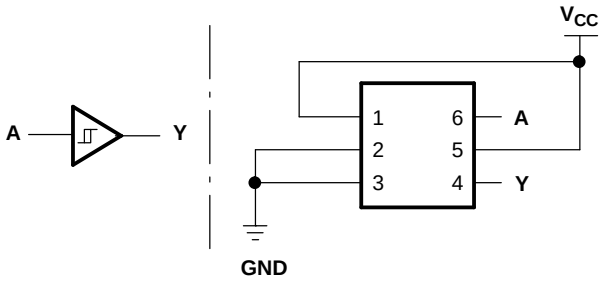


Figure 6. Noninverted Buffer

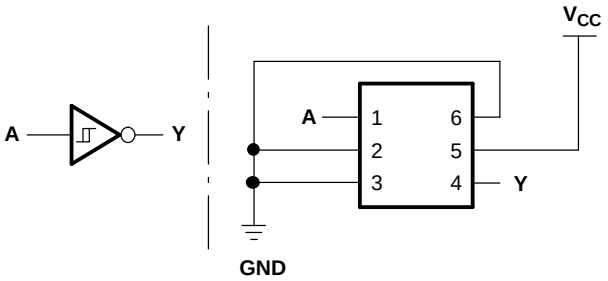


Figure 7. Inverter

Absolute Maximum Ratings(1)

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

			MIN	MAX	UNIT
V_{CC}	Supply voltage range		–0.5	6.5	V
V_I	Input voltage range(2)		–0.5	6.5	V
V_O	Voltage range applied to any output in the high-impedance or power-off state(2)(3)		–0.5	6.5	V
V_O	Voltage range applied to any output in the high or low state		–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			±50	mA
	Continuous current through V_{CC} or GND			±100	mA
θ_{JA}	Package thermal impedance(4)	DBV package		165	°C/W
		DCK package		259	
		DRL package		142	
		YEA/YZA package		143	
		YEP/YZP package		123	
T_{stg}	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 negative-voltage and output voltage ratings may be exceeded if the input and output current ratings are observed.
(3) The value of V_{CC} is provided in the recommended operating conditions table.
(4) The package thermal impedance is calculated in accordance with JESD 51-7.

Recommended Operating Conditions(1)

			MIN	MAX	UNIT
V_{CC}	Supply voltage	Operating	1.65	5.5	V
		Data retention only	1.5		
V_I	Input voltage		0	5.5	V
V_O	Output voltage		0	V_{CC}	V
I_{OH}	High-level output current	V_{CC} = 1.65 V		–4	mA
		V_{CC} = 2.3 V		–8	
		V_{CC} = 3 V		–16	
				–24	
		V_{CC} = 4.5 V		–32	
I_{OL}	Low-level output current	V_{CC} = 1.65 V		4	mA
		V_{CC} = 2.3 V		8	
		V_{CC} = 3 V		16	
				24	
		V_{CC} = 4.5 V		32	
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. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

Electrical Characteristics

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

PARAMETER	TEST CONDITIONS	V_{CC}	MIN	TYP(1)	MAX	UNIT
V_{T+} Positive-going input threshold voltage		1.65 V	0.79		1.16	V
		2.3 V	1.11		1.56	
		3 V	1.5		1.87	
		4.5 V	2.16		2.74	
		5.5 V	2.61		3.33	
V_{T-} Negative-going input threshold voltage		1.65 V	0.35		0.62	V
		2.3 V	0.58		0.87	
		3 V	0.84		1.19	
		4.5 V	1.41		1.9	
		5.5 V	1.87		2.29	
ΔV_T Hysteresis ($V_{T+} - V_{T-}$)		1.65 V	0.3		0.62	V
		2.3 V	0.4		0.8	
		3 V	0.53		0.87	
		4.5 V	0.71		1.04	
		5.5 V	0.71		1.11	
V_{OH}	I_{OH} = –100 µA	1.65 V to 5.5 V	V_{CC} – 0.1			V
	I_{OH} = –4 mA	1.65 V	1.2			
	I_{OH} = –8 mA	2.3 V	1.9			
	I_{OH} = –16 mA	3 V	2.4			
	I_{OH} = –24 mA		2.3			
	I_{OH} = –32 mA	4.5 V	3.8			
V_{OL}	I_{OL} = 100 µA	1.65 V to 5.5 V			0.1	V
	I_{OL} = 4 mA	1.65 V			0.45	
	I_{OL} = 8 mA	2.3 V			0.3	
	I_{OL} = 16 mA	3 V			0.4	
	I_{OL} = 24 mA				0.55	
	I_{OL} = 32 mA	4.5 V			0.55	
I_I	V_I = 5.5 V or GND	0 to 5.5 V			±5	µA
I_{off}	V_I or V_O = 5.5 V	0			±10	µA
I_{CC}	V_I = 5.5 V or GND, I_O = 0	1.65 V to 5.5 V			10	µA
ΔI_{CC}	One input at V_{CC} – 0.6 V, Other inputs at V_{CC} or GND	3 V to 5.5 V			500	µA
C_i	V_I = V_{CC} or GND	3.3 V		3.5		pF

(1) All typical values are at V_{CC} = 3.3 V, T_A = 25°C.

Switching Characteristics

over recommended operating free-air temperature range (unless otherwise noted) (see Figure 8)

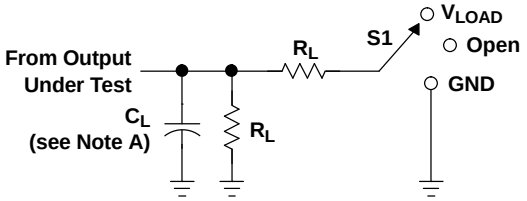
PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC} = 1.8 V ± 0.15 V		V_{CC} = 2.5 V ± 0.2 V		V_{CC} = 3.3 V ± 0.3 V		V_{CC} = 5 V ± 0.5 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{pd}	Any In	Y	3.2	14.4	2	8.3	1.5	6.3	1.1	5.1	ns

Operating Characteristics

T_A = 25°C

PARAMETER		TEST CONDITIONS	V_{CC} = 1.8 V	V_{CC} = 2.5 V	V_{CC} = 3.3 V	V_{CC} = 5 V	UNIT
			TYP	TYP	TYP	TYP	
C_{pd}	Power dissipation capacitance	f = 10 MHz	23	23	23	26	pF

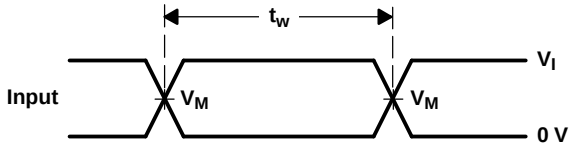
PARAMETER MEASUREMENT INFORMATION



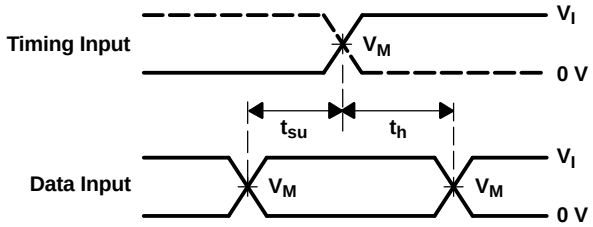
LOAD CIRCUIT

TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	V_{LOAD}
t_{PHZ}/t_{PZH}	GND

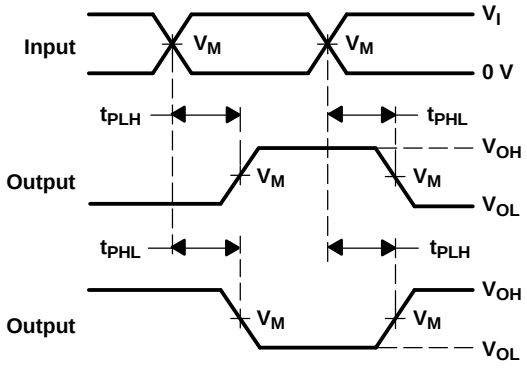
V_{CC}	INPUTS		V_M	V_{LOAD}	C_L	R_L	V_Δ
	V_I	t_r/t_f					
1.8 V ± 0.15 V	V_{CC}	≤2 ns	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	1 kΩ	0.15 V
2.5 V ± 0.2 V	V_{CC}	≤2 ns	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	500 Ω	0.15 V
3.3 V ± 0.3 V	3 V	≤2.5 ns	1.5 V	6 V	50 pF	500 Ω	0.3 V
5 V ± 0.5 V	V_{CC}	≤2.5 ns	$V_{CC}/2$	$2 \times V_{CC}$	50 pF	500 Ω	0.3 V



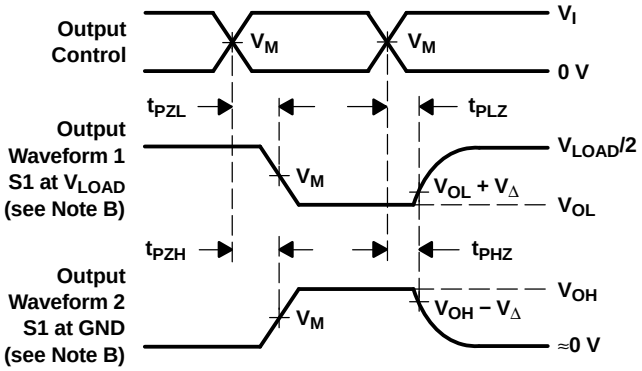
VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
INVERTING AND NONINVERTING OUTPUTS



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.
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. t_{PLH} and t_{PHL} are the same as t_{pd}.
H. All parameters and waveforms are not applicable to all devices.

Figure 8. Load Circuit and Voltage Waveforms

PACKAGE OPTION ADDENDUM

3-Jun-2005

PACKAGING INFORMATION

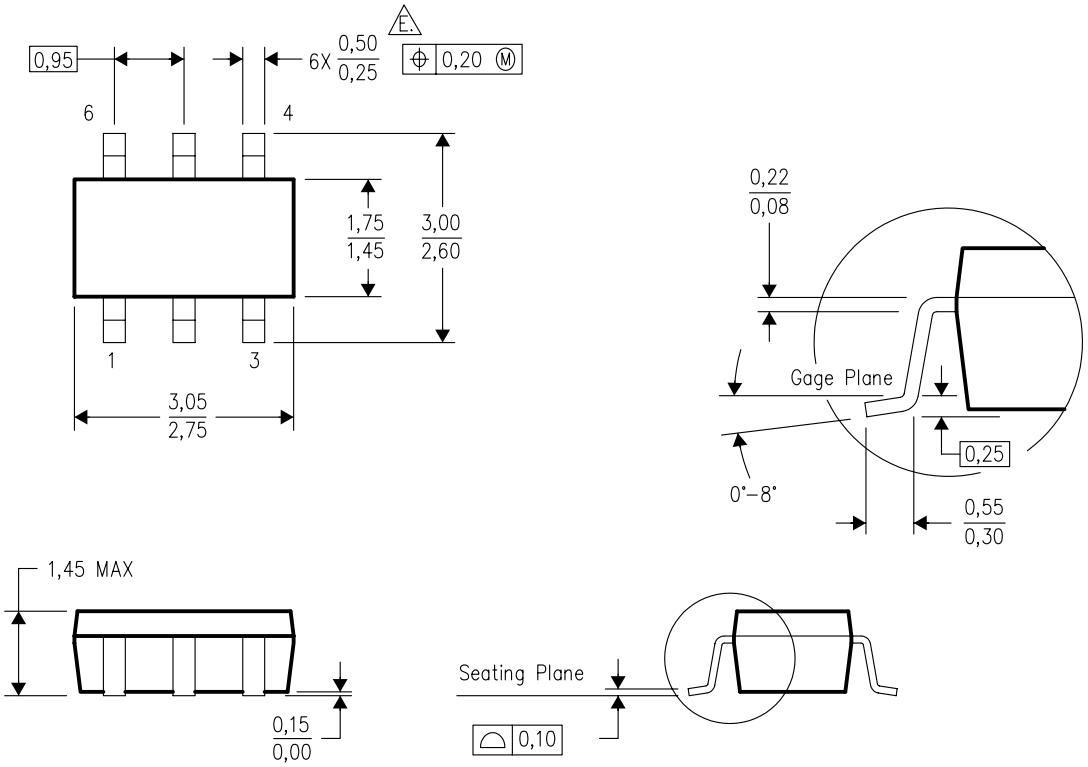
Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
SN74LVC1G98DBVR	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC1G98DBVRG4	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC1G98DBVT	ACTIVE	SOT-23	DBV	6	250	Pb-Free (RoHS)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC1G98DBVTE4	ACTIVE	SOT-23	DBV	6	250	TBD	Call TI	Call TI
SN74LVC1G98DCKR	ACTIVE	SC70	DCK	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC1G98DCKT	ACTIVE	SC70	DCK	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC1G98DCKTE4	ACTIVE	SC70	DCK	6	250	TBD	Call TI	Call TI
SN74LVC1G98DRLR	ACTIVE	SOP	DRL	6	4000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC1G98YEAR	ACTIVE	WCSP	YEA	6	3000	TBD	SNPB	Level-1-260C-UNLIM
SN74LVC1G98YEPR	ACTIVE	WCSP	YEP	6	3000	TBD	SNPB	Level-1-260C-UNLIM
SN74LVC1G98YZAR	ACTIVE	WCSP	YZA	6	3000	Pb-Free (RoHS)	SNAGCU	Level-1-260C-UNLIM
SN74LVC1G98YZPR	ACTIVE	WCSP	YZP	6	3000	Pb-Free (RoHS)	SNAGCU	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.

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

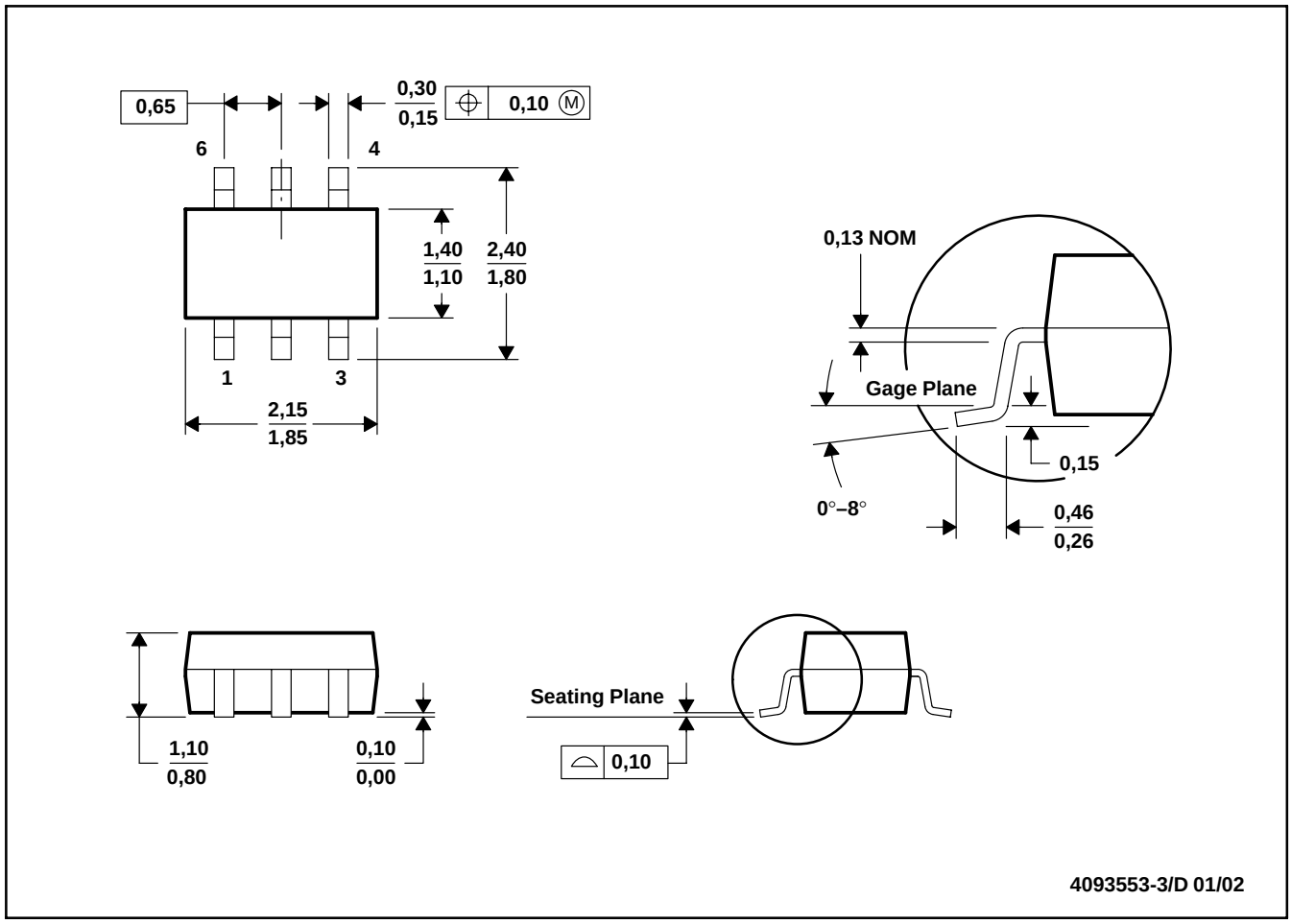


4073253–5/I 04/2005

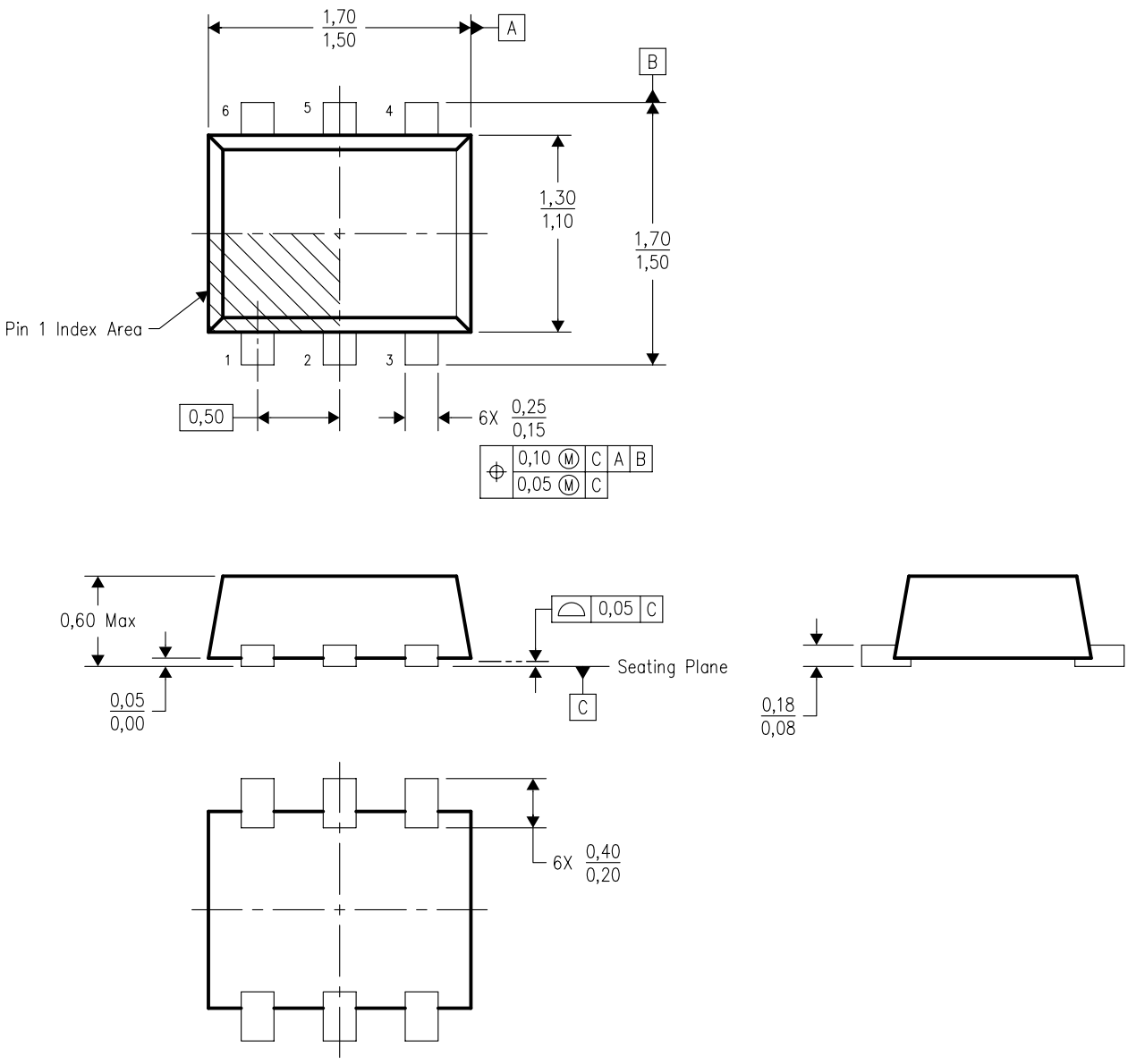
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion.
D. Leads 1,2,3 may be wider than leads 4,5,6 for package orientation.
E. Falls within JEDEC MO–178 Variation AB, except minimum lead width.

MPDS114 – FEBRUARY 2002

DCK (R-PDSO-G6) **PLASTIC SMALL-OUTLINE PACKAGE**

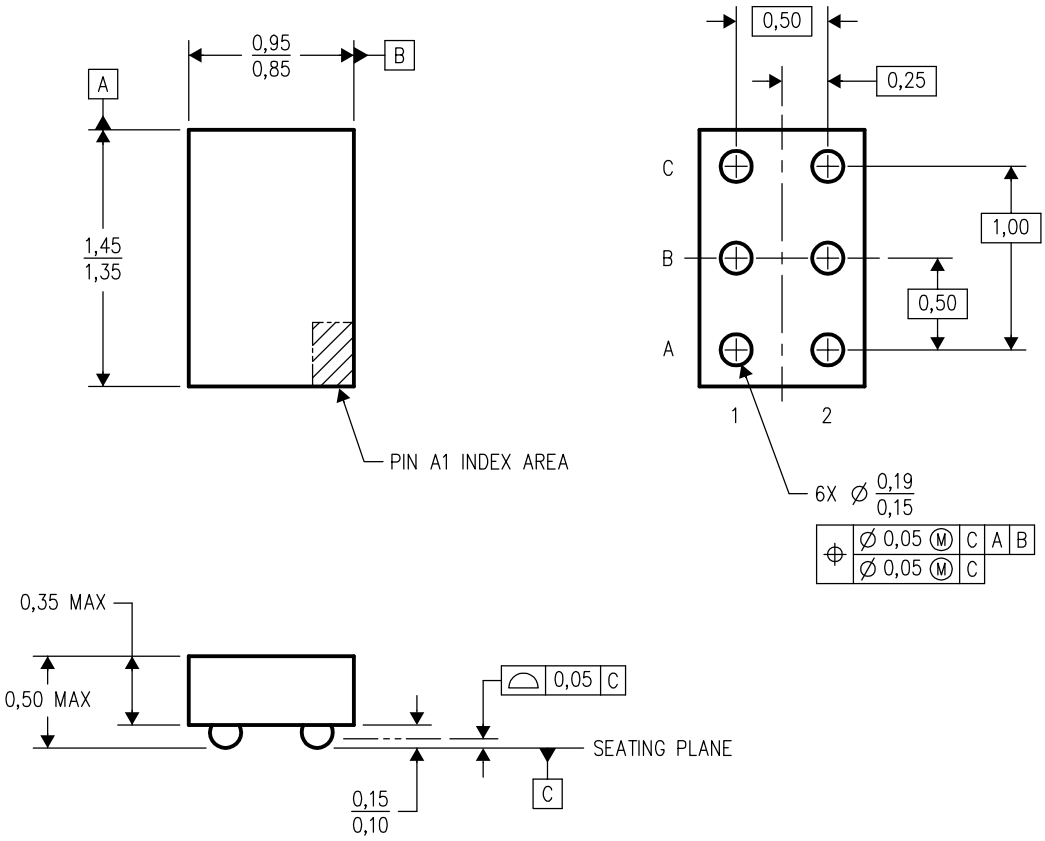


NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion.
D. Falls within JEDEC MO-203



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. JEDEC package registration is pending.

YEA (R–XBGA–N6) DIE–SIZE BALL GRID ARRAY

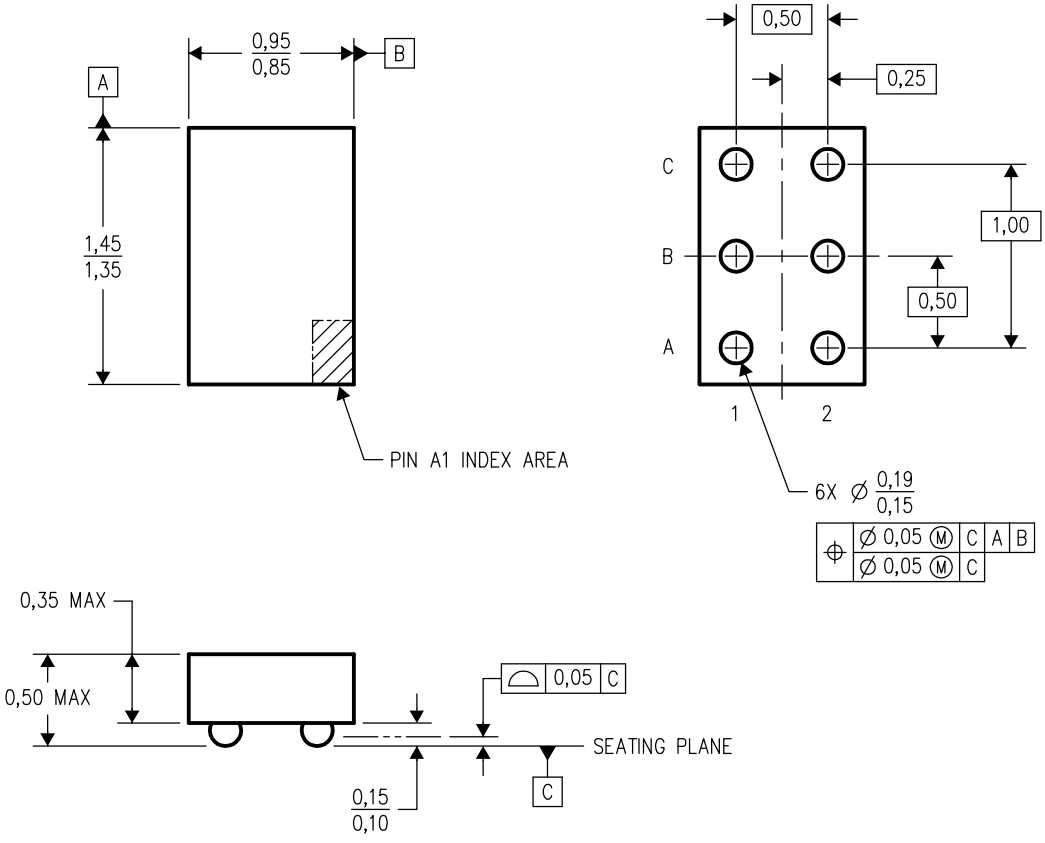


4203167–3/C 04/2002

NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. NanoStar™ package configuration.
D. Package complies to JEDEC MO–211 variation EA.
E. This package is tin–lead (SnPb). Refer to the 6 YZA package (drawing 4204151) for lead–free.

NanoStar is a trademark of Texas Instruments.

YZA (R–XBGA–N6) DIE–SIZE BALL GRID ARRAY

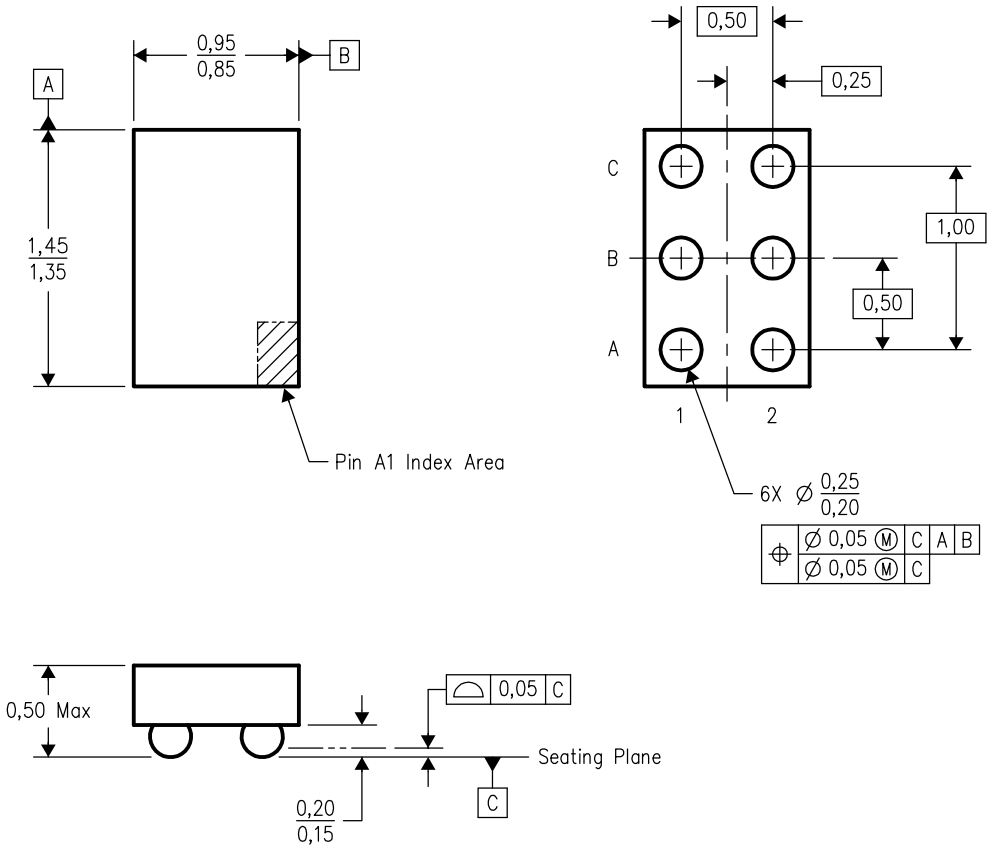


4204151–3/B 03/2002

NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. NanoFree™ package configuration.
D. Package complies to JEDEC MO–211 variation EA.
E. This package is lead–free. Refer to the 6 YEA package (drawing 4203167) for tin–lead (SnPb).

NanoFree is a trademark of Texas Instruments.

YZP (R–XBGA–N6) DIE–SIZE BALL GRID ARRAY



4204741–3/A 10/2002

NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. NanoFree™ package configuration.
D. This package is lead–free. Refer to the 6 YEP package (drawing 4204725) for tin–lead (SnPb).

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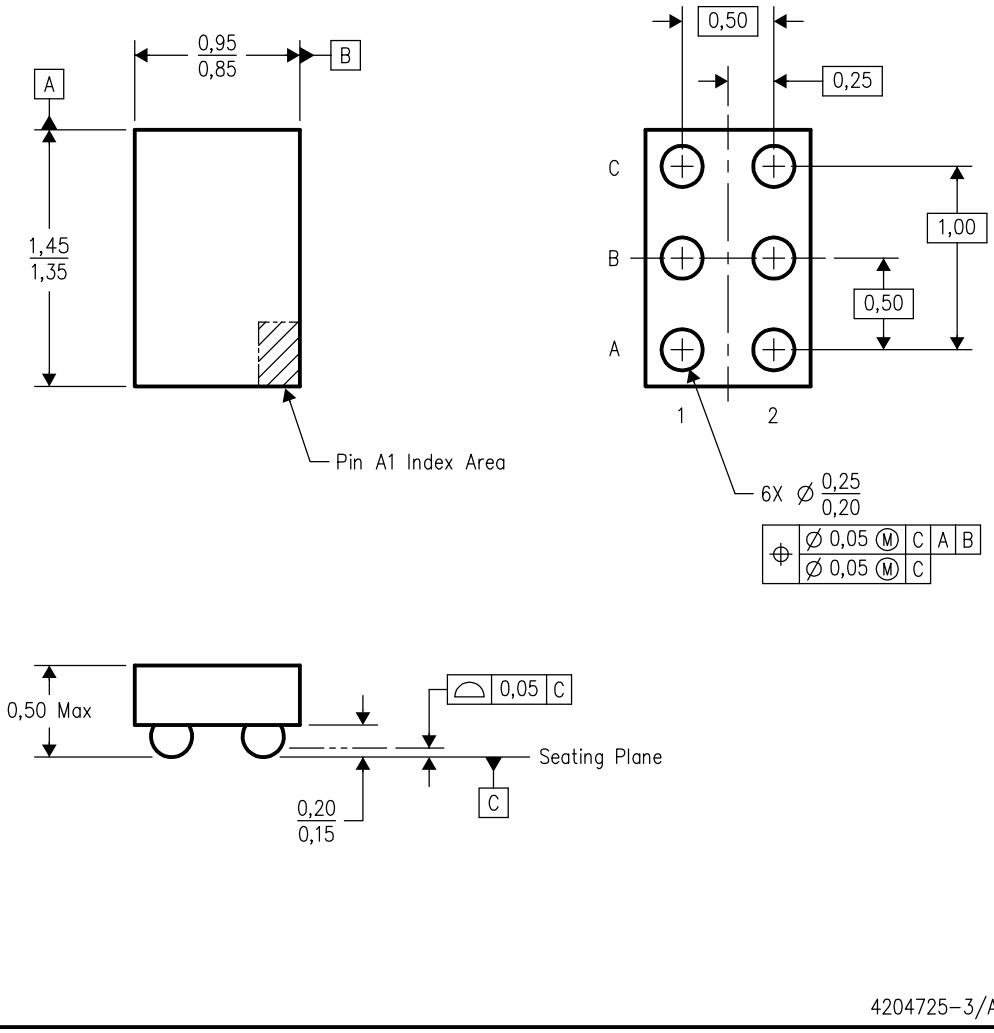
YEP (R–XBGA–N6) DIE–SIZE BALL GRID ARRAY



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. NanoStar™ package configuration.
D. This package is tin–lead (SnPb). Refer to the 6 YZP package (drawing 4204741) for lead–free.

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