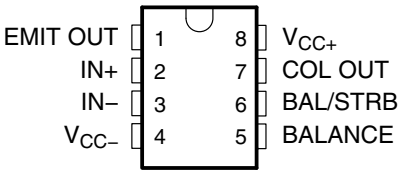
- **Low Power Drain . . . 900 μW Typical With 5-V Supply**
- **Operates From ±15 V or From a Single Supply as Low as 3 V**
- **Output Drive Capability of 25 mA**
- **Emitter Output Can Swing Below Negative Supply**
- **Response Time . . . 1.2 μs Typ**
- **Low Input Currents:**
  Offset Current . . . 2 nA Typ
  Bias Current . . . 15 nA Typ
- **Wide Common-Mode Input Range:**
  –14.5 V to 13.5 V Using ±15-V Supply
- **Offset Balancing and Strobe Capability**
- **Same Pinout as LM211, LM311**
- **Designed To Be Interchangeable With Industry-Standard LP311**

LP211 . . . D PACKAGE
LP311 . . . D, P, OR PS PACKAGE
(TOP VIEW)



description/ordering information

The LP211 and LP311 devices are low-power versions of the industry-standard LM211 and LM311 devices. They take advantage of stable, high-value, ion-implanted resistors to perform the same function as the LM311 series, with a 30:1 reduction in power consumption, but only a 6:1 slowdown in response time. They are well suited for battery-powered applications and all other applications where fast response times are not needed. They operate over a wide range of supply voltages, from ±18 V down to a single 3-V supply with less than 300-μA current drain, but are still capable of driving a 25-mA load. The LP211 and LP311 are quite easy to apply free of oscillation if ordinary precautions are taken to minimize stray coupling from the output to either input or to the trim pins. In addition, offset balancing is available to minimize input offset voltage. Strobe capability also is provided to turn off the output (regardless of the inputs) by pulling the strobe pin low.

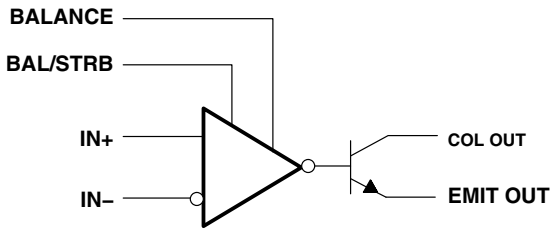
The LP211 is characterized for operation from –25°C to 85°C. The LP311 is characterized for operation from 0°C to 70°C.

ORDERING INFORMATION

T_A	V_{IO} max AT 25°C	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–0°C to 70°C	7.5 mV	PDIP (P)	Tube of 50	LP311P	LP311P
		SOIC (D)	Tube of 75	LP311D	LP311
			Reel of 2500	LP311DR	
		SOP (PS)	Reel of 2000	LP311PSR	L311
–25°C to 85°C	7.5 mV	SOIC (D)	Tube of 75	LP211D	LP211
			Reel of 2500	LP211DR	

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

functional block diagram



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

Supply voltage (see Note 1): V_{CC+} . . . . . 18 V
V_{CC-} . . . . . –18 V
Differential input voltage, V_{ID} (see Note 2) . . . . . ±30 V
Input voltage, V_I (either input, see Notes 1 and 3) . . . . . ±15 V
Voltage from emitter output to V_{CC-} . . . . . 30 V
Voltage from collector output to V_{CC-} . . . . . 40 V
Voltage from collector output to emitter output . . . . . 40 V
Duration of output short circuit (see Note 4) . . . . . 40 V
Package thermal impedance, θ_{JA} (see Notes 5 and 6): D package . . . . . 97°C/W
P package . . . . . 85°C/W
PS package . . . . . 95°C/W
Operating virtual junction temperature, T_J . . . . . 150°C
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 in the recommended operating conditions section of this specification is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES: 1. All voltage values, unless otherwise noted, are with respect to the midpoint between V_{CC+} and V_{CC-}.
2. Differential input voltages are at IN+ with respect to IN–.
3. The magnitude of the input voltage must never exceed the magnitude of the supply voltage of ±15 V, whichever is less.
4. The output may be shorted to ground or to either power supply.
5. Maximum power dissipation is a function of $T_J(max)$, θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) - T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.
6. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions

		MIN	MAX	UNIT
($\|V_{CC\pm}\| \le 15$ V)	Input voltage	V_{CC-} + 0.5	V_{CC+} – 1.5	V
$V_{CC+} - V_{CC-}$	Supply voltage	3.5	30	V

electrical characteristics at specified free-air temperature, $V_{CC\pm}$ = ±15 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A	MIN	TYP†	MAX	UNIT
V_{ID}	Input offset voltage	RS < 100 kΩ,	See Note 7	25°C		2	7.5	mV
				Full range			10	
V_{OL}	Low-level output voltage	V_{ID} < –10 mV, See Note 8	I_{OL} = 25 mA,	25°C		0.4	1.5	V
		V_{CC} = 4.5 V, V_{ID} < –10 mV, See Note 8	V_{CC-} = 0, I_{OL} = 1.6 mA,	Full range		0.1	0.4	
I_{IO}	Input offset current	See Note 7		25°C		2	25	nA
				Full range			35	
I_{IB}	Input bias current			25°C		15	100	nA
				Full range			150	
	Low-level strobe current	$V_{(strobe)}$ = 0.3 V, See Note 9	V_{ID} < –10 mV,	25°C		100	300	μA
$I_{O(off)}$	Output off-state current	V_{ID} > 10 mV,	V_{CE} = 35 V	25°C		0.2	100	nA
A_{VD}	Large-signal differential-voltage amplification	R_L = 5 kΩ		25°C	40	100		V/mV
I_{CC+}	Supply current from V_{CC+}	V_{ID} = –50 mV,	R_L = ∞	Full range		150	300	μA
I_{CC-}	Supply current from V_{CC-}	V_{ID} = 50 mV,	R_L = ∞	Full range		– 80	– 180	μA

† All typical values are at $V_{CC\pm}$ = ±15 V, T_A = 25°C.

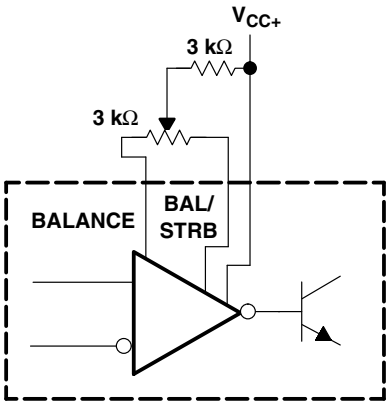
NOTES: 7. The offset voltages and offset currents given are the maximum values required to drive the output within 1 V of either supply with a 1-mA load. Thus, these parameters define an error band and take into account the worst-case effects of voltage gain and input impedance.
8. Voltages are with respect to EMIT OUT and V_{CC-} tied together.
9. The strobe should not be shorted to ground; it should be current driven at 100 μA to 300 μA.

switching characteristics, $V_{CC\pm}$ = ±5 V, T_A = 25°C (unless otherwise noted)

PARAMETER	TEST CONDITIONS	TYP	UNIT
Response time	See Note 10	1.2	μs

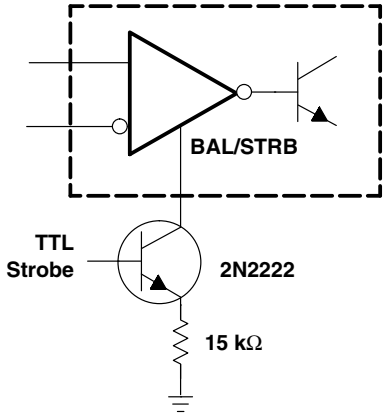
NOTE 10: The response time is specified for a 100-mV input step with 5-mV overdrive.

TYPICAL APPLICATION CIRCUIT



NOTE: If offset balancing is not used, the BALANCE and BAL/STRB pins should be shorted together.

Figure 1. Offset Balancing



NOTE: Do not connect strobe pin directly to ground, because the output is turned off whenever current is pulled from the strobe pin.

Figure 2. Strobing

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
LP211D	ACTIVE	SOIC	D	8	75	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-25 to 85	LP211	Samples
LP211DR	ACTIVE	SOIC	D	8	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-25 to 85	LP211	Samples
LP211DRG4	LIFEBUY	SOIC	D	8	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-25 to 85	LP211	
LP311D	ACTIVE	SOIC	D	8	75	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	LP311	Samples
LP311DR	ACTIVE	SOIC	D	8	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	LP311	Samples
LP311P	ACTIVE	PDIP	P	8	50	RoHS & Green	NIPDAU	N / A for Pkg Type	0 to 70	LP311P	Samples
LP311PE4	LIFEBUY	PDIP	P	8	50	RoHS & Green	NIPDAU	N / A for Pkg Type	0 to 70	LP311P	

(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.

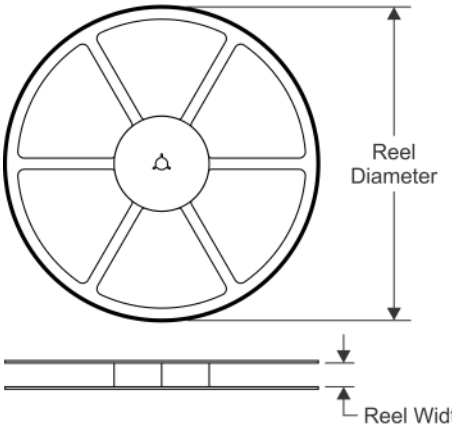
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(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.

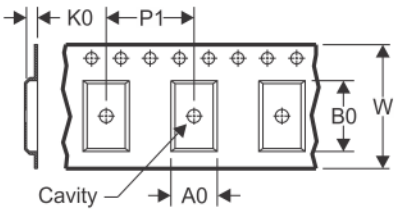
(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

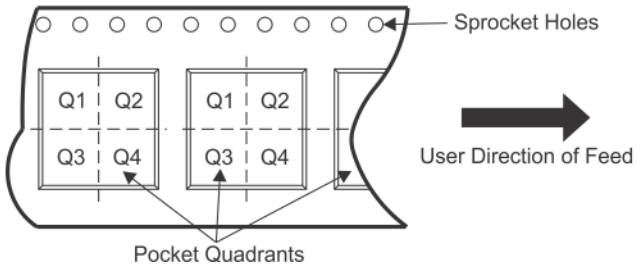


TAPE DIMENSIONS



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

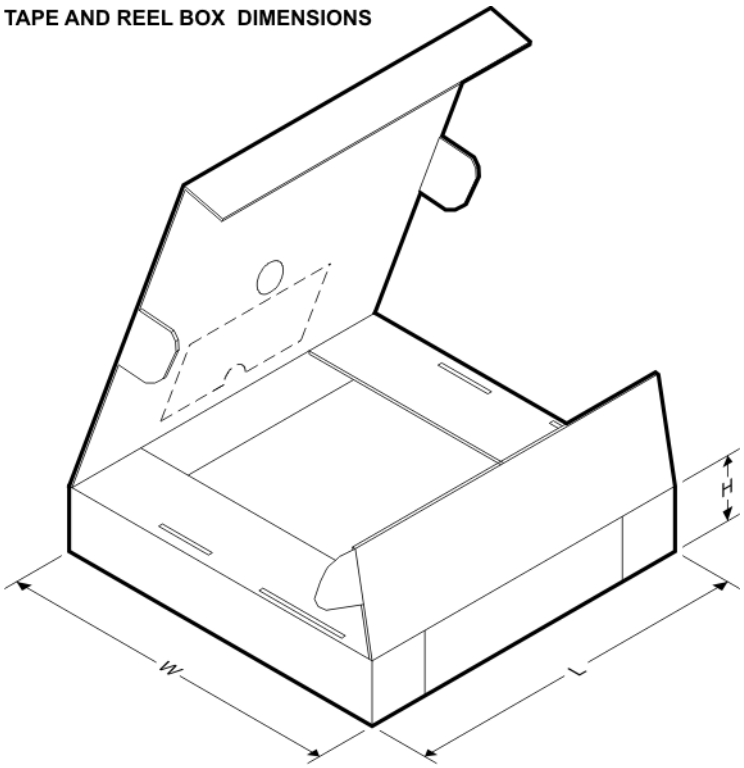
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
LP211DR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
LP311DR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1

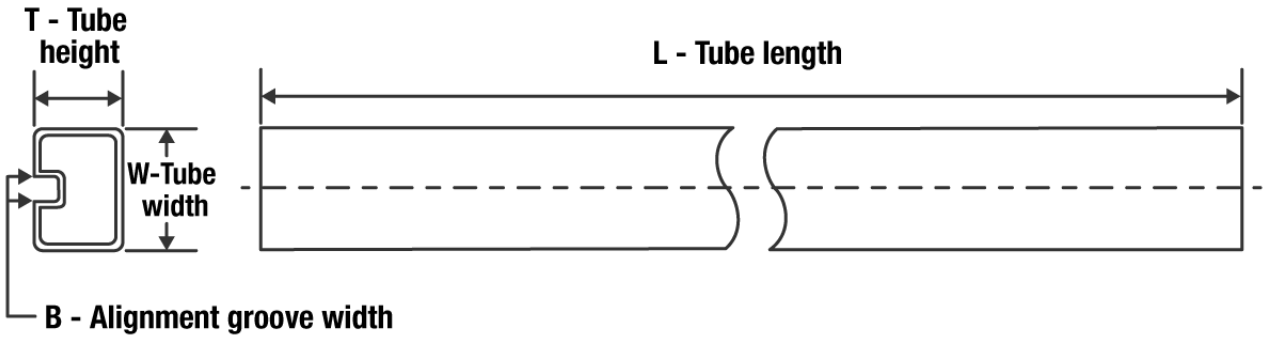
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

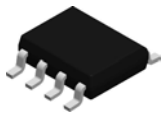
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LP211DR	SOIC	D	8	2500	340.5	336.1	25.0
LP311DR	SOIC	D	8	2500	340.5	336.1	25.0

TUBE



*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
LP211D	D	SOIC	8	75	507	8	3940	4.32
LP311D	D	SOIC	8	75	507	8	3940	4.32
LP311P	P	PDIP	8	50	506	13.97	11230	4.32
LP311PE4	P	PDIP	8	50	506	13.97	11230	4.32

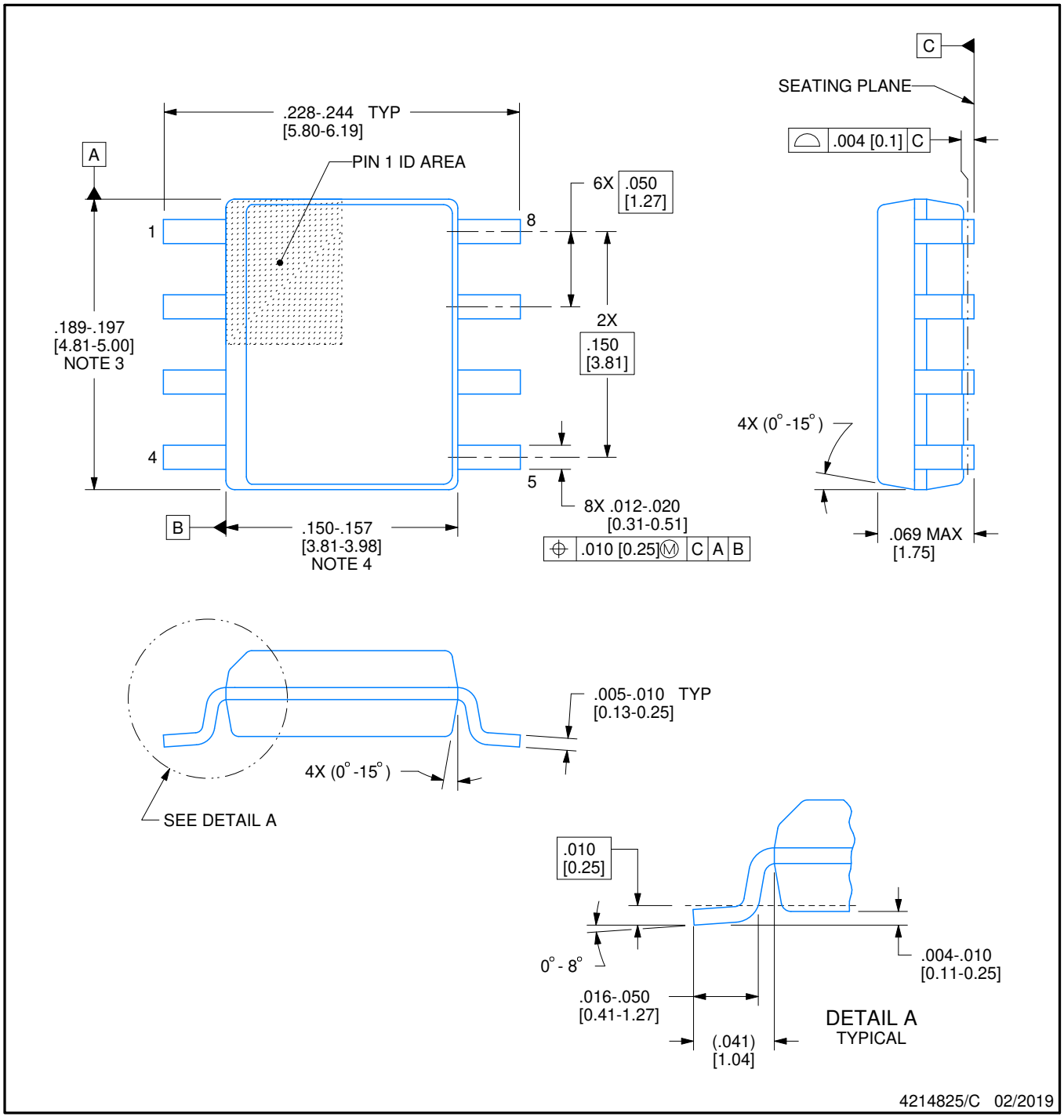


PACKAGE OUTLINE

D0008A

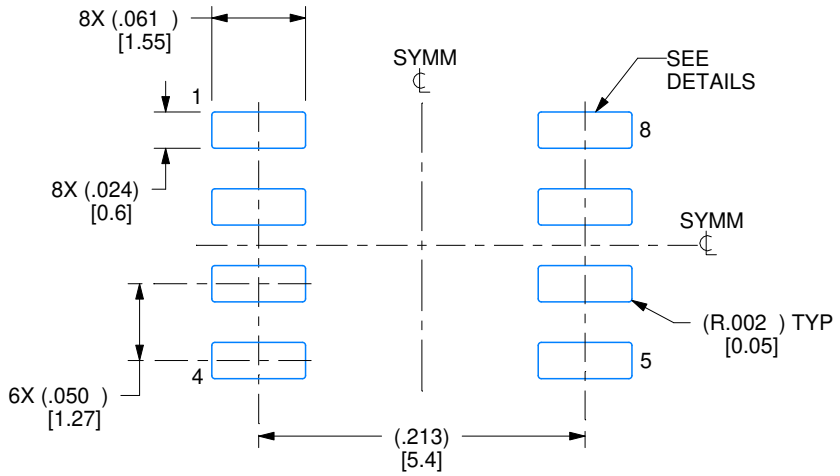
SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT

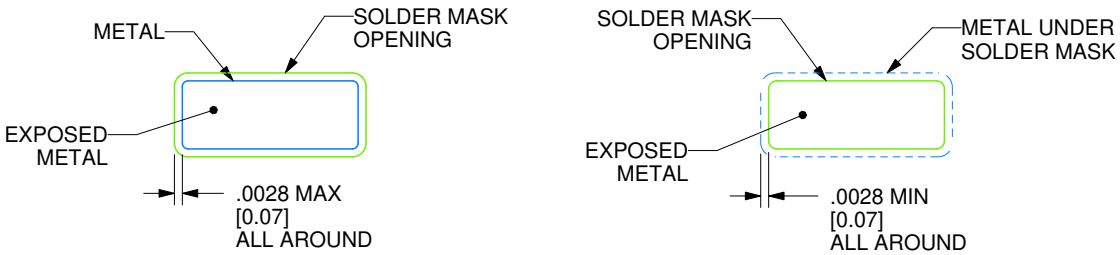


NOTES:

1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. 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 .006 [0.15] per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:8X



SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

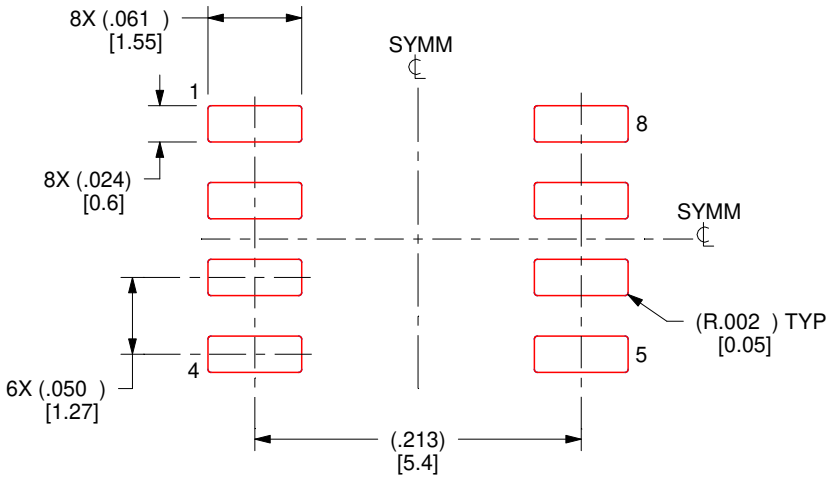
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



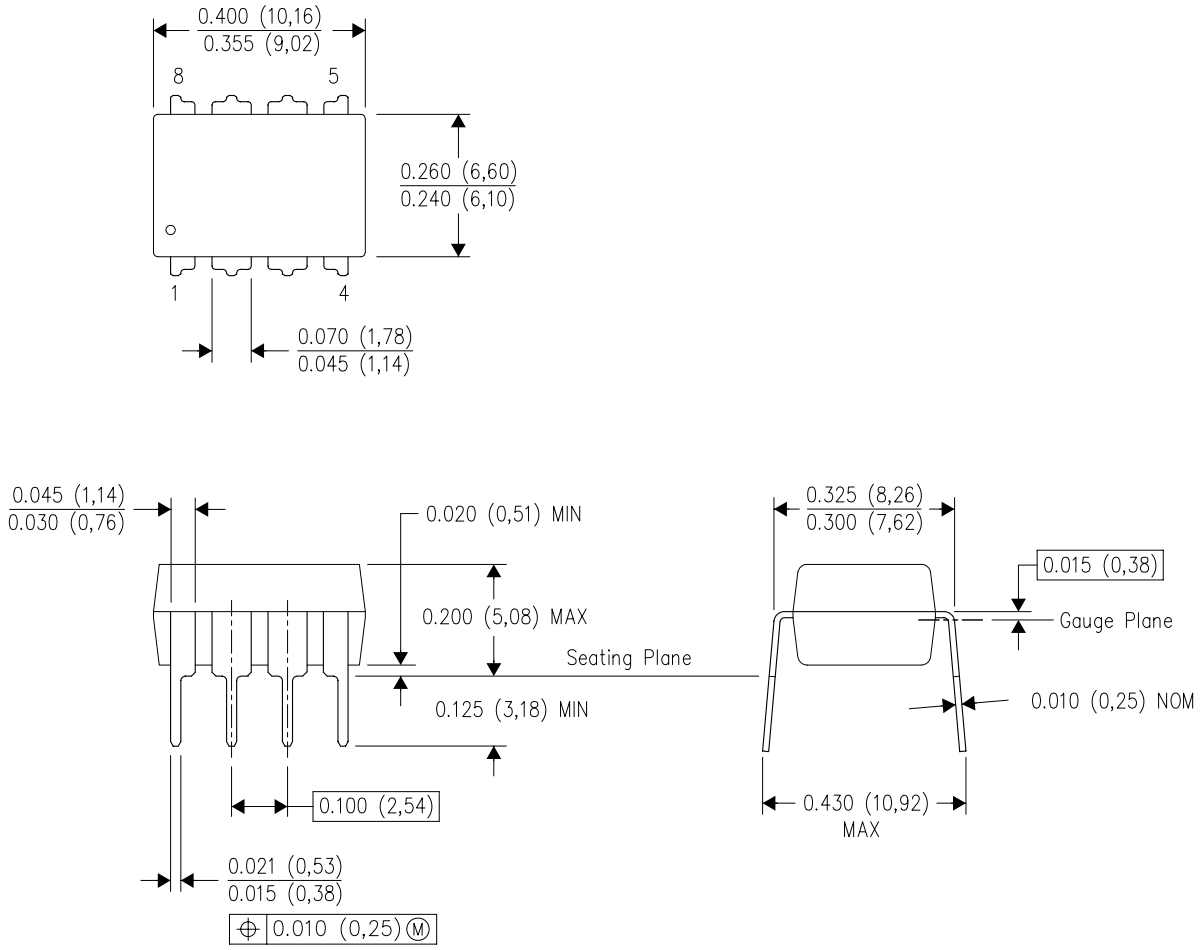
SOLDER PASTE EXAMPLE
BASED ON .005 INCH [0.125 MM] THICK STENCIL
SCALE:8X

4214825/C 02/2019

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.

P (R–PDIP–T8) PLASTIC DUAL–IN–LINE PACKAGE



NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS–001 variation BA.

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