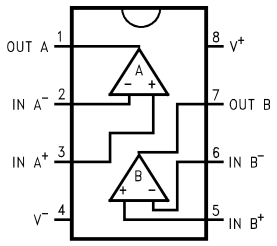
LMC6762 Dual MicroPower Rail-To-Rail Input CMOS Comparator with Push-Pull Output

1 FEATURES

- (Typical Unless Otherwise Noted)
- Low Power Consumption (Max): I_S = 10µA
- Wide Range of Supply Voltages: 2.7V to 15V
- Rail-To-Rail Input Common Mode Voltage Range
- Rail-To-Rail Output Swing (Within 100mV of the Supplies, @ V^+ = 2.7V, and I_{LOAD} = 2.5 mA)
- Short Circuit Protection: 40 mA
- Propagation Delay (@ V^+ = 5V, 100mV Overdrive): 420ns

2 APPLICATIONS

- Laptop Computers
- Mobile Phones
- Metering Systems
- Hand-Held Electronics
- RC Timers
- Alarm and Monitoring Circuits
- Window Comparators, Multivibrators



Connection Diagram - 8-Pin PDIP/SOIC Top View

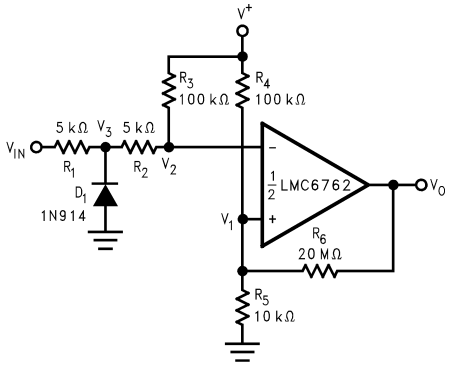
3 DESCRIPTION

The LMC6762 is an ultra low power dual comparator with a maximum supply current of 10 µA. It is designed to operate over a wide range of supply voltages, from 2.7V to 15V. The LMC6762 has ensured specifications at 2.7V to meet the demands of 3V digital systems.

The LMC6762 has an input common-mode voltage range which exceeds both supplies. This is a significant advantage in low-voltage applications. The LMC6762 also features a push-pull output that allows direct connections to logic devices without a pull-up resistor.

A quiescent power consumption of 50 µW (@ V^+ = 5V) makes the LMC6762 ideal for applications in portable phones and hand-held electronics. The ultra-low supply current is also independent of power supply voltage. Ensured operation at 2.7V and a rail-to-rail performance makes this device ideal for battery-powered applications.

Refer to the LMC6772 datasheet for an open-drain version of this device.



Typical Application - Zero Crossing Detector

An IMPORTANT NOTICE at the end of this data sheet addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers. PRODUCTION DATA.

4 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.

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5 Absolute Maximum Ratings (1) (2)

ESD Tolerance(3)	2KV
Differential Input Voltage	$(V^+)+0.3V$ to $(V^-)-0.3V$
Voltage at Input/Output Pin	$(V^+)+0.3V$ to $(V^-)-0.3V$
Supply Voltage ($V^+–V^-$)	16V
Current at Input Pin	±5mA
Current at Output Pin(5) (4)	±30mA
Current at Power Supply Pin, LMC6762	40mA
Lead Temperature (Soldering, 10 seconds)	260°C
Storage Temperature Range	−65°C to +150°C
Junction Temperature(6)	150°C

(1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not ensured. For ensured specifications and the test conditions, see the electrical characteristics.
(2) If Military/Aerospace specified devices are required, please contact the TI Sales Office/ Distributors for availability and specifications.
(3) Human body model, 1.5kΩ in series with 100pF.
(4) Applies to both single-supply and split-supply operation. Continuous short circuit operation at elevated ambient temperature can result in exceeding the maximum allowed junction temperature of 150°C. Output currents in excess of ±30 mA over long term may adversely affect reliability.
(5) Do not short circuit output to V^+, when V^+ is greater than 12V or reliability will be adversely affected.
(6) The maximum power dissipation is a function of $T_{J(max)}$, θ_{JA}, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(max)} – T_A)/\theta_{JA}$.All numbers apply for packages soldered directly into a PC board.

6 Operating Ratings (1)

Supply Voltage		$2.7 \le V_S \le 15V$
Junction Temperature Range	LMC6762AI, LMC6762BI	$-40°C \le T_J \le +85°C$
Thermal Resistance (θ_{JA})	D0008A Package, 8-Pin SOICD0008A Package, 8-Pin SOIC	136°C/W

(1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not ensured. For ensured specifications and the test conditions, see the electrical characteristics.

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7 2.7V Electrical Characteristics

Unless otherwise specified, all limits ensured for T_J = 25°C, V^+ = 2.7V, V^- = 0V, V_{CM} = V^+/2. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions	Typ[1]	LMC6762AI	LMC6762BI	Units
				Limit[2]	Limit[2]	
V_{OS}	Input Offset Voltage		3	5 **8**	15 **18**	mV max
TCV_{OS}	Input Offset VoltageTemperature Drift		2.0			µV/°C
I_B	Input Current		0.02			pA
I_{OS}	Input Offset Current		0.01			pA
CMRR	Common Mode Rejection Ratio		75			dB
PSRR	Power Supply Rejection Ratio	±1.35V < V_S < ±7.5V	80			dB
A_V	Voltage Gain	(By Design)	100			dB
V_{CM}	Input Common-Mode Voltage Range	CMRR > 55dB	3.0	2.9 **2.7**	2.9 **2.7**	V min
			−0.3	−0.2 **0.0**	−0.2 **0.0**	V max
V_{OH}	Output Voltage High	I_{LOAD} = 2.5mA	2.5	2.4 **2.3**	2.4 **2.3**	V min
V_{OL}	Output Voltage Low	I_{LOAD} = 2.5mA	0.2	0.3 **0.4**	0.3 **0.4**	V max
I_S	Supply Current	For Both Comparators (Output Low)	12	20 **25**	20 **25**	µA max

(1) Typical Values represent the most likely parametric norm.
(2) All limits are specified by testing or statistical analysis.

8 5.0V and 15.0V Electrical Characteristics

Unless otherwise specified, all limits ensured for T_J = 25°C, V^+ = 5.0V and 15.0V, V^- = 0V, V_{CM} = V^+/2. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions	Typ[1]	LMC6762AI	LMC6762BI	Units
				Limit[2]	Limit[1]	
V_{OS}	Input Offset Voltage		3	5 **8**	15 **18**	mV max
TCV_{OS}	Input Offset VoltageTemperature Drift	V^+ = 5V	2.0			µV/°C
I_B	Input Current	V = 5V	0.04			pA
I_{OS}	Input Offset Current	V^+ = 5V	0.02			pA
CMRR	Common Mode Rejection Ratio	V^+ = 5V	75			dB
		V^+ = 15V	82			dB
PSRR	Power Supply Rejection Ratio	±2.5V < V_S < ±5V	80			dB
A_V	Voltage Gain	(By Design)	100			dB

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Unless otherwise specified, all limits ensured for T_J = 25°C, V^+ = 5.0V and 15.0V, V^- = 0V, V_{CM} = V^+/2. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions	Typ[1]	LMC6762AI	LMC6762BI	Units
				Limit[2]	Limit[1]	
V_{CM}	Input Common-Mode Voltage Range	V^+ = 5.0V CMRR > 55dB	5.3	5.2 **5.0**	5.2 **5.0**	V min
			−0.3	−0.2 **0.0**	−0.2 **0.0**	V max
		V^+ = 15V CMRR > 55dB	15.3	15.2 **15.0**	15.2 **15.0**	V min
			−0.3	−0.2 **0.0**	−0.2 **0.0**	V max
V_{OH}	Output Voltage High	V^+ = 5V I_{LOAD} = 5mA	4.8	4.6 **4.45**	4.6 **4.45**	V min
		V^+ = 15V I_{LOAD} = 5mA	14.8	14.6 **14.45**	14.6 **14.45**	V min
V_{OL}	Output Voltage Low	V^+ = 5V I_{LOAD} = 5mA	0.2	0.4 **0.55**	0.4 **0.55**	V max
		V^+ = 15V I_{LOAD} = 5mA	0.2	0.4 **0.55**	0.4 **0.55**	V max
I_S	Supply Current	For Both Comparators (Output Low)	12	20 **25**	20 **25**	µA max
I_{SC}	Short Circuit Current	Sourcing	30			mA
		Sinking, V_O = 12V[3]	45			

(1) Typical Values represent the most likely parametric norm.
(2) All limits are specified by testing or statistical analysis.
(3) Do not short circuit output to V^+, when V^+ is greater than 12V or reliability will be adversely affected.

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9 AC Electrical Characteristics

Unless otherwise specified, all limits ensured for T_J = 25°C, V^+ = 5V, V^- = 0V, V_{CM} = V_O = V^+/2. **Boldface** limits apply at the temperature extreme.

Symbol	Parameter	Conditions		Typ(1)	LMC6762AI	LMC6762BI	Units
					Limit(2)	Limit(2)	
t_{RISE}	Rise Time	f = 10kHz, C_L = 50pF, Overdrive = 10mV(3)		15			ns
t_{FALL}	Fall Time	f = 10kHz, C_L = 50pF, Overdrive = 10mV(3)		15			ns
t_{PHL}	Propagation Delay (High to Low)	f = 10kHz, C_L = 50pF(3)	Overdrive = 10mV	900			ns
			Overdrive = 100mV	450			ns
t_{PLH}	Propagation Delay (Low to High)	f = 10kHz, C_L = 50pF(3)	Overdrive = 10mV	900			ns
			Overdrive = 100mV	420			ns

(1) Typical Values represent the most likely parametric norm.
(2) All limits are specified by testing or statistical analysis.
(3) C_L includes the probe and jig capacitance.

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10 Typical Characteristics

T_A = 25°C, V_S = 12V, R_{PULLUP} = 2.5k, C_L = 20pF, V_{CM} = 0V, $V_{UNDERDRIVE}$ = 100mV, $V_{OVERDRIVE}$ = 100mV unless otherwise noted.

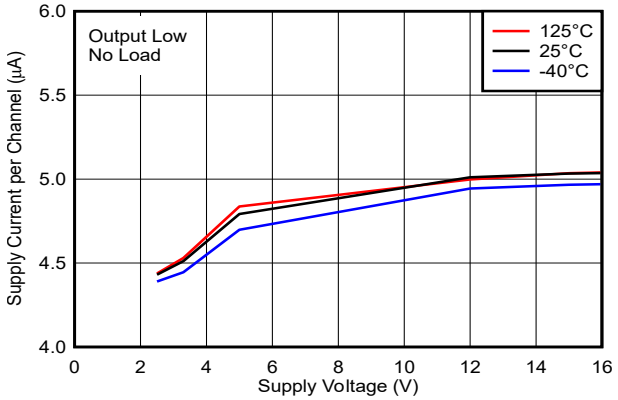

Figure 10-1. Supply Current per Channel vs. Supply Voltage, Output Low

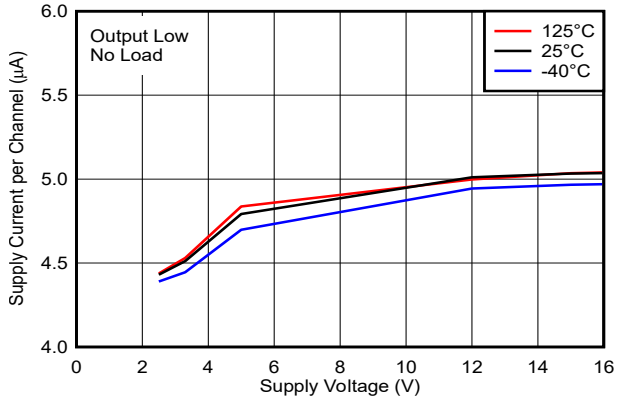

Figure 10-2. Supply Current per Channel vs. Supply Voltage, Output High

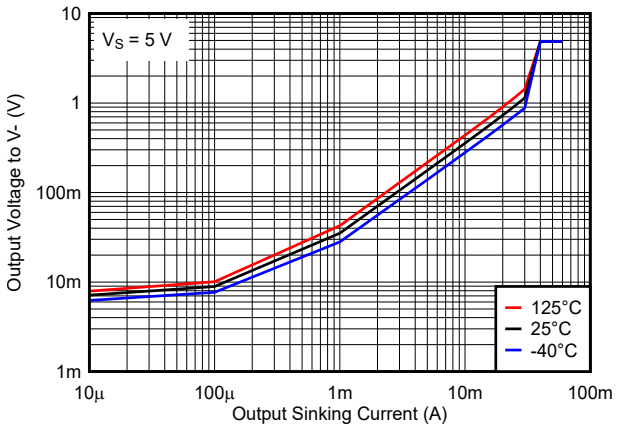

Figure 10-3. Output Voltage vs. Output Sinking Current, 5V

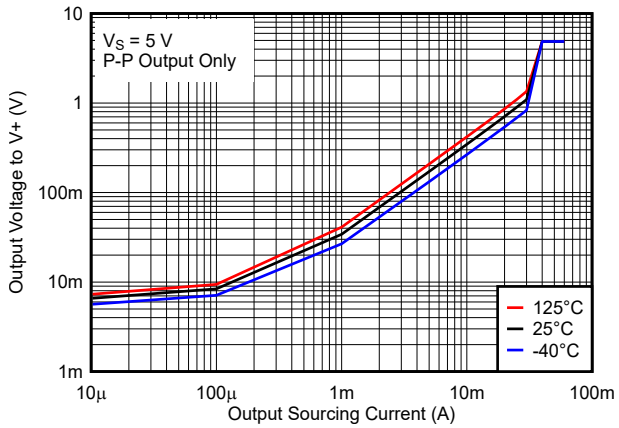

Figure 10-4. Output Voltage vs. Output Sourcing Current, 5V

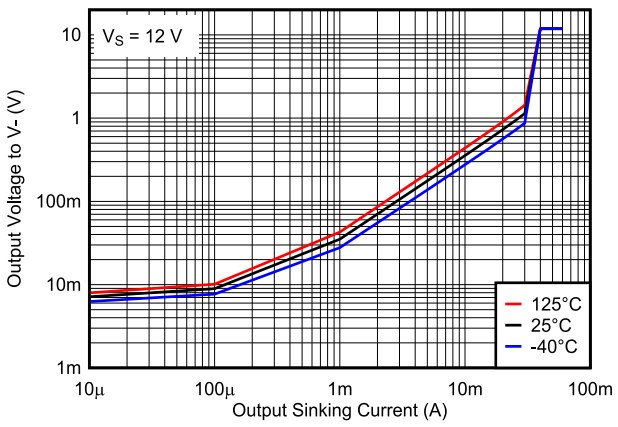

Figure 10-5. Output Voltage vs. Output Sinking Current, 12V

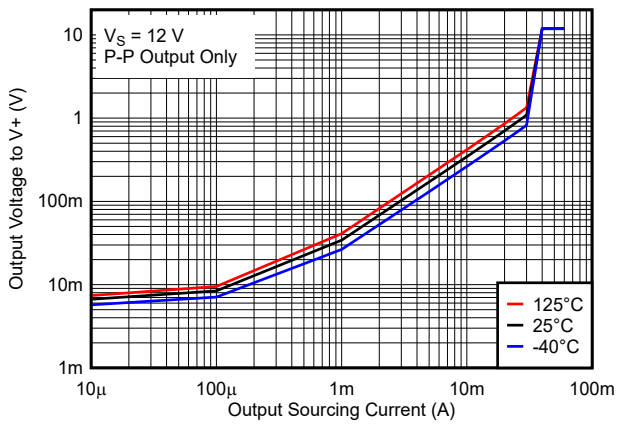

Figure 10-6. Output Voltage vs. Output Sourcing Current, 12V

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10 Typical Characteristics (continued)

T_A = 25°C, V_S = 12V, R_{PULLUP} = 2.5k, C_L = 20pF, V_{CM} = 0V, $V_{UNDERDRIVE}$ = 100mV, $V_{OVERDRIVE}$ = 100mV unless otherwise noted.

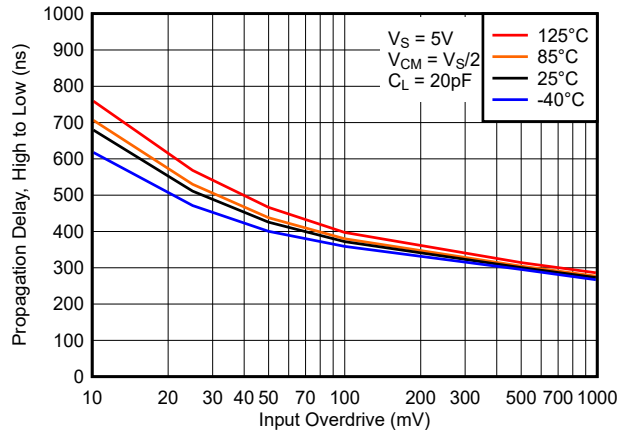

Figure 10-7. Propagation Delay, High to Low, 5V

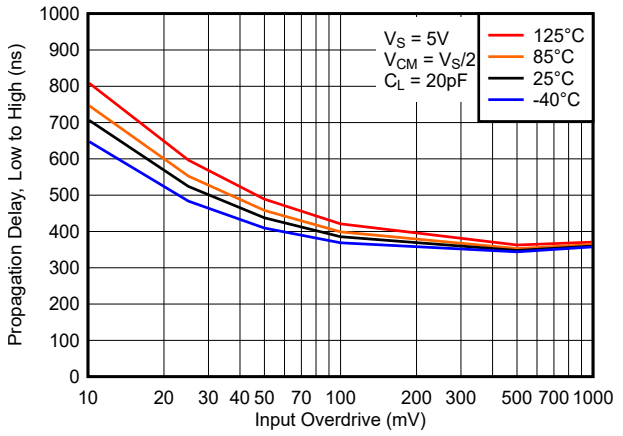

Figure 10-8. Propagation Delay, Low to High, 5V

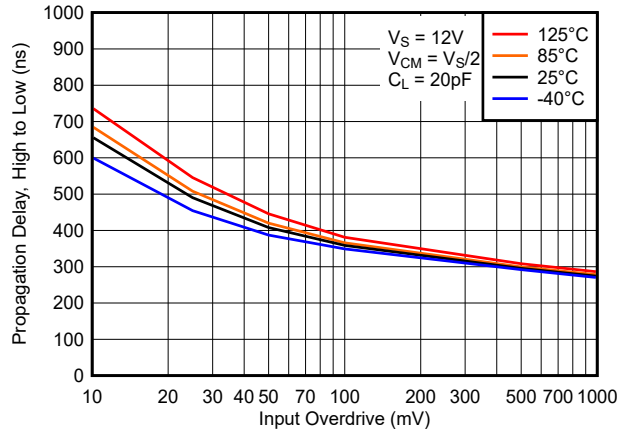

Figure 10-9. Propagation Delay, High to Low, 12V

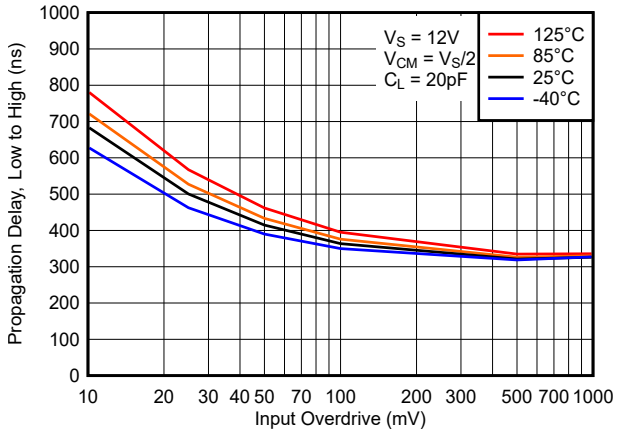

Figure 10-10. Propagation Delay, Low to High, 12V

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11 Application Hints

11.1 Input Common-Mode Voltage Range

At supply voltages of 2.7V, 5V and 15V, the LMC6762 has an input common-mode voltage range which exceeds both supplies. As in the case of operational amplifiers, CMVR is defined by the V_{OS} shift of the comparator over the common-mode range of the device. A CMRR ($\Delta V_{OS}/\Delta V_{CM}$) of 75dB (typical) implies a shift of < 1mV over the entire common-mode range of the device. The absolute maximum input voltage at V^+ = 5V is 200mV beyond either supply rail at room temperature.

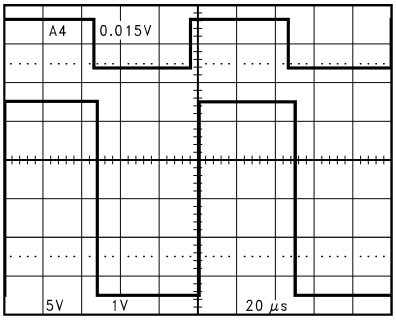

Figure 11-1. An Input Signal Exceeds the LMC6762 Power Supply Voltages with No Output Phase Inversion

A wide input voltage range means that the comparator can be used to sense signals close to ground and also to the power supplies. This is an extremely useful feature in power supply monitoring circuits.

An input common-mode voltage range that exceeds the supplies, 20fA input currents (typical), and a high input impedance makes the LMC6762 ideal for sensor applications. The LMC6762 can directly interface to sensors without the use of amplifiers or bias circuits. In circuits with sensors which produce outputs in the tens to hundreds of millivolts, the LMC6762 can compare the sensor signal with an appropriately small reference voltage. This reference voltage can be close to ground or the positive supply rail.

11.2 Low Voltage Operation

Comparators are the common devices by which analog signals interface with digital circuits. The LMC6762 has been designed to operate at supply voltages of 2.7V without sacrificing performance to meet the demands of 3V digital systems.

At supply voltages of 2.7V, the common-mode voltage range extends 200mV (maintained) below the negative supply. This feature, in addition to the comparator being able to sense signals near the positive rail, is extremely useful in low voltage applications.

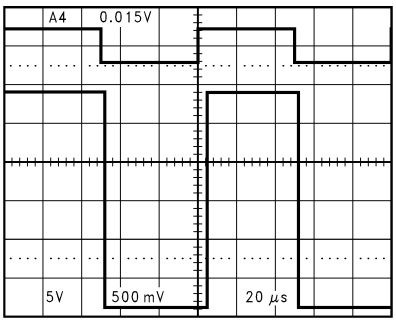

Figure 11-2. Even at Low-Supply Voltage of 2.7V, an Input Signal which Exceeds the Supply Voltages Produces No Phase Inversion at the Output

At V^+ = 2.7V, propagation delays are t_{PLH} = 420ns and t_{PHL} = 450ns with overdrives of 100mV. Please refer to the Section 10 for more extensive characterization.

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11.3 Output Short Circuit Current

The LMC6762 has short circuit protection of 40mA. However, it is not designed to withstand continuous short circuits, transient voltage or current spikes, or shorts to any voltage beyond the supplies. A resistor is series with the output should reduce the effect of shorts. For outputs which send signals off PC boards additional protection devices, such as diodes to the supply rails, and varistors may be used.

11.4 Hysteresis

If the input signal is very noisy, the comparator output might trip several times as the input signal repeatedly passes through the threshold. This problem can be addressed by making use of hysteresis as shown below.

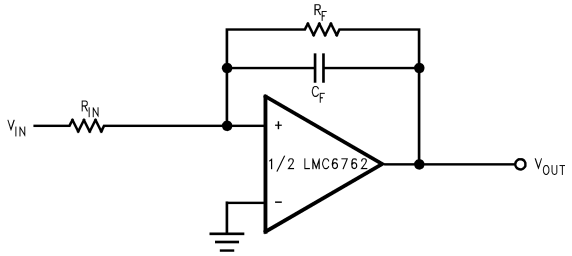

Figure 11-3. Canceling the Effect of Input Capacitance

The capacitor added across the feedback resistor increases the switching speed and provides more short term hysteresis. This can result in greater noise immunity for the circuit.

11.5 Spice Macromodel

A Spice Macromodel is available for the LMC6762. The model includes a simulation of:

- Input common-mode voltage range
- Quiescent and dynamic supply current
- Input overdrive characteristics

and many more characteristics as listed on the macromodel disk.

A SPICE macromodel of this and many other op amps is available at no charge from the WEBENCH Design Center Team at http://www.ti.com/ww/en/analog/webench/

11.6 Typical Applications

11.6.1 One-Shot Multivibrator

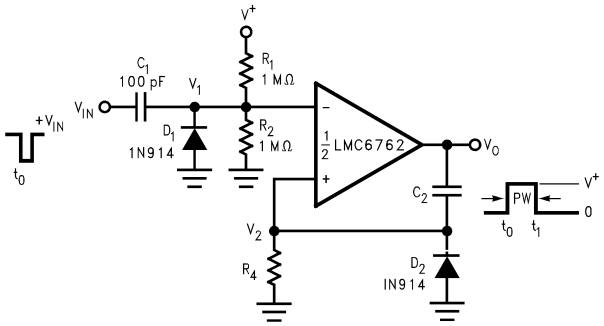

Figure 11-4. One-Shot Multivibrator

A monostable multivibrator has one stable state in which it can remain indefinitely. It can be triggered externally to another quasi-stable state. A monostable multivibrator can thus be used to generate a pulse of desired width.

The desired pulse width is set by adjusting the values of C_2 and R_4. The resistor divider of R_1 and R_2 can be used to determine the magnitude of the input trigger pulse. The LMC6762 will change state when $V_1 < V_2$. Diode

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D_2 provides a rapid discharge path for capacitor C_2 to reset at the end of the pulse. The diode also prevents the non-inverting input from being driven below ground.

11.6.2 Bi-Stable Multivibrator

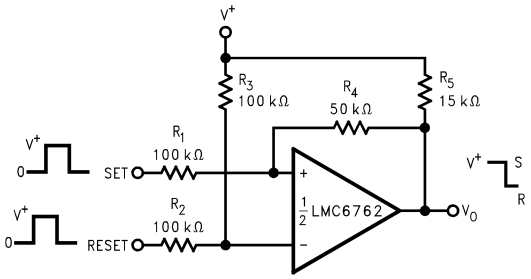

Figure 11-5. Bi-Stable Multivibrator

A bi-stable multivibrator has two stable states. The reference voltage is set up by the voltage divider of R_2 and R_3. A pulse applied to the SET terminal will switch the output of the comparator high. The resistor divider of R_1, R_4, and R_5 now clamps the non-inverting input to a voltage greater than the reference voltage. A pulse applied to RESET will now toggle the output low.

11.6.3 Zero Crossing Detector

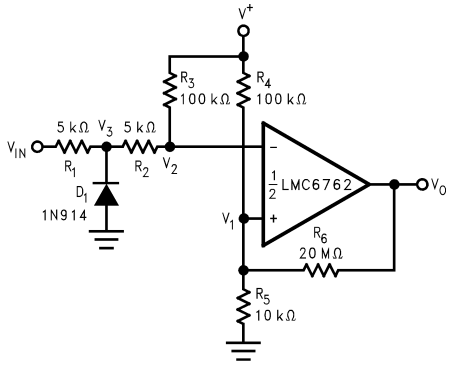

Figure 11-6. Zero Crossing Detector

A voltage divider of R_4 and R_5 establishes a reference voltage V_1 at the non-inverting input. By making the series resistance of R_1 and R_2 equal to R_5, the comparator will switch when V_{IN} = 0. Diode D_1 insures that V_3 never drops below −0.7V. The voltage divider of R_2 and R_3 then prevents V_2 from going below ground. A small amount of hysteresis is setup to ensure rapid output voltage transitions.

11.6.4 Oscillator

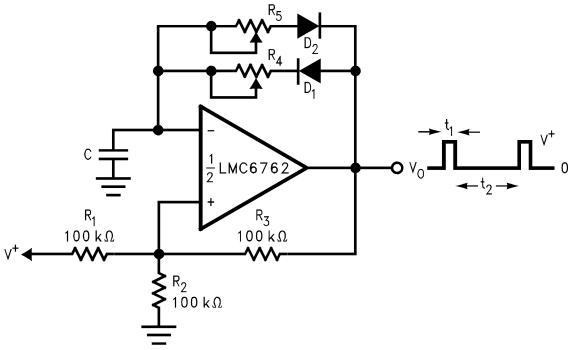

Figure 11-7. Square Wave Generator

Figure 11-7 shows the application of the LMC6762 in a square wave generator circuit. The total hysteresis of the loop is set by R_1, R_2 and R_3. R_4 and R_5 provide separate charge and discharge paths for the capacitor C. The charge path is set through R_4 and D_1. So, the pulse width t_1 is determined by the RC time constant of R_4 and C. Similarly, the discharge path for the capacitor is set by R_5 and D_2. Thus, the time t_2 between the pulses can be changed by varying R_5, and the pulse width can be altered by R_4. The frequency of the output can be changed by varying both R_4 and R_5.

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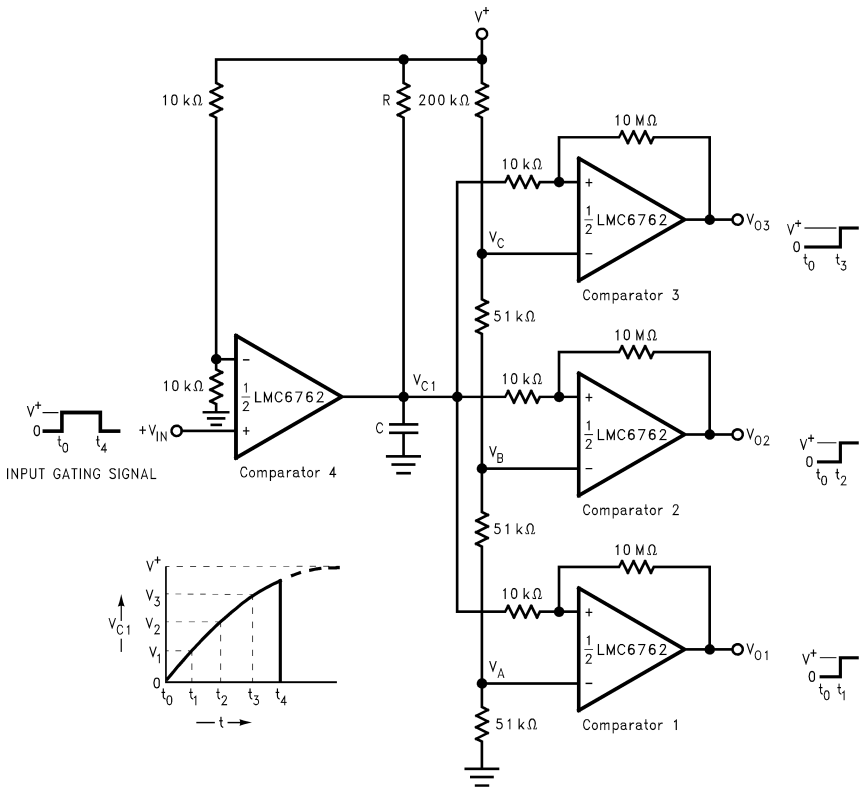

Figure 11-8. Time Delay Generator

The circuit shown above provides output signals at a prescribed time interval from a time reference and automatically resets the output when the input returns to ground. Consider the case of V_{IN} = 0. The output of comparator 4 is also at ground. This implies that the outputs of comparators 1, 2, and 3 are also at ground. When an input signal is applied, the output of comparator 4 swings high and C charges exponentially through R. This is indicated above.

The output voltages of comparators 1, 2, and 3 switch to the high state when V_{C1} rises above the reference voltage V_A, V_B and V_C. A small amount of hysteresis has been provided to insure fast switching when the RC time constant is chosen to give long delay times.

12 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision D (March 2013) to Revision E (November 2025)	Page
• Updated typical input offset voltage drift over time from Electrical Characteristics	4
• Updated AC Electrical Characteristics throughout document	6
• Updated typical performance curves and removed Shoot-Through Current graphs	7

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Changes from Revision C (March 2013) to Revision D (March 2013)	Page
• Changed layout of National Data Sheet to TI format	11

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
LMC6762AIM	Obsolete	Production	SOIC (D) | 8	-	-	Call TI	Call TI	-40 to 85	LMC67 62AIM
LMC6762AIM.B	Obsolete	Production	SOIC (D) | 8	-	-	Call TI	Call TI	-40 to 85	LMC67 62AIM
LMC6762AIM/NOPB	Obsolete	Production	SOIC (D) | 8	-	-	Call TI	Call TI	-40 to 85	LMC67 62AIM
LMC6762AIMX	Obsolete	Production	SOIC (D) | 8	-	-	Call TI	Call TI	-40 to 85	LMC67 62AIM
LMC6762AIMX/NOPB	Active	Production	SOIC (D) | 8	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	(6762AI, LMC67) 62AIM
LMC6762AIMX/NOPB.A	Active	Production	SOIC (D) | 8	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	(6762AI, LMC67) 62AIM
LMC6762BIM	Obsolete	Production	SOIC (D) | 8	-	-	Call TI	Call TI	-40 to 85	LMC67 62BIM
LMC6762BIM/NOPB	Obsolete	Production	SOIC (D) | 8	-	-	Call TI	Call TI	-40 to 85	LMC67 62BIM
LMC6762BIMX/NOPB	Active	Production	SOIC (D) | 8	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	(6762BI, LMC67) 62BIM
LMC6762BIMX/NOPB.A	Active	Production	SOIC (D) | 8	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	(6762BI, LMC67) 62BIM

(1) **Status:** For more details on status, see our product life cycle.

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

(4) **Lead finish/Ball material:** Parts 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.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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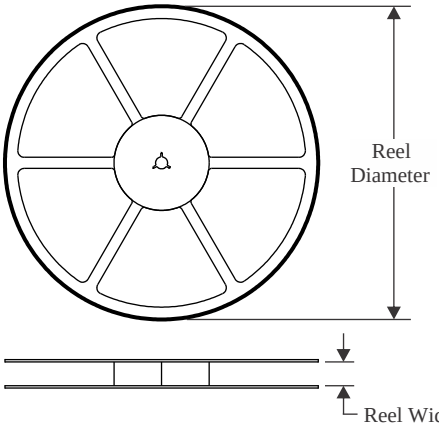
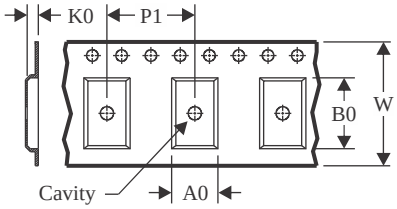
TAPE AND REEL INFORMATION

REEL DIMENSIONS

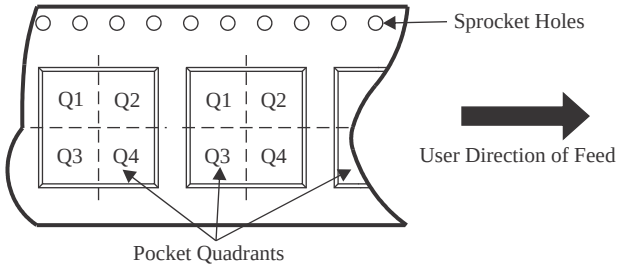


TAPE DIMENSIONS



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

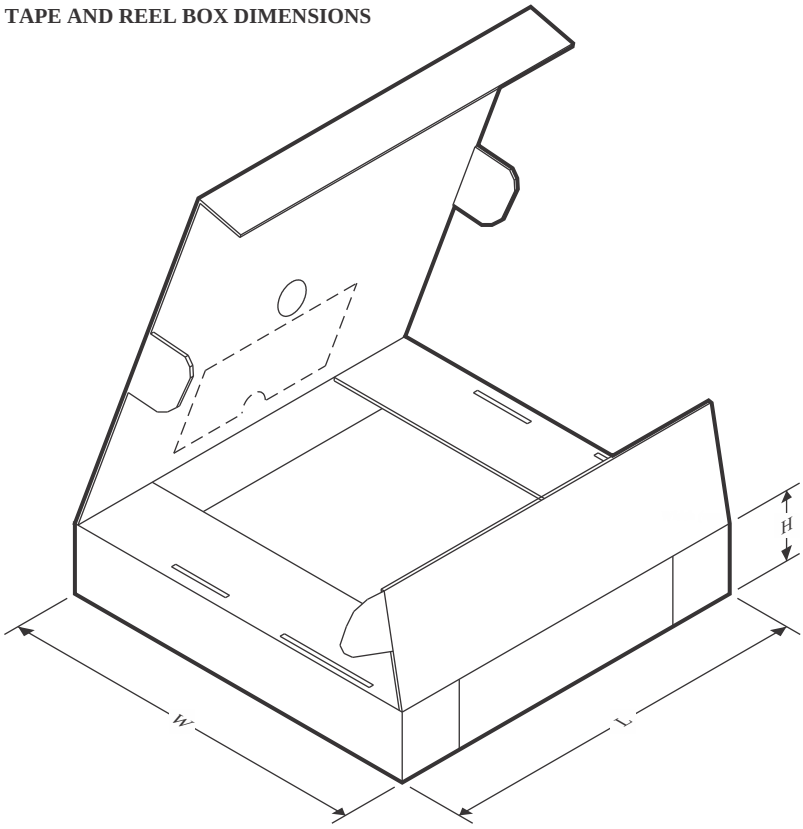
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

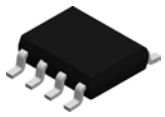
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
LMC6762AIMX/NOPB	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
LMC6762BIMX/NOPB	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LMC6762AIMX/NOPB	SOIC	D	8	2500	353.0	353.0	32.0
LMC6762BIMX/NOPB	SOIC	D	8	2500	353.0	353.0	32.0

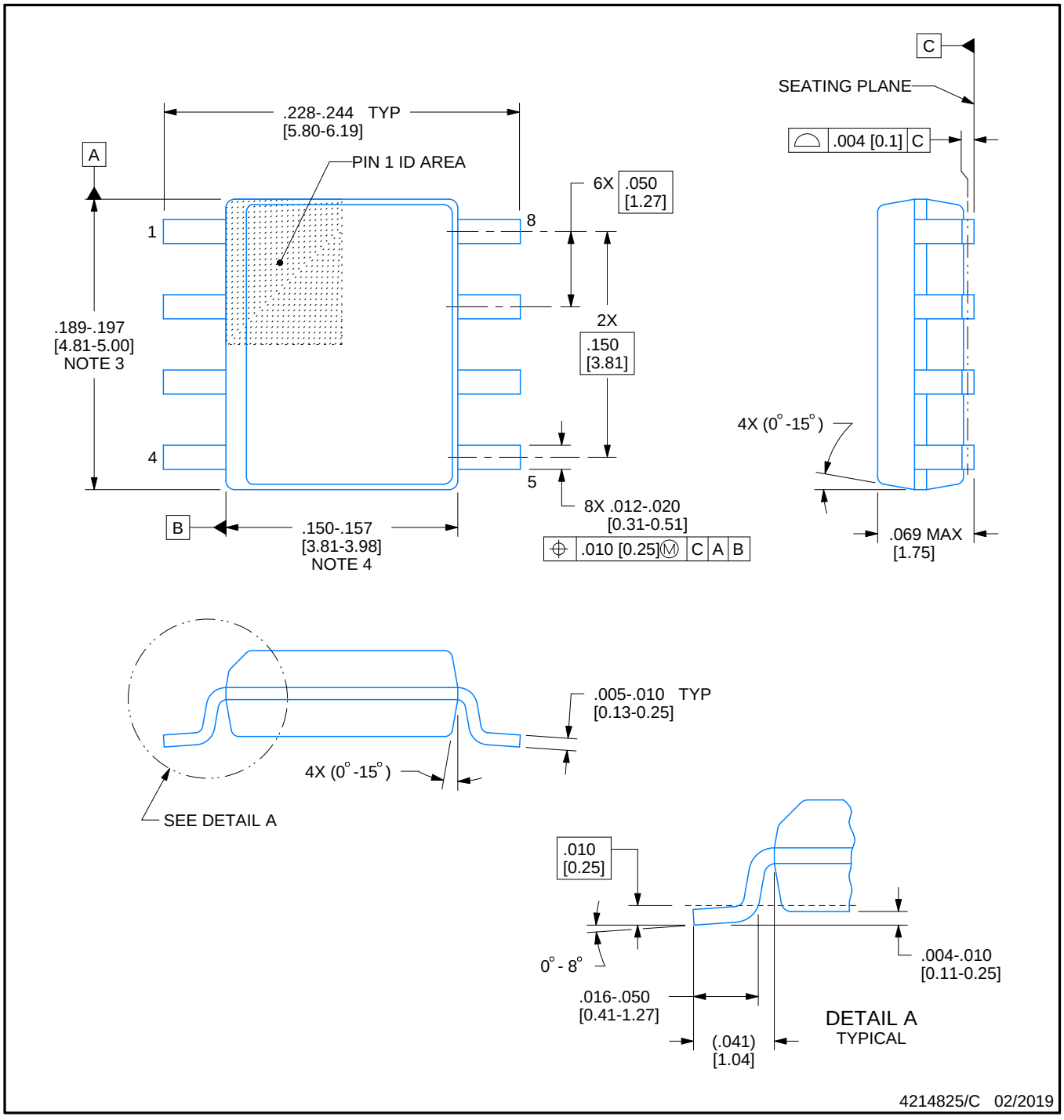


PACKAGE OUTLINE

D0008A

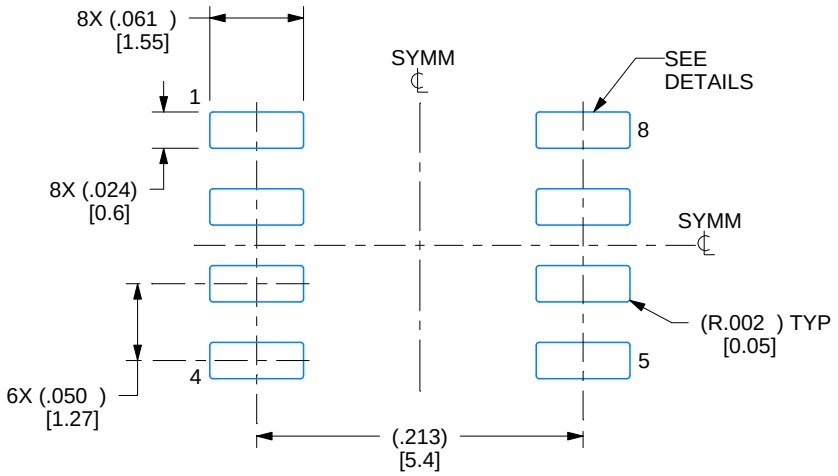
SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT

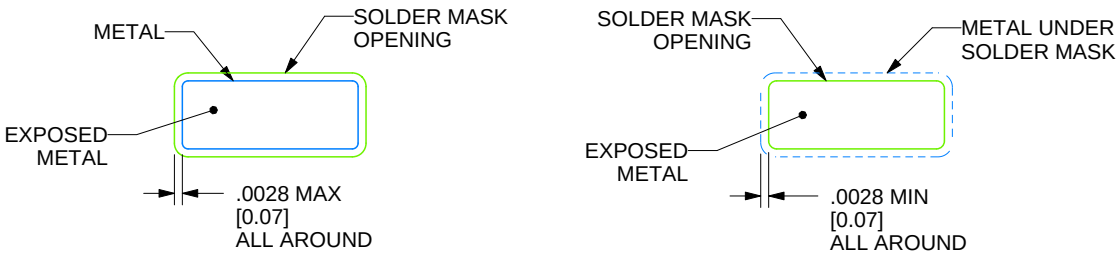


NOTES:

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)

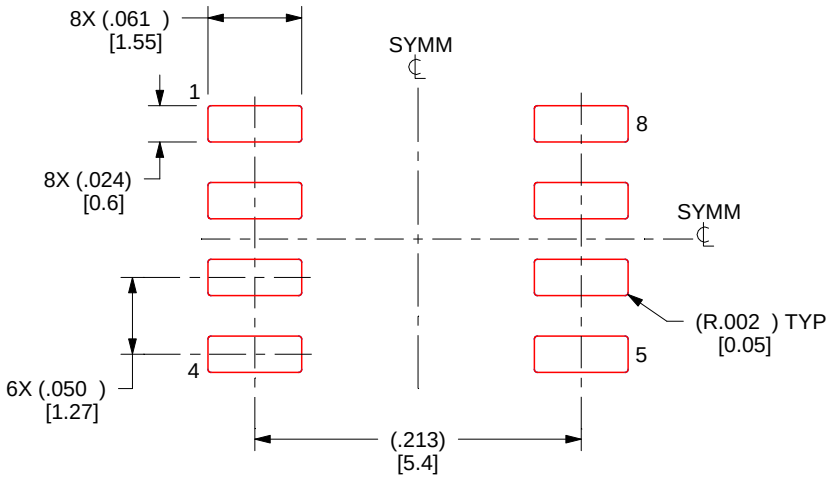
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

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.

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