

LM567/LM567C Tone Decoder

 Check for Samples: [LM567](#), [LM567C](#)

FEATURES

- 20 to 1 frequency range with an external resistor
- Logic compatible output with 100 mA current sinking capability
- Bandwidth adjustable from 0 to 14%
- High rejection of out of band signals and noise
- Immunity to false signals
- Highly stable center frequency
- Center frequency adjustable from 0.01 Hz to

500 kHz

APPLICATIONS

- Touch tone decoding
- Precision oscillator
- Frequency monitoring and control
- Wide band FSK demodulation
- Ultrasonic controls
- Carrier current remote controls
- Communications paging decoders

DESCRIPTION

The LM567 and LM567C are general purpose tone decoders designed to provide a saturated transistor switch to ground when an input signal is present within the passband. The circuit consists of an I and Q detector driven by a voltage controlled oscillator which determines the center frequency of the decoder. External components are used to independently set center frequency, bandwidth and output delay.

Connection Diagram

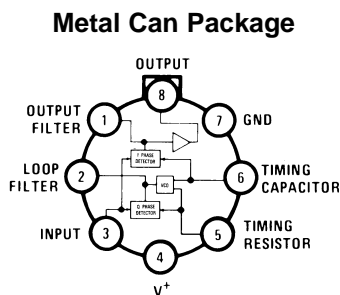


Figure 1. Top View
Order Number LM567H or LM567CH
See NS Package Number H08C
OBSOLETE



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Dual-In-Line and Small Outline Packages

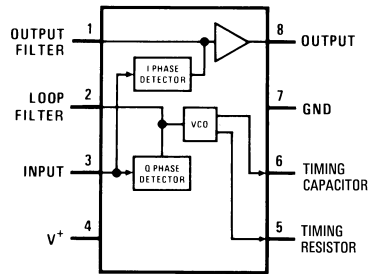


Figure 2. Top View
Order Number LM567CM
See NS Package Number M08A
Order Number LM567CN
See NS Package Number N08E



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

Absolute Maximum Ratings ⁽¹⁾

Supply Voltage Pin	9V
Power Dissipation ⁽²⁾	1100 mW
V_8	15V
V_3	-10V
V_3	$V_4 + 0.5V$
Storage Temperature Range	-65°C to +150°C
Operating Temperature Range	
LM567H	-55°C to +125°C
LM567CH, LM567CM, LM567CN	0°C to +70°C
Soldering Information	
Dual-In-Line Package	
Soldering (10 sec.)	260°C
Small Outline Package	
Vapor Phase (60 sec.)	215°C
Infrared (15 sec.)	220°C
See AN-450 "Surface Mounting Methods and Their Effect on Product Reliability" for other methods of soldering surface mount devices.	

- (1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not guarantee specific performance limits. Electrical Characteristics state DC and AC electrical specifications under particular test conditions which guarantee specific performance limits. This assumes that the device is within the Operating Ratings. Specifications are not guaranteed for parameters where no limit is given, however, the typical value is a good indication of device performance.
- (2) The maximum junction temperature of the LM567 and LM567C is 150°C. For operating at elevated temperatures, devices in the TO-5 package must be derated based on a thermal resistance of 150°C/W, junction to ambient or 45°C/W, junction to case. For the DIP the device must be derated based on a thermal resistance of 110°C/W, junction to ambient. For the Small Outline package, the device must be derated based on a thermal resistance of 160°C/W, junction to ambient.

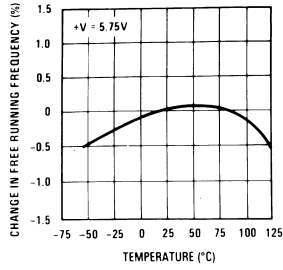
Electrical Characteristics

 AC Test Circuit, $T_A = 25^\circ\text{C}$, $V^+ = 5\text{V}$

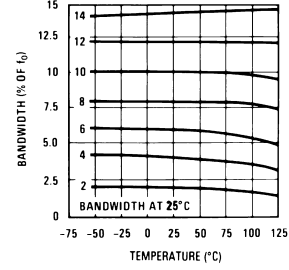
Parameters	Conditions	LM567			LM567C/LM567CM			Units
		Min	Typ	Max	Min	Typ	Max	
Power Supply Voltage Range		4.75	5.0	9.0	4.75	5.0	9.0	V
Power Supply Current Quiescent	$R_L = 20\text{k}$		6	8		7	10	mA
Power Supply Current Activated	$R_L = 20\text{k}$		11	13		12	15	mA
Input Resistance		18	20		15	20		k Ω
Smallest Detectable Input Voltage	$I_L = 100\text{ mA}$, $f_i = f_o$		20	25		20	25	mVrms
Largest No Output Input Voltage	$I_C = 100\text{ mA}$, $f_i = f_o$	10	15		10	15		mVrms
Largest Simultaneous Outband Signal to Inband Signal Ratio			6			6		dB
Minimum Input Signal to Wideband Noise Ratio	$B_n = 140\text{ kHz}$		-6			-6		dB
Largest Detection Bandwidth		12	14	16	10	14	18	% of f_o
Largest Detection Bandwidth Skew			1	2		2	3	% of f_o
Largest Detection Bandwidth Variation with Temperature			± 0.1			± 0.1		%/ $^\circ\text{C}$
Largest Detection Bandwidth Variation with Supply Voltage	4.75–6.75V		± 1	± 2		± 1	± 5	%V
Highest Center Frequency		100	500		100	500		kHz
Center Frequency Stability (4.75–5.75V)	$0 < T_A < 70$ $-55 < T_A < +125$		35 ± 60 35 ± 140			35 ± 60 35 ± 140		ppm/ $^\circ\text{C}$ ppm/ $^\circ\text{C}$
Center Frequency Shift with Supply Voltage	4.75V–6.75V 4.75V–9V		0.5	1.0 2.0		0.4	2.0 2.0	%/V %/V
Fastest ON-OFF Cycling Rate			$f_o/20$			$f_o/20$		
Output Leakage Current	$V_g = 15\text{V}$		0.01	25		0.01	25	μA
Output Saturation Voltage	$e_i = 25\text{ mV}$, $I_g = 30\text{ mA}$ $e_i = 25\text{ mV}$, $I_g = 100\text{ mA}$		0.2 0.6	0.4 1.0		0.2 0.6	0.4 1.0	V
Output Fall Time			30			30		ns
Output Rise Time			150			150		ns

Typical Performance Characteristics

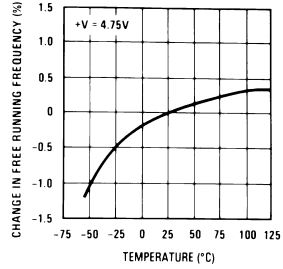
Typical Frequency Drift



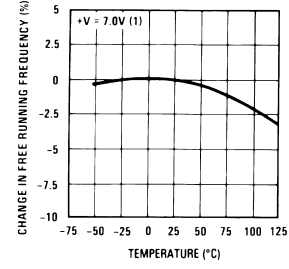
Typical Bandwidth Variation



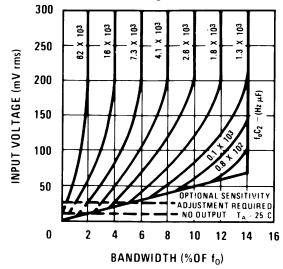
Typical Frequency Drift



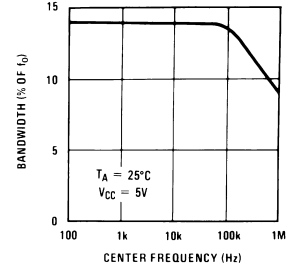
Typical Frequency Drift



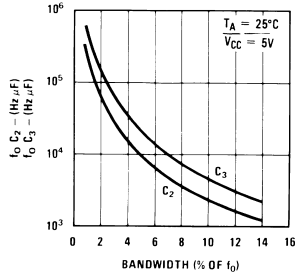
Bandwidth vs Input Signal Amplitude



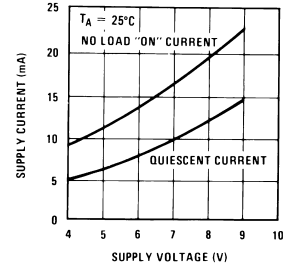
Largest Detection Bandwidth



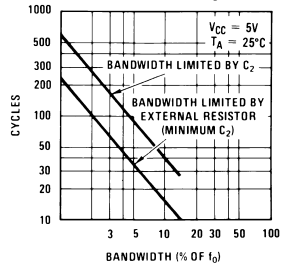
Detection Bandwidth as a Function of C2 and C3



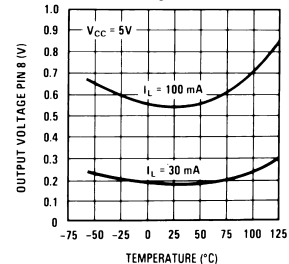
Typical Supply Current vs Supply Voltage



Greatest Number of Cycles Before Output

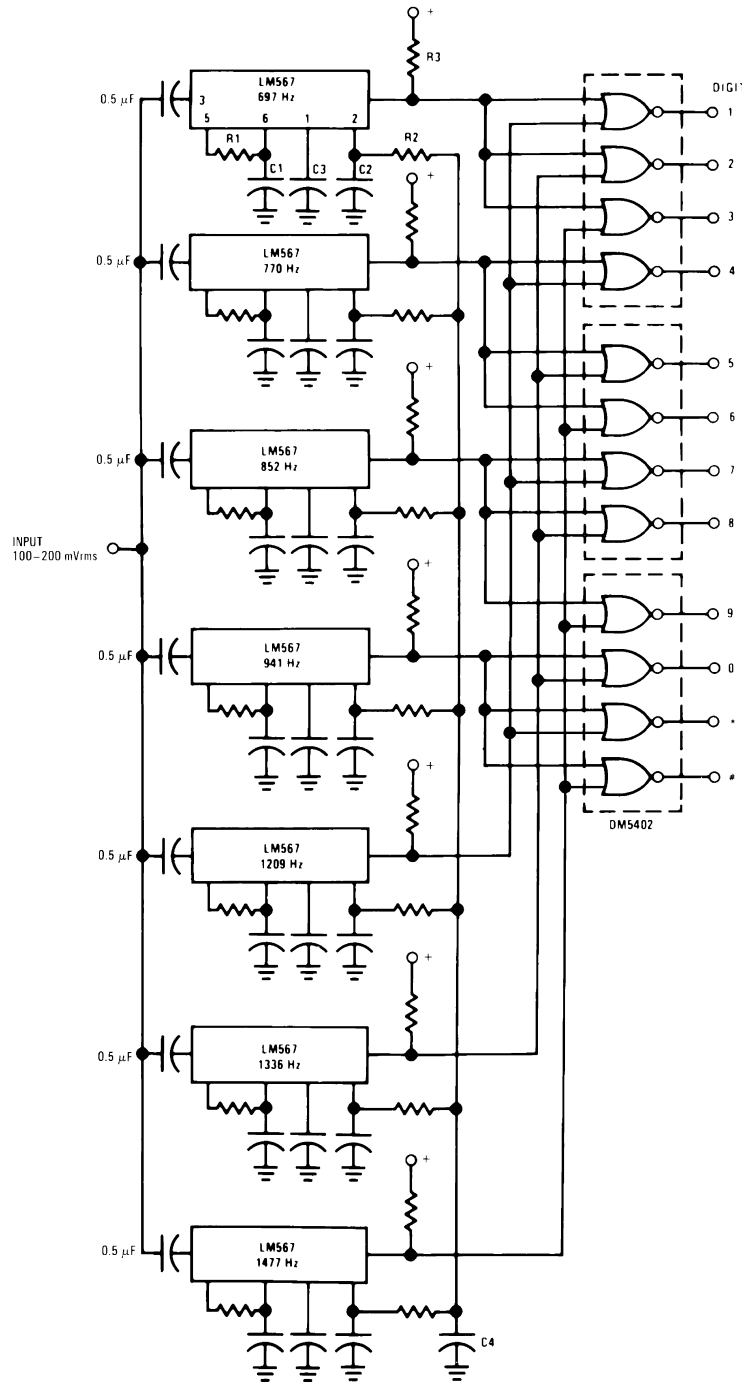


Typical Output Voltage vs Temperature



Typical Applications

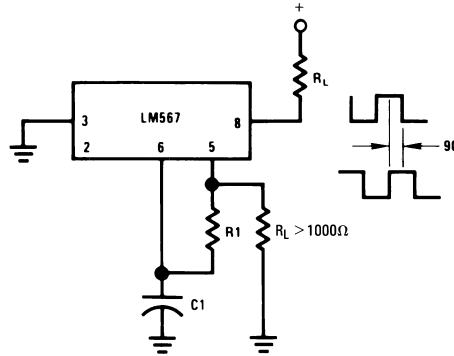
Figure 3. Touch-Tone Decoder



Component values (typ)

- R1 6.8 to 15k
- R2 4.7k
- R3 20k
- C1 0.10 mfd
- C2 1.0 mfd 6V
- C3 2.2 mfd 6V
- C4 250 mfd 6V

Figure 4. Oscillator with Quadrature Output



Connect Pin 3 to 2.8V to Invert Output

Figure 5. Oscillator with Double Frequency Output

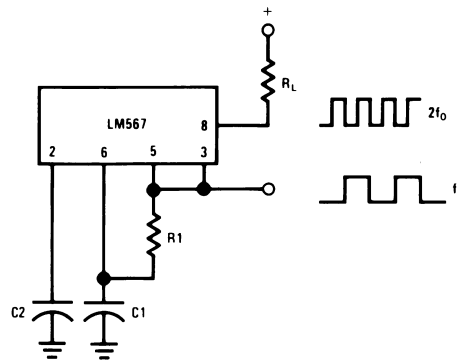
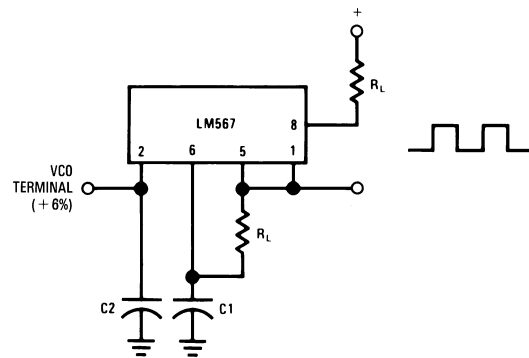
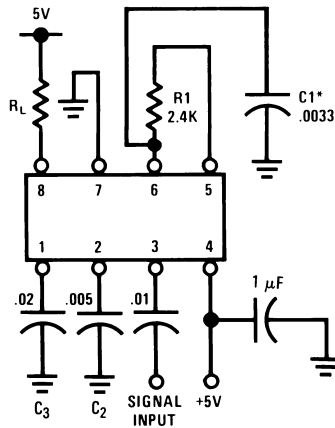


Figure 6. Precision Oscillator Drive 100 mA Loads



AC Test Circuit



$f_i = 100 \text{ kHz} + 5V$

*Note: Adjust for $f_o = 100 \text{ kHz}$.

Applications Information

The center frequency of the tone decoder is equal to the free running frequency of the VCO. This is given by

$$f_o \cong \frac{1}{1.1 R_1 C_1} \tag{1}$$

The bandwidth of the filter may be found from the approximation

$$BW = 1070 \sqrt{\frac{V_i}{f_o C_2}} \text{ in \% of } f_o \tag{2}$$

Where:

V_i = Input voltage (volts rms), $V_i \leq 200\text{mV}$

C_2 = Capacitance at Pin 2(μF)

**LM567C MDC MWC
Tone Decoder**

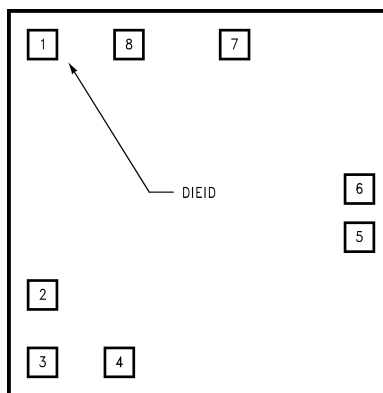


Figure 7. Die Layout (C - Step)

Table 1. Die/Wafer Characteristics

Fabrication Attributes		General Die Information	
Physical Die Identification	LM567C	Bond Pad Opening Size (min)	91 μm x 91 μm
Die Step	C	Bond Pad Metalization	0.5% COPPER_BAL. ALUMINUM

Table 1. Die/Wafer Characteristics (continued)

Physical Attributes		Passivation	VOM NITRIDE
Wafer Diameter	150mm	Back Side Metal	BARE BACK
Dise Size (Drawn)	1600 μ m x 1626 μ m 63.0mils x 64.0mils	Back Side Connection	Floating
Thickness	406 μ m Nominal		
Min Pitch	198 μ m Nominal		

Special Assembly Requirements:
Note: Actual die size is rounded to the nearest micron.
Die Bond Pad Coordinate Locations (C - Step)

 (Referenced to die center, coordinates in μ m) NC = No Connection, N.U. = Not Used

SIGNAL NAME	PAD# NUMBER	X/Y COORDINATES		PAD SIZE		
		X	Y	X		Y
OUTPUT FILTER	1	-673	686	91	x	91
LOOP FILTER	2	-673	-419	91	x	91
INPUT	3	-673	-686	91	x	91
V+	4	-356	-686	91	x	91
TIMING RES	5	673	-122	91	x	91
TIMING CAP	6	673	76	91	x	91
GND	7	178	686	117	x	91
OUTPUT	8	-318	679	117	x	104

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PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Samples (Requires Login)
LM567CM	ACTIVE	SOIC	D	8	95	TBD	CU SNPB	Level-1-235C-UNLIM	
LM567CM/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
LM567CMX/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
LM567CN	ACTIVE	PDIP	P	8	40	TBD	Call TI	Level-1-NA-UNLIM	
LM567CN/NOPB	ACTIVE	PDIP	P	8	40	Green (RoHS & no Sb/Br)	Call TI	Level-1-NA-UNLIM	
NE567V	ACTIVE	PDIP	P	8	40	TBD	Call TI	Level-1-NA-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.

OBSELETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), 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.

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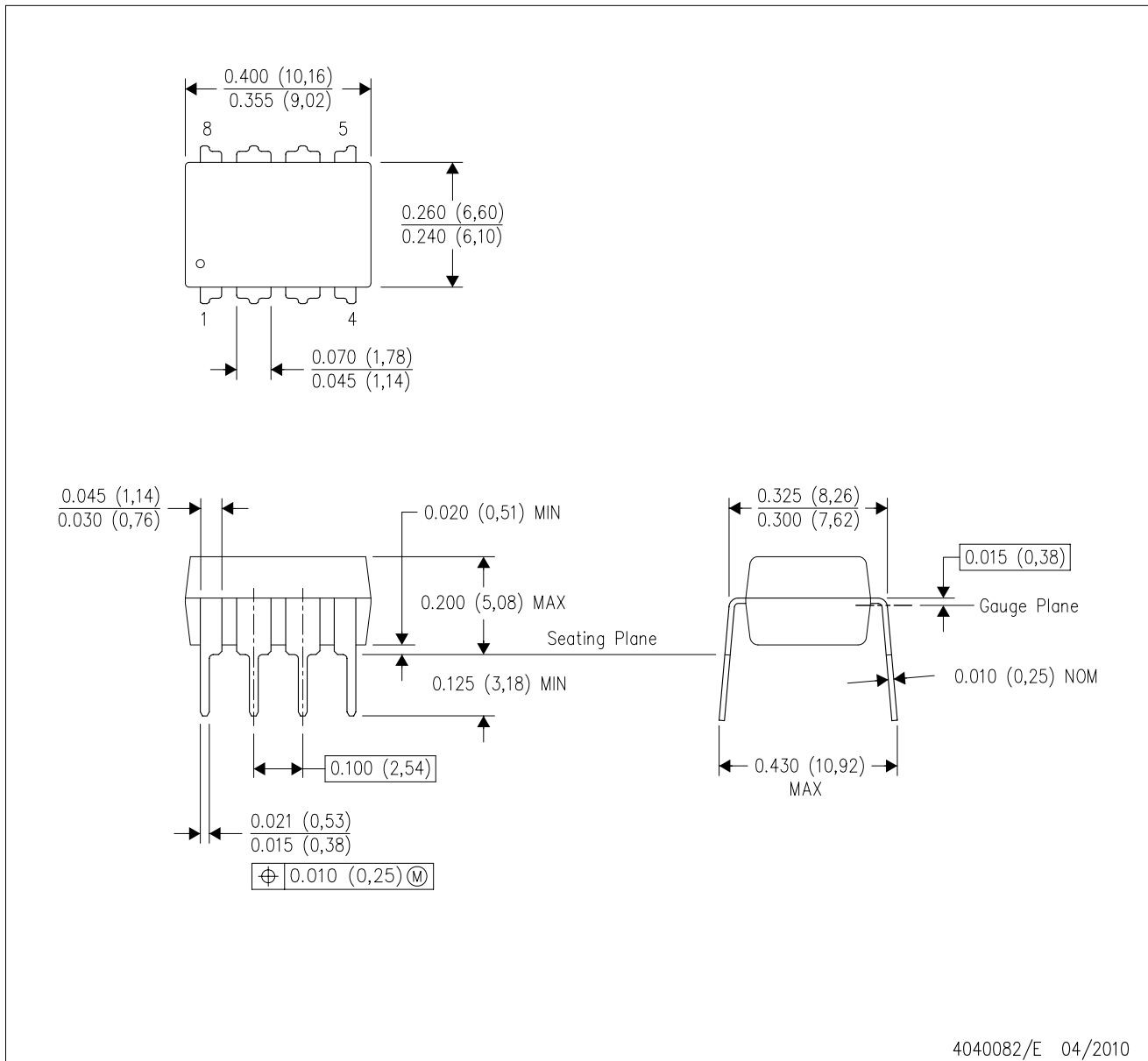
(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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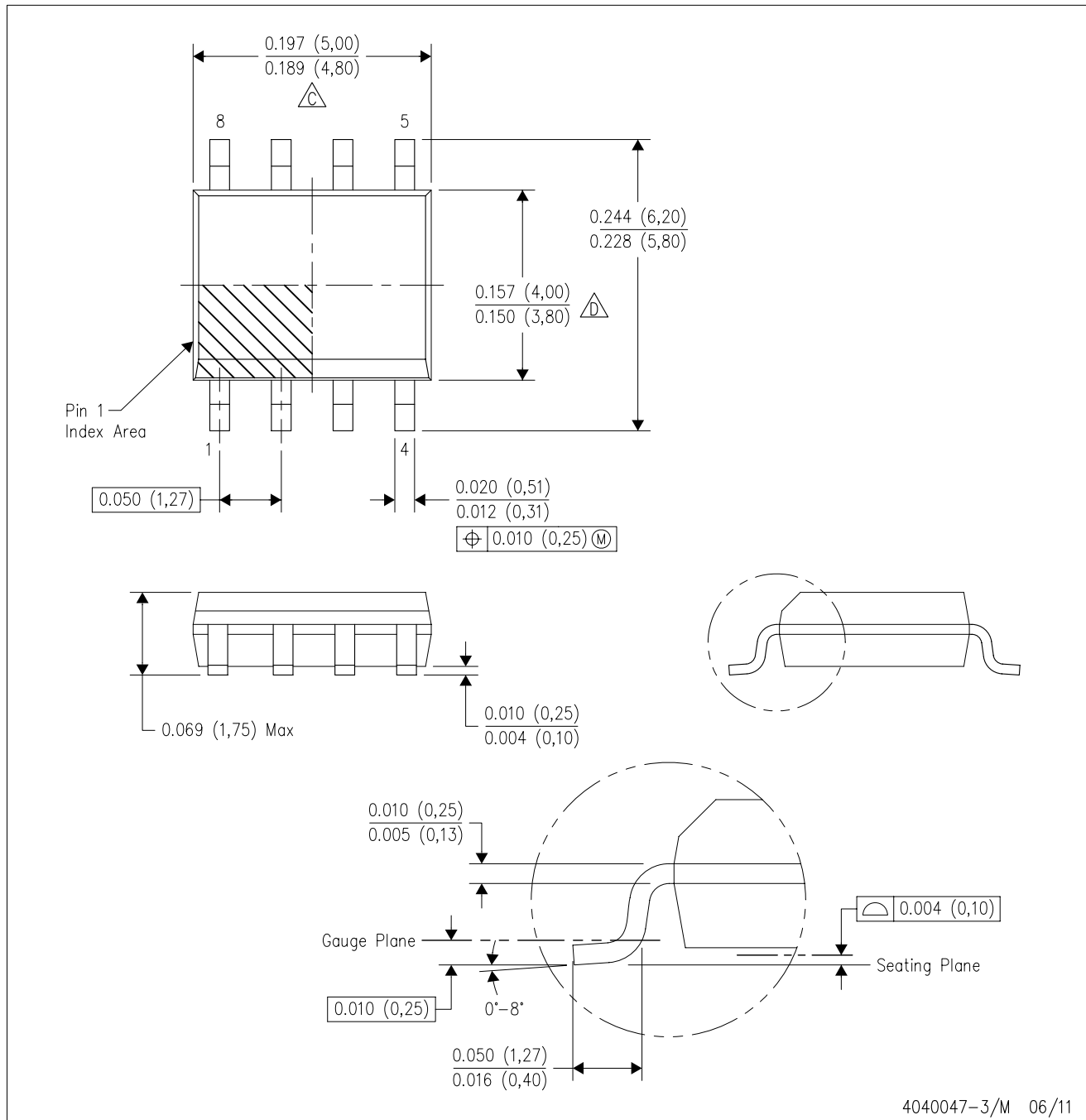
PLASTIC DUAL-IN-LINE PACKAGE



- 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.

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
 - D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AA.

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