

# LM567/LM567C Tone Decoder

## General 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.

## Features

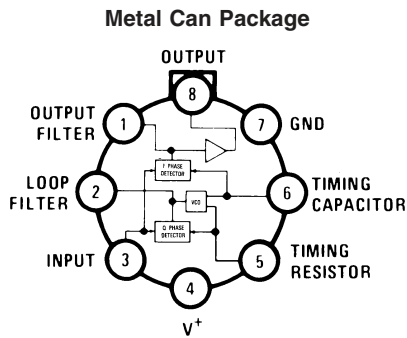
- 20 to 1 frequency range with an external resistor
- Logic compatible output with 100 mA current sinking capability
- Bandwidth adjustable from 0 to 14%

- 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

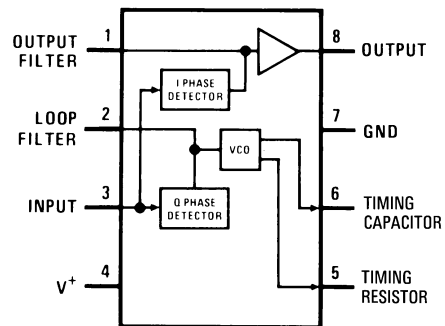
## Connection Diagrams



00697501

**Top View**  
Order Number LM567H or LM567CH  
See NS Package Number H08C

### Dual-In-Line and Small Outline Packages



00697502

**Top View**  
Order Number LM567CM  
See NS Package Number M08A  
Order Number LM567CN  
See NS Package Number N08E

## Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage Pin	9V
Power Dissipation (Note 2)	1100 mW
$V_B$	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.

## Electrical Characteristics

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

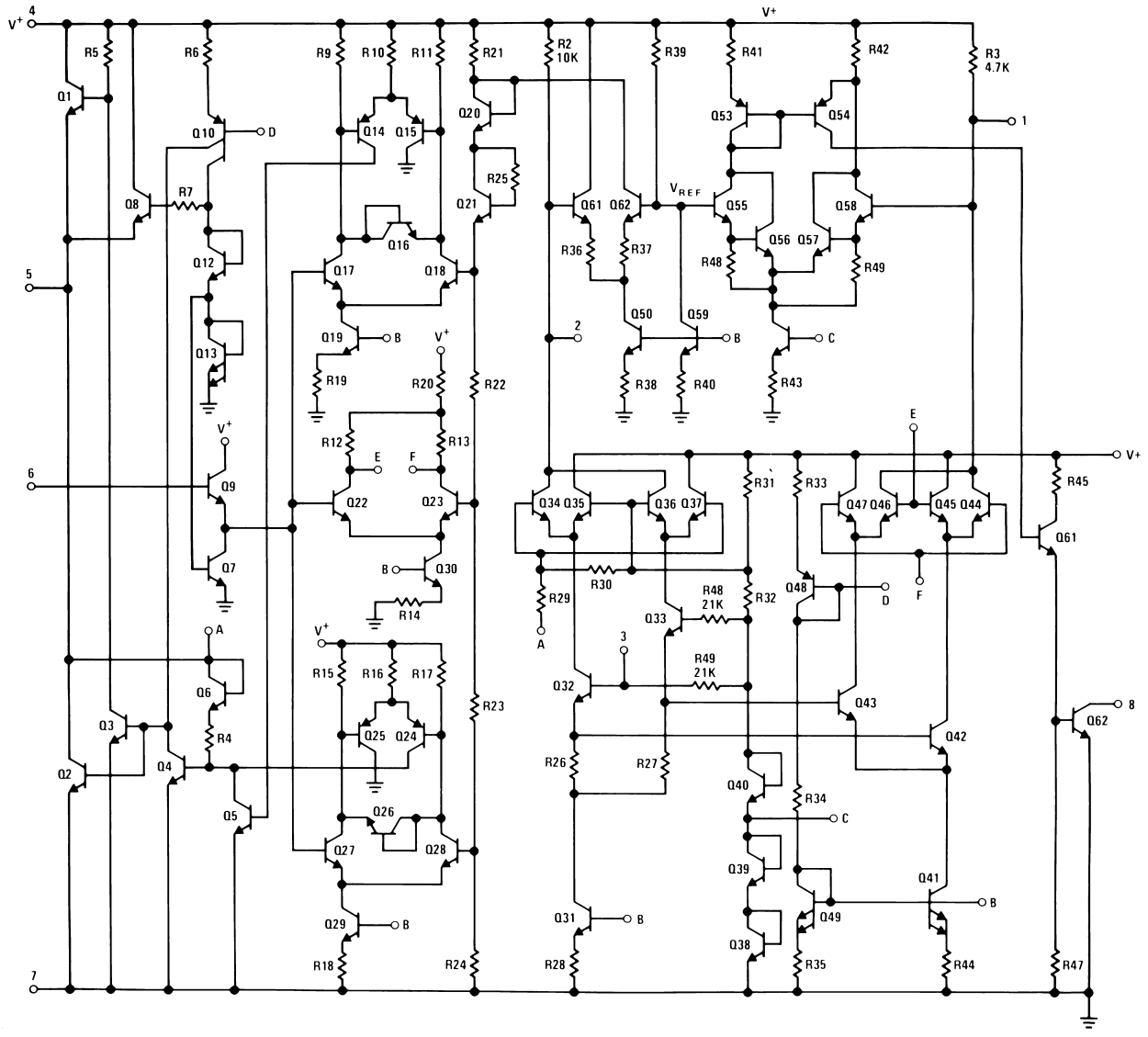
Parameters	Conditions	LM567			LM567C/LM567CM			Units
		Min	Typ	Max	Min	Typ	Max	
Power Supply Voltage Range		4.75	5.0	9.0	4.75	5.0	9.0	V
Power Supply Current Quiescent	$R_L = 20k$		6	8		7	10	mA
Power Supply Current Activated	$R_L = 20k$		11	13		12	15	mA
Input Resistance		18	20		15	20		k $\Omega$
Smallest 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			$\pm 0.1$			$\pm 0.1$		%/°C
Largest Detection Bandwidth Variation with Supply Voltage	4.75–6.75V		$\pm 1$	$\pm 2$		$\pm 1$	$\pm 5$	%V
Highest Center Frequency		100	500		100	500		kHz
Center Frequency Stability (4.75–5.75V)	$0 < T_A < 70$ $-55 < T_A < +125$		$35 \pm 60$ $35 \pm 140$			$35 \pm 60$ $35 \pm 140$		ppm/°C ppm/°C
Center Frequency Shift with Supply Voltage	4.75V–6.75V 4.75V–9V		0.5 2.0	1.0 2.0		0.4 2.0	2.0 2.0	%/V %/V
Fastest ON-OFF Cycling Rate			$f_o/20$			$f_o/20$		
Output Leakage Current	$V_B = 15V$		0.01	25		0.01	25	$\mu\text{A}$
Output Saturation Voltage	$e_i = 25 \text{ mV}$ , $I_B = 30 \text{ mA}$ $e_i = 25 \text{ mV}$ , $I_B = 100 \text{ mA}$		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

**Note 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.

**Note 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.

**Note 3:** Refer to RETS567X drawing for specifications of military LM567H version.

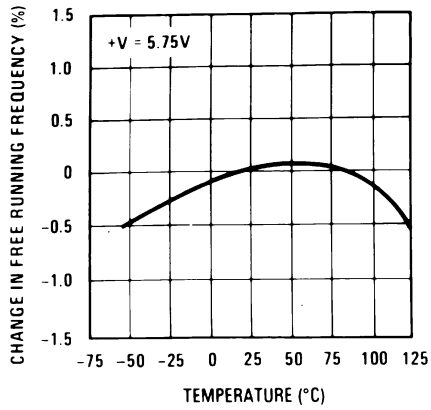
# Schematic Diagram



00697503

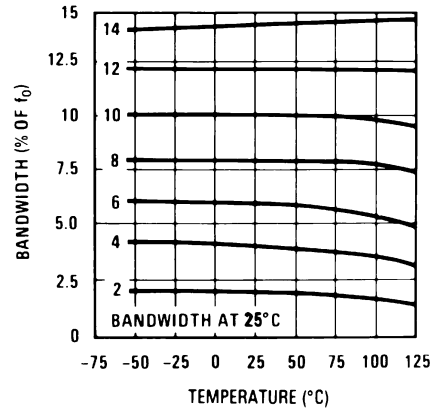
# Typical Performance Characteristics

Typical Frequency Drift



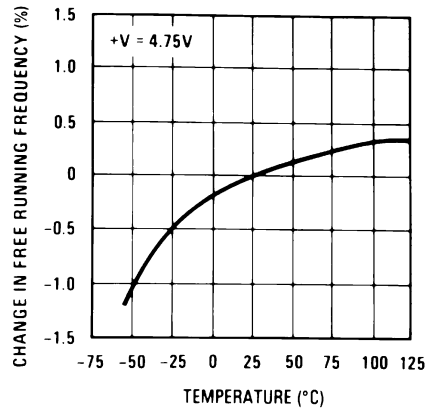
00697510

Typical Bandwidth Variation



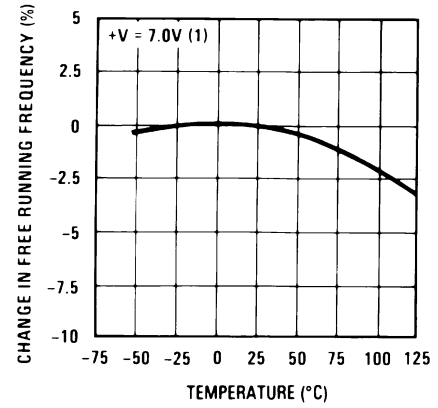
00697511

Typical Frequency Drift



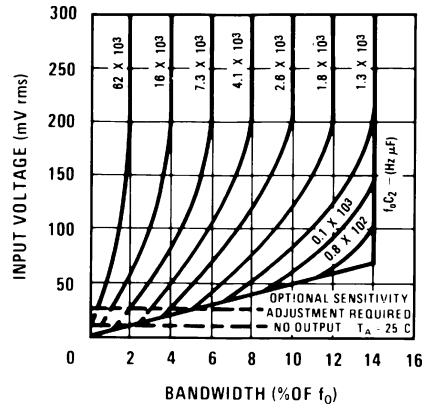
00697512

Typical Frequency Drift



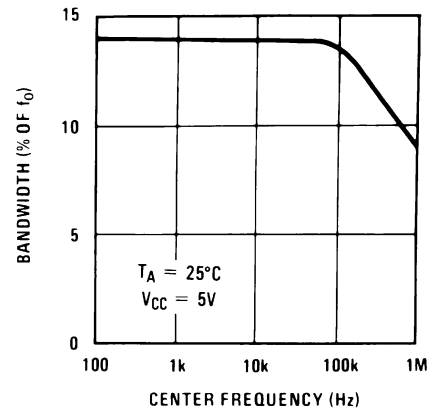
00697513

Bandwidth vs Input Signal Amplitude



00697514

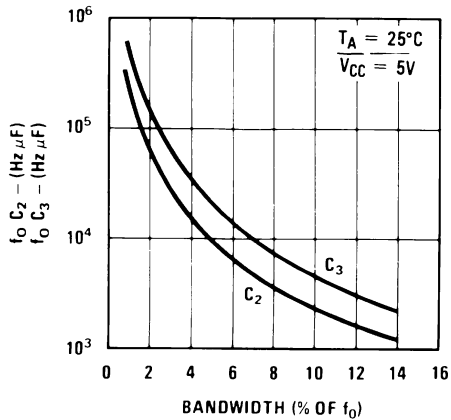
Largest Detection Bandwidth



00697515

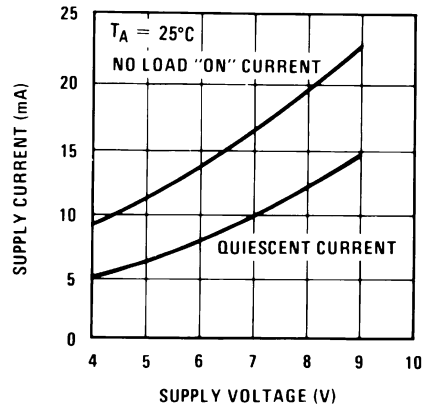
# Typical Performance Characteristics (Continued)

Detection Bandwidth as a Function of  $C_2$  and  $C_3$



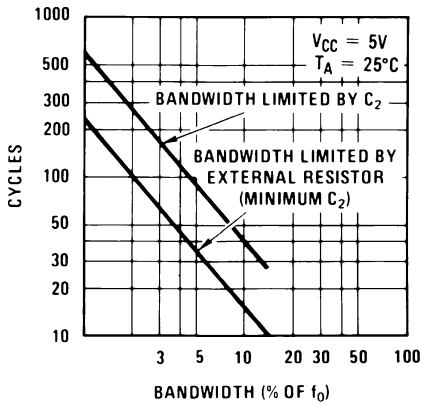
00697516

Typical Supply Current vs Supply Voltage



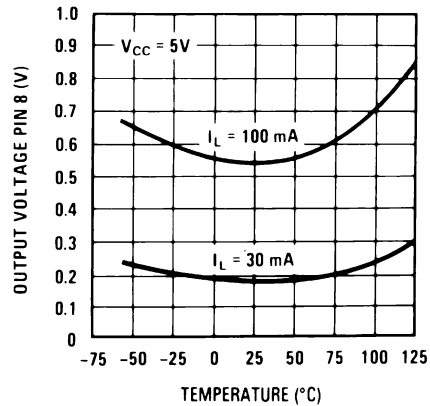
00697517

Greatest Number of Cycles Before Output



00697518

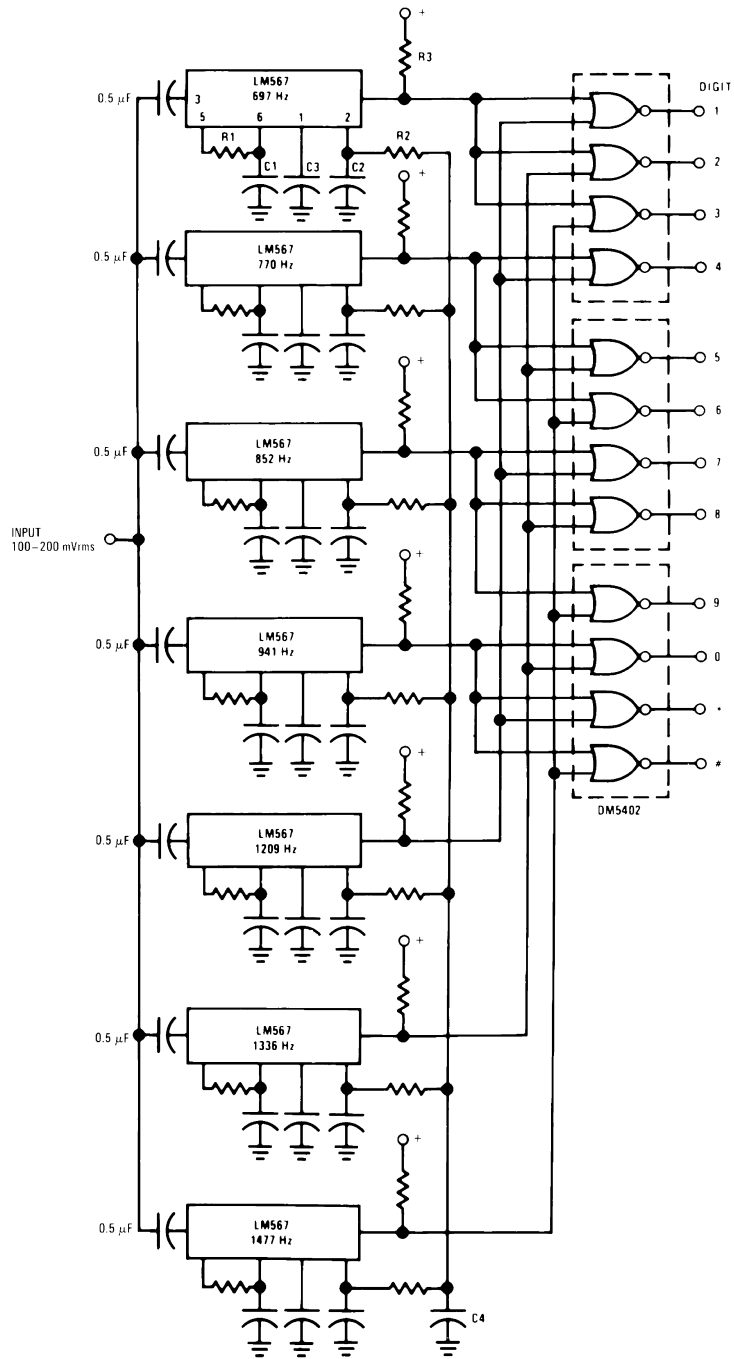
Typical Output Voltage vs Temperature



00697519

# Typical Applications

## 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

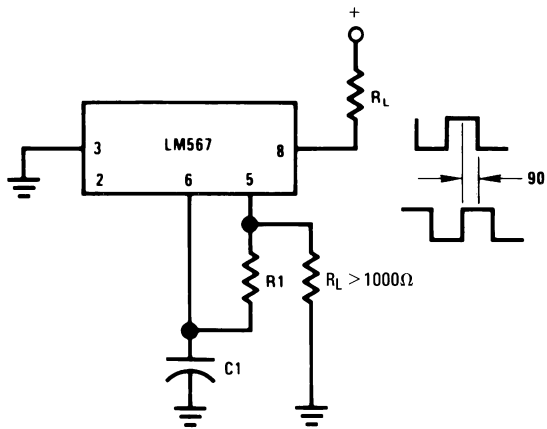
C3 2.2 mfd 6V

C4 250 mfd 6V

00697505

# Typical Applications (Continued)

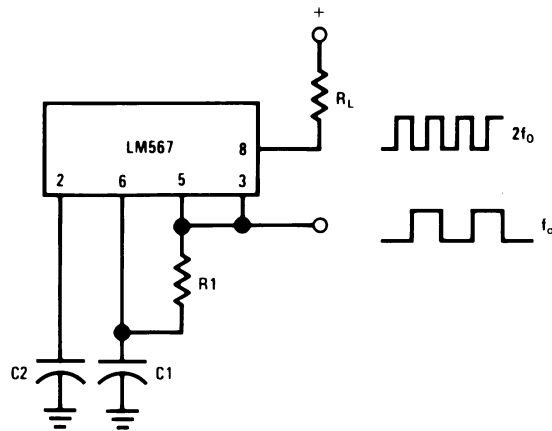
### Oscillator with Quadrature Output



00697506

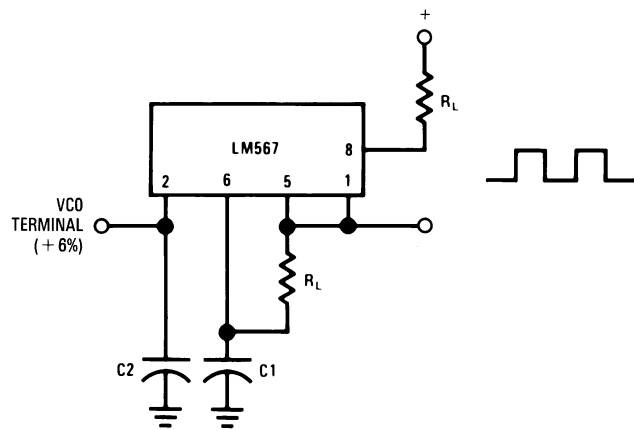
Connect Pin 3 to 2.8V to Invert Output

### Oscillator with Double Frequency Output



00697507

### Precision Oscillator Drive 100 mA Loads

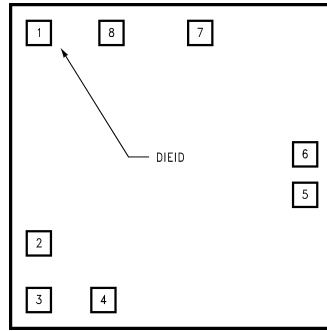


00697508





# LM567C MDC MWC TONE DECODER



00697523

**Die Layout (C - Step)**

## DIE/WAFER CHARACTERISTICS

Fabrication Attributes		General Die Information	
Physical Die Identification	LM567C	Bond Pad Opening Size (min)	91 $\mu$ m x 91 $\mu$ m
Die Step	C	Bond Pad Metalization	0.5% COPPER_BAL. ALUMINUM
Physical Attributes		Passivation	VOM NITRIDE
Wafer Diameter	150mm	Back Side Metal	BARE BACK
Dise Size (Drawn)	1600 $\mu$ m x 1626 $\mu$ m 63.0mils x 64.0mils	Back Side Connection	Floating
Thickness	406 $\mu$ m Nominal		
Min Pitch	198 $\mu$ 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  $\mu$ m) NC = No Connection, N.U. = Not Used

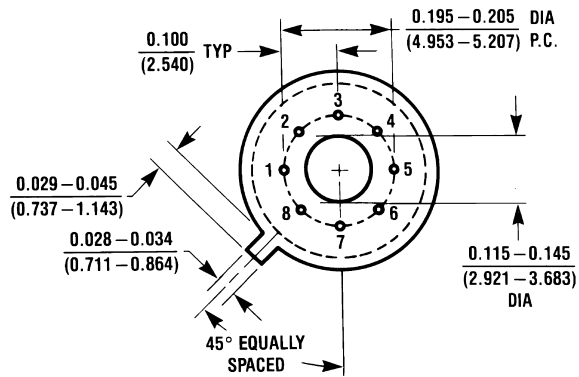
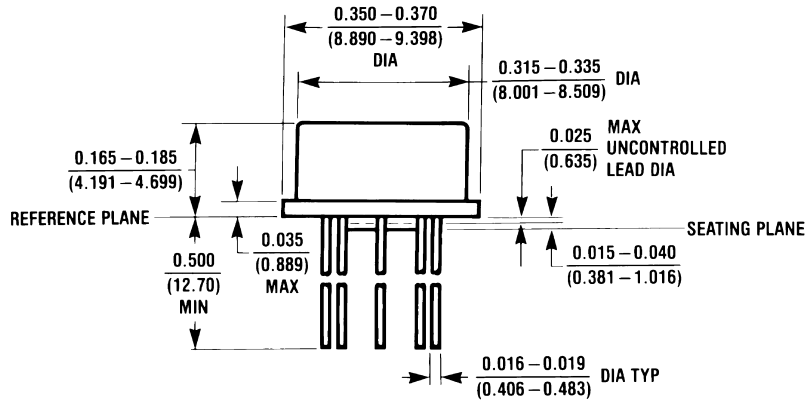
SIGNAL NAME	PAD# NUMBER	X/Y COORDINATES		PAD SIZE		
		X	Y	X		Y
OUTPUT FILTER	1	-673	686	91	x	91
LOOP FILTER	2	-673	-419	91	x	91
INPUT	3	-673	-686	91	x	91
V+	4	-356	-686	91	x	91
TIMING RES	5	673	-122	91	x	91
TIMING CAP	6	673	76	91	x	91
GND	7	178	686	117	x	91
OUTPUT	8	-318	679	117	x	104

**LM567C MDC MWC  
TONE DECODER** (Continued)

<b>IN U.S.A</b>	
Tel #:	1 877 Dial Die 1 877 342 5343
Fax:	1 207 541 6140
<b>IN EUROPE</b>	
Tel:	49 (0) 8141 351492 / 1495
Fax:	49 (0) 8141 351470
<b>IN ASIA PACIFIC</b>	
Tel:	(852) 27371701
<b>IN JAPAN</b>	
Tel:	81 043 299 2308

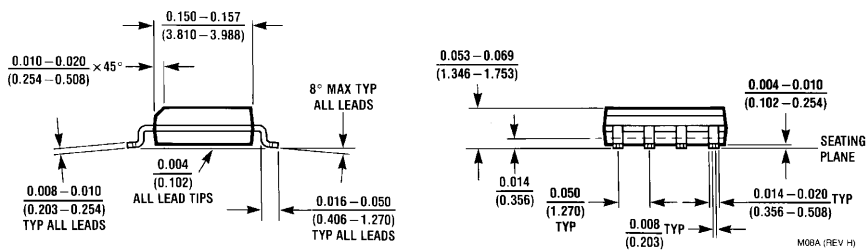
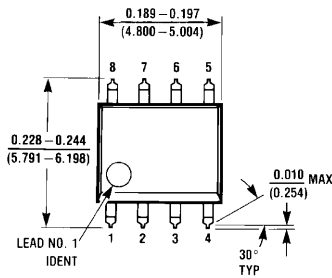
**Physical Dimensions** inches (millimeters)

unless otherwise noted



H08C (REV E)

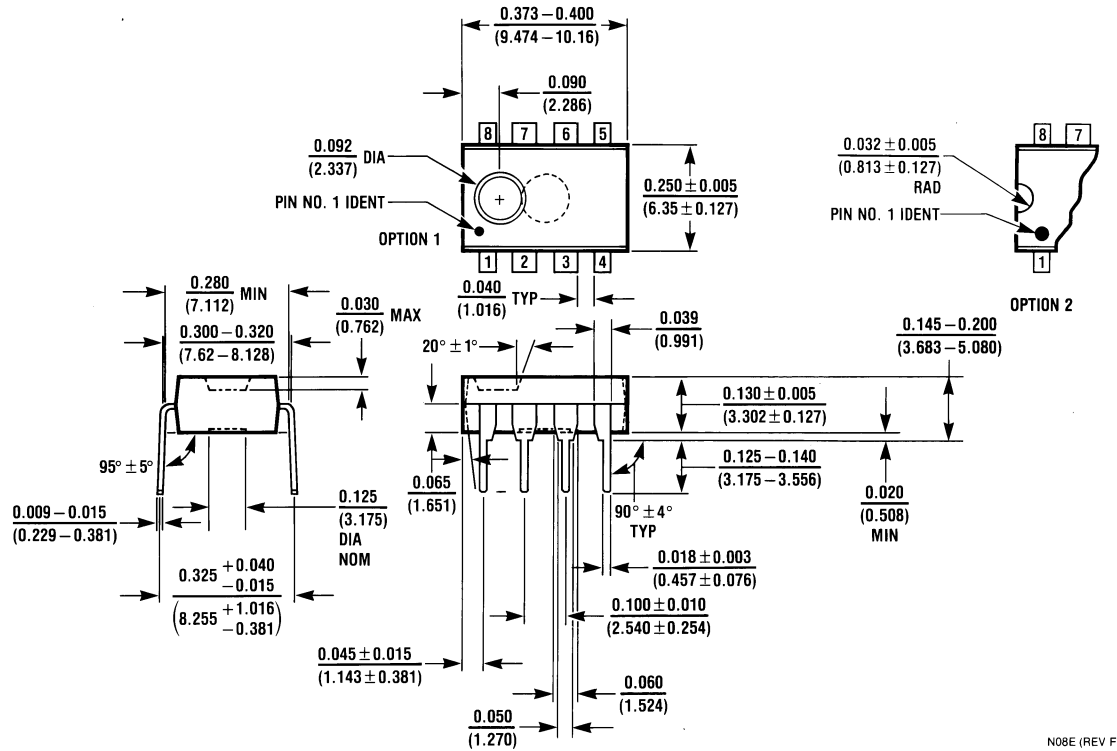
**Metal Can Package (H)**  
**Order Number LM567H or LM567CH**  
**NS Package Number H08C**



M08A (REV H)

**Small Outline Package (M)**  
**Order Number LM567CM**  
**NS Package Number M08A**

**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



**Molded Dual-In-Line Package (N)**  
**Order Number LM567CN**  
**NS Package Number N08E**

N08E (REV F)

National does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and National reserves the right at any time without notice to change said circuitry and specifications.

For the most current product information visit us at [www.national.com](http://www.national.com).

**LIFE SUPPORT POLICY**

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT AND GENERAL COUNSEL OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

**BANNED SUBSTANCE COMPLIANCE**

National Semiconductor certifies that the products and packing materials meet the provisions of the Customer Products Stewardship Specification (CSP-9-111C2) and the Banned Substances and Materials of Interest Specification (CSP-9-111S2) and contain no "Banned Substances" as defined in CSP-9-111S2.



**National Semiconductor**  
**Americas Customer Support Center**  
 Email: [new.feedback@nsc.com](mailto:new.feedback@nsc.com)  
 Tel: 1-800-272-9959

**National Semiconductor**  
**Europe Customer Support Center**  
 Fax: +49 (0) 180-530 85 86  
 Email: [europe.support@nsc.com](mailto:europe.support@nsc.com)  
 Deutsch Tel: +49 (0) 69 9508 6208  
 English Tel: +44 (0) 870 24 0 2171  
 Français Tel: +33 (0) 1 41 91 8790

**National Semiconductor**  
**Asia Pacific Customer Support Center**  
 Email: [ap.support@nsc.com](mailto:ap.support@nsc.com)

**National Semiconductor**  
**Japan Customer Support Center**  
 Fax: 81-3-5639-7507  
 Email: [jpn.feedback@nsc.com](mailto:jpn.feedback@nsc.com)  
 Tel: 81-3-5639-7560

[www.national.com](http://www.national.com)