

May 1999

# 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%

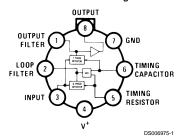
- High rejection of out of band signals and noise
- Immunity to false signals
- Highly stable center frequency
- Center frequency adjustable from 0.01 Hz to 500 kHz

# **Applications**

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

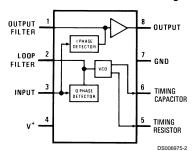
## **Connection Diagrams**

### Metal Can Package



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

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



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 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

260°C Soldering (10 sec.)

Small Outline Package

215°C Vapor Phase (60 sec.) 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**

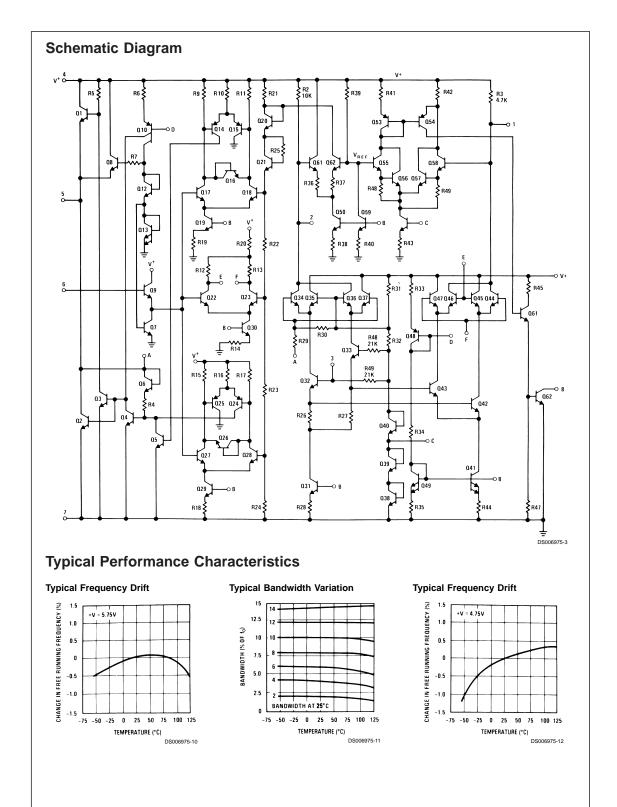
AC Test Circuit,  $T_A = 25^{\circ}C$ ,  $V^+ = 5V$ 

Parameters	Conditions	LM567			LM567C/LM567CM			11
		Min	Тур	Max	Min	Тур	Max	Units
Power Supply Voltage Range		4.75	5.0	9.0	4.75	5.0	9.0	V
Power Supply Current Quiescent	R <sub>L</sub> = 20k		6	8		7	10	mA
Power Supply Current Activated	R <sub>L</sub> = 20k		11	13		12	15	mA
Input Resistance		18	20		15	20		kΩ
Smallest Detectable Input Voltage	$I_L = 100 \text{ mA}, f_i = f_o$		20	25		20	25	mVrms
Largest No Output Input Voltage	$I_{\rm C} = 100 \text{ mA}, f_{\rm i} = f_{\rm o}$	10	15		10	15		mVrms
Largest Simultaneous Outband Signal to Inband Signal Ratio			6			6		dB
Minimum Input Signal to Wideband Noise Ratio	B <sub>n</sub> = 140 kHz		-6			-6		dB
Largest Detection Bandwidth		12	14	16	10	14	18	% of f <sub>o</sub>
Largest Detection Bandwidth Skew			1	2		2	3	% of f <sub>o</sub>
Largest Detection Bandwidth Variation with Temperature			±0.1			±0.1		%/°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 <sub>A</sub> < 70 -55 < T <sub>A</sub> < +125		35 ± 60 35 ± 140			35 ± 60 35 ± 140		ppm/°C ppm/°C
Center Frequency Shift with Supply	4.75V-6.75V		0.5	1.0		0.4	2.0	%/V
Voltage	4.75V-9V			2.0			2.0	%/V
Fastest ON-OFF Cycling Rate			f <sub>o</sub> /20			f <sub>o</sub> /20		
Output Leakage Current	V <sub>8</sub> = 15V		0.01	25		0.01	25	μA
Output Saturation Voltage	$e_i = 25 \text{ mV}, I_8 = 30 \text{ mA}$ $e_i = 25 \text{ mV}, I_8 = 100 \text{ mA}$		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.

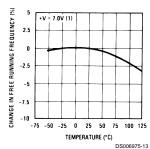
Note 2: The maximum junction temperature of the LM567 and LM567C is 150°C. For operating at elevated temperatures, devices in the TO-5 package must be derated based on a thermal resistance of 150°C/W, junction to ambient or 45°C/W, junction to case. For the DIP the device must be derated based on a thermal 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.

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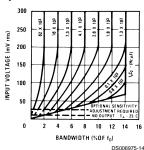


# Typical Performance Characteristics (Continued)

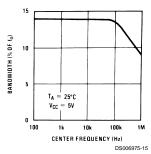
## Typical Frequency Drift



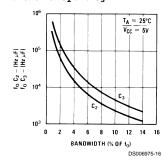
## Bandwidth vs Input Signal Amplitude



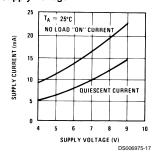
## Largest Detection Bandwidth



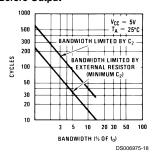
# Detection Bandwidth as a Function of ${\bf C_2}$ and ${\bf C_3}$



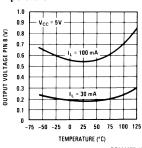
## Typical Supply Current vs Supply Voltage



# **Greatest Number of Cycles Before Output**



## Typical Output Voltage vs Temperature

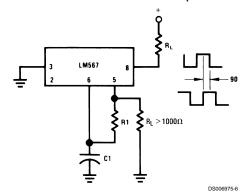


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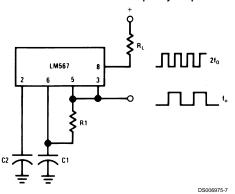
# **Typical Applications** Touch-Tone Decoder INPUT 100-200 mVrms **O**-DM5402 DS006975-5 Component values (typ) R1 6.8 to 15k R2 4.7k R3 20k C1 0.10 mfd C2 1.0 mfd 6V C3 2.2 mfd 6V C4 250 mfd 6V

# Typical Applications (Continued)

## Oscillator with Quadrature Output

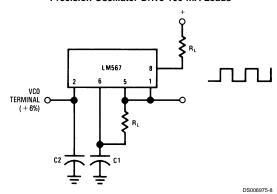


Oscillator with Double Frequency Output

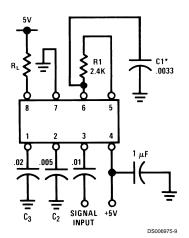


Connect Pin 3 to 2.8V to Invert Output

### Precision Oscillator Drive 100 mA Loads



# **AC Test Circuit**



 $f_i$  = 100 kHz + 5V \*Note: Adjust for  $f_o$  = 100 kHz.

# **Applications Information**

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

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

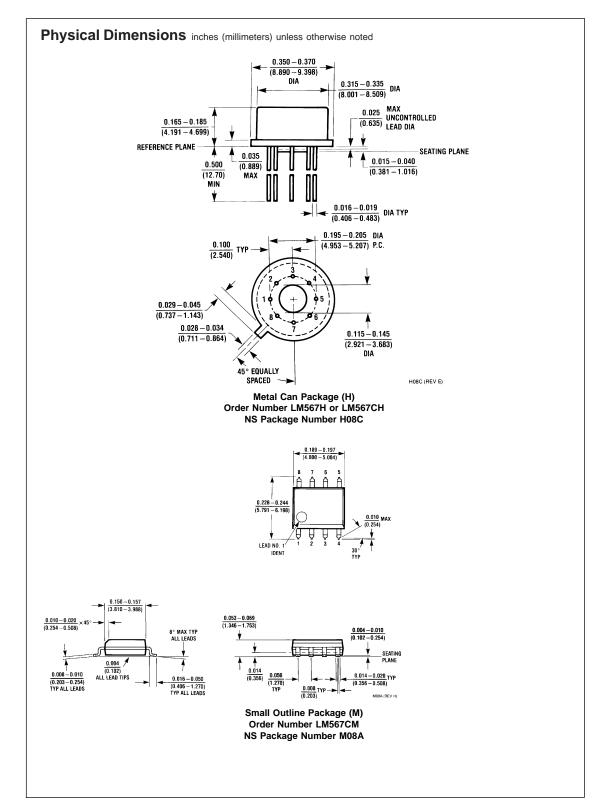
The bandwidth of the filter may be found from the approximation

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

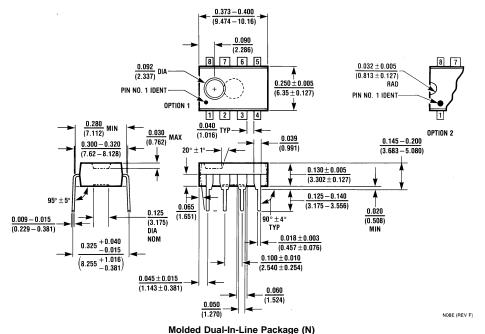
Where:

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

 $C_2$  = Capacitance at Pin 2 (µF)



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



Order Number LM567CN NS Package Number N08E

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