

## 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

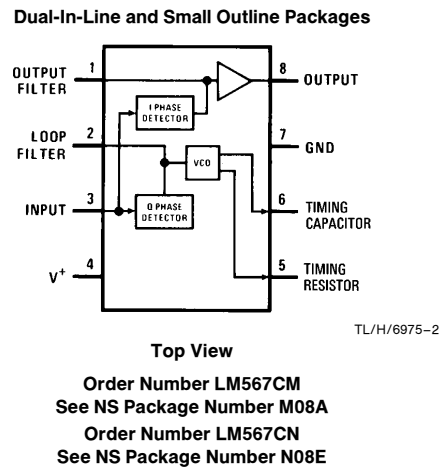
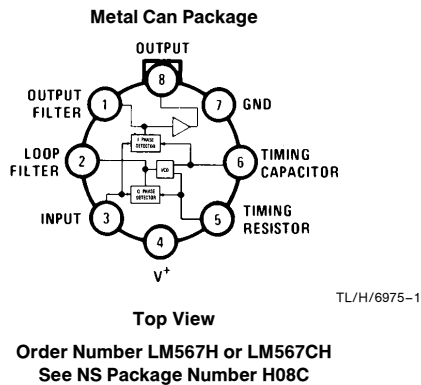
- 20 to 1 frequency range with an external resistor
- Logic compatible output with 100 mA current sinking capability

- 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



## Absolute Maximum Ratings

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 1)	1100 mW
V <sub>8</sub>	15V
V <sub>3</sub>	-10V
V <sub>3</sub>	V <sub>4</sub> + 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

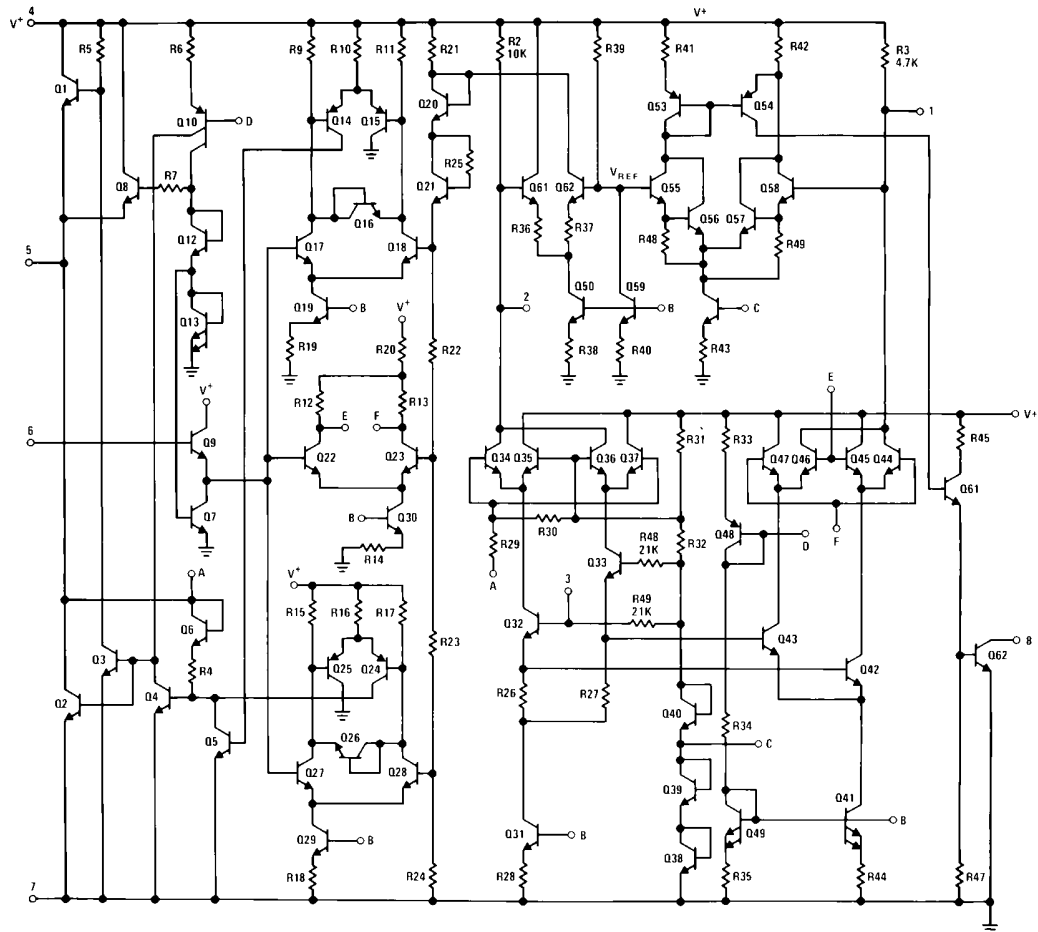
AC Test Circuit, T<sub>A</sub> = 25°C, V<sup>+</sup> = 5V

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 <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 <sub>L</sub> = 100 mA, f <sub>i</sub> = f <sub>o</sub>		20	25		20	25	mVrms
Largest No Output Input Voltage	I <sub>C</sub> = 100 mA, f <sub>i</sub> = f <sub>o</sub>	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 Voltage	4.75V - 6.75V 4.75V - 9V		0.5	1.0 2.0		0.4 2.0	2.0 2.0	%/V %/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 <sub>i</sub> = 25 mV, I <sub>8</sub> = 30 mA e <sub>i</sub> = 25 mV, I <sub>8</sub> = 100 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:** 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.

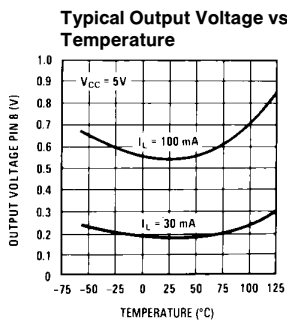
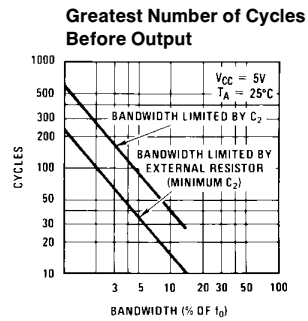
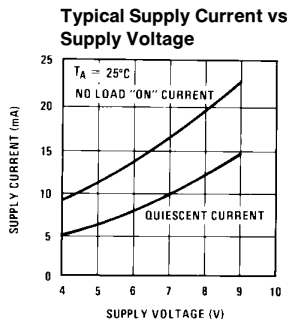
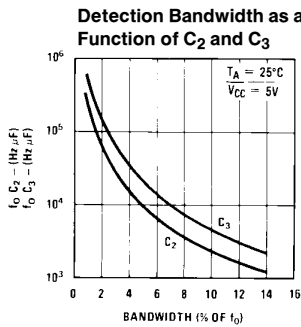
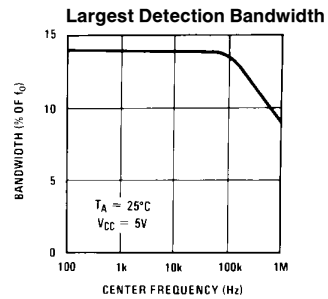
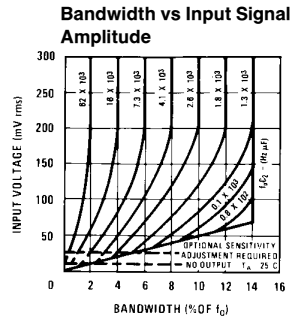
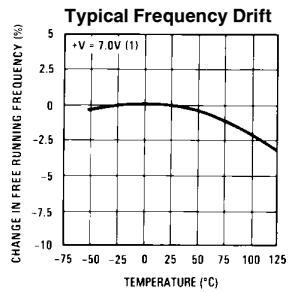
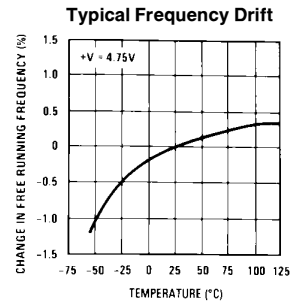
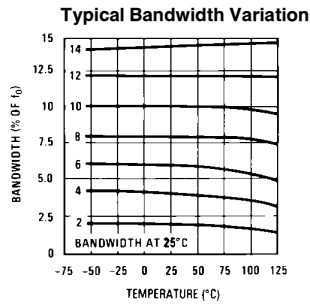
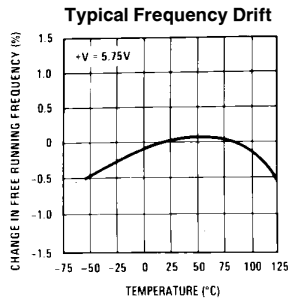
**Note 2:** Refer to RETS567X drawing for specifications of military LM567H version.

# Schematic Diagram



TL/H/6975-3

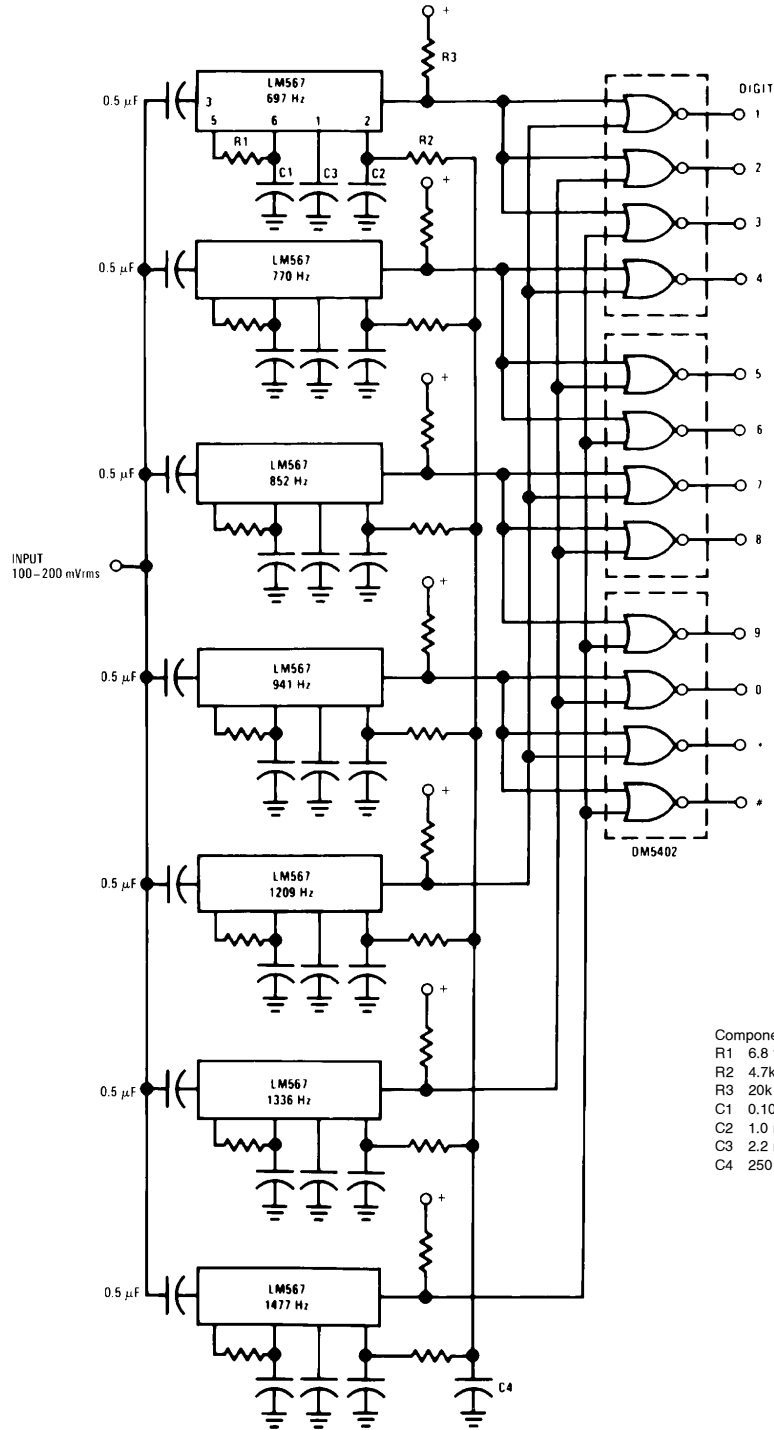
# Typical Performance Characteristics



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# Typical Applications

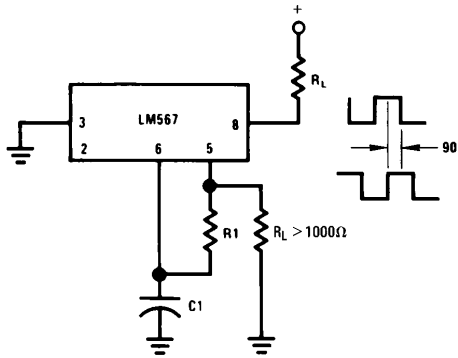
## Touch-Tone Decoder



TL/H/6975-5

## Typical Applications (Continued)

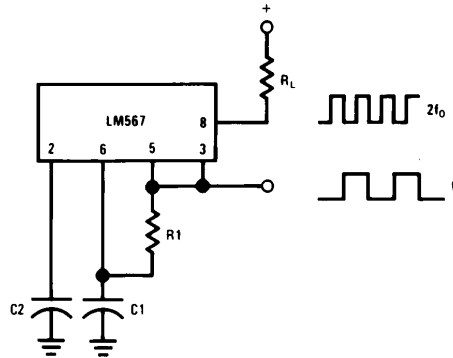
### Oscillator with Quadrature Output



Connect Pin 3 to 2.8V to Invert Output

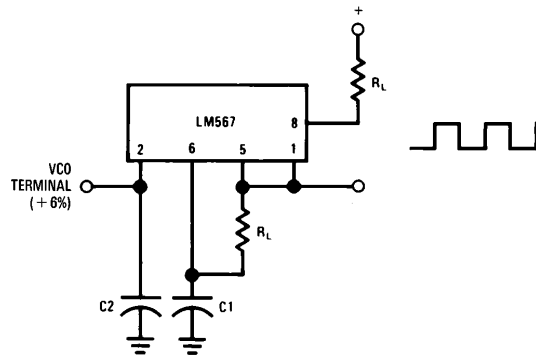
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### Oscillator with Double Frequency Output



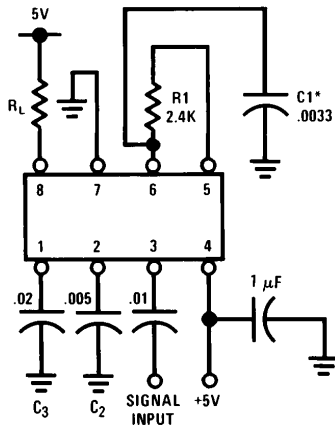
TL/H/6975-7

### Precision Oscillator Drive 100 mA Loads



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## AC Test Circuit



TL/H/6975-9

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

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

The bandwidth of the filter may be found from the approximation

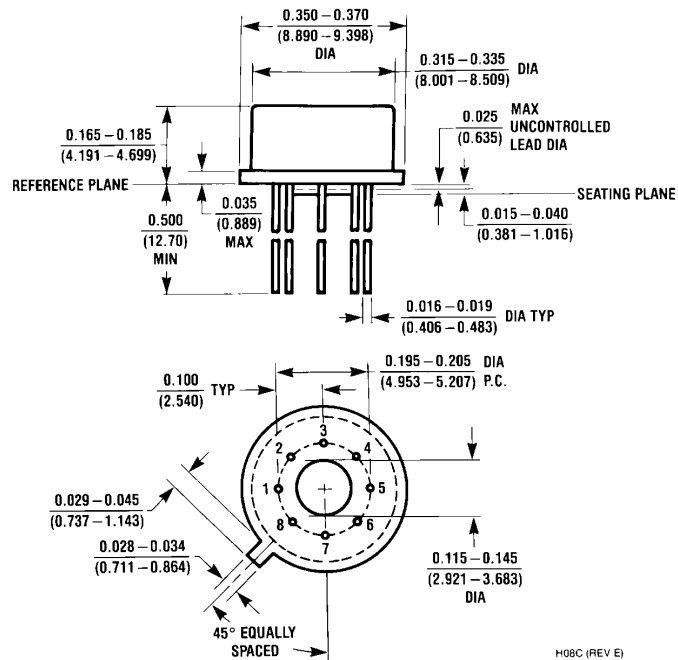
$$BW = 1070 \sqrt{\frac{V_i}{f_o C_2}} \text{ in \% of } f_o$$

Where:

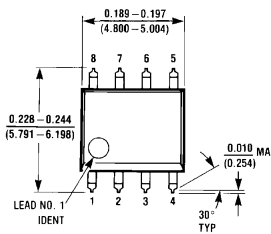
$V_i$  = Input voltage (volts rms),  $V_i \leq 200 \text{ mV}$

$C_2$  = Capacitance at Pin 2 ( $\mu\text{F}$ )

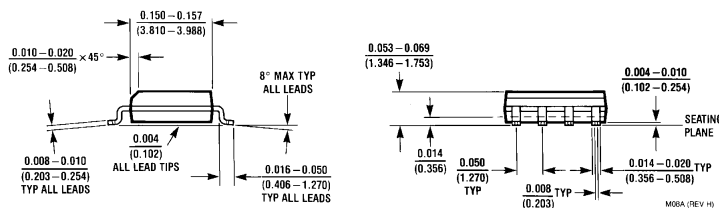
**Physical Dimensions** inches (millimeters)



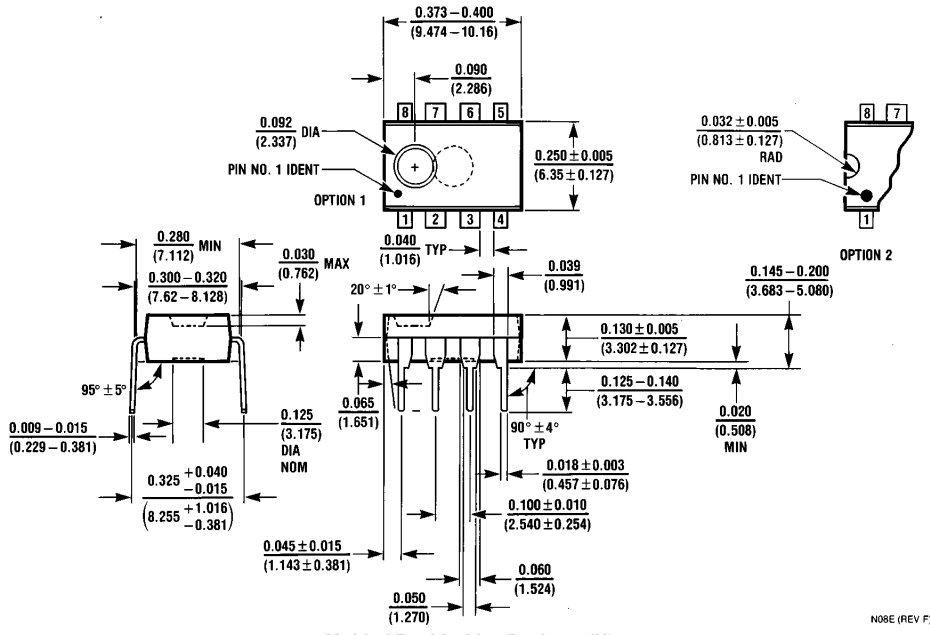
**Metal Can Package (H)**  
**Order Number LM567H or LM567CH**  
**NS Package Number H08C**



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



**Physical Dimensions** inches (millimeters) (Continued)




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

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