

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

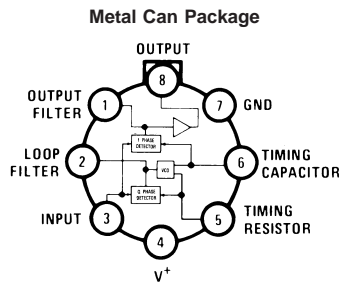
- 20 to 1 frequency range with an external resistor
- Logic compatible output with 100 mA current sinking capability
- Bandwidth adjustable from 0 to 14%

- 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

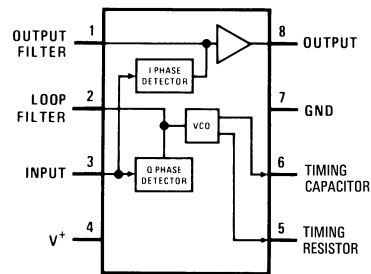
- Touch tone decoding
- Precision oscillator
- Frequency monitoring and control
- Wide band FSK demodulation
- Ultrasonic controls
- Carrier current remote controls
- Communications paging decoders

Connection Diagrams



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 |
| 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, $T_A = 25^\circ\text{C}$, $V^+ = 5V$

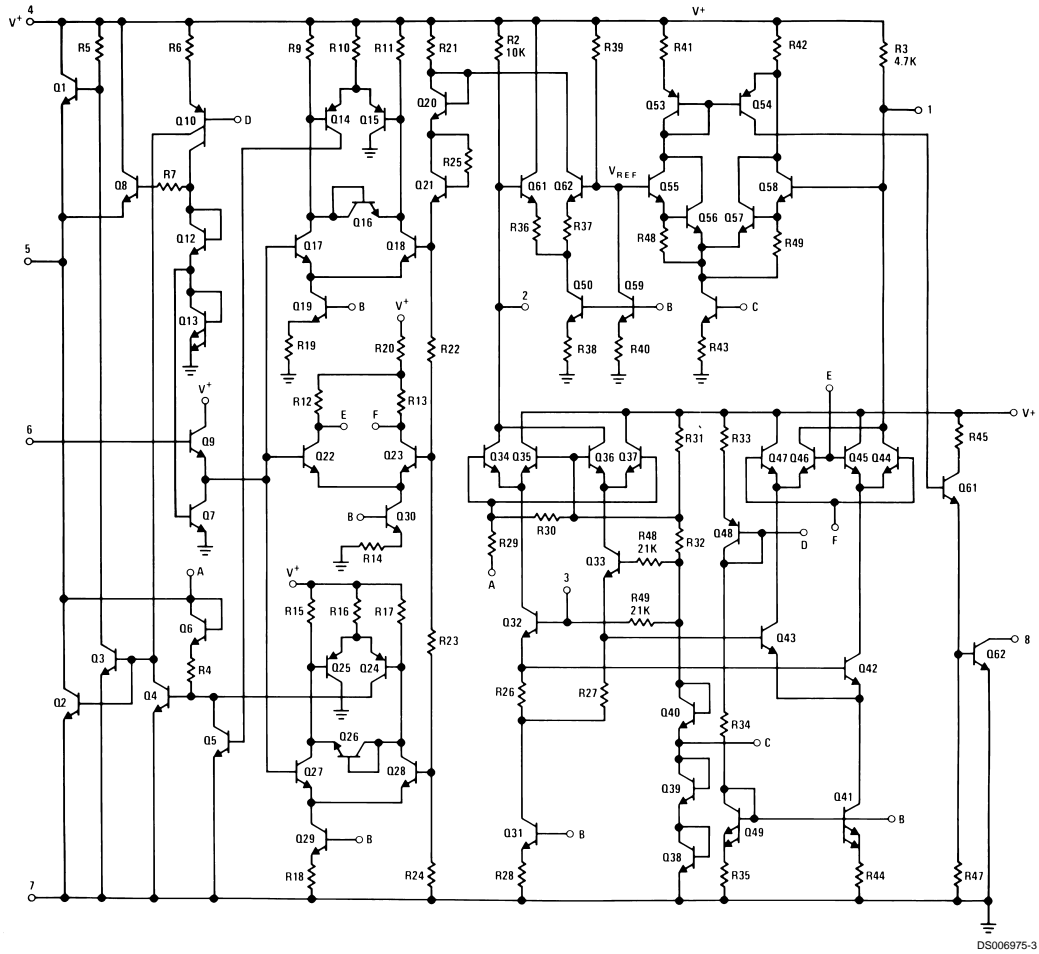
| Parameters | Conditions | LM567 | | | LM567C/LM567CM | | | Units |
|--|---|-------|----------------------------------|------------|----------------|----------------------------------|------------|------------------|
| | | Min | Typ | Max | Min | Typ | Max | |
| Power Supply Voltage Range | | 4.75 | 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 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 | | %/°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 $35 \pm$ 140 | | | 35 ± 60 $35 \pm$ 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 | %/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 | μA |
| 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.

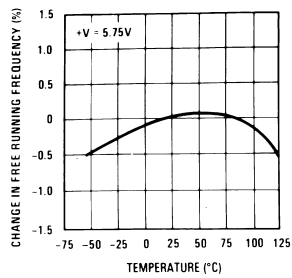
Note 3: Refer to RETS567X drawing for specifications of military LM567H version.

Schematic Diagram

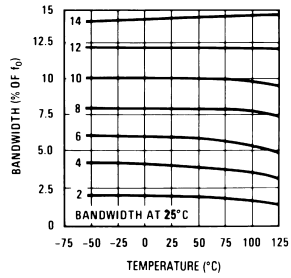


Typical Performance Characteristics

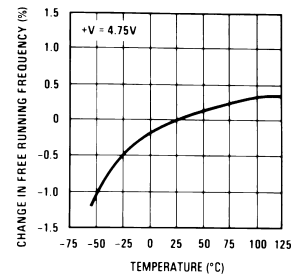
Typical Frequency Drift



Typical Bandwidth Variation

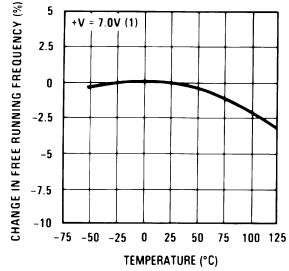


Typical Frequency Drift



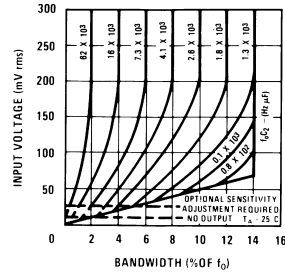
Typical Performance Characteristics (Continued)

Typical Frequency Drift



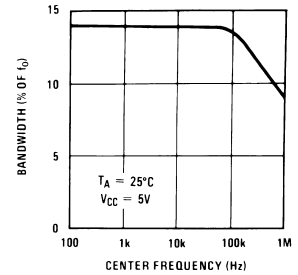
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Bandwidth vs Input Signal Amplitude



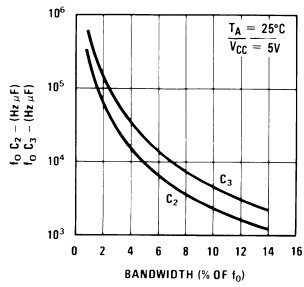
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Largest Detection Bandwidth



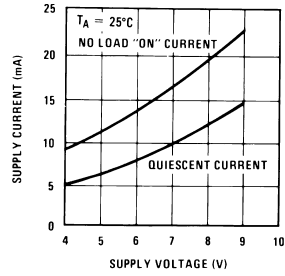
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Detection Bandwidth as a Function of C_2 and C_3



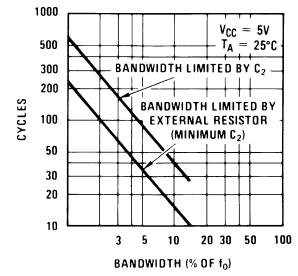
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Typical Supply Current vs Supply Voltage



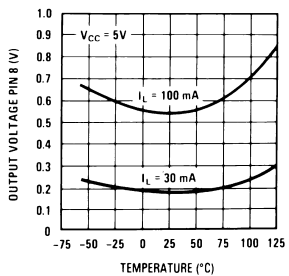
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Greatest Number of Cycles Before Output



DS006975-18

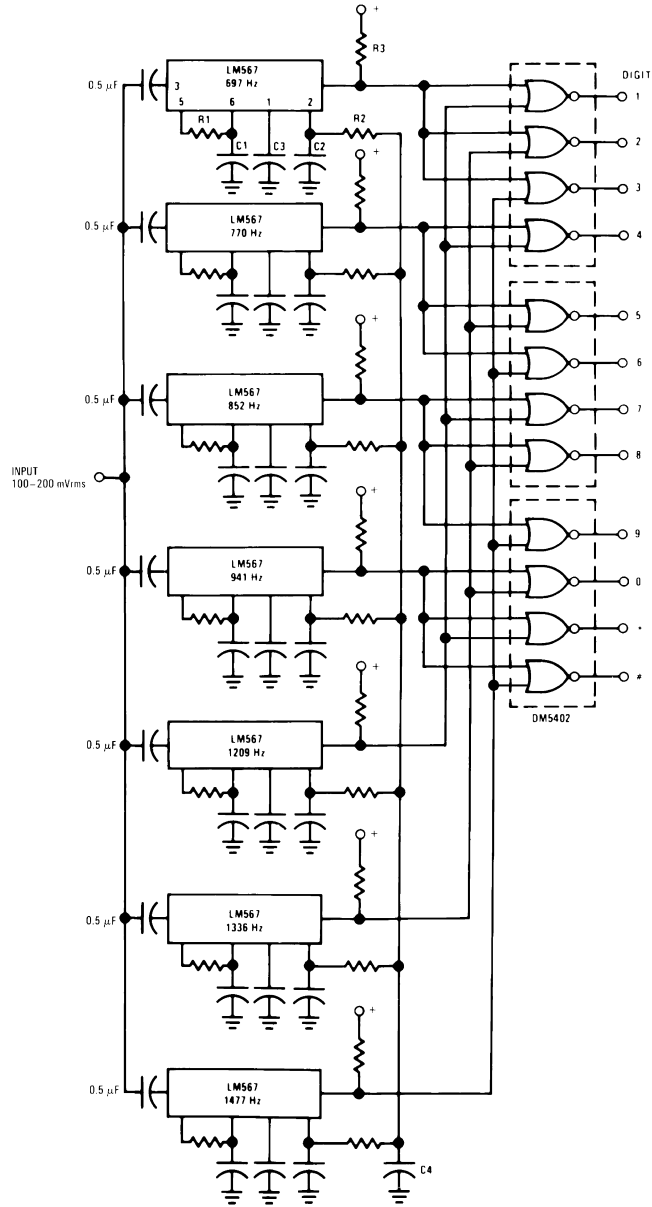
Typical Output Voltage vs Temperature



DS006975-19

Typical Applications

Touch-Tone Decoder



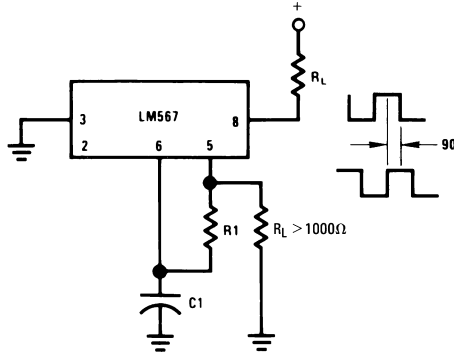
Component values (typ)

- 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

DS006975-5

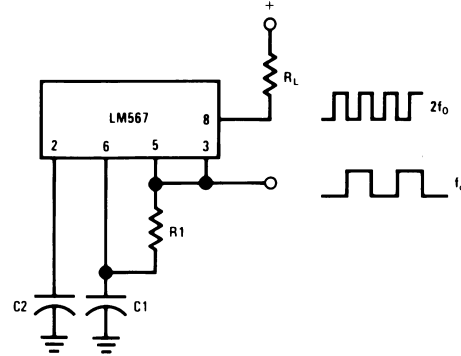
Typical Applications (Continued)

Oscillator with Quadrature Output



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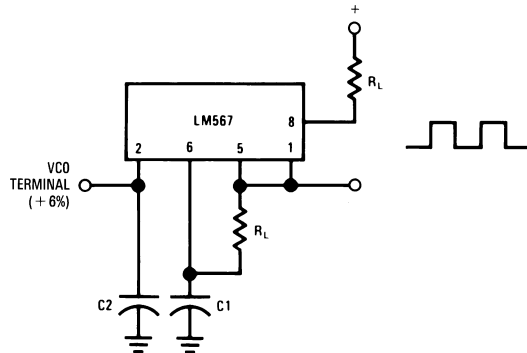
Oscillator with Double Frequency Output



DS006975-7

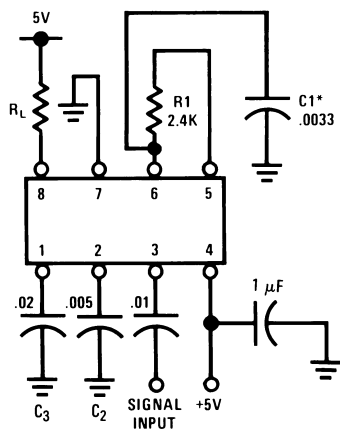
Connect Pin 3 to 2.8V to Invert Output

Precision Oscillator Drive 100 mA Loads



DS006975-8

AC Test Circuit



DS006975-9

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

*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

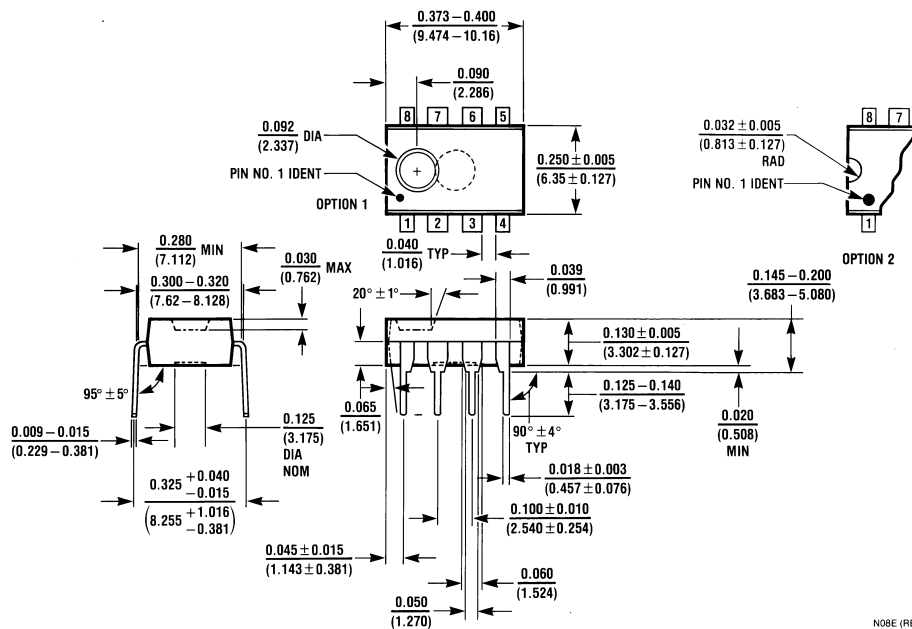
$$BW = 1070 \sqrt{\frac{V_i}{f_o C_2}} \text{ in } \% \text{ of } f_o$$

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)



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

N08E (REV F)

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