

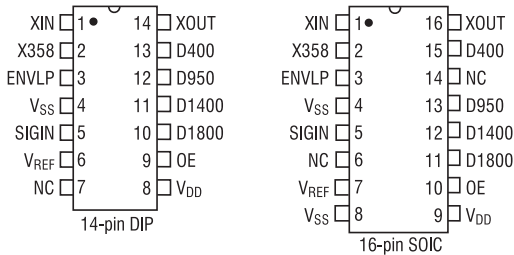
### Features

- Detects single-frequency tones used for error indication and call progress in telephone systems
- Provides detection windows for:
  - 400/425 Hz (Call Progress)
  - 950 Hz (Special and error indication)
  - 1400 Hz (Special and error indication)
  - 1800 Hz (Special and error indication)
- Separate tri-state outputs for each tone window
- Inexpensive 3.58 MHz crystal time base
- Auxiliary 3.58 MHz clock output
- 14-pin DIP package and 16-pin SOIC package
- Single supply 3 to 5 volt (low power CMOS)
- Wide dynamic range (30 dBm)

### Applications

- Automatic dialers
- Modems
- Telecom test equipment
- Telephone traffic measurement,
- Service evaluation
- Billing equipment

### Pin Diagram



### Description

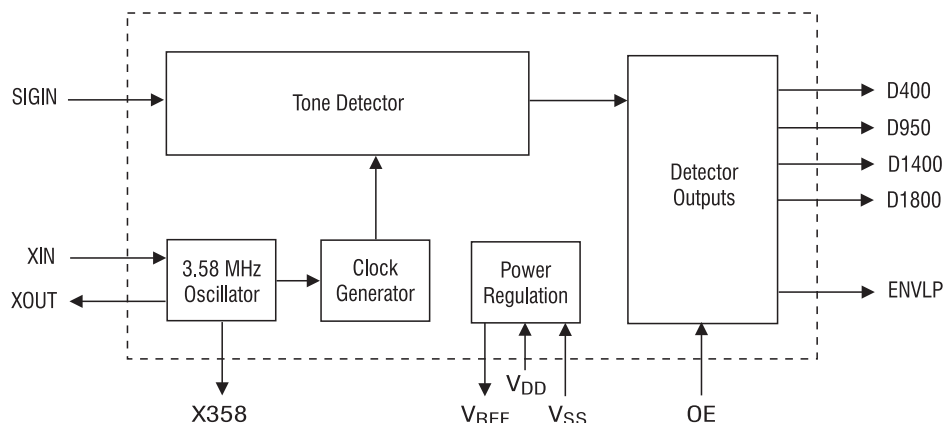
The M-984-02 Special Information Tone Detector is a monolithic integrated circuit designed to provide reliable detection of many common telephone network status signals. In particular, it detects the signals known as Special Information Tones (SITs) or error tones as defined by the CCITT, and single tones often used as dial tone, audible ringing, and other general progress indications. The M-984-02 uses CMOS switched capacitor filters and a crystal time base to achieve the high stability and accuracy specified. Each tone detection window has an associated output pin, which can be placed in a high impedance state for use with time-share microcomputer bus applications.

In comparison with the earlier M-984, the M-984-02 has wider acceptance bands for SIT tones to facilitate reception of tape-loop tones, lower power consumption at 5V operation, 3V operation, superior temperature performance, lower cost, and is available in DIP, SOIC, and SOIC tape and reel versions.

### Ordering Information

Part #	Description
M-984-02P	14-pin plastic DIP
M-984-02S	16-pin plastic, SOIC
M-984-02T	16-pin SOIC, Tape and Reel

### Block Diagram



**M-984-02****Absolute Maximum Ratings**

DC Supply Voltage	7V
Input Voltage on SIGIN	$V_{SS} - 6.5V$ to $V_{DD} + 0.3V$
Input Voltage on Any Pin (except SIGIN)	$V_{SS} - 0.3$ to $V_{DD} + 0.3V$
Storage Temperature Range	-40°C to +150°C
Operating Temperature Range	-40°C to +85°C
Lead Soldering Temperature	260°C for 5 seconds

**Note:**

Exceeding these ratings may permanently damage the device.

*Absolute Maximum Ratings are stress ratings. Stresses in excess of these ratings can cause permanent damage to the device. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this data sheet is not implied. Exposure of the device to the absolute maximum ratings for an extended period may degrade the device and effect its reliability.*

**Specifications**

Parameter		Conditions	Min	Max	Units	
Operating Conditions	$V_{DD}$	-	2.7	5.5	V	
	Power supply noise	0.1 - 5 kHz	-	20	mV p-p	
Power	Current drain ( $I_{DD}$ )	$V_{REF}$ open	-	15	mA	
$V_{REF}$	$V_{REF}$	-	48% of $V_{DD}$	52% of $V_{DD}$	V	
	Impedance	-	3.25	8.25	k $\Omega$	
Signal Detection	Frequency Range	-	Note 1	Note 1	-	
	Level: $V_{DD} = 5.0V$	-	-30 (24.5 mV)	0 (775 mV)	dBm	
	Level: $V_{DD} = 3.0V$	-	-33 (17.4 mV)	-3 (173.5 mV)	dBm	
	Duration	$f_c = 400$ Hz	-	85	-	ms
		$f_c = 950, 1400, 1800$ Hz	-	50	-	ms
	Bridge Time	-	-	15	ms	
Signal to Noise Ratio	-	-	16	-	dB	
Signal Rejection	Frequency Range	-	Note 1	Note 1	-	
	Level: $V_{DD} = 5.0V$	-	-	-40 (7.8 mV)	dBm	
	Level: $V_{DD} = 3.0V$	-	-	-43 (5.5 mV)	dBm	
	Duration	-	-	50	ms	
Outputs	Except X358	$V_{OL}$	$I_{SINK} = -1.0$ mA	-	0.5	V
		$V_{OH}$	$I_{SOURCE} = 1.0$ mA	$V_{DD} - 0.5$	-	V
	Dn pins only	$I_{OZ}$	$V_O = V_{DD}, V_{SS}$	-	1	$\mu$ A
Inputs	EN pin	$V_{IL}$	-	-	0.5	V
		$V_{IH}$	$V_{DD} = 5V$	$V_{DD} - 2.0$	-	V
	Pull-up and Pull-down currents	MODE = $V_{SS}$	$V_{DD} = 5V$	12.5	50	$\mu$ A
			$V_{DD} = 2.7V$	4	20	$\mu$ A
		/XRANGE + $V_{SS}$	-	2	6	$\mu$ A
			MODE2 = $V_{DD}$	$V_{DD} = 5V$	12.5	100
			$V_{DD} = 2.7V$	12.5	25	$\mu$ A
		PD = $V_{DD}$	-	4	10	$\mu$ A
	SIGIN pin	Voltage range	-	-6.5	$V_{DD}$	V
		Input impedance	$f = 500$ Hz	80	-	k $\Omega$
Input Spectrum		-	-	28	kHz	
Clock	External clock connected to XIN pin	$V_{IL}$	XOUT open	-	0.2	V
		$V_{IH}$	XOUT open	$V_{DD} - 0.2$	-	V
	XIN, XOUT with crystal ocs. active	Duty cycle	XOUT open	40	60	%
		Capacitance	-	-	10	pF
	X358 pin	Internal res.	-	20	-	M $\Omega$
		$V_{OL}$	$C_L = 20$ pF, $I_{SINK} = -1.0$ mA	-	0.5	V
			$V_{OH}$	$C_L = 20$ pF, $I_{SOURCE} = 1.0$ mA	$V_{DD} - 0.5$	-
Duty cycle	$C_L = 20$ pF	40	60	%		
Tri-state Operation	$t_{FN}$ (High Z to Low Z)	$C_L = 50$ pF	-	250	ns	
	$t_{DE}$ (Low Z to High Z)	RL = 100 K $\Omega$	-	250	ns	

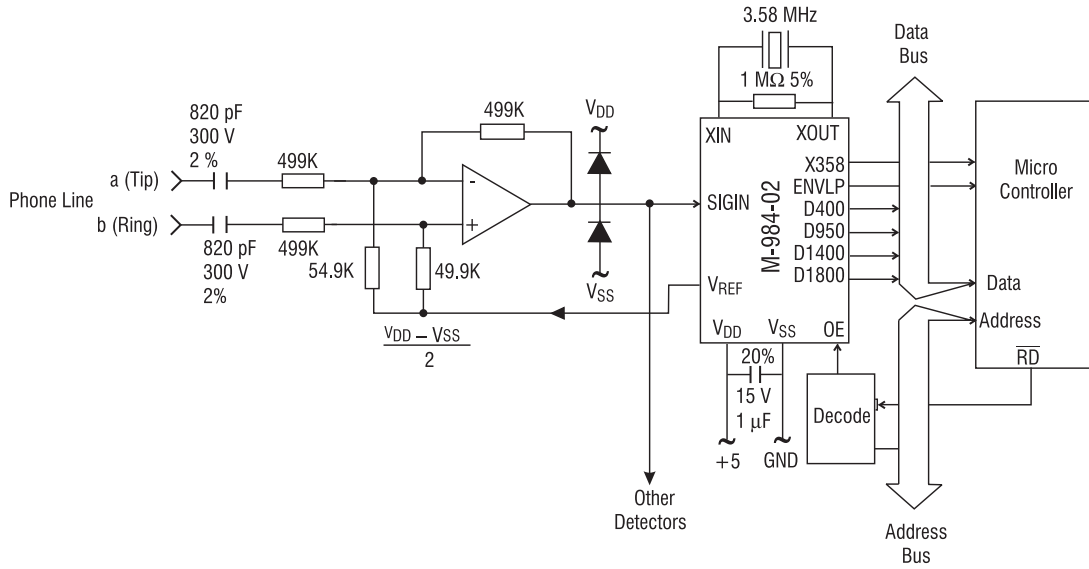
Unless otherwise noted, specifications hold over  $V_{DD} - V_{SS} = 2.8V$  to 5.5V power supply, and  $T_{OL} -40^\circ C$  to +85°C.**Notes:**

1. See the Detector Frequency Windows table on page 4 for detection/ rejection frequencies.

### Pin Functions

PIN	FUNCTION
XIN	Crystal Connection — 3.58 MHz crystal across these pins will produce the timebase needed for proper operation of the M-984-02. An external clock signal may be fed to XIN providing the clock signal has a duty cycle of $50 \pm 10\%$ and comes within 0.2 volts of the supply rails. XOUT remains unconnected when an external clock is used.
XOUT	
X358	A buffered output pin. A 3.58 MHz clock signal is available for use in other circuits as a timebase. Leave open when unused.
ENVLP	The ENVLP pin is a common detection indicator for the four detect pins. Simply put, the ENVLP is a logical "OR" of the active detect circuits for each of the four windows, though there is a delay provided to permit ENVLP to latch the first active detect pin. ENVLP is not tri-state controlled.
$V_{SS}$	The power supply pins, $V_{DD}$ being the most positive. Commonly, $V_{DD}$ is at 3-5 volts, while $V_{SS}$ is at ground.
$V_{DD}$	
SIGIN	Analog signal input. (Internally capacitively coupled.)
$V_{REF}$	$V_{REF}$ is a bias voltage generated in the chip for use in external analog circuits, such as active filters and AC-coupled buffers. Leave open when unused.
OE	The tri-state control pin. OE places the DET pins in the active mode when at logic "1". When at logic "0," OE causes the DET outputs to appear as high impedance. Should be tied to logic "1" when the M-984-02 is not used in a time-shared bus application.
D1800	The detect outputs associated with each window. Tri-state control is available through use of the OE pin. Timing is shown in the Timing Diagram on page 4.
D1400	
D950	
D400	

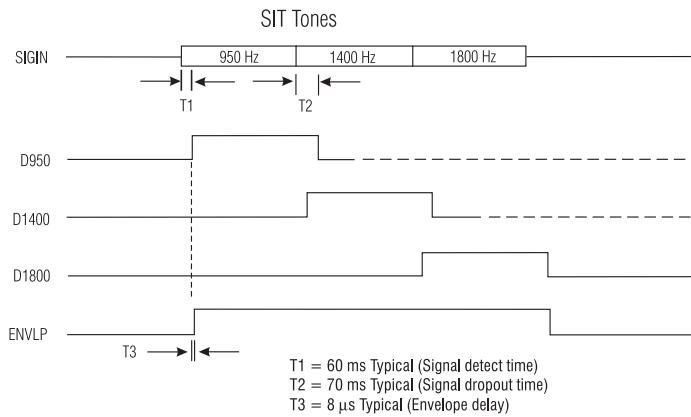
Typical Application



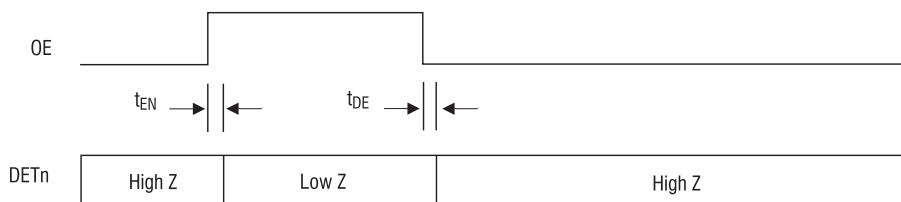
Detector Frequency Windows

Detector	Low Reject	Low Accept	High Accept	High Reject
D400	363	392	459	493
D950	835	885	1016	1070
D1400	1275	1328	1472	1527
D1800	1656	1722	1854	1924

Timing Diagram

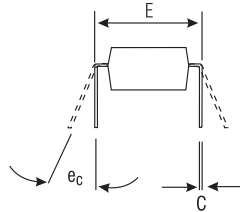
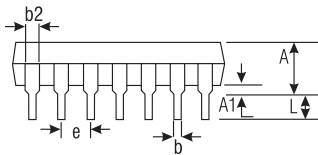
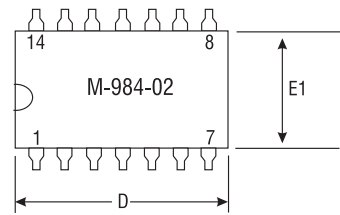


Tri-State Timing



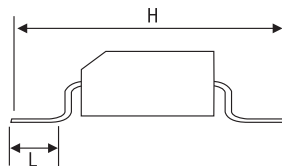
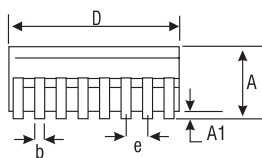
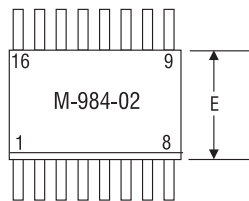
**Mechanical Dimensions**

**14-Pin DIP**



	Tolerances			
	Inches		Metric (mm)	
	Min	Max	Min	Max
A	-	.210	-	5.33
A1	.015	-	.38	-
b	.014	.022	.36	.56
b2	.045	.070	1.1	1.8
C	.008	.014	.20	.36
D	.735	.775	18.7	19.7
E	.300	.325	7.6	8.3
E1	.240	.280	6.1	7.1
e	.100 BSC		2.54 BSC	
ec	0°	15°	0°	15°
L	.115	.150	2.9	4.1

**16-Pin SOIC**



	Tolerances			
	Inches		Metric (mm)	
	Min	Max	Min	Max
A	.093	.104	2.35	2.65
A1	.004	.012	.10	.30
b	.013	.020	.33	.51
D	.398	.413	10.10	10.50
E	.291	.299	7.4	7.6
e	.050 BSC		1.27 BSC	
H	.394	.419	10.00	10.65
L	.016	.050	.40	1.27

Drawing not to scale.  
Does not reflect actual part marking.

Dimensions  
mm  
(inches)



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