M-982 Precise Call Progress Tone Detector

The Teltone® M-982 is an integrated circuit precise tone detector for special purpose use in automatic following of switched telephone calls. The circuit uses low-power CMOS techniques to provide the complete filtering and control required for this function. The basic timing of the M-982 is designed to permit operation with almost any progress tone system.

The use of integrated circuit techniques allows the M-982 to pack the four filters and amplitude detectors for call progress following into a single 22-pin DIP. A 3.58 MHz crystal-controlled time base guarantees accuracy and repeatability.

Features

- Precise detection of call progress tones
- Linear (analog) input
- Digital (CMOS compatible), tri-statable outputs
- 22-pin DIP and other package types
- Single supply 5 volt CMOS (low power)
- Inexpensive 3.58-MHz time base
- Wide dynamic range (30 dB)

Applications

- Automatic dialers
- Dialing modems
- Traffic measurement equipment
- Test equipment
- Service evaluation
- Billing systems

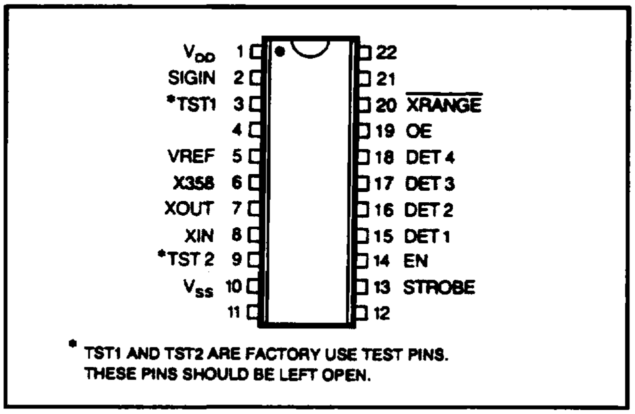

Figure 1 Pin Diagram

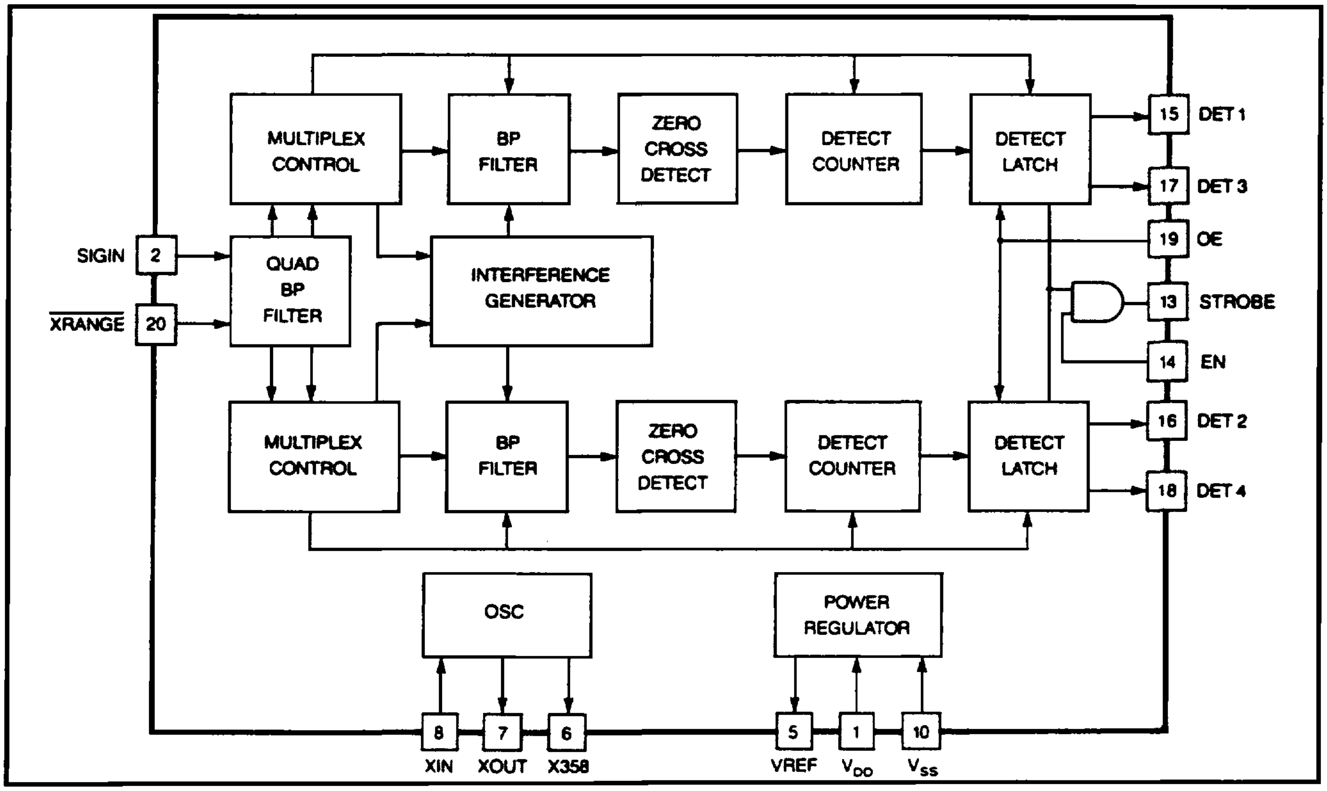

Figure 2 Block Diagram

Call Progress Tone Detection

Call progress tones are audible tones sent from switching systems to calling parties to show the status of calls. Calling parties can identify the success of a call placed by what is heard after dialing. The type of tone used and its timing vary from system to system, and though intended for human ears these signals can provide valuable information for automated calling systems.

The Teltone M-982 contains four signal detectors sensitive to the frequencies often used for these progress tones. Electronic equipment monitoring the DET n outputs of the M-982 can determine the nature of signals present by measuring their duty cycle. See Figure 4 for a diagram of a circuit that could be used to permit a microcomputer to directly monitor tones on the telephone line. Much of the character of the progress tones is in their duty cycle or cadence (sometimes referred to as interruption rate). This information, coupled with level and frequency indication from the M-982, can be used to decide what progress tones have been encountered.

For example, dial tones as shown in the table are usually "on" continuously and last until the first dial digit is received by the switching system. Line Busy, on the other hand, is turned off and on at a rate of 1 Hz with a a 50% duty cycle, or an interruption rate of 60 times per minute (60 IPM). The tones can be distinguished in this way. Table 4 shows some call progress tones with on/off times—0.25/0.25 being 250 ms on, 250 ms off on a repeating basis. It should be noted that while such techniques will usually be effective, there are some circumstances in which the M-982 cannot be accurately used. Examples include situations where ringback tone may be short or not even encountered. Ringback may be provided at ringing voltage frequency (20 or 30 Hz) with some harmonics and may not fall in the detect range, and speech or other strong noise may obscure tones making cadence measurement difficult.

As can be seen, the tones used for the same purposes in different systems may not be the same. Standards do exist and should be consulted for your particular application. In North America AT&T's "Notes on the Network" or EIA's RS-464 PBX standard should be reviewed. In Europe tone plans may vary with locale, in which case the CEPT administration in each country must be consulted. Outside these areas, national PTT organizations can provide information on the systems within their borders.

Table 1 Pin Functions

Pin	Function
DET1	Active high tri-stateable output, detect for 350 Hz.
DET2	Active high tri-stateable output, detect for 620 Hz.
DET3	Active high tri-stateable output, detect for 440 Hz.
DET4	Active high tri-stateable output, detect for 480 Hz.
EN	Active high enable, when low drives STROBE low.
OE	Active high input. When low tri-states DETn pins.
SIGIN	Analog signal input (internally capacitive coupled).
STROBE	Active high output, indicates valid DETn.
V_{DD}	Most positive power supply input pin.
VREF	Internally generated mid-power supply voltage (output).
V_{SS}	Most negative power supply input pin.
X358	Buffered oscillator output (3.58 MHz).
XIN	Crystal oscillator or digital clock input.
XOUT	Crystal oscillator output.
$\overline{XRANGE}$	Active low input. Adds 10 dB of gain to input stage.

Table 2 Truth Table

Signal present (fo)	DET1	DET2	DET3	DET4	STROBE	OE	EN
350 Hz	1	X	X	X	1	1	1
620 Hz	X	1	X	X	1	1	1
440 Hz	X	X	1	X	1	1	1
480 Hz	X	X	X	1	1	1	1
Other In-Band	0	0	0	0	0	1	1
Any	High Impedance				X	0	1
Any	High Impedance				0	0	0

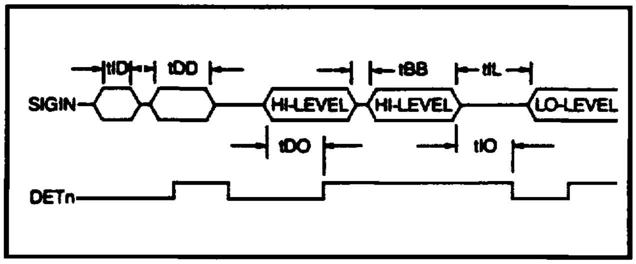

Figure 3 Signal Timing (See Table 3)

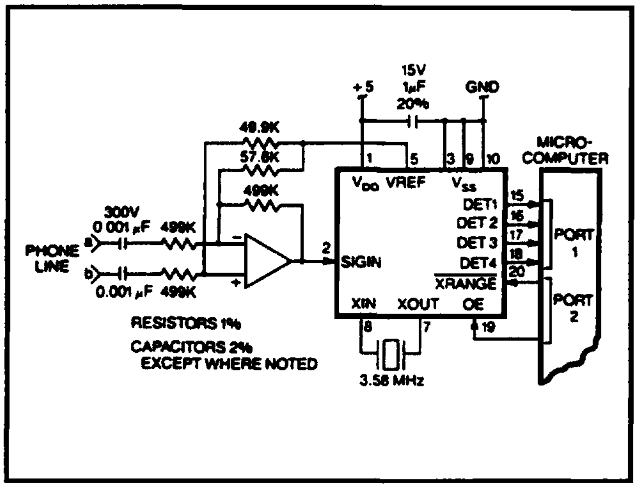

Figure 4 A Telephone Line Circuit Application

Table 3 Specifications

Unless otherwise noted, V_{DD} - V_{SS} = 5V and Ta = 25 °C							
Parameter		Conditions	Min	Typ	Max	Units	Notes
Operating Conditions	V_{DD}	—	4.75	—	5.5	V	1
	Power supply noise	0.1 - 5 kHz	—	—	20	mV p-p	
Power	Current drain (IDD)	—	—	—	20	mA	
Signal Detection	Frequency range	in-band signal	-1	—	+1	% of f_o	
	Level	—	-24	—	0	dBm	2
	Duration (tDD)	—	200	—	—	ms	
	Bridge time (tBB)	—	—	—	30	ms	
	Level skew between adjacent in-band signals	for detection of both	—	—	6	dB	3
	High level to low level signal for detection of both (tIL)	high = 0 dBm low = -30 dBm	1	—	—	s	
	Time to output (tDO)	—	—	—	200	ms	
Signal Rejection	Level	noise at SIGIN 0.2 - 3.4 kHz	—	—	-50	dBm	4, 5
	Interval duration (tID)	—	115	—	—	ms	
	Time to output (TIO)	—	—	—	200	ms	
Outputs	DETECT pins (DETn):						
	VOL	ISINK = -1 mA	—	—	0.5	V	
	VOH	ISOURCE = 1 mA	V_{DD} -0.5	—	—	V	
	IOZ	VO = V_{DD}, V_{SS}	—	—	1	µA	
	STROBE pin:						
	VOL	ISINK = -1 mA	—	—	0.5	V	
Inputs	EN, OE, $\overline{\text{XRANGE}}$ pins:						
	VIL	—	—	—	0.5	V	
	VIH	—	V_{DD} -2.0	—	—	V	
	Pullup current	EN, OE, $\overline{\text{XRANGE}}$ = V_{SS}	—	—	10	µA	
	SIGIN pin:						
	Voltage range	—	V_{DD} -18	—	V_{DD}	V	
	Input impedance	f = 500 Hz	80K	—	—	ohms	
Gain		$\overline{\text{XRANGE}}$ = 0	9.9	—	10.1	dB	
Clock	External clock:	XOUT open					
	VIL	—	—	—	-0.2	V	
	VIH	—	V_{DD} -0.2	—	—	V	
	Duty cycle	—	40	—	60	%	
	XIN, XOUT loading	Crystal osc. active					
	Capacitance	—	—	—	10	pF	
	Resistance	—	20M	—	—	ohms	
	X358 pin:	CL = 20 pF					
	VOL	ISINK = -10 µA	—	—	0.2	V	
	VOH	ISOURCE = 10 µA	V_{DD} -0.2	—	—	V	
	Duty cycle	—	40	—	60	%	
Three-state Operation	Enable time, TEN, Z to lo or hi	CL = 50 pF	—	—	450	ns	
	Disable time, TDE, lo or hi to Z	RL = 100 kohms	—	—	450	ns	

Notes:

1. All parameters are specified at V_{DD} = 5 volts and $\overline{\text{XRANGE}}$ at a logical "hi" state (i.e., unity front-end gain). Power levels are in dBm referenced to 600 ohms. All DC voltages are referenced to V_{SS}.
2. A post-filter AGC is employed to enhance end-of-tone detection for high-level signals. A drop in amplitude of the input tone may cause an end-of-tone (interval) indication.
3. Any tone 40 Hz from center frequency must adhere to this specification.
4. Large input voltage transients may cause excessive ringing in the highly selective filter, causing spurious detection. The detects are not considered as incorrect circuit operation.
5. Frequency 6% away from center frequency.

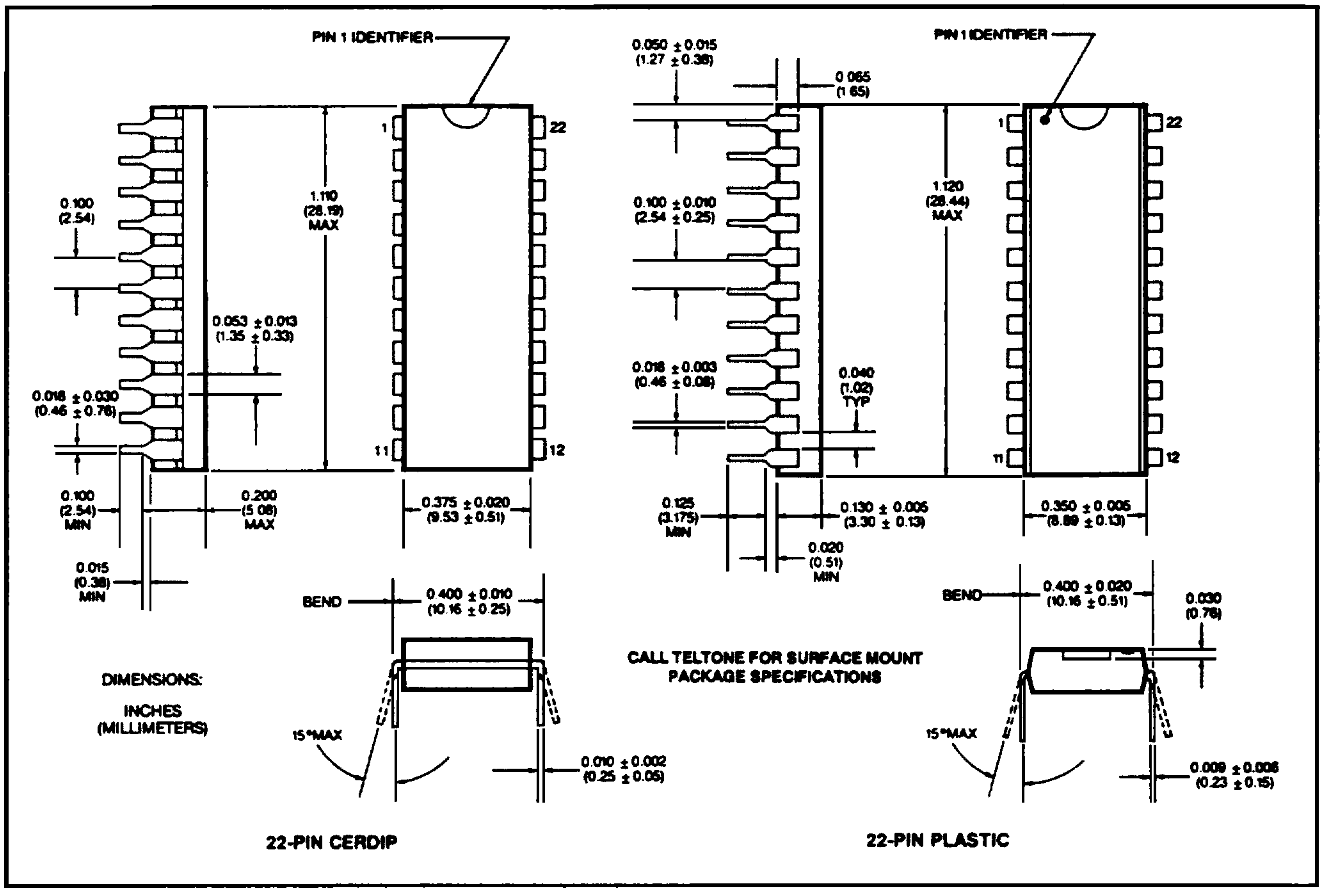

Figure 5 Package Dimensions

Table 4 Call Progress Tones

FREQUENCY (HZ)		USE
1	2	
350	440	Dial Tone
400	Off	Special
440	Off	Alert Tone
440	480	Audible Ring
440	620	Pre-empt
480	Off	Bell High Tone
480	620	Reorder (Bell Low)
350	Off	Special
620	Off	Special
941	1209	DTMF "*"

Table 5 Absolute Maximum Ratings (Note 1)

Storage Temperature	−40 to 125°C
Operating Ambient Temperature	−0 to 70°C
V_{DD}	15 V
Input Voltage on SIGIN	V_{SS} −22 to V_{DD} +0.5 V
Input Voltages (except SIGIN)	V_{SS} −0.3 to V_{DD} +0.3 V
Lead Soldering Temperature	260°C for 5 seconds

Note:

1. Exceeding these ratings may permanently damage the M-982.