ELECTRONICS, INC.
44 FARRAND STREET
BLOOMFIELD, NJ 07003
(973) 748–5089
http://www.nteinc.com

NTE1690
Integrated Circuit
Telephone DTMF Dialer

Description:
The NTE1690 is a monolithic integrated circuit in a 16–Lead DIP type package fabricated using CMOS process and is designed specifically for integrated tone dialer applications.

Features:
- High Accuracy Tones
- Digital Divider Logic, Resistive Ladder Network and CMOS Operational Amplifier on a Single Chip
- Uses Inexpensive 3.579545MHz Television Color Burst Crystal
- Invalid Key Entry Can Result in Either Single Tone or No Tone
- Tone Disable Allows Any Key Down Output to Function from Keyboard Input Without Generating Tones

Functions:
- Fixed Supply Operation
- Negative–True Keyboard Input
- Tone Disable Input
- Stable–Output Level

Absolute Maximum Ratings: (T_A = +25°C unless otherwise specified)
Supply Voltage, V_{DD} 10.5V
Any Input Relative to V_{DD} (Except Pin10), V_N 0.3V
Any Input Relative to GND (Except Pin10), V_N . . . . . –0.3V
Power Dissipation, P_D 500mW
Operating Temperature Range, T_{opr} . . . . . –30° to +60°C
Storage Temperature Range, T_{stg} . . . . . –55° to +150°C

Electrical Characteristics: (–30°C < T_A < +60°C unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Supply Voltage	V_{DD}		3	–	10	V
Input “0”	V_{IL}		0	–	$0.3V_{CC}$	V
Input “1”	V_{IH}		$0.7V_{CC}$	–	V_{CC}	V
Input Pull–Up Resistor	R_I		20	–	100	KΩ

Electrical Characteristics (Cont'd): (−30°C < T_A < +60°C unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
$\overline{\text{Tone Disable}}$	TD	Note 4	0	–	$0.3V_{CC}$	V
Tone Output	V_{OUT}	Note 1	−10	–	−7	dBm
Preemphasis, High Band			2.4	2.7	3.0	dB
Output Distortion, Measured in Terms of Total Out−of−Band Power Relative to RMS sum of flow and Column fundamental Power		Note 2	–	–	−20	dB
Rise Time	T_{RISE}	Note 3	–	2.8	5.0	mS
$\overline{\text{Any Key Down}}$ Sink Current to GND	I_{AKD}	At V_{OUT} = 0.5V	500	–	–	µA
$\overline{\text{Any Key Down}}$ Off Leakage Current	I_{AKDO}	At V_{OUT} = 5V	–	–	2	µA
Supply Current Operating	I_{OD}	At V_{DD} = 3.V, Note 6	–	–	2	mA
Supply Current Standby	I_{DD}	At V_{DD} = 10V, Note 5	–	–	200	µA
Tone Output−No Key Down	NKD		–	–	−80	dBm

Note 1. Single−tone, low−group. Any V_{DD} between 3.4V and 3.6V, odBm = 0.775V, R_{LOAD} = 10K.

Note 2. Any dual−tone. Any V_{DD} between 3.4V and 10.0V.

Note 3. Time from a valid keystroke with no bounce to allow the waveform to go from min to 90% of the final magnitude of either frequency. Crystal parameters defined as R_S = 100Ω, L = 96mH, C = 0.02pF, and C_h = 5pF, $V_{DD} \geq 3.4V$, f = 3.57954Mhz ±0.02%.

Note 4. Only tones will be disabled when $\overline{\text{TD}}$ is taken to logical "0". Other chip functions may activate. Pull−up resistor on $\overline{\text{TD}}$ input will meet the same spec as other inputs. Logic 0 = GND.

Note 5. Stand−by condition is defined as no keys activated, $\overline{\text{TD}}$ = Logical 1, $\overline{\text{Single Tone Inhibit}}$ = Logical 0.

Note 6. One key depressed only. Outputs unloaded.

Pin Descriptions:

Row and Column Inputs (Pins 3, 4, 5, 9, 11, 12, 13, 14): With Single Tone Inhibit at V_{CC}, connection of GND to a single column will cause the generation of that column tone. Connection of GND to more than one column will result in no tones being generated. The application of GND to only a row pin or pins has no effect on the circuit. There must always be at least one column connected to GND for row tones to be generated. If a single row tone is desired, it may be generated by tying any two column pins and the desired row pin to GND. Dual tones will be generated if a single row pin and a single column pin are connected to GND.

Any Key Down Output (Pin10): The any key down output is used for electronic control of receiver and/or transmitter switching and other desired functions. It switches to GND when a keyboard button is pushed and is open circuited when not. The any key down output switches regardless of the tone disable and single tone inhibit inputs.

Tone Disable Input (Pin2): The Tone Disable input is used to defeat tone generation when the keyboard is used for other functions besides DTMF signaling. It has a pull−up to V_{DD} and when tied to GND tones are inhibited. All chip functions operate normally.

Single Tone Inhibit Input (Pin15): The Single Tone Inhibit is used to inhibit the generation of other than dual tones. It has a pull−down to GND and when floating or tied to GND, any input situation that would normally result in a single tone will now result in no tone, with all other chip functions operating normally.

Tone Output (Pin16): The tone output pin is connected internally in the NTE1690 to the emitter of an NPN transistor whose collector is tied to V_{DD}. The input to this transistor is the on−chip operational amplifier which mixes the row and column tones together and provides output level regulation.

Functional Description:

Oscillator

The network contains an on−board inverter with sufficient loop gain to provide oscillation when used with a low cost television color−burst crystal. The inverter's input is OSC in (Pin7) and the output is OSC out (Pin5). The circuit is designed to work with a crystal cut to 3.579545Mhz to give the frequencies in Table 1. The oscillator is disabled whenever a keyboard input is not sensed.

Table 1. Standard DTMF and Output Frequencies

Key	f	Standard DTMF (Hz)	Tone Output Frequency using 3.57954Mhz Crystal (Hz)	% Deviation from Standard
ROW	f1	697	701.3	+0.62
	f2	770	771.4	+0.19
	f3	852	857.2	+0.61
	f4	941	935.1	−0.63
COL	f5	1209	1215.9	+0.57
	f6	1336	1331.7	−0.32
	f7	1477	1471.9	−0.35
	f8	16334	1645.0	+0.73

Most crystals don't vary more than 0.02%. Any crystal frequency deviation from 3.5795Mhz will be reflected in the tone output frequency.

Output Waveform

The row and column output waveforms are digitally synthesized using on−chip D/A converters. Distortion measurement of these unfiltered waveforms will show a typical distortion of 7% or less. The on−chip operational amplifier of the NTE1690 mixes the row and column tones together to result in a dula−tone waveform.

Spectral analysis of this waveform will show that typically all harmonic and intermodulation distortion components will be −30dB down when referenced to the strongest fundamental (column tone).

Output Tone Level

The output tone level of the NTE1690 is proportional to the applied DC supply voltage. Operation will normally be with a regulated supply. This results in enhanced temperature stability, since the supply voltage may be made temperature stable.

Keyboard Configuration

Each keyboard input is standard CMOS with a pull−up resistor to V_{CC}. These inputs may be controlled by a keyboard or electronic means. Open collector TTL or standard CMOS (operated off same as the NTE1690) may be used for electronic control.

The switch contacts used in the keyboards may be void of precious metals, due to the CMOS network's ability to recognize resistance up to 1KΩ as a valid key closure.

Pin Connection Diagram