



# LC73860

## DTMF Receiver IC

### Overview

The LC73860 is a DTMF signal detector receiver that incorporates all the necessary filters for telephone answering machines.

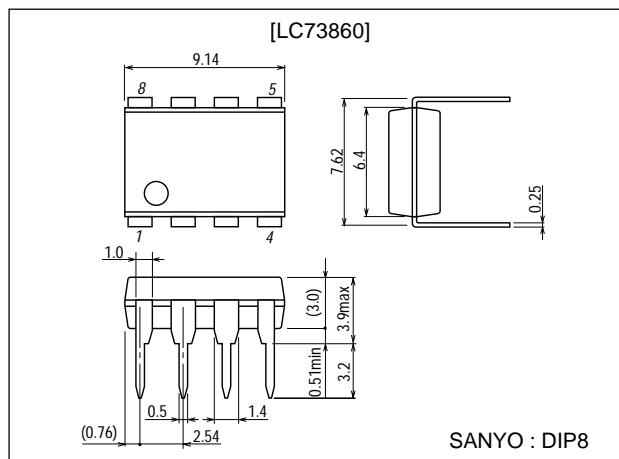
### Features

- 16-DTMF tone signal decoder.
- DTMF receiver with all necessary filters built-in.
  - Dial tone filter.
  - High-group bandpass filter.
  - Low-group bandpass filter.
- Extended dynamic range.
- Serial data output.
- Microcontroller guard-time compatible.
- 4.5 to 5.5V operating supply voltage range.
- Available in 8-pin plastic DIPs (300 mil).

### Package Dimensions

unit:mm

3001C-DIP8



### Specifications

**Absolute Maximum Ratings** at  $T_a=25\pm 2^\circ\text{C}$ ,  $V_{SS}=0\text{V}$

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	$V_{DD\text{ max}}$		-0.3 to +6.0	V
Input voltage	$V_{IN\text{ max}}$		-0.3 to $V_{DD}+0.3$	V
Input current	$I_{IN\text{ max}}$		-10 to +10	mA
Output voltage	$V_{OUT\text{ max}}$		-0.3 to $V_{DD}+0.3$	V
Allowable power dissipation	$P_d\text{ max}$	$T_a\leq 85^\circ\text{C}$	500	mW
Operating temperature	$T_{opr}$		-40 to +85	$^\circ\text{C}$
Storage temperature	$T_{stg}$		-50 to +125	$^\circ\text{C}$

**Recommended Operating Conditions** at  $T_a=-40$  to  $+85^\circ\text{C}$ ,  $V_{SS}=0\text{V}$

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Operating supply voltage	$V_{DD}$		4.5		5.5	V
Input HIGH-level voltage	$V_{IH}$	ACK pin	0.7 $V_{DD}$			V
		PD pin	0.85 $V_{DD}$			V
Input LOW-level voltage	$V_{IL}$	ACK pin			0.3 $V_{DD}$	V
		PD pin			0.15 $V_{DD}$	V

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## LC73860

### DC Electrical Characteristics at $T_a=25\pm 2^{\circ}\text{C}$ , $V_{DD}=5\text{V}$ , $V_{SS}=0\text{V}$

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Operating supply current	$I_{DD(op)}$			3.0	7.0	mA
Standby supply current	$I_{DD(st)}$	$V_{PD}=5\text{V}$			10	$\mu\text{A}$
Output HIGH-level current	$I_{OH}$	$V_{OUT}=4.6\text{V}$ , SD and EST pins			-0.4	mA
Output LOW-level current	$I_{OL}$	$V_{OUT}=0.4\text{V}$ , SD and EST pins	1			mA
Input impedance	$Z_{in}$	INPUT pin	10			$\text{k}\Omega$

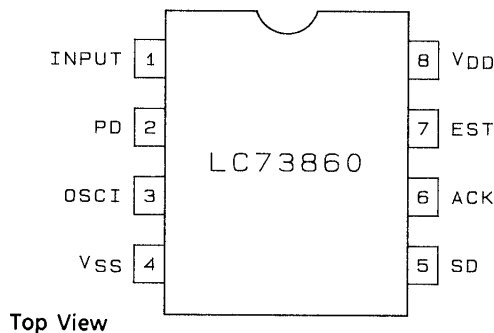
### AC Electrical Characteristics at $T_a=25\pm 2^{\circ}\text{C}$ , $V_{DD}=5\text{V}$ , $V_{SS}=0\text{V}$ , $f_{OSC}=4.194304\text{MHz}$

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Valid input signal level		See notes 1, 2, 3, 5, 6 and 9.	-49.5		0	dBm
Positive twist accept		See notes 2, 3, 4, 9 and 11.		6		dB
Frequency deviation accept		See notes 2, 3, 5 and 9.	$\pm 1.5\%\pm 2$			Hz
Frequency deviation reject		See notes 2, 3 and 5.	$\pm 3.5$			%
Third tone tolerance		See notes 2, 3, 4, 5, 9 and 10.		-16		dB
Dial tone tolerance		See notes 2, 3, 4, 5, 8, 9 and 10.		22		dB
Noise tolerance		See notes 2, 3, 4, 5, 8, 9 and 10.		-12		dB
Tone present detect time	$t_{DP}$	See timing chart.	3		20	ms
Tone absent detect time	$t_{DA}$	See timing chart.	0.5		20	ms
Data shift rate					1	MHz
Data output delay time	$t_{PAD}$	See timing chart.		100		ns
Setup time delay	$t_{DL}$	See timing chart.	0			ns
Data hold time	$t_{DH}$	See timing chart.	30			ns
Oscillator frequency	$f_{OSC}$		4.152362	4.194304	4.236247	MHz

#### Notes

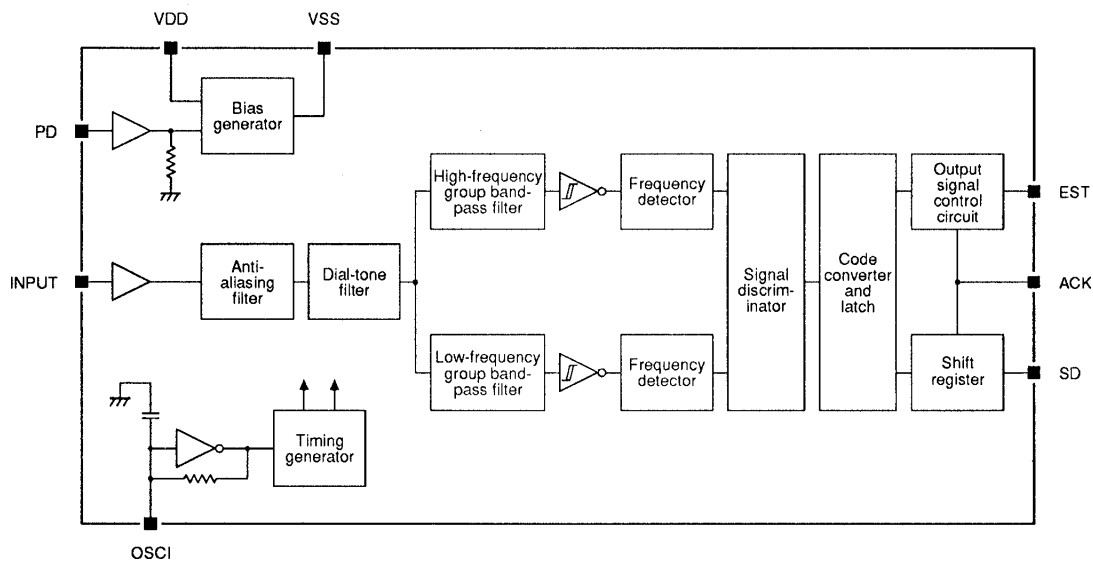
1. 0dBm=1mW power when driving a 600 $\Omega$  load.
2. All 16 DTMF signal frequencies.
3. 40ms DTMF signal period and 40ms pause period.
4. Nominal DTMF frequency.
5. Low-frequency group and High-frequency group signal levels are the same.
6. DTMF signal frequency deviation is within  $\pm 1.5\% \pm 2\text{Hz}$ .
7. Bandwidth limited (0 to 3kHz) Gaussian noise.
8. 350Hz and 440Hz dial tone frequencies.
9. Error rate of less than 1 in 10,000.
10. Referenced to the lowest frequency component of the DTMF signal.
11. Twist=High-frequency group tone level  $\div$  Low-frequency group tone level.

### Pin Assignment



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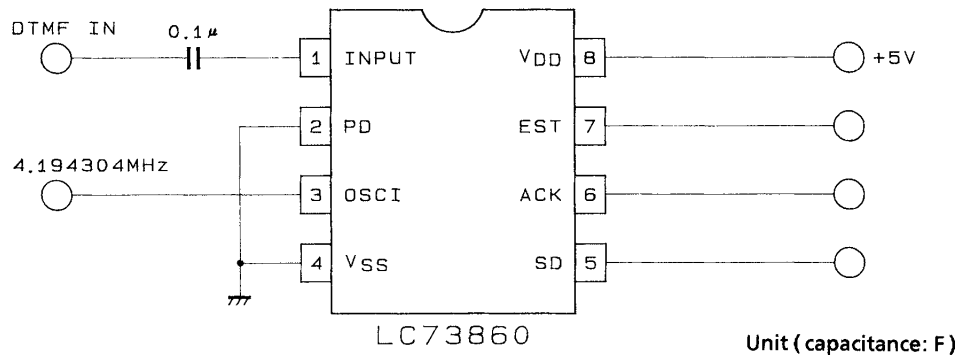
## Block Diagram



## Pin Functions

Number	Name	I/O	Description
1	INPUT	I	Input coupling capacitor connection. Biased internally to $V_{DD}/2$ .
2	PD	I	Power-down mode is selected when HIGH.
3	OSCI	I	4.194304MHz external clock input.
4	VSS		Ground (0V).
5	SD	O	Outputs the 4-bit serial, decoded DTMF output, least significant bit first.
6	ACK	I	Shift data to SD control. Four pulses are used to output the 4-bit DTMF code. Before the first rising edge, the data is latched into the shift register.
7	EST	O	Indicates the presence of a DTMF signal when HIGH. This pin can be monitored and after a short delay, data can be accessed by applying 4 pulses to ACK.
8	VDD	O	4.5 to 5.5V supply voltage.

## Test/Application Circuit



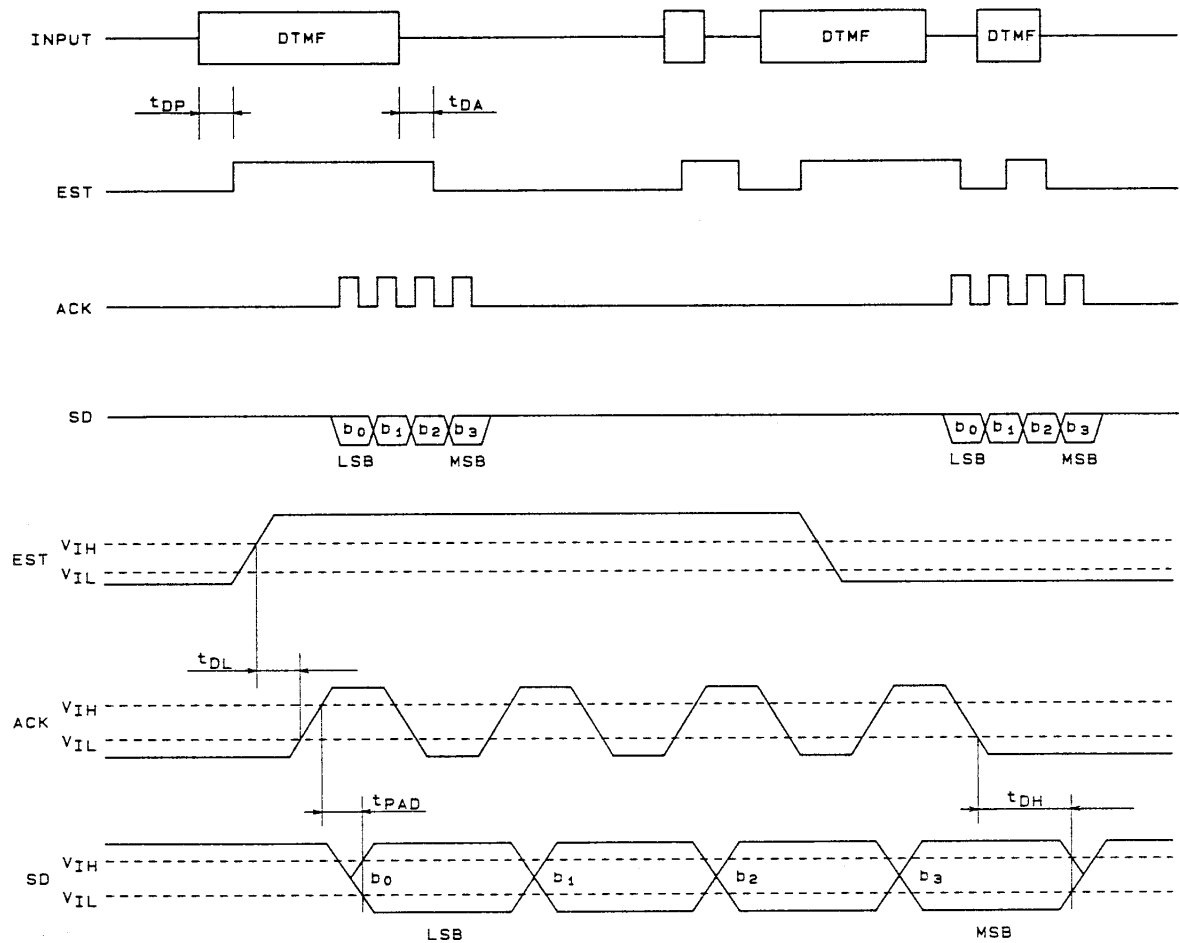
Output Code Table

F <sub>L</sub>	F <sub>H</sub>	KEY	b3	b2	b1	b0
697	1209	1	L	L	L	H
697	1336	2	L	L	H	L
697	1477	3	L	L	H	H
770	1209	4	L	H	L	L
770	1336	5	L	H	L	H
770	1477	6	L	H	H	L
852	1209	7	L	H	H	H
852	1336	8	H	L	L	L
852	1477	9	H	L	L	H
941	1336	0	H	L	H	L
941	1209	×	H	L	H	H
941	1477	#	H	H	L	L
697	1633	A	H	H	L	H
770	1633	B	H	H	H	L
852	1633	C	H	H	H	H
941	1633	D	L	L	L	L

DTMF Dialing Matrix

	C1	C2	C3	C4
R1	1	2	3	A
R2	4	5	6	B
R3	7	8	9	C
R4	×	0	#	D

Timing Chart



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