Ordering number : EN5000A

CMOS LSI

LC73881M

DTMF Receiver LSI

Applications

Remote controllers for telephone answering machines and other telephone products

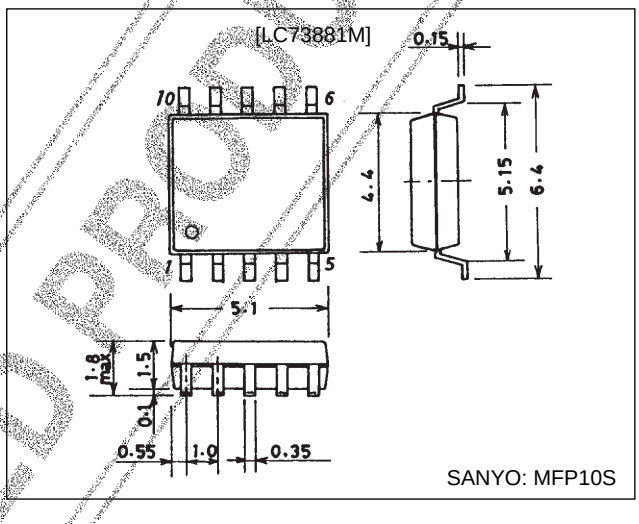
Features

Detects 16 DTMF signals.
Includes on-chip all filters required in a DTMF receiver
Ñ Dial-tone filter
Ñ High-frequency group bandpass filter
Ñ Low-frequency group bandpass filter
Serial data output
Supports microprocessor-controlled guard times.
Wide operating power-supply voltage range: 2.7 to 5.5 V
Supports a low power mode that allows current dissipation to be reduced.

Package Dimensions

unit: mm

3086A-MFP10S



SANYO: MFP10S

Specifications

Absolute Maximum Ratings at Ta = 25 C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{DD} max		–0.3 to + 6.0	V
Input voltage	V_{IN}		–0.3 to V_{DD} + 0.3	V
Input current	I_{IN}		–10 to +10	mA
Output voltage	V_{OUT}		–0.3 to V_{DD} + 0.3	V
Allowable power dissipation	Pd max	Ta ≤ 70°C	120	mW
Operating temperature	Topr		–35 to +70	°C
Storage temperature	Tstg		–50 to +125	°C

Allowable Operating Ranges at Ta = 35 to +70 C, V_{SS} = 0 V

Parameter	Symbol	Conditions	min	typ	max	Unit
Operating supply voltage	V_{DD}		2.7		5.5	V
Input high-level voltage	V_{IH}	Pin 7	0.7 V_{DD}			V
		Pin 2	0.85 V_{DD}			V
Input low-level voltage	V_{IL}	Pin 7			0.3 V_{DD}	V
		Pin 2			0.15 V_{DD}	V

DC Electrical Characteristics at Ta = 25 C, V_{DD} = 3 V, V_{SS} = 0 V

Parameter	Symbol	Conditions	min	typ	max	Unit
Operating supply current	I_{DD} (op)			1.6	2.8	mA
Standby supply current	I_{DD} (st)	PD pin = 3 V			20	µA
Output high-level current	I_{OH}	Pins 6, 8 and 9, V_{OUT} = 2.6 V			–0.3	mA
Output low-level current	I_{OL}	Pins 6, 8 and 9, V_{OUT} = 0.4 V	0.6			mA
Input impedance	Zin	Pin 1	10			kΩ
Pull-down resistor current	I_{SI}	PD = 3 V		1.2	3.0	µA

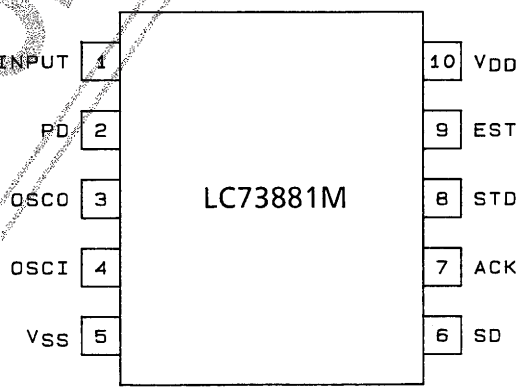
SANYO Electric Co.,Ltd. Semiconductor Bussiness Headquarters
TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110-8534 JAPAN

AC Electrical Characteristics at Ta = 25 C, V_{DD} = 3 V, V_{SS} = 0 V, f_{OSC} = 4.194304 MHz

Parameter	Symbol	Conditions	min	typ	max	Unit
Input signal valid level	—	*1, 2, 3, 5, 6, 9	–45		–20	dBm
Positive twist accept	—	*2, 3, 6, 9, 11		±10		dB
Frequency detection accept	—	*2, 3, 5, 9	±1.5% ± 2			Hz
Frequency rejection accept	—	*2, 3, 5	±3.5			%
Third tone tolerance	—	*2, 3, 4, 5, 9, 10		–16		dB
Dial tone tolerance	—	*2, 3, 4, 5, 8, 9, 10		+22		dB
Noise tolerance	—	*2, 3, 4, 5, 7, 9, 10		–8		dB
Tone present detection time	t_{DP}	See the timing chart.	3		20	ms
Tone absent detection time	t_{DA}	See the timing chart.	0.5		20	ms
Tone duration accept	$t_{\overline{REC}}$	See the timing chart.			20	ms
Tone duration reject	t_{REC}	See the timing chart.	45			ms
Inter-digit pause invalid time	t_{DO}	See the timing chart.			20	ms
Inter-digit pause valid time	t_{ID}	See the timing chart.	40			ms
Data shift speed	—				1	MHz
Data output delay time	t_{PAD}	See the ACK/SD timing chart		100		ns
Setup time delay	t_{DL}	See the ACK/SD timing chart	4			µs
Data hold time	t_{DH}	See the ACK/SD timing chart	30			ns
Oscillator frequency	f_{OSC}		4.190109	4.194304	4.198498	MHz
Load capacitance	C_{XO}	The OSCI and OSCO pins			30	pF

Note: 1. The dBm values are defined such that 0 dBm is the 1 mW power level for a 600 Ω load.
2. All 16 DTMF signals frequency
3. With a 40 ms DTMF signal period and a 40 ms pause period
4. Nominal DTMF signal frequencies
5. Low-group and high-group signal levels are the same.
6. DTMF signal frequency deviations within ±1.5% ± 2 Hz
7. Gaussian noise with a 0 to 3 kHz bandwidth
8. 350 and 440 Hz dial tone frequencies
9. Error rate of less than 1 error in 10,000 events
10. Referenced to the lowest component of the DTMF signal.
11. Twist = $\frac{\text{High-frequency group tone level}}{\text{Low-frequency group tone level}}$

Pin Assignment



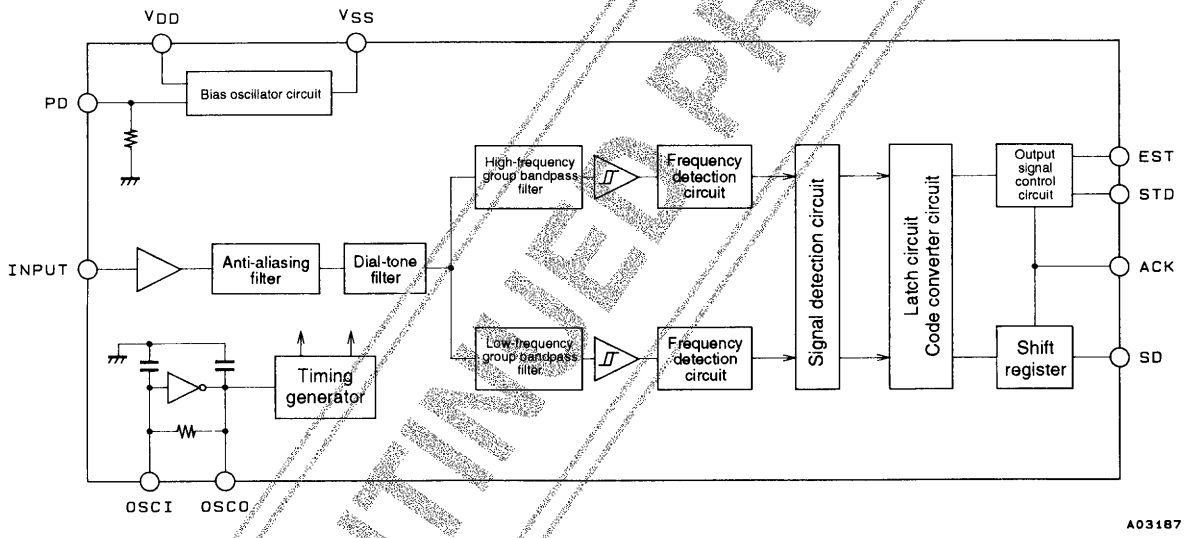
Top view

A03186

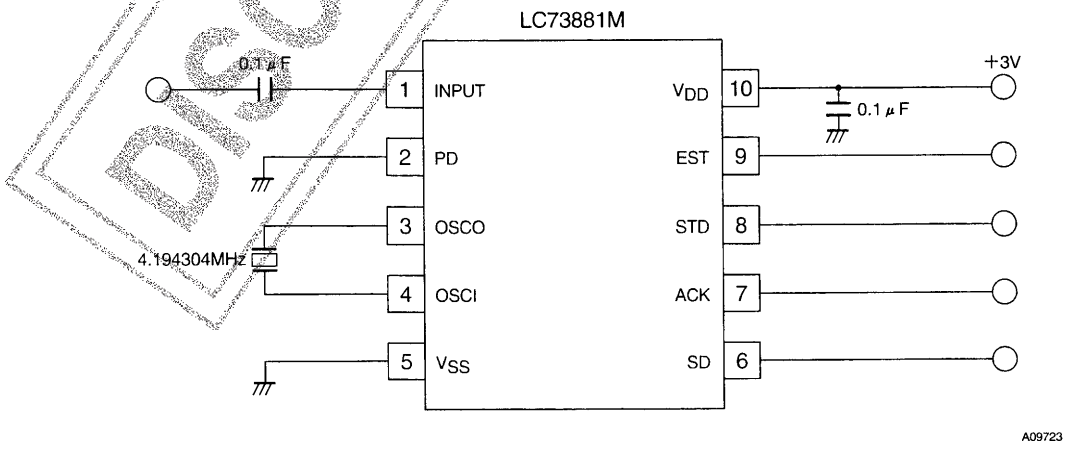
Pin Functions

Pin No.	Symbol	I/O	Function
1	INPUT	I	The input must be capacitor coupled. This signal is biased to $V_{DD}/2$ internally.
2	PD	I	The LC73881M goes to low power mode when this pin is set high.
3	OSCO	O	Connect a 4.194304 MHz crystal oscillator or ceramic resonator to these pins to from an oscillator circuit. When using a ceramic resonator, a capacitor of approximately 30 pF must be connected to each pin.
4	OSCI	I	
5	V_{SS}		Power supply pin. Normally 0 V.
6	SD	O	The decoded DTMF signal is output, this pin in a 4-bit LSB first format.
7	ACK	I	The ACK pin is used to shift out data from the SD pin. Four pulses are required to shift out the DTMF character, which consists of four bits. The rising edge of the first pulse latches the data (before shifting) into the shift register.
8	STD	O	A high level indicates the presence of a DTMF signal. Although the rise of this signal is later than that of the EST pin, it is less sensitive to burst waveforms and other noise.
9	EST	O	A high level indicates the presence of a DTMF signal. Applications should monitor this pin and, after waiting an appropriate period, apply four pulses to the ACK pin to access the data.
10	V_{DD}		Power supply pin. Normally 2.7 to 5.5 V.

Block Diagram

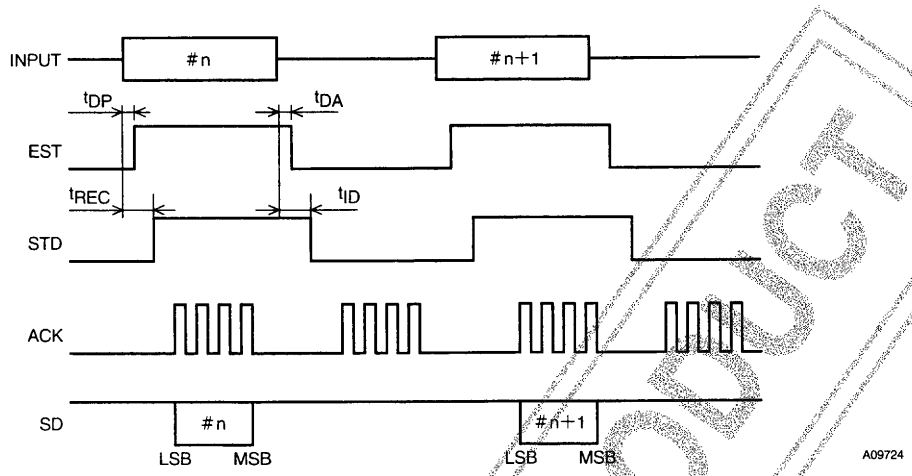


Test Circuit, Sample Application Circuit

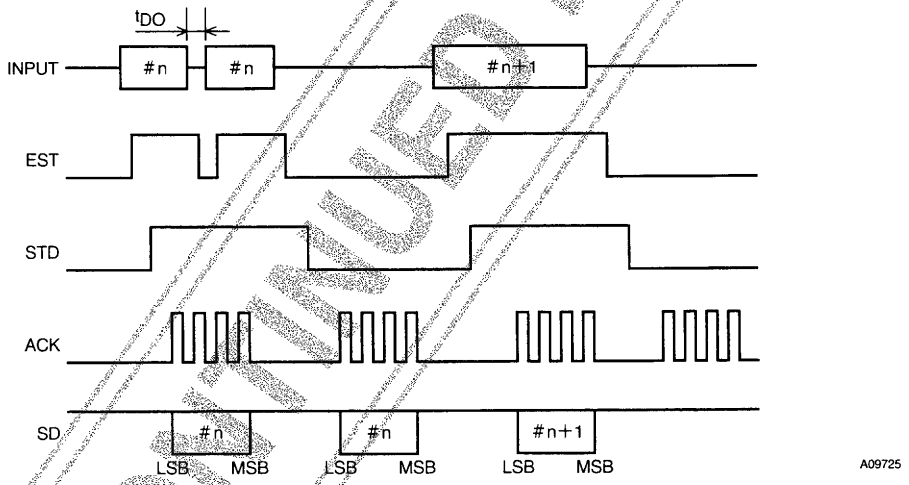


Timing Chart

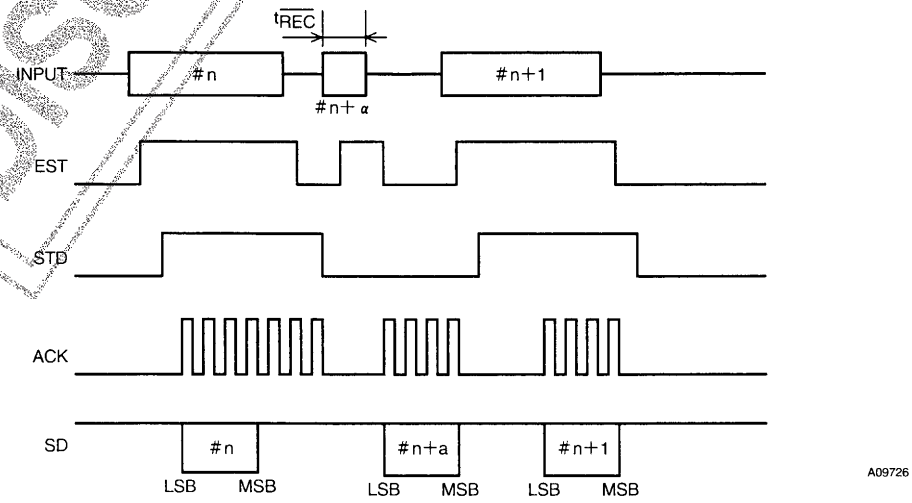
Normal State Timing Chart



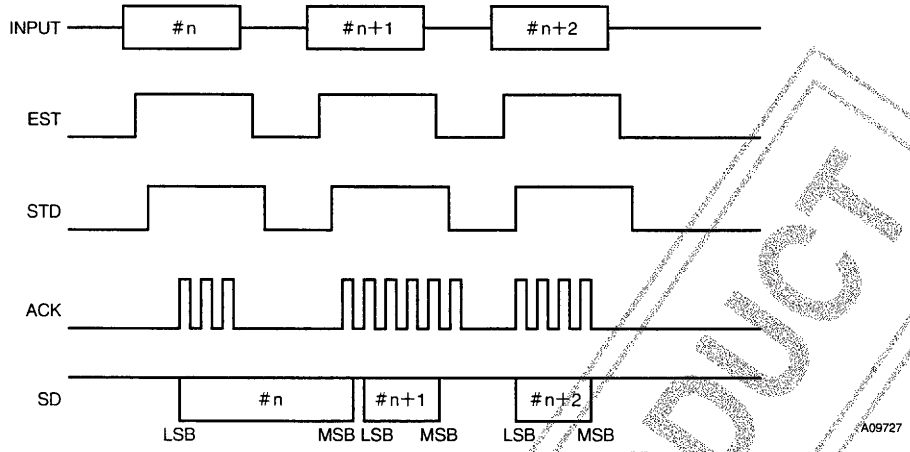
When the DTMF signal (#n) is split due to, for example, the burst signal



When noise (#n+a) similar to a DTMF signal is input

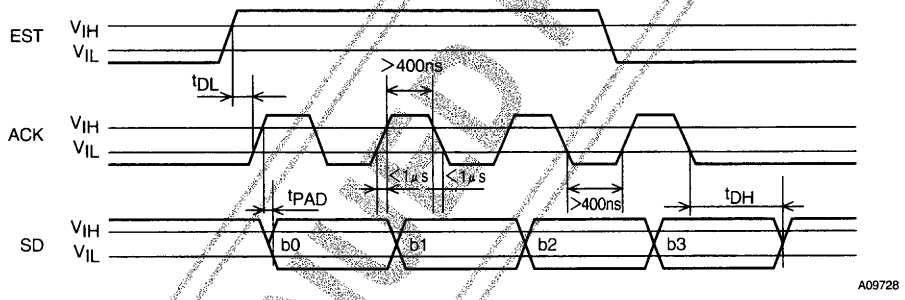


When the data output is disrupted due to input clock displacement.

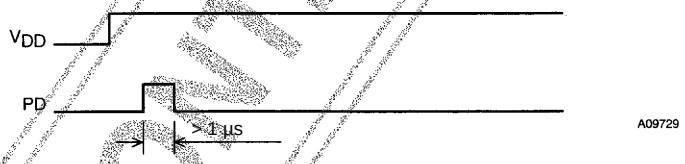


Data is output from the SD pin after 4 pulses are input to the ACK pin. However, note that if 5 or more pulses are input between one rising edge on the EST pin and the next rising edge on the EST pin, the fifth and later pulses will be ignored.

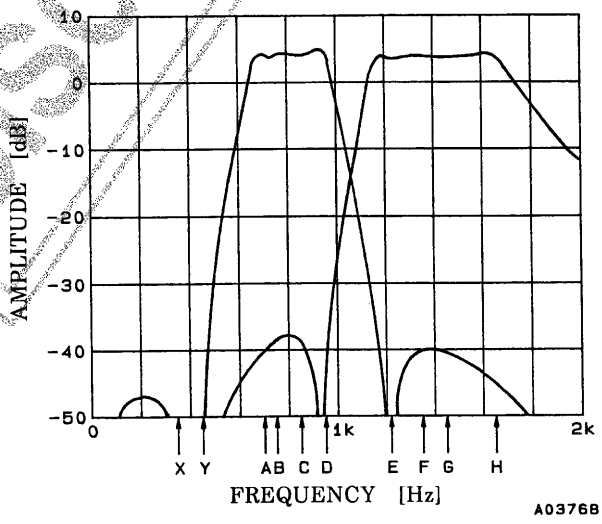
ACK/SD Timing Chart



Reset Timing at Power On



Filter Characteristics



PRECISE
DIAL TONES

X=350Hz
Y=440Hz

DTMF TONES

A=697Hz
B=770Hz
C=852Hz
D=941Hz
E=1209Hz
F=1336Hz
G=1477Hz
H=1633Hz

Output Code Table

F_L	F_H	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