

**SANYO**

No. 4368

**LC7387M****DTMF Receiver**

## Overview

The LC7387M is a DTMF signal detection receiver IC for use in telephone answering machines. It includes the filters required for DTMF signal detection on chip.

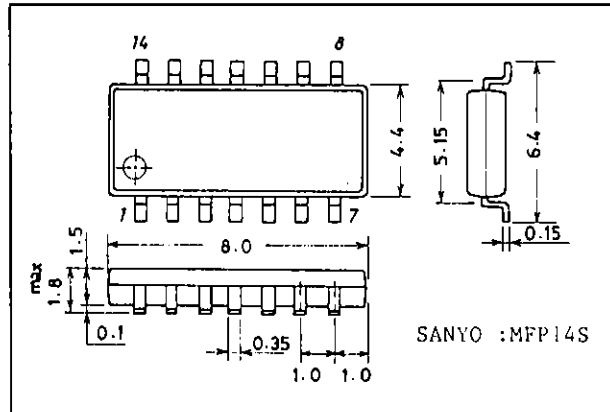
## Features

- Detects all 16 DTMF signals.
- Includes on-chip all filters required in a DTMF receiver.
  - Dial tone filter
  - High frequency group band pass filter
  - Low frequency group band pass filter
- Extended dynamic range
- Serial data output
- Supports microprocessor control guard time.
- Operating supply voltage range: 4.5 to 5.5 V
- Supports a low power mode that allows current dissipation to be reduced.
- Serial output data can be read out multiple times.

## Package Dimensions

unit: mm

3111-MFP14S



## Specifications

### Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Condition	Rating	Unit
Maximum supply voltage	V <sub>DD</sub> max		-0.3 to +6.0	V
Maximum input voltage	V <sub>IN</sub> max		-0.3 to V <sub>DD</sub> +0.3	V
Maximum input current	I <sub>IN</sub> max		-10 to +10	mA
Maximum output voltage	V <sub>OUT</sub> max		-0.3 to V <sub>DD</sub> +0.3	V
Power dissipation	P <sub>d</sub> max	Ta ≤ 85°C	300	mW
Operating temperature	T <sub>opr</sub>		-40 to +85	°C
Storage temperature	T <sub>stg</sub>		-50 to +125	°C

**SANYO Electric Co., Ltd. Semiconductor Business Headquarters**

TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110 JAPAN

**LC7387M**

**Allowable Operating Ranges at Ta = -40 to +85°C, VSS = 0 V**

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Operating supply voltage	V <sub>DD</sub>		4.5		5.5	V
High level input voltage	V <sub>IH</sub>	Pins ACK and $\overline{\text{LOAD}}$	0.7 V <sub>DD</sub>			V
		Pin PD	0.85 V <sub>DD</sub>			V
Low level input voltage	V <sub>IL</sub>	Pins ACK and $\overline{\text{LOAD}}$			0.3 V <sub>DD</sub>	V
		Pin PD			0.15 V <sub>DD</sub>	V

**DC Electrical Characteristics at Ta = 25 ±2°C, VDD = 5 V, VSS = 0 V**

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Operating supply current	I <sub>DD(OP)</sub>			3	7	mA
Standby supply current	I <sub>DD(ST)</sub>	Pin PD = 5 V			10	µA
High level output current	I <sub>OH</sub>	V <sub>OUT</sub> = 4.6 V; Pins SD, EST, and STD		-0.8	-0.4	mA
Low level output current	I <sub>OL</sub>	V <sub>OUT</sub> = 0.4 V; Pins SD, EST, and STD	1.0	2.5		mA
Input impedance	Z <sub>in</sub>	Pin INPUT	10			kΩ

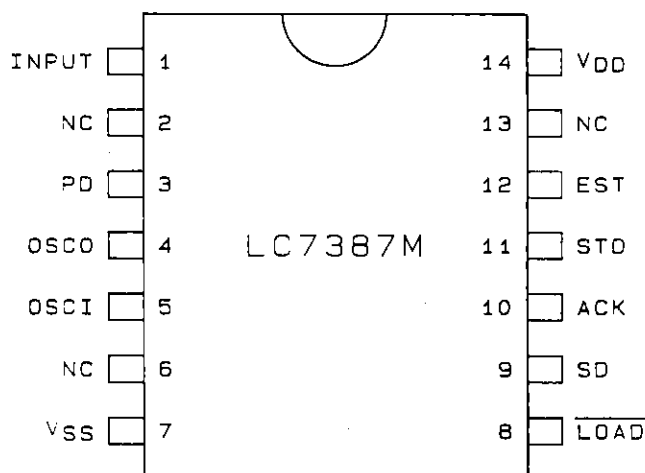
**AC Electrical Characteristics at Ta = 25°C, VDD = 5 V, VSS = 0 V, fOSC = 4.194304 MHz**

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Valid input signal level		Conditions: 1, 2, 3, 5, 6, 9	-45		0	dBm
Positive twist accept		Conditions: 2, 3, 6, 9, 11		10		dB
Frequency detection accept		Conditions: 2, 3, 5, 9	±1.5% ±2			Hz
Frequency non-detection accept		Conditions: 2, 3, 5	±3.5			%
Third tone tolerance		Conditions: 2, 3, 4, 5, 9, 10		-16		dB
Dial tone tolerance		Conditions: 2, 3, 4, 5, 8, 9, 10		22		dB
Noise tolerance		Conditions: 2, 3, 4, 5, 8, 9, 10		-12		dB
Tone present detection time	t <sub>DP</sub>	See the timing charts	3		20	ms
Tone absent detection time	t <sub>DA</sub>	See the timing charts	0.5		20	ms
Tone duration accept	t <sub>REC</sub>	See the timing charts	20			ms
Tone duration reject	t <sub>REC</sub>	See the timing charts			45	ms
Inter-digit pause accept	t <sub>DO</sub>	See the timing charts	20			ms
Inter-digit pause reject	t <sub>ID</sub>	See the timing charts			40	ms
Data shift speed					1	MHz
Data output delay time	t <sub>PAD</sub>	See the timing charts		100		ns
Set up time delay	t <sub>OL</sub>	See the timing charts	0			ns
Data hold time	t <sub>DH</sub>	See the timing charts	30			ns
Oscillator frequency	f <sub>OSC</sub>		4.152362	4.194304	4.236247	MHz
Load capacitance	C <sub>XO</sub>	Pins OSC1 and OSC0			30	pF

- Notes:
- The 0 dBm level is defined to be a 1 mW output into a 600 Ω load.
  - All 16 DTMF signals frequency
  - For a 40 ms DTMF signal period and a 40 ms pause period
  - Nominal DTMF frequency
  - Low group and high group signal levels are the same.
  - DTMF signal frequency deviations within ±1.5% and ±2 Hz
  - Bandwidth limited (0 to 3 kHz) Gaussian noise
  - 350 and 440 Hz dial tone frequencies
  - Error rate of less than 1 in 10,000
  - Referenced to the lowest component of the DTMF signal.
  - Twist = High-frequency group tone level + Low-frequency group tone level.

## LC7387M

### Pin Assignment

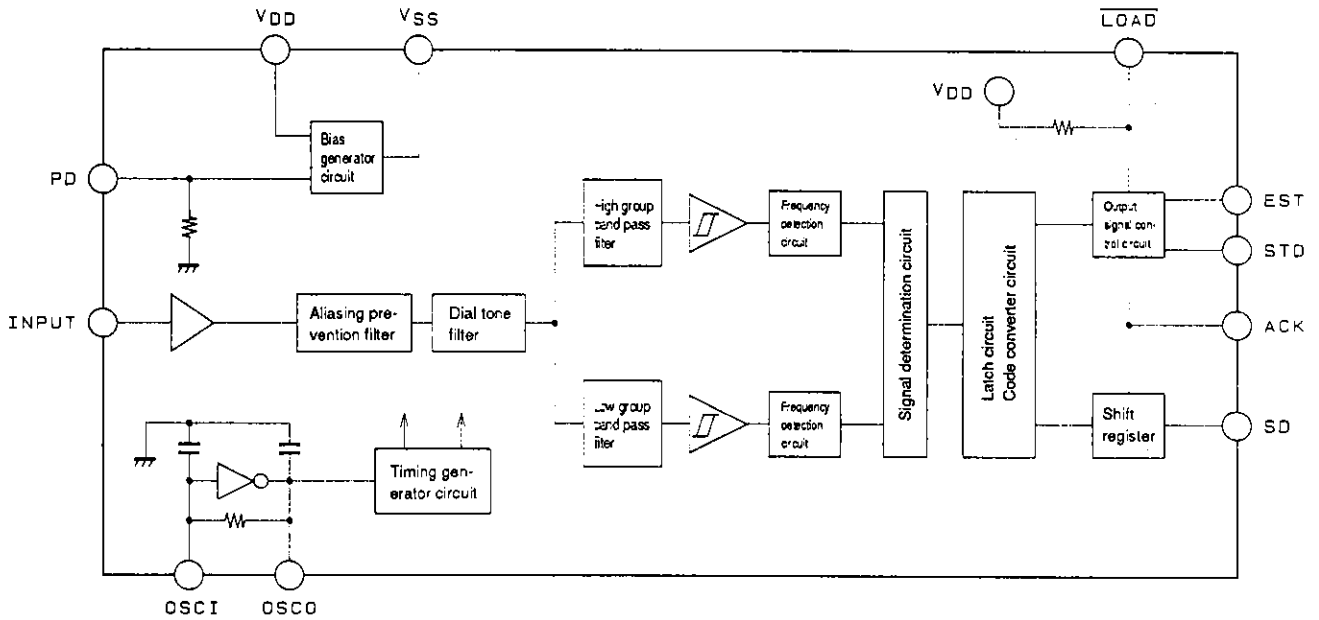


AO1051

### Pin Functions

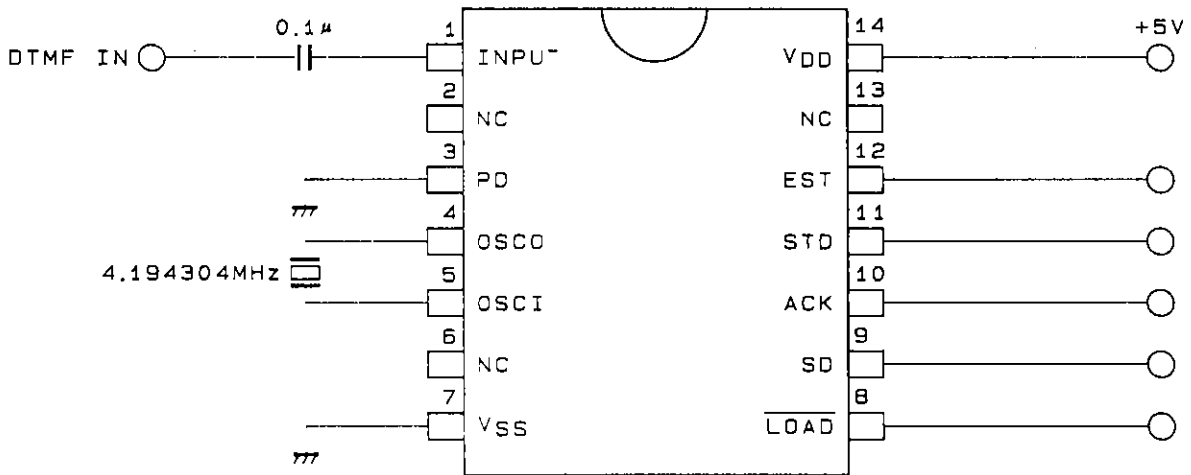
Pin No.	Symbol	I/O	Function
1	INPUT	I	An input coupling capacitor is required. Biased to $V_{DD}/2$ internally.
2	NC		No connection
3	PD	I	The IC goes to low power mode when this pin is pulled high.
4	OSCO	O	Connect a 4.194304 MHz crystal oscillator or ceramic resonator to these pins to form an oscillator circuit. When using a ceramic resonator, a capacitor of approximately 30 pF must be connected to each pin.
5	OSCI	I	
6	NC		No connection
7	$V_{SS}$		Power supply pin: Normally 0 V.
8	LOAD	I	Inputting a clock to this pin allows the serial data to be output two or more times.
9	SD	O	The decoded DTMF signal is output, this pin in a 4-bit LSB first format.
10	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 4 bits. The rising edge of the first pulse latches the data (before shifting) into the shift register.
11	STD	O	A high level indicates the presence of a DTMF signal. The rise of this signal is delayed with respect to that of the EST signal, but it is less sensitive to burst waveforms and other anomalies.
12	EST	O	A high level indicates the presence of a DTMF signal. Monitor this pin externally, and after an appropriate waiting time has passed, apply 4 pulses to the ACK pin to access the data.
13	NC		No connection
14	$V_{DD}$		Power supply pin: normally 4.5 to 5.5 V

Equivalent Circuit Block Diagram



A01052

Test Circuit/Application Circuit Example



Unit (capacitance: F)

A01053

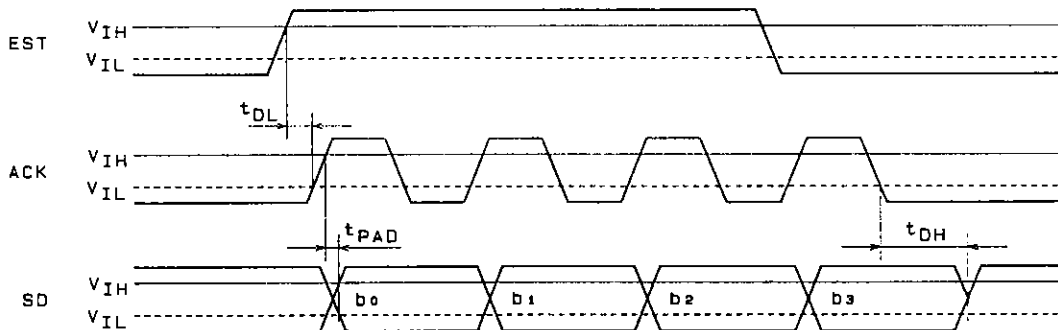
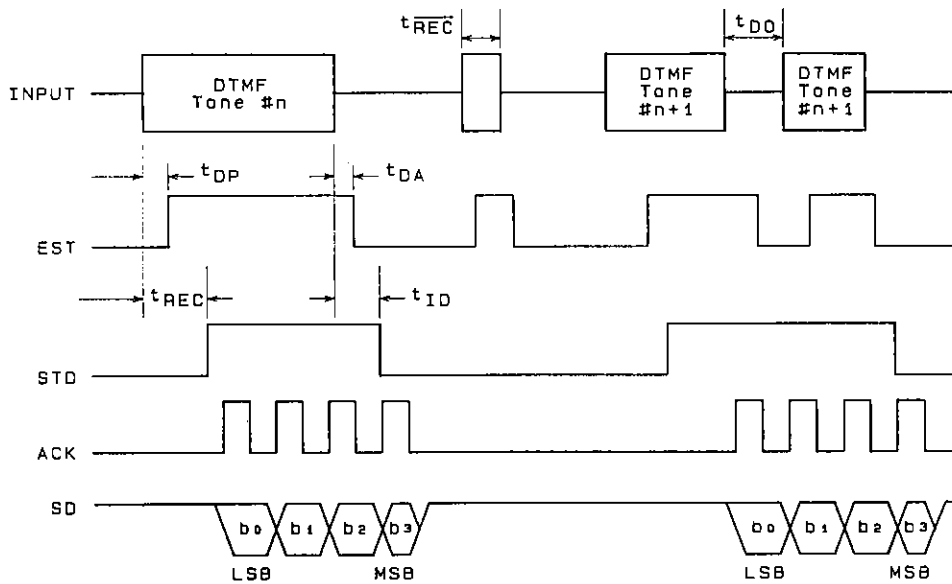
Output Code Table

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

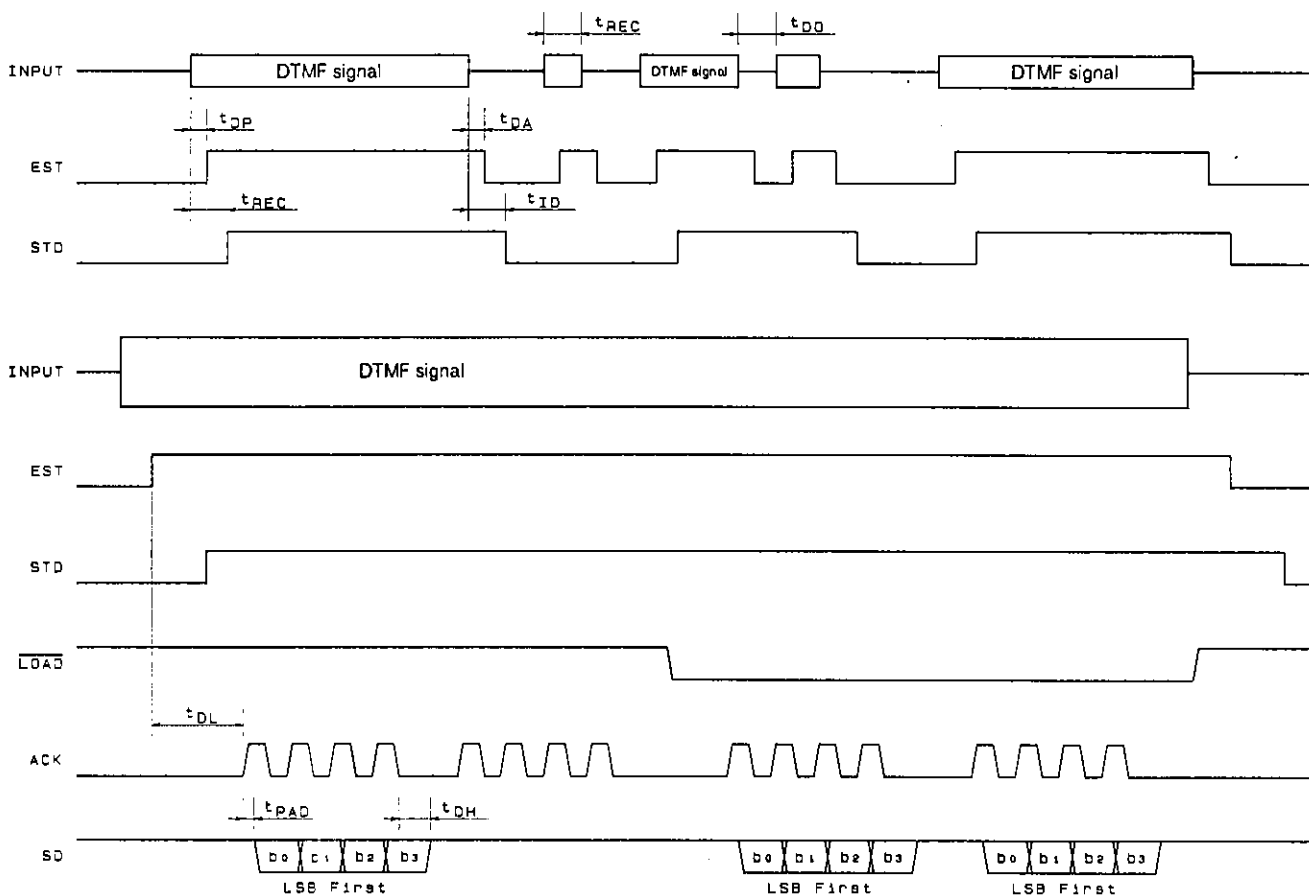
	C1	C2	C3	C4
R1	1	2	3	A
R2	4	5	6	B
R3	7	8	9	C
R4	*	0	#	D

Timing Charts



A01597

## Serial Data Read Out Timing for Second and Later Accesses



A01054

- No products described or contained herein are intended for use in surgical implants, life-support systems, aerospace equipment, nuclear power control systems, vehicles, disaster/crime-prevention equipment and the like, the failure of which may directly or indirectly cause injury, death or property loss.
- Anyone purchasing any products described or contained herein for an above-mentioned use shall:
  - ① Accept full responsibility and indemnify and defend SANYO ELECTRIC CO., LTD., its affiliates, subsidiaries and distributors and all their officers and employees, jointly and severally, against any and all claims and litigation and all damages, cost and expenses associated with such use:
  - ② Not impose any responsibility for any fault or negligence which may be cited in any such claim or litigation on SANYO ELECTRIC CO., LTD., its affiliates, subsidiaries and distributors or any of their officers and employees jointly or severally.
- Information (including circuit diagrams and circuit parameters) herein is for example only; it is not guaranteed for volume production. SANYO believes information herein is accurate and reliable, but no guarantees are made or implied regarding its use or any infringements of intellectual property rights or other rights of third parties.