

SANYO

No. 3926 ※

LC73711N**Switchable DTMF/Pulse Dialer with Memory****Preliminary****OVERVIEW**

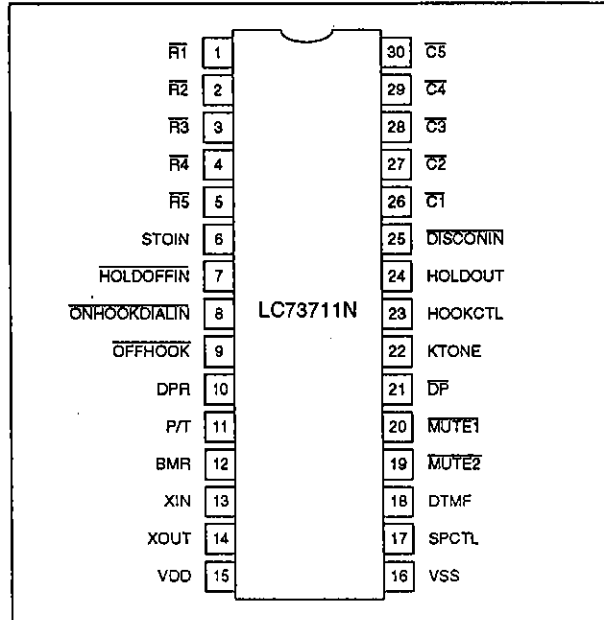
The LC73711N is a DTMF/pulse dialer CMOS LSI for push-button telephones. It incorporates memory for eight 31-digit one-touch dial numbers and ten quick-dial numbers (of which five numbers are common to both).

The LC73711N features a 63-digit redial function, on-hook and mixed-mode dialing, a hold mode and a hookflash function.

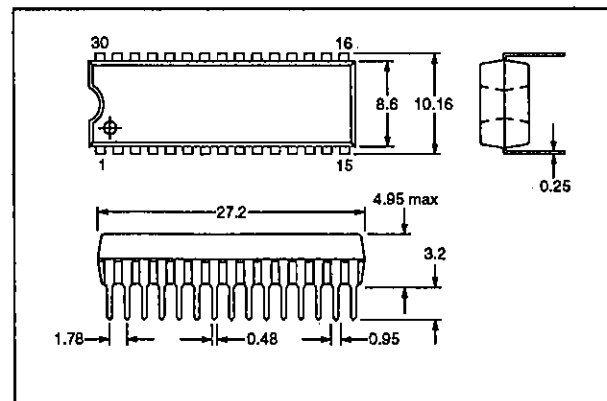
The LC73711N operates from a 2.0 to 5.5 V supply in DTMF mode and a 1.5 to 5.5 V supply in pulse mode. It is available in 30-pin DIPs.

FEATURES

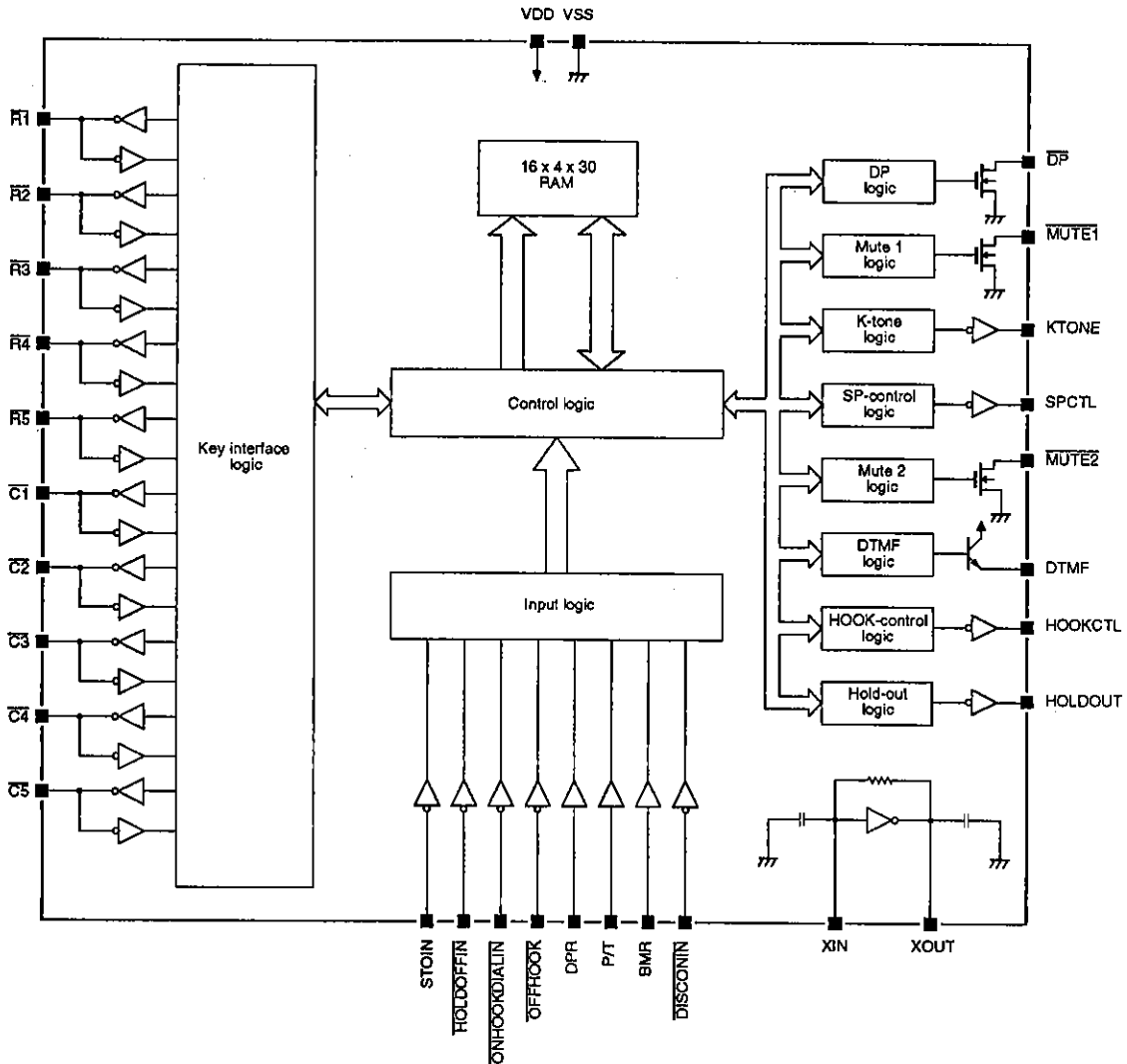
- No external supply needed
- On-chip oscillator designed for use with a low-cost, color-burst crystal or ceramic resonator
- Connects directly to a keypad.
- Supports on-hook dialing and memory setting.
- Supports mixed-mode dialing.
- 63-digit redial function
- Memory for eight 31-digit one-touch dial numbers and ten 31-digit quick dial numbers (of which five numbers are common to both)
- Mode change and pause data can be stored in memory
- Hold mode
- Hookflash function
- 12 high-accuracy DTMF tones
- Selectable 10 or 20 pps pulse rate
- Selectable 33 or 39% make ratio
- Key-touch tone output in pulse mode
- Confirm tone output when data stored in memory
- Automatic pause after mode change and hookflash
- On-chip key debounce and input settling delay
- 2.0 to 5.5 V supply in DTMF mode
- 1.5 to 5.5 V supply in pulse mode
- 30-pin DIP

PINOUT**PACKAGE DIMENSIONS**

Unit: mm

3061-DIP30S

BLOCK DIAGRAM



PIN DESCRIPTION

Number	Name	Description
1 to 5	R1 to R5	Keypad row inputs
6	STO	Memory set mode input
7	HOLD OFF	Hold-mode cancel input
8	ON HOOK DIAL	On-hook dial input
9	OFF HOOK	Hook switch input
10	DPR	Dial pulse rate select input
11	P/T	Pulse/tone dial mode select input
12	BMR	Make ratio select input
13	XIN	Crystal or ceramic resonator connections
14	XOUT	
15	VDD	Supply voltage

LC73711N

Number	Name	Description
16	VSS	Ground
17	SP CTL	Speaker control output. Complementary output
18	DTMF	DTMF output. npn-transistor emitter follower
19	MUTE $\bar{2}$	DTMF-mode mute output. n-channel open drain
20	MUTE $\bar{1}$	Pulse-mode mute output. n-channel open drain
21	$\bar{D}P$	Pulse dialing output. n-channel open drain
22	KTONE	Key-touch tone output. Complementary output
23	HOOK CTL	Hook control output. Complementary output
24	HOLD	Hold-mode output. Complementary output
25	DISCON	Disconnect input
26 to 30	$\bar{C}1$ to $\bar{C}5$	Keypad column inputs

SPECIFICATIONS

Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Supply voltage range	V_{DD}	-0.3 to 6.5	V
Input voltage range	V_I	-0.3 to $V_{DD} + 0.3$	V
Output voltage range	V_O	-0.3 to $V_{DD} + 0.3$	V
Power dissipation	P_D	250	mW
Operating temperature range	T_{opr}	-30 to 70	°C
Storage temperature range	T_{stg}	-40 to 125	°C
DTMF and VSS minimum load resistance	R_L	1	k Ω

Recommended Operating Conditions

$T_a = 25\text{ }^\circ\text{C}$

Parameter	Symbol	Rating	Unit
Pulse-mode supply voltage range	V_{DDP}	1.5 to 5.5	V
DTMF-mode supply voltage range	V_{DDT}	2.0 to 5.5	V

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LC73711N

Electrical Characteristics

$V_{DDP} = 1.5$ to 5.5 V, $V_{DDT} = 2.0$ to 5.5 V, $T_a = 25$ °C, $f_{osc} = 3.579545$ MHz unless otherwise noted

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
LOW-level input voltage	V_{IL}		V_{SS}	–	$0.3 V_{DD}$	V
HIGH-level input voltage	V_{IH}		$0.7 V_{DD}$	–	V_{DD}	V
LOW-level output voltage. See note 1.	V_{OL}	$V_{DD} = 1.5$ V, $I_{OL} = 250$ μ A	–	–	0.4	V
		$V_{DD} = 5.5$ V, $I_{OL} = 1$ mA	–	–	0.4	
HIGH-level output voltage. See note 1.	V_{OH}	$V_{DD} = 1.5$ V, $I_{OH} = -250$ μ A	$V_{DD} - 0.5$	–	–	V
		$V_{DD} = 5.5$ V, $I_{OH} = -1$ mA	$V_{DD} - 1$	–	–	
Supply voltage for data retention	V_{DR}		1	–	–	V
Supply current for data retention	I_{DR}	$V_{DD} = 1$ V	0.5	–	–	mA
Pulse-mode operating current consumption	I_{DDP}	$V_{DD} = 0.3$ V, outputs open	–	0.3	0.5	mA
DTMF-mode operating current consumption	I_{DDT}	$V_{DD} = 0.3$ V, outputs open	–	0.5	1.0	mA
Standby-mode current consumption	I_{DDs}	$V_{DD} = 1.5$ to 5.5 V, outputs open	–	–	1	μ A
LOW-level input current. See note 2.	I_{IL}	$V_{IL} = V_{SS}$	–1	–	–	μ A
HIGH-level input current. See note 2.	I_{IH}	$V_{IH} = V_{DD}$	–	–	1	μ A
Key input current	I_{ILK}	$V_{DD} = 1.5$ V, $V_{ILK} = V_{SS}$	–20	–	–	μ A
		$V_{DD} = 5.5$ V, $V_{ILK} = V_{SS}$	–300	–	–	
Key output current	I_{OLK}	$V_{DD} = 1.5$ V, $V_{OLK} = 0.4$ V	200	–	–	μ A
		$V_{DD} = 5.5$ V, $V_{OLK} = 0.4$ V	700	–	–	
\overline{DP} , $\overline{MUTE1}$ and $\overline{MUTE2}$ leakage current	I_{OFF}	$V_O = V_{DD} = 5.5$ V. Output is OFF.	–	–	1	μ A

Notes

1. Pins \overline{KTONE} , \overline{DP} , $\overline{MUTE1}$, $\overline{MUTE2}$, SP CTL, HOLD and HOOK CTL
2. Pins STO, HOOK SW, DPR, P/T, BMR, ON HOOK, HOLD OFF and DISCON

AC characteristics

$V_{DDP} = 1.5$ to 5.5 V, $V_{DDT} = 2.0$ to 5.5 V, $T_a = 25$ °C, $f_{osc} = 3.579545$ MHz unless otherwise noted

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Key contact resistance	R_{k0}		–	–	3.0	k Ω
Key capacitance	C_{k1}		–	–	330	pF
Key debounce time	t_{KD}		16.4	17.5	18.4	ms
Input settling delay time	t_{PCHT}		28.9	30.0	30.9	ms
Key scan frequency	f_{KSC}		–	258.9	–	Hz
Key-touch tone frequency	f_{KT}		–	1035.7	–	Hz

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Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Key-touch tone output time	t_{KT}		-	30.9	-	ms
Automatic pause time	t_{AP}		3.88	3.90	3.93	s
DTMF ON time	$t_{M\text{PON}}$		98	100	102	ms
DTMF interdigit delay	$t_{M\text{FOFF}}$		93	95	97	ms
Hook time	t_{HK}		740	750	760	ms
Hook pause time	t_{HKP}		0.98	1.00	1.02	s
Memory write confirm tone frequency	f_{KST}		-	2071.4	-	Hz
Memory write confirm tone output time	t_{KSTON}		-	278.1	-	ms
Low tone output voltage	V_{OR}	$V_{DD} = 3.5 \text{ V}, R_L = 10 \text{ k}\Omega$	165	200	240	mV
Tone output ratio	dB_{CR}	$V_{DD} = 2.0 \text{ to } 5.5 \text{ V}, R_L = 10 \text{ k}\Omega$	1	2	3	dB
Tone output distortion	%DIS	$V_{DD} = 2.0 \text{ to } 5.5 \text{ V}, R_L = 10 \text{ k}\Omega$	-	-	10	%
Oscillator startup time	t_{START}	$V_{DD} = 1.5 \text{ to } 5.5 \text{ V}$	-	-	30	ms
		$V_{DD} = 3.0 \text{ V}$	-	1	-	

Resonator

$V_{DDP} = 1.5 \text{ to } 5.5 \text{ V}, V_{DDT} = 2.0 \text{ to } 5.5 \text{ V}, T_a = 25 \text{ }^\circ\text{C}$

Parameter	Symbol	Rating	Unit
Resonator frequency	f_{osc}	3.579545	MHz
Resonator frequency variation	Δf_{osc}	± 1.3	%
Resonator resistance	R_s	100	Ω

Pulse dial output

$V_{DDP} = 1.5 \text{ to } 5.5 \text{ V}, V_{DDT} = 2.0 \text{ to } 5.5 \text{ V}, T_a = 25 \text{ }^\circ\text{C}, f_{osc} = 3.579545 \text{ MHz}$

DPR	BMR	Pulse dial rate (pps)	Pause between digits (ms)	Make ratio (%)
LOW	LOW	9.94	834.2	39.2
LOW	HIGH	9.94	834.2	33.2
HIGH	LOW	19.89	525.2	39.2
HIGH	HIGH	19.89	525.2	33.2

DTMF output

$V_{DDP} = 1.5 \text{ to } 5.5 \text{ V}, V_{DDT} = 2.0 \text{ to } 5.5 \text{ V}, T_a = 25 \text{ }^\circ\text{C}, f_{osc} = 3.579545 \text{ MHz}$

Input	Output frequency (Hz)		Deviation (%)
	Specification	LC73711N	
R1	697	697.0	+0.01
R2	770	770.1	-0.02
R3	852	852.3	-0.03
R4	941	942.0	-0.11
C1	1209	1209.3	-0.03

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Input	Output frequency (Hz)		Deviation (%)
	Specification	LC73711N	
C2	1336	1335.7	+0.03
C3	1477	1476.7	+0.02

FUNCTIONAL DESCRIPTION

Key Functions

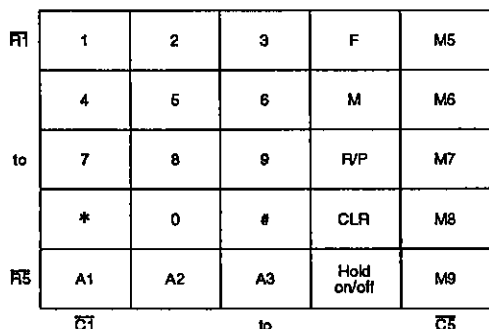


Figure 1. Keypad layout

0 to 9 keys

After lifting the receiver, pressing the numeric keys will initiate normal dialing.

In combination with **M** and **STO**, the numeric keys set the quick-dial and one-touch dial memory and retrieve quick-dial numbers.

* and # keys

In DTMF dialing mode, ***** and **#** are legitimate dialing digits and can be stored in memory.

In pulse dialing mode, ***** switches to DTMF dialing mode and **#** is not used.

R/P key

After lifting the receiver off-hook, pressing **R/P** redials the last number dialed.

During manual dialing, redialing and automatic dialing, pressing **R/P** inserts a pause in the output sequence.

While a pause is being executed, pressing **R/P** cancels the pause.

M key

M, in combination with the number keys and **STO**, sets the quick-dial memory.

Pressing **M** followed by a number key dials a quick-dial number from memory.

The following figure shows the result of misdialing while attempting to dial a number from memory. The sequence **M**, **#** was dialed instead of the correct sequence **M**, **0**. Since **M**, **#** is not a valid combination, the resulting output is 7, 8, 9, 1.

Key input: **7** **8** **9** **M** **#** **1**

Key-tone output: [Pulse] [Pulse] [Pulse] [Pulse] [Pulse]

The following figure shows the result of misdialing while attempting to store a number in memory. Again, the sequence **M**, **#** was dialed instead of **M**, **0**.

Key input: **1** **2** **3** **M** **#** **0** **M** **0**

Key-tone output: [Pulse] [Pulse] [Pulse] [Pulse] [Pulse] [Pulse] [Pulse] [Pulse]

After misdialing, in this example, all keys other than **M** or **CLR** are ignored. The result of this input is to store the sequence 1, 2, 3 in **M0**.

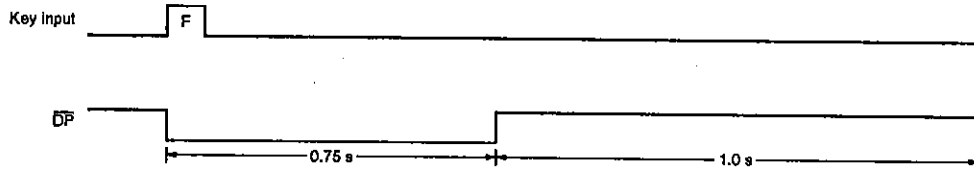
The following figure shows the use of **CLR** while attempting to store a number in memory. When **CLR** is pressed, all previous input is cleared. The result of this input is to store a 4 in **M0**.

Key input: **1** **2** **3** **M** **CLR** **4** **M** **0**

Key-tone output: [Pulse] [Pulse] [Pulse] [Pulse] [Pulse] [Pulse] [Pulse]

F key

During manual dialing, pressing **F**, the flash key, sets DP LOW for 0.75 s and then HIGH for 1.0 s as shown



Pressing **R/P** after **F** redials the previous number sequence. Note that **F** cannot be stored in memory and pressing **F** during a hookflash has no affect.

CLR key

During redialing, pressing **CLR** cancels the redial and clears the redial memory.

After pressing **M**, **CLR** cancels memory operation. During memory storage, pressing **CLR** clears a memory location.

HOLD key

Toggles hold mode ON and OFF.

Dialing examples

The following table shows some example dialing sequences and the corresponding output.

Function		Key input	Dialer output
Normal dialing (pulse mode)		↑ D_1, D_2 to D_n	D_1, D_2 to D_n
Normal dialing with pause (pulse mode)		↑ $D_1, D_2, R/P, D_3$	$D_1, D_2, (4\text{ s pause}), D_3$
Normal dialing with redial (pulse mode)	Dial	↑ D_1, D_2 to D_n	D_1, D_2 to D_n
	Redial	↑ R/P	D_1, D_2 to D_n
Normal dialing with mode change	Using mode change key	↑ $D_1, \blacksquare, D_2, D_3$	$D_1, (4\text{ s pause}), D_2', D_3'$
	Using P/T	↑ $D_1, (P/T\text{ LOW}), D_2, D_3$	$D_1, (4\text{ s pause}), D_2', D_3'$
Dialing from memory	Quick dial	Store (pulse mode)	↓ (STO HIGH), D_1, D_2, D_3, M, D_4
		Dial	↑ M, D_4
	One-touch dial	Store (DTMF mode)	↓ (STO HIGH), D_1, D_2, D_3, A_n
		Dial	↑ A_n

Notes

- ↓ On-hook
- ↑ Off-hook
- D_n Key input
- D_n Pulse-mode output
- D_n DTMF-mode output
- \blacksquare Mode change

in the following figure. This is equivalent to the receiver being placed on-hook for 0.75 s followed by a 1 s pause.

A1 to **A3** keys

Pressing **A1** to **A3**, the one-touch dial keys, dials the number from the corresponding memory.

In combination with STO, **A1** to **A3** are used to set the one-touch dial memory.

M5 to **M9** keys

M5 to **M9** are also one-touch dial keys. They correspond to quick-dial numbers M5 to M9.

Pin Functions

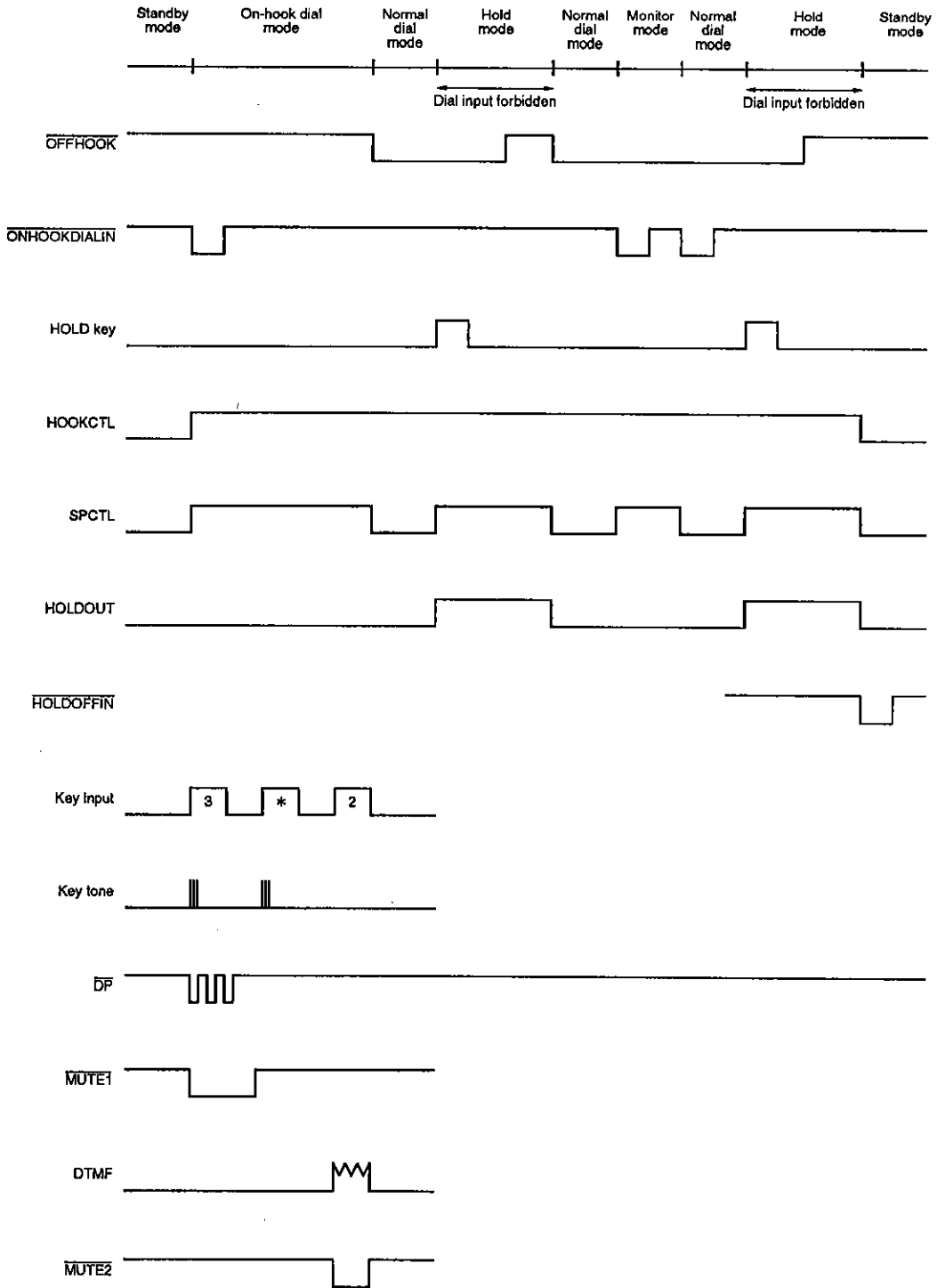


Figure 2. LC73711N timing

When P/T is HIGH, the LC73711N is in pulse dialing mode, and when P/T is LOW, it is in DTMF dialing mode. The mode can be changed from pulse to DTMF while dialing, allowing mixed-mode dialing.

When STO and $\overline{\text{ON HOOK}}$ are HIGH, memory store mode is ON and one-touch and quick-dial numbers can be set.

The falling edge of $\overline{\text{ON HOOK DIAL}}$ toggles the dialing mode. When the receiver is on-hook ($\overline{\text{OFF HOOK}}$ HIGH), $\overline{\text{ON HOOK DIAL}}$ toggles between standby

mode and on-hook dial mode. When the receiver is off-hook ($\overline{\text{OFF HOOK}}$ LOW), $\overline{\text{ON HOOK DIAL}}$ toggles between normal dial mode and monitor mode.

When DPR is LOW, the dial pulse rate is 10 pps, and when DPR is HIGH, it is 20 pps. When BMR is LOW, the pulse contact make ratio is 39%, and when BMR is HIGH, it is 33%.

When $\overline{\text{DISCON}}$ is LOW, the LC73711N is in standby mode and undergoes a reset.

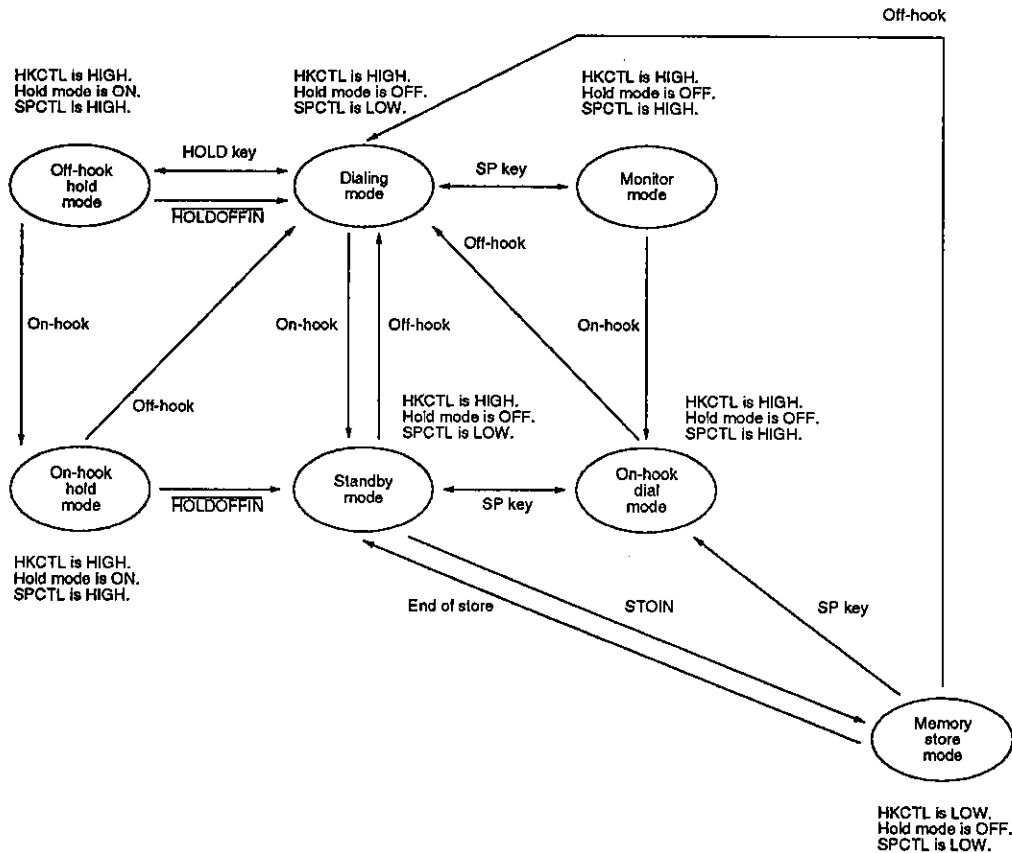


Figure 3. LC73711N operating mode state diagram

Key Debounce and Input Settling Delay Circuits

The LC73711N incorporates a key debounce circuit to prevent multiple entries from a single keystroke. A single keystroke is registered during a 17.5 ms debounce

interval, and the key then has to be released for at least 17.5 ms before another keystroke can be registered.

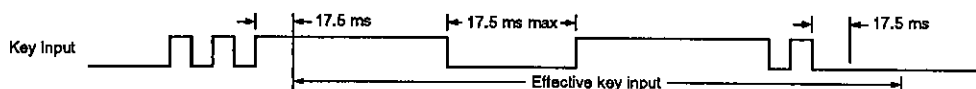


Figure 4. Key debounce timing

An input settling delay circuit is also incorporated. A pin's state is not registered as valid until it has remained constant for 30 ms.

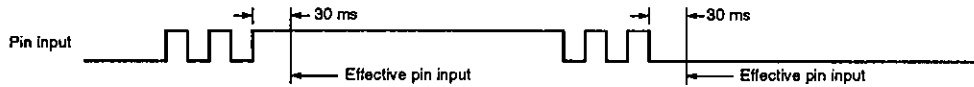


Figure 5. Input settling delay timing

One-touch and quick dial

If dial keys are pressed while in memory store mode (STO HIGH), a 1036 Hz, 31 ms confirm tone is output on KTONE. If more than 31 digits are entered, the confirmation tone is not output and subsequent keystrokes are not stored in memory.

After entering the data to be stored, pressing the appropriate one-touch dial key stores the data for this

key. For quick dial, pressing **M**, followed by a numeric key, stores the data to this address. After the data has been stored, a 2072 Hz, 279 ms confirm tone is output on KTONE.

If, in memory store mode, no data is entered and a one-touch dial key is pressed or a quick-dial address is set, the data for this key or address is deleted.

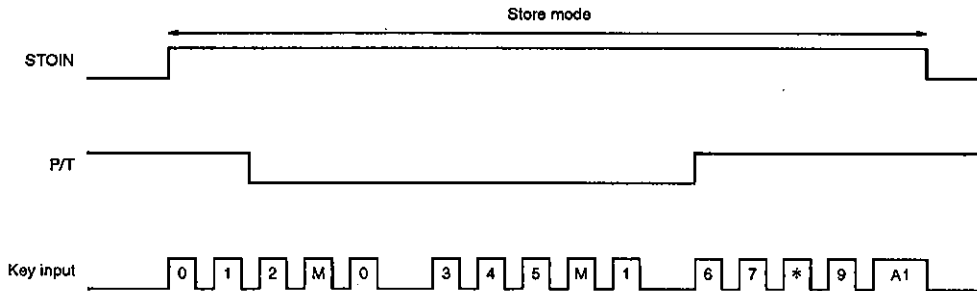


Figure 6. Store mode timing using slide switch to set STO

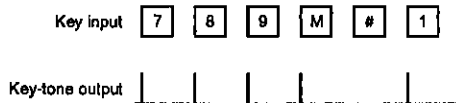


Figure 7. Store mode timing using push button to set STO

Table 1 shows the results of the operations in the above figures.

Table 1. Memory settings

Memory address	Dial start mode flag	Dial data
M0	P	0, 1, *, 2
M1	T	3, 4, 5
A1	P	6, 7, *, 9

Note

* = mode change

TYPICAL APPLICATION

