

LR48061

Pulse/Tone Dialer LSI

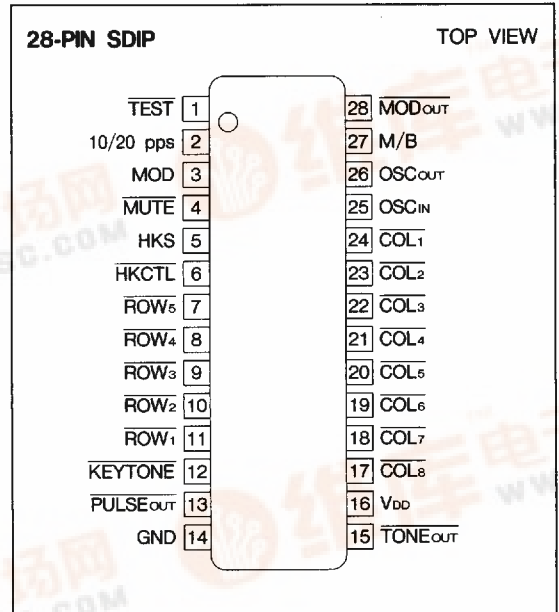
DESCRIPTION

The LR48061 is a CMOS pulse/tone dialer LSI providing auto-dialing and redialing. It features a built-in 16-digit×20-channel automatic dialing memory including a 16-digit×5 one-touch memory and a 32-digit redial memory.

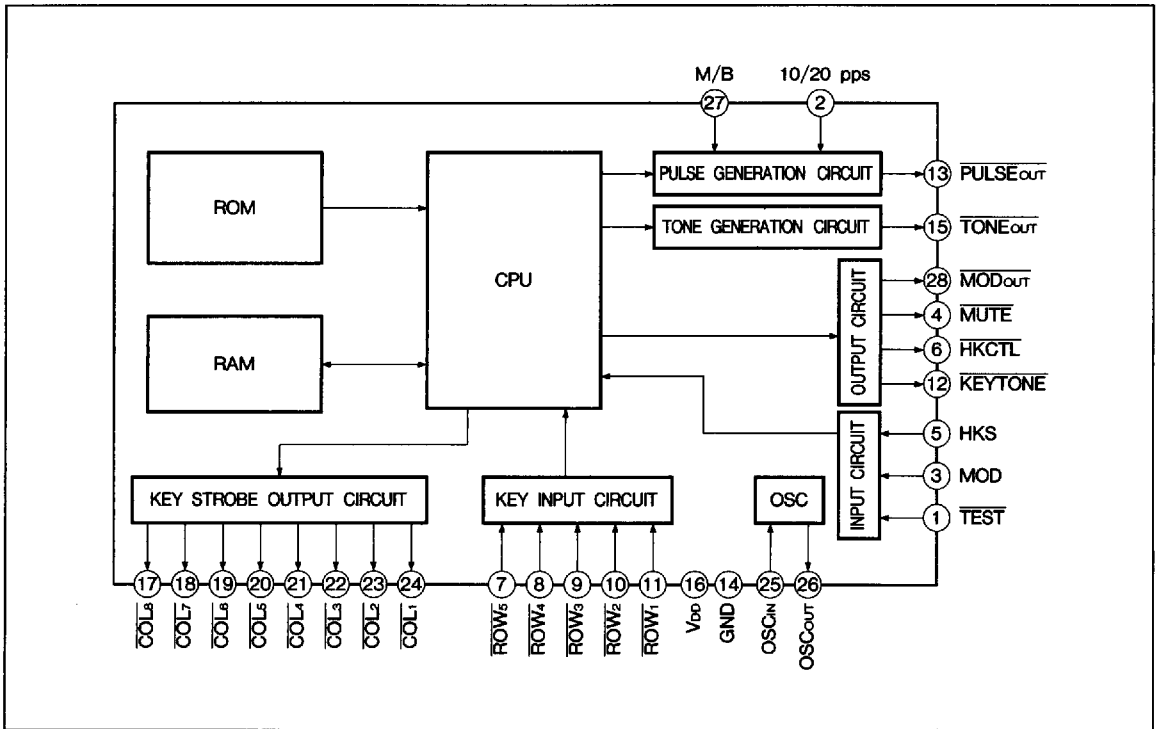
FEATURES

- 32-digit redial memory
- Auto memory dialing :
16D×5M one-touch dialing
16D×15M three-touch dialing
- Make ratio : 33/37% pin-selectable
- Pulse rate : 10/20 pps pin-selectable
- Key tone output (1 kHz)
- Normal/memory combination dialing
- Key or switch input allows switching from pulse to tone mode to provide mixed-dialing capability
- Pulse/tone dialer operation can be selected by the pin
- Flash signal output
- PBX pause storage
- Key input control of On/Off-Hook setting
- Package : 28-pin SDIP (SDIP028-P-0400A)

PIN CONNECTIONS



BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATING	UNIT	NOTE
Supply voltage	V _{DD}	6.5	V	1
Operating temperature	T _{opr}	-30 to +60	°C	
Storage temperature	T _{stg}	-55 to +150	°C	
Power dissipation	P _D	500	mW	2
Pin voltage	V _{IN1}	-0.3	V	3
Pin voltage	V _{IN2}	+0.3	V	4

NOTES :

1. Referenced to GND.
2. Ta=25°C
3. The maximum applicable voltage on any pin with respect to GND.
4. The maximum applicable voltage on any pin with respect to V_{DD}.

DC CHARACTERISTICS

(Ta=25°C, GND=0 V)

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT	NOTE
Supply voltage	V _{DD}		2.0		6.0	V	
Standby current	I _{SP}	V _{DD} =3.5 V		1.0	4.0	μA	1
Operating current	I _{OPP}	V _{DD} =3.5 V pulse mode		0.5	2.0	mA	2
	I _{OPT}	V _{DD} =3.5 V tone mode		1.0	3.0	mA	
Input current	I _{IL}		GND		0.2V _{DD}	V	3
	I _{IH}		0.8V _{DD}		V _{DD}	V	
Sink current	I _{OL}	V _{DD} =2.0 V, V _{OL} =0.5 V	1.0	2.0		mA	4
PULSE sink current	I _{PL}	V _{DD} =2.0 V, V _{OL} =0.5 V	1.0			mA	
KEYSTONE output current	I _{TL}	V _{DD} =2.0 V, V _{OL} =0.5 V	1.0	2.0		mA	
	I _{TH}	V _{DD} =2.0 V, V _{OH} =1.5 V	1.0	2.0		mA	
Output leakage current	I _{LEAKG}	V _{DD} =6.0 V, V _{OH} =6.0 V			1.0	μA	5
COLUMN output current	I _{CL}	V _{DD} =3.5 V, V _{OL} =0.5 V	25	100	600	μA	
	I _{CH}	V _{DD} =3.5 V, V _{OH} =3.0 V	1.0	5.0	15	μA	
ROW input current	I _{RP}	V _{DD} =3.5 V, V _{IL} =0 V	3.0	35	150	μA	
HKS input current	I _{HP}	V _{DD} =3.5 V, V _{IL} =0 V	3.0	58	150	μA	
TEST input current	I _{TP}	V _{DD} =3.5 V, V _{IL} =0 V	3.0	58	150	μA	

NOTES :

1. Current necessary for memory retention; no load on all outputs; On-Hook mode.
2. Current during operation; no load on all outputs.
3. Applied to all input pins.
4. Applicable to MUTE, MOD_{OUT}, HKCTL pins.
5. Applicable to MUTE, MOD_{OUT}, HKCTL, PULSE_{OUT} pins.

TONE OUTPUT CHARACTERISTICS

(Ta=25°C, GND=0 V)

PARAMETER		SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT	NOTE
Tone output voltage	ROW	V _{OR}	R _L = 10 kΩ, V _{DD} = 4.0 V	130	210	310	mV _{rms}	
	COLUMN	V _{OC}	R _L = 10 kΩ, V _{DD} = 4.0 V	180	260	360	mV _{rms}	
Output distortion		DIS	R _L = 10 kΩ, V _{DD} ≥ 2.5 V			-20	dB	1
Pre-emphasis		PE _{HB}	R _L = 10 kΩ, V _{DD} ≥ 4.0 V	1.0	2.0	3.0	dB	
Inter-digital pause		t _{IDP}			100		ms	
Tone output time		t _{OD}			100		ms	
Tone output rate		t _{OR}			200		ms	

NOTE :

- Output distortion measured in terms of total out-of-band power (20 Hz to 80 kHz frequency range) relative to fundamental power of ROW and COLUMN signals.

AC CHARACTERISTICS

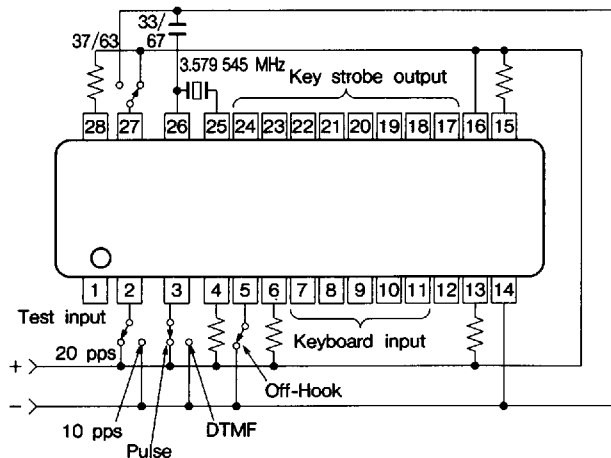
(Ta=25°C, GND=0 V)

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT	NOTE
Oscillation start time	t _{OS}				8.0	ms	1
Pulse rate	Pr	PIN2 = GND		10		pps	
		PIN2 = V _{DD}		20		pps	
Break time	t _B	PIN27 = GND		67		ms	2
		PIN27 = V _{DD}		63		ms	
Inter-digital pause time	t _{IDP}	10 pps mode		850		ms	
		20 pps mode		500		ms	
Mute overlap time	t _{MOLT/MOLP}			2.0		ms	2
Pre-digital pause time	t _{PDP}	PIN27 = GND		33		ms	
		PIN27 = GND		37		ms	

NOTES :

- Crystal resonator parameters : R_s = 100 Ω, L_M = 96 mH, C_M = 0.02 pF, C_n = 5 pF, f = 3.579 545 MHz.
- During 10 pps pulse mode (1/2 during 20 pps mode).

TEST CIRCUIT



PIN FUNCTION

SYMBOL	I/O	FUNCTION	SYMBOL	I/O	FUNCTION
COL1-COL8	O	Key strobe outputs	HKS	I	Hook switch input pin
OSCIN	I	Crystal oscillation circuit pin	HKCTL	O	Hook control signal output pin
OSCOU	O	Crystal oscillation circuit pin	ROW1-ROW5	I	Key inputs
M/B	I	Make/Break ratio select pin	KEYTONE	O	Beep tone output pin
MODOUT	O	Pulse/tone mode output pin	PULSEOUT	O	Pulse output pin
TEST	I	Test pin	TONEOUT	O	Tone output pin
10/20 pps	I	10/20 pps select pin	VDD	I	Power supply pin
MOD	I	Pulse/tone mode select pin	GND	I	Power supply pin
MUTE	O	Mute signal output pin			

PIN DESCRIPTIONS

10/20 pps (Pin 2), Make/Break (Pin 27) Select
In pulse mode, the pulse rate and Make/Break ratio can be selected by connecting pins 2 and 20, respectively, as follows.

10/20 pps PIN	Pulse RATE
GND	10 pps
VDD	20 pps

M/B PIN	MAKE/BREAK RATIO
GND	33/67
VDD	37/63

Pulse/Tone Mode Selection (Pin 3)

The mode immediately after going On-Hook or Off-Hook is selected by the MOD pin (Pin 3). If the MOD key is depressed in pulse mode, the rest of the dialing will be performed in tone mode. Mode key input data is stored in memory along with other data.

The key input mode will be output at the MODOUT pin (Pin 28).

MOD PIN	INITIAL MODE
GND	Tone mode
VDD	Pulse mode

CONDITION	MODE	MODOUT OUTPUT
Off-Hook	Pulse mode	High impedance
	Tone mode	"LOW" level
On-Hook*	Pulse/tone	High impedance

*: If an ON/OFF key input brings the pin low following a transition to On-Hook mode (by bringing the HKS pin to VDD level), the MODOUT pin outputs the signal according to the mode in Off-Hook state, despite the HKS pin being On-Hook.

MUTE Output (Pin 4)

The MUTE pin consists of an N-channel open-drain transistor. The signal is used to mute the receiver while a pulse signal is being output on the telephone line.

Hook Switch Input (Pin 5)

An internal pull-up resistor connects this pin to VDD. When this pin is at GND level, the circuit is Off-Hook.

HKS PIN	MODE
GND	Off-Hook
Open or VDD	On-Hook

KEYTONE Output (Pin 12)

This CMOS complementary output produces a 1kHz tone signal (a rectangular wave) while the key is held depressed.

PULSEOUT (Pin 13)

The pulse output is an N-channel open-drain pin that produces a pulse signal in pulse mode. It also outputs flash signal.

TONEOUT (Pin 15)

The tone output produces a DTMF signal in tone mode. Fig. 1 shows the output circuit diagram.

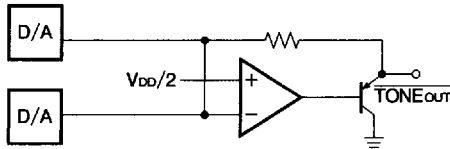


Fig. 1 Tone Output Circuit Diagram

Hook Control Pin (Pin 6)

This N-channel open-drain pin is controlled by the ON/OFF key and is used for ON/OFF hook control.

CURRENT STATE		INPUT	HKCTL OUTPUT
HOOK SWITCH	HKCTL		
-	HZ	ON/OFF key	LOW
-	LOW	ON/OFF key	HZ
ON-HOOK	-	To OFF-HOOK	HZ
OFF-HOOK	HZ	To ON-HOOK	HZ
OFF-HOOK	LOW	To ON-HOOK	LOW

HZ : High impedance

TEST (Pin 1)

The TEST pin is used to reset and test the circuit. It is pulled-up to VDD. For normal dialing, it should be connected to VDD.

TEST PIN	ROW5	MODE
GND	GND	Single tone
GND	Open or VDD	Reset
VDD		Normal dialing

The reset function initializes the system and clears memory of all its contents. Provide a reset switch to guard against memory corruption caused by abrupt changes in supply voltage.

	COL1	COL2	COL3	COL4	COL5
ROW1	1	2	3	M1	REDIAL
ROW2	4	5	6	M2	PAUSE
ROW3	7	8	9	M3	MOD
ROW4	*	0	#	M4	CLR
ROW5	FLASH	RECALL/STORE	ON/OFF	M5	

Fig. 2 Key Matrix

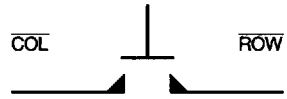


Fig. 3 Single Contact Key

Key Function

KEY	FUNCTION
0 - 9	Number key
*	Tone mode : Data key
#	Tone mode : Data key
M1 - M5	One-touch memory recall key
FLASH	Flash function key
ON/OFF	Hook function ON/OFF key
RECALL/STORE	Auto-dial memory recall, store key
REDIAL	Redial key
PAUSE	Pause key
MOD	Pulse → tone switch key
CLR	Memory clear key

Table 1 DTMF Output Frequencies

		STANDARD DTMF (Hz)	LR48061 (Hz)	DEVIATION (%)
Lower-group frequency	ROW1	697	701.3	+0.62
	ROW2	770	771.4	+0.19
	ROW3	852	857.2	+0.61
	ROW4	941	935.1	-0.63
Higher-group frequency	COL1	1209	1215.9	+0.57
	COL2	1336	1331.7	-0.32
	COL3	1477	1471.9	-0.35

NOTE :

These values are obtained with an oscillator frequency of 3.579 545 MHz. Any deviations of the oscillation frequency will affect the tone output frequency. When a data key connected to COL1-COL3, ROW1-ROW4 is depressed in tone mode, one of the DTMF signals shown above will be output. In normal mode, a signal will be output while a key is held down. However, if the key is depressed for less than 100 ms, the signal will only be output for 100 ms.

Test Mode Output Frequencies

KEY INPUT	HIGH LEVEL FREQUENCY (HZ)	LOW LEVEL FREQUENCY (HZ)
7	1215.9	—
2	1331.7	—
6	1471.9	—
3		701.3
4		771.4
8		857.2
0		935.1

In test mode, the single tones shown above are output when individual keys are depressed.

Key Input Specification

PARAMETER	SPECIFICATIONS
Double keys depressed	Only one of the two will be recognized as valid input according to a given priority scheme.
Bounce count	22 ms
Key-on time	30 ms (minimum) required
Key cycle time	130 ms (maximum) for data keys

FUNCTIONAL DESCRIPTIONS

Normal Dialing

Any data key input (pulse mode : 0-9, tone mode : 0-9, # and *) following a transition to Off-Hook mode will put you in normal dialing mode. Up to 32 digits of input data can be stored in buffer memory. Any input that exceeds 32 digits will be ignored and no dialing will occur. A CLR key input during dialing stops the dialing and clears the memory.

INPUT	DIAL OUTPUT	MEMORY CONTENTS
Pulse Mode Off-Hook 07436 5 1321	0743651321	last number dialed 0743651321 (NOTE 1)
Tone Mode Off-Hook 07436 5 1321 # *	(DTMF Signal) [0743651321 # *]	last number dialed 0743651321 # * (NOTE 2)
Tone Mode Off-Hook 07436 5 1321	(DTMF Signal) [0743651321]	last number dialed 0743651321 (NOTE 2)

NOTES :

1. In pulse mode, # or * key input will be ignored (i.e., will not be stored in buffer memory) and no dialing will occur.
2. Setting the HKS pin to a different position while holding a data key down in tone mode will provide continuous DTMF signal output.

Redialing

A REDIAL key input immediately following a transition to Off-Hook mode causes the contents of buffer memory to be dialed.

INPUT	DIAL OUTPUT	MEMORY CONTENTS
Off-Hook REDIAL	0743651321	0743651321

However, even when the HKS pin is in the on-hook position, REDIAL key input immediately after the HKCTL pin is turned "LOW" will cause the buffer memory contents to be dialed. A CLR key input during redialing stops redialing and clears the buffer memory.

For continued redialing in Off-Hook mode, the HKCTL pin alternates between two states, high impedance and low level, with each ON/OFF key input during redialing. A FLASH key input stops redialing and starts the flash operation. Pauses entered in redialing can only be cleared by the REDIAL key. Any other key input will be ignored.

Memory Dialing

The LR48061 has twenty 16-digit memory slots, fifteen of which can be recalled by indirect dialing, and five of which can be recalled by one-touch input through keys M₁-M₅. As shown in the memory dialing example that follows, two successive memory dialing operations are allowed. What was memory dialed will be stored in buffer memory.

INPUT	DIAL OUTPUT	MEMORY CONTENTS
Tone-Mode Off-Hook M ₁ M ₂ M ₃	[07436] [51321] —	(M ₁)=07436, (M ₂)=51321 (R)=07436 (R)=0743651321 (R)=0743651321

NOTE :

[] : DTMF signal, (R) : Contents of buffer memory

The following example shows a one-touch key used in conjunction with indirect dialing provides memory dialing capability.

INPUT	DIAL OUTPUT	MEMORY CONTENTS
Pulse-Mode Off-Hook		(M01)=07436, (M02)=51321 (M1)=07436, (M2)=51321
M1	07436	(R)=07436
RECALL/STORE 02	51321	(R)=0743651321
On-Hook		
Off-Hook		
RECALL/STORE 01	07436	(R)=07436
M2	51321	(R)=0743651321

- (M1) : Memory contents recalled by M1 key
- (M2) : Memory contents recalled by M2 key
- (M01) : Memory contents recalled by RECALL/STORE and 0, 1 keys
- (M02) : Memory contents recalled by RECALL/STORE and 0, 2 keys. Memory dialing can also be used in conjunction with indirect dial to provide memory dialing capability.

INPUT	DIAL OUTPUT	MEMORY CONTENTS
Tone-Mode Off-Hook		(M01)=07436, (M02)=51321
RECALL/STORE 01	[07436]	(R)=07436
RECALL/STORE 02	[51321]	(R)=0743651321

Although memory dialing is normally done in Off-Hook mode, memory dialing is possible even in On-Hook mode when an ON/OFF key input sets the HKCTL pin to the "LOW" position. Memory dialing assumes one of the following forms :

RECALL/STORE 01 - **RECALL/STORE** 15
M1 - M5

Indirect dialing of any of these in conjunction with a one-touch key input permits memory dialing. Note, however, that a CLR key input during memory dialing stops dialing and clears the buffer memory. Also, the HKCTL pin alternates between two states, high impedance and low level, with each ON/OFF input in Off-Hook mode. A FLASH key input during memory dialing causes

dialing to be aborted. Pauses put in memory dialing can be cleared with a REDIAL key input as in redialing. Two successive memory dialing operations renders any other key input ineffective.

MEMORY OPERATIONS

Initial non-buffer memory contents should be set up in On-Hook mode.

INPUT	MEMORY CONTENTS
On-Hook	(R)=last number dialed
RECALL/STORE 02	(M02)=(R)=last number dialed
07436	(R)=07436 then (M02)=(R)
RECALL/STORE 01	=07436 (NOTE)
Off-Hook	
On-Hook	(R)=07436
51321	(R)=51321 then (M1)=(R)
RECALL/STORE M1	=51321
RECALL/STORE M2	(M2)=(R)=51321

NOTE :

Up to 32 digits can be stored in buffer memory, but digits stored after the 17th are ignored.

Memory contents can be cleared by the following procedure.

INPUT	MEMORY CONTENTS
On-Hook	(R)=last number dialed, (M1)=0743651321
CLR	(R)= -, (M1)=0743651321
RECALL/STORE M1	(R)= -, (M1)= -

Mixed Mode Dialing

The use of the MOD key changes pulse mode to tone mode.

INPUT	DIAL OUTPUT	MEMORY CONTENTS
MOD pin = VDD		
Off-Hook		
07436	07436 (PAUSE)	(R)=07436 MOD
MOD 51321	[51321]	1321

The mode key input will be stored as a single digit in buffer memory, just like other data key inputs. Note that a pause will be inserted automatically as the pulse mode changes to tone mode (refer to the Pause Function).

Combination Dialing

The LR48061 provides combination dialing capability, combining memory dialing and normal dialing, as shown in the following example. In combination dialing mode, normal dialing can be performed in exactly the same way as in normal dialing mode, except in those cases for which the number of input digits is limited (See Note).

INPUT	DIAL OUTPUT	MEMORY CONTENTS
Off-Hook		(M01)=07436
Pulse Mode		(M2)=51321
[RECALL/STORE] 01	07436	(R)=07436
51321	51321	(R)=0743651321
		(Note 1)
On/Off-Hook		(R)=0743651321
Tone-Mode		
07436 # *	[07436 # *]	(R)=07436 # *
		(Note 2)
M2	[51321]	(R)=07436 # * 51321

NOTES :

1. Up to 16 digits can be dialed in this case, but the data key input from the 17th on will be ignored.
2. Normal dialing of more than 17 digits disables memory dialing thereafter. This means that any M1-M6, RECALL/STORE key input will be ignored.

Pause Function

The PAUSE key is used to suspend dial output for intervals of about 4 seconds. Pause key input is stored in memory like input is.

INPUT	DIAL OUTPUT	MEMORY CONTENTS
Off-Hook		
07436PAUSE	07436 (PAUSE)	(R)=07436PAUSE51321
51321	51321	

A REDIAL key input during a pause clears the pause.

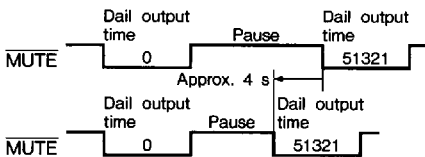


Fig. 4 Pause Operation

Flash Function

A flash key input in Off-Hook mode causes the PULSEOUT and MUTE pins to produce signal outputs as shown in Fig. 5.

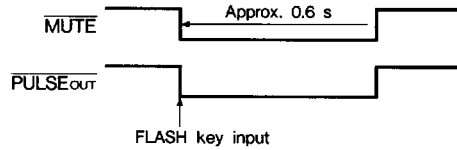


Fig. 5 Flash Function

