LR48067 Pulse/Tone Dialer LSI

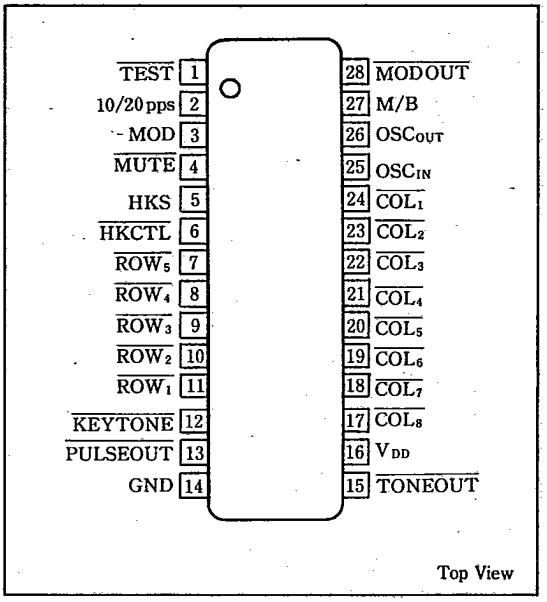
Description

The LR48067 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×20 one-touch memory and a 32-digit redial memory

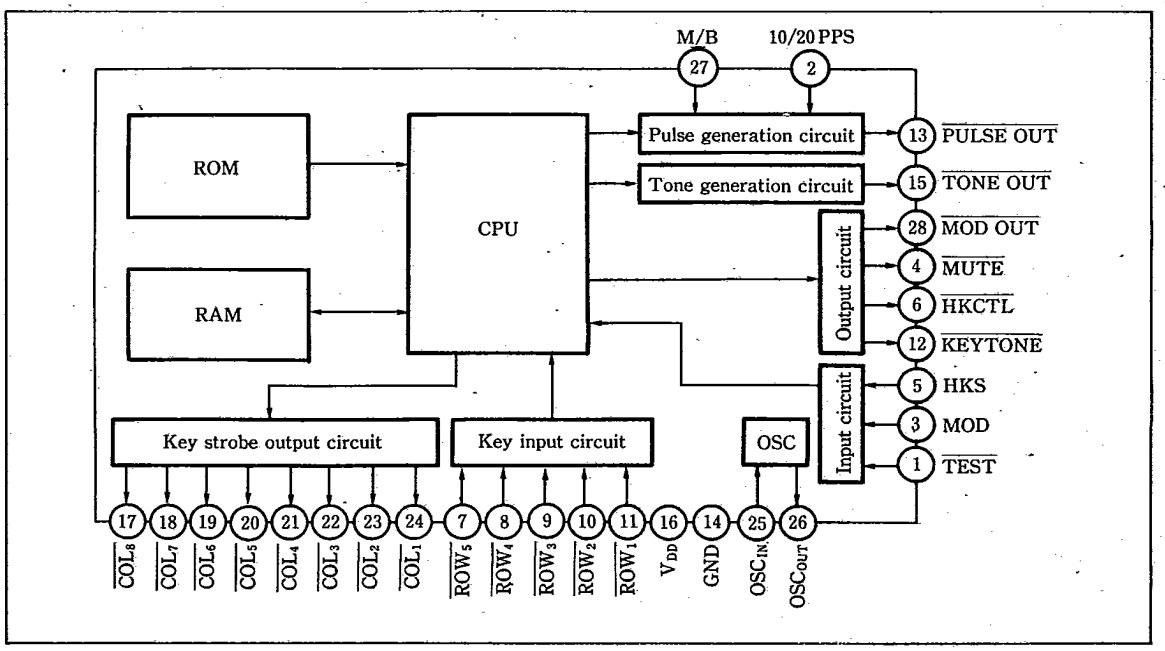
Features

1. 32-digit redial memory
2. Auto memory dialing : 16D×max. 20M one-touch dialing
3. Make ratio : 33/37% pin-selectable
4. Pulse rate : 10/20pps pin-selectable
5. Key tone output (1kHz)
6. Normal/memory combination dialing
7. Key or switch input allows switching from pulse to tone mode to provide mixed-dialing capability
8. Pulse/tone dialer operation pin-selectable
9. Flash signal output
10. PBX pause storage
11. On/Off-Hook switching controlled by key input
12. 28-pin dual-in-line package

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	℃	
Storage temperature	T_{stg}	−55 to +150	℃	
Power dissipation	P_D	500	mW	2
Pin voltage (1)	V_{IN1}	−0.3	V	3
Pin voltage (2)	V_{IN2}	+0.3	V	4

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

DC Characteristics

(Ta=25℃, GND=0V)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit	Note
Supply voltage	V_{DD}		2.0		6.0	V	
Standby current	I_{SP}	V_{DD}=3.5V		1.0	4.0	μA	1
Operating current	I_{OPP}	V_{DD}=3.5V, pulse mode		0.5	2.0	mA	2
	I_{OPT}	V_{DD}=3.5V, 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}=2.0V, V_{OL}=0.5V	1.0	2.0		mA	4
PULSE sink current	I_{PL}	V_{DD}=2.0V, V_{OL}=0.5V	1.0			mA	
KEYTONE output current	I_{TL}	V_{DD}=2.0V, V_{OL}=0.5V	1.0	2.0		mA	
	I_{TH}	V_{DD}=2.0, V_{OH}=1.5V	1.0	2.0		mA	
Output leakage current	I_{LKG}	V_{DD}=6.0V, V_{OH}=6.0V			1.0	μA	5
COLUMN output current	I_{CL}	V_{DD}=3.5V, V_{OL}=0.5V		100		μA	
	I_{CH}	V_{DD}=3.5V, V_{OH}=3.0V		5		μA	
ROW input current	I_{RP}	V_{DD}=3.5V, V_{IL}=0V		35		μA	
HKS input current	I_{HP}	V_{DD}=3.5V, V_{IL}=0V		58		μA	
TEST input current	I_{TP}	V_{DD}=3.5V, V_{IL}=0V		58		μA	

Note 1 : Current necessary for memory retention ; no load on all outputs ; On-Hook mode.
Note 2 : Current during operation ; no load on all outputs.
Note 3 : Applicable to all input pins.
Note 4 : Applicable to $\overline{\text{MUTE}}$, MODOUT, $\overline{\text{HKCTL}}$ pins.
Note 4 : Applicable to $\overline{\text{MUTE}}$, MODOUT, $\overline{\text{HKCTL}}$ PULSEOUT pins.

Tone Output Characteristics

(Ta=25℃, GND=0V)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit	Note
Tone output voltage	ROW	V_{OR}	R_L=10kΩ, V_{DD}=4.0V		210		mV_{rms}	
	COLUMN	V_{OC}	R_L=10kΩ, V_{DD}=4.0V		260		mV_{rms}	
Output distortion		DIS	R_L=10kΩ, V_{DD}≧2.5V			−20	dB	1
Pre-emphasis		PE_{HB}	R_L=10kΩ, V_{DD}≧4.0V	1.0	2.0	3.0	dB	
Inter-digital pause		t_{IDP}	V_{DD}=3.5V, V_{IL}=0V		100		ms	
Tone output time		t_{OD}	V_{DD}=3.5V, V_{IL}=0V		100		ms	
Tone output rate		t_{OR}	V_{DD}=3.5V, V_{IL}=0V		200		ms	

Note 1 : Output distortion measured in terms of total out-of-band power (20Hz to 80kHz frequency range) relative to fundamental power of ROW and COLUMN.

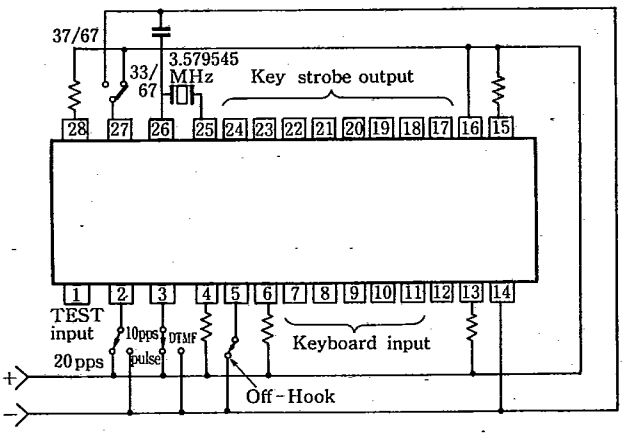
■ AC Characteristics

(Ta=25℃, GND=0V)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit	Note
Oscillation start time	t_{OS}				8.0	ms	1
Pulse rate	Pr	P_{IN2}=GND		10		pps	
		P_{IN2}=V_{DD}		20		pps	
Break time	t_B	P_{IN27}=GND		67		ms	2
		P_{IN27}=V_{DD}		63		ms	
Inter-digital pause time	t_{IDP}	10pps mode		850		ms	
		20pps mode		500		ms	
Mute overlap time	$t_{MOLT/MOLP}$			2		ms	2
Pre-digital pause time	t_{PDP}	P_{IN27}=GND		33		ms	2
		P_{IN27}=GND		37		ms	

Note 1 : When crystal oscillation parameters R_S=100Ω, L_M=96mH, C_M=0.02pF, C_h=5pF, f=3.579545MHz are used.
Note 2 : 10pps pulse mode value. The values for 20pps are half of these values.

■ Test Circuit



Pin Functions

Name	I/O	Function
$\overline{COL_1}$-$\overline{COL_8}$	O	Key strobe outputs
OSC_{IN}	I	Crystal oscillation circuit pin
OCS_{OUT}	O	Crystal oscillation circuit pin
M/B	I	Make/Break ratio select pin
$\overline{MODOUT}$	O	Pulse/tone mode output pin
$\overline{TEST}$	I	Test pin
10/20pps	I	10/20pps select pin
MOD	I	Pulse/tone mode select pin
$\overline{MUTE}$	O	Mute signal output pin
HKS	I	Hook switch input pin
$\overline{HKCTL}$	O	Hook control signal output pin
$\overline{ROW_1}$-$\overline{ROW_5}$	I	Key input pin
KEY TONE	O	Beep tone output pin
$\overline{PULSE\ OUT}$	O	Pulse output pin
$\overline{TONE\ OUT}$	O	Tone output pin
V_{DD}	I	Power supply pin
GND	I	Power supply pin

Pin Descriptions

10/20pps (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.

10/20pps pin	Pulse rate
GND	10pps
V_{DD}	20pps

M/B pin	Make/Break ratio
GND	33/67
V_{DD}	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 $\overline{MODOUT}$ pin (N-channel open-drain).

MOD pin	Initial mode
GND	Tone mode
V_{DD}	Pulse mode

$\overline{Mute}$ Output (Pin 4)

The mute output consists of an N-channel open-drain transistor. The output 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 V_{DD}. When this pin is at GND level, the circuit is Off-Hook.

HKS pin	Mode
GND	Off-Hook
Open or V_{DD}	On-Hook

Keytone Output (Pin 12)

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

$\overline{PULSEOUT}$ (Pin 13)

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

$\overline{TONEOUT}$ (Pin 15)

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

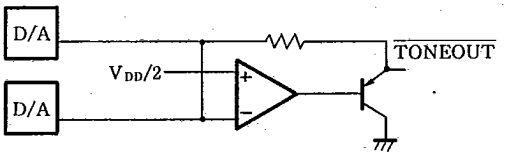


Fig. 1 Tone output circuit diagram

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	$\overline{HKCTL}$ output
Hook switch	$\overline{HKCTL}$		
—	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
Note : The $\overline{HKCTL}$ output goes low during an ARD operation as well. (Refer to the ARD Function).

$\overline{\text{TEST}}$ (Pin 1)

The $\overline{\text{Test}}$ pin is used to reset and test the circuit. It is pulled-up to V_{DD}. For normal dialing, it should be connected to V_{DD}.

$\overline{\text{TEST}}$ pin	$\overline{\text{ROW}_5}$	Mode
GND	GND	Single tone
GND	Open or V_{DD}	Reset
V_{DD}		Normal dialing

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

$\overline{\text{COL}_1}$	$\overline{\text{COL}_2}$	$\overline{\text{COL}_3}$	$\overline{\text{COL}_4}$	$\overline{\text{COL}_5}$	$\overline{\text{COL}_6}$	$\overline{\text{COL}_7}$	$\overline{\text{COL}_8}$	
1	2	3	FLASH	M1	M6	M11	M16	$\overline{\text{ROW}_1}$
4	5	6	STORE	M2	M7	M12	M17	$\overline{\text{ROW}_2}$
7	8	9	CLR	M3	M8	M13	M18	$\overline{\text{ROW}_3}$
*	0	#	REDIAL	M4	M9	M14	M19	$\overline{\text{ROW}_4}$
MOD	PAUSE	ON/OFF	ARD	M5	M10	M15	M20	$\overline{\text{ROW}_5}$

Fig. 2 Key matrix

Fig. 3 Single contact key

■ Key Functions

Key	Function
0-9	Number key
*	Pulse mode : pause key
	Tone mode : data key
#	Pulse mode : redial key
	Tone mode : data key
REDIAL	Redial key
PAUSE	Pause key
STORE	Memory store key
M1-M20	Memory recall key
MOD	Pulse→tone switch key
FLASH	Flash function key
ON/OFF	Hook control on/off key
ARD	Automatically repeated dial key
CLR	Memory clear key

■ DTMF Output Frequencies

		Standard DTMF (Hz)	LR48067 (Hz)	Deviation (%)
Low group frequency	$\overline{\text{ROW}_1}$	697	701.3	+0.62
	$\overline{\text{ROW}_2}$	770	771.4	+0.19
	$\overline{\text{ROW}_3}$	852	857.2	+0.61
	$\overline{\text{ROW}_4}$	941	935.1	−0.63
High group frequency	$\overline{\text{COL}_1}$	1209	1215.9	+0.57
	$\overline{\text{COL}_2}$	1336	1331.7	−0.32
	$\overline{\text{COL}_3}$	1477	1471.9	−0.35

Note : These values were obtained with an oscillator frequency of 3.579545MHz.
Any deviations of the oscillation frequency will affect the tone output frequency.
When a data key connected to $\overline{\text{COL}_1}$-$\overline{\text{COL}_3}$, $\overline{\text{ROW}_1}$-$\overline{\text{ROW}_4}$ 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 100msec, the signal will only be output for 100msec.

■ 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).
Bounce count	22msec
Key-on time	30msec (minimum) required
Key cycle time	130msec (maximum) for data keys

■ Functional Description

Normal Dialing

Input Data through data keys (pulse mode ; 0 to 9, tone mode : 0 to 9, "*", and "#"), in Off-Hook mode, for an ordinary dial operation. Up to 32 digits of input data is stored in buffer memory. Data exceeding 32 digits is accepted after dial operation for the initial 32 digits has completed. The buffer memory is then cleared to store up to 32 digits of new data when the input of the 33rd digit is accepted.

Input	Dial output	Memory contents
Pulse mode		
Off-Hook		(R)=last number dialed
07436 5 1321	0743651321	(R)=0743651321
Tone mode		
Off-Hook		(R)=last number dialed
07436 5 1321 # *	[0743651321 # *]	(R)=0743651321 # *
Pulse mode		
Off-Hook		(R)=last number dialed
07436 5 1321 # *	0743651321	(R)=0743651321
Pulse mode		
Off-Hook		(R)=last number dialed
1234567.....012	1234567.....012	(R)=1234567...012
32 columns	32 columns	
3456789	3456789	(R)=3456789

Note [ ] DTMF Signal
(R) : Contents of buffer memory

Redialing Function

Depress the REDIAL key, Off-Hook, to redial data in the buffer memory. The "#" key also works as a redialing key in PAUSE mode.

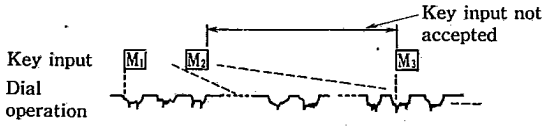
The next key input cannot be accepted until the redialing operation is completed.

Input	Dial output	Memory contents
Pulse mode		
Off-Hook		(R) 0743651321
REDIAL or #	0743651321	

Memory Dialing

The LR48067 has twenty 16-digit memories. Depress M1 to M20 keys to access one-touch memory dialing. Depress two memory keys sequentially to store memory-dialed data in the buffer memory. A third key input cannot be accepted until the dial operation corresponding to the preceding two memory key inputs has completed. Depress the third memory key to clear the buffer memory and then to store data from this key.

Input	Dial output	Memory contents
Tone mode		(M1)=07436
Off-Hook		(M2)=51321
		(M3)=2116
M1	[07436]	(R)=07436
M2	[51321]	(R)=0743651321
M3	[2116]	(R)=2116



M_i : Memory key input

Fig. 4 Memory dialing

Memory Operations

Set the buffer memory On-Hook.

Input	Memory contents
On-Hook	(R)=last number dialed
STORE M1	(M1)=(R)=last number dialed
STORE 07436 M2	(R)=07436 then (M2)=(R)=07436 (Note)
STORE 51321 REDIAL	(R)=51321

(Note) When the input in the buffer memory exceeds 16 digits, digits beyond the 17th are ignored.

Erase data from the buffer memory, as follows :

Input	Memory contents
On-Hook	(R)=last number dialed, (M1)=0743651321
CLR	(R)=____, (M1)=0743651321
STORE M1	(R)=____, (M1)=____

Mixed Mode Dialing

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

Input	Dial output	Memory contents
MOD pin=V_{DD}		
Off-Hook		
07436 MOD 51321	07436 (PAUSE) [51321]	(R)=07436MOD1321

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

Memory Dialing plus Normal Dialing

Normal dialing is accepted after memory dialing by memory key, Off-Hook, to store in the buffer memory both memory = dialed data and a maximum of 16 columns of data input through normal dialing. Further input on the keys is accepted when the dialing for data stored in the buffer memory is over. In this case, the buffer memory clears old data to store new ones of the 17th column on.

Input	Output dialed	Memory contents
Pulse Mode		(R)=last number dialed,
Off-Hook		(M1)=07436
M1	07436	(R)=07436
1234.....456	0743651234.....456	(R)=074361234.....456
16columns		
7890	7890	(R)=7890
Pulse Mode		(R)=last number dialed,
Off-Hook		(M1)=123MOD456
M1	123 (Pause) [456]	(R)=123MOD456
0246	[0246]	(R)=123MOD4560246

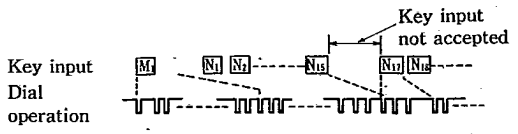


Fig. 5 Memory dialing plus normal dialing

Normal Dialing plus Memory Dialing

Memory dialing is accepted after normal dialing, in Off-Hook mode.

Depress a memory key to store the data input by normal and memory keys into the buffer memory, after a maximum of 16 columns of data has been input on normal keys. Further input on the keys is accepted when dialing of data in the buffer memory is over. In this case, the buffer memory clears old data to accept the new input.

An input on two memory keys in succession is accepted when, in Off-Hook mode, 17 to 32 columns of data is input and normal dialing for all columns is over. In this case, the buffer memory clears old data when it accepts new data from the keys.

Input	Dial output	Memory contents
Pulse Mode		(R)=last number dialed,
On-Hook		(M1)=51321
07436	07436	(R)=07436
M1	51321	(R)=0743651321
2116	2116	(R)=2116
Pulse Mode		(R)=last number dialed,
Off-Hook		(M1)=51321, (M2)=2116
12345678901234567	12345678901234567	(R)=12345678901234567
M1	51321	(R)=51321
M2	2116	(R)=513212116
Pulse Mode		(R)=last number dialed,
Off-Hook		(M1)=123MOD456
0246	0246	(R)=0246
M1	123 (Pause) [456]	(R)=0246123MOD456

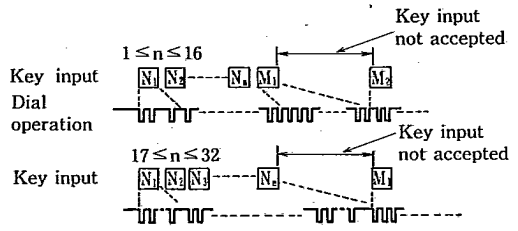


Fig. 6 Normal dialing plus memory dialing

Pause Function

The PAUSE key is used to suspend dial output for intervals of about 4 seconds. Pause key input is stored in memory in the same way as data key input.

Input	Dial output	Memory contents
Off-Hook 07436PAUSE51321	07436 (PAUSE) 51321	(R)=07436PAUSE51321

A REDIAL key input during a pause clears the pause.

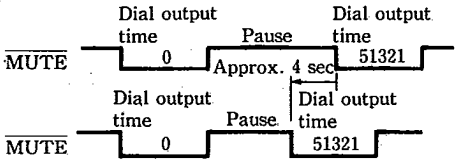


Fig. 7 Pause operation

Flash Function

A flash key input in Off-Hook mode causes the PULSEOUT and MUTE pins to produce signal outputs as shown in Fig. 8.

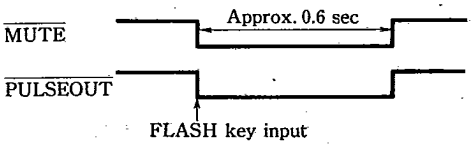


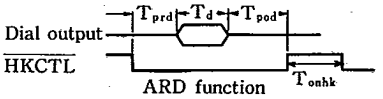
Fig.8 Flash function

ARD Function

In On-Hook mode, an ARD key input causes the contents of buffer memory to be automatically dialed in succession.

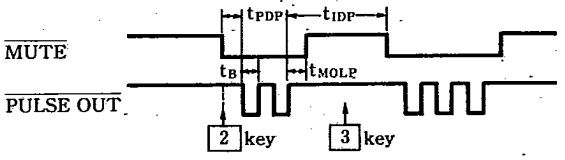
ARD operation

	M/B pin=GND	M/B pin=V_{DD}
Tprd	3sec	3sec
Tpod	25sec	25sec
Tonhk	60sec	30sec
Number of repetitions	2 times	10 times

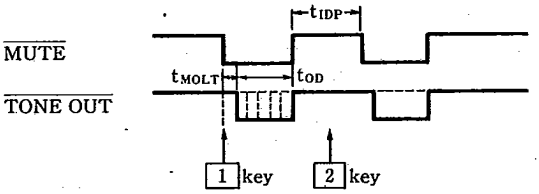


■ Timing Diagrams

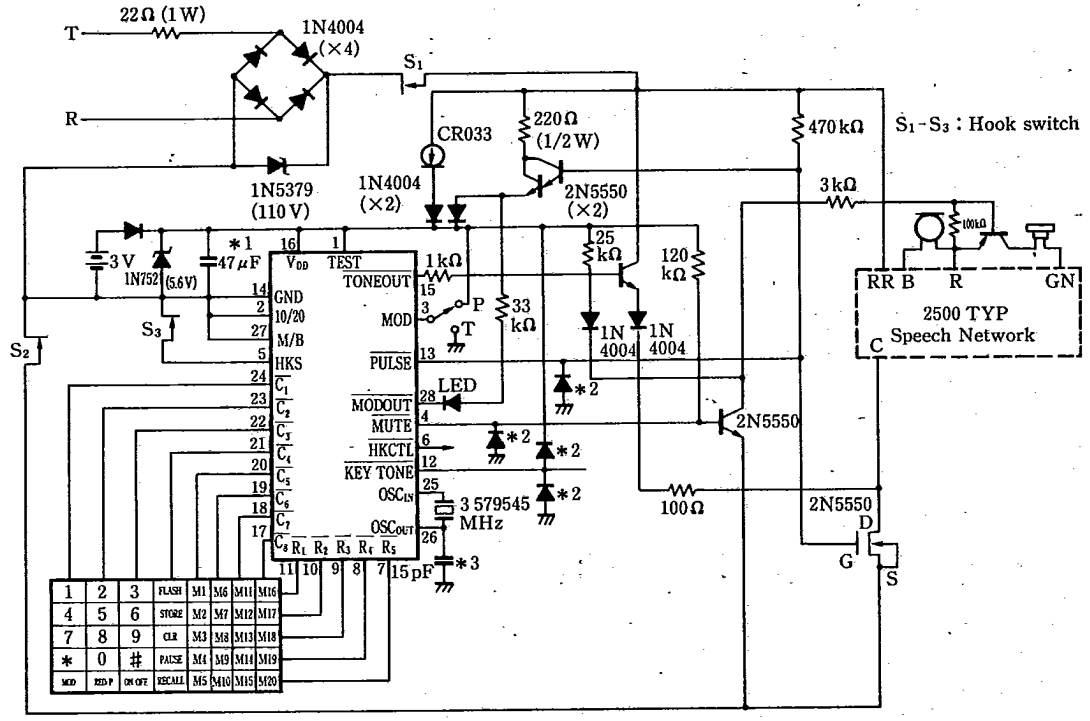
Pulse mode timing



Tone mode timing



■ System Configuration Example



*1 Insert a capacitor to smooth the power supply and prevent latch-up.
*2 Insert a protective circuit not to apply voltages higher than the absolute maximum ratings.
*3 Insert a capacitor to prevent abnormal oscillation.