

LR48251

PULSE/TONE DIALER LSI

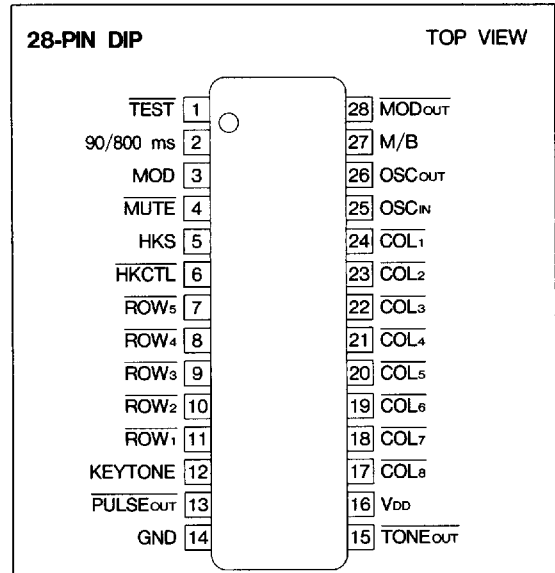
DESCRIPTION

The LR48251 is a single-chip telephone system featuring pulse/tone dial mode switching capability and 20 single-push repertory memories of 16-digit each.

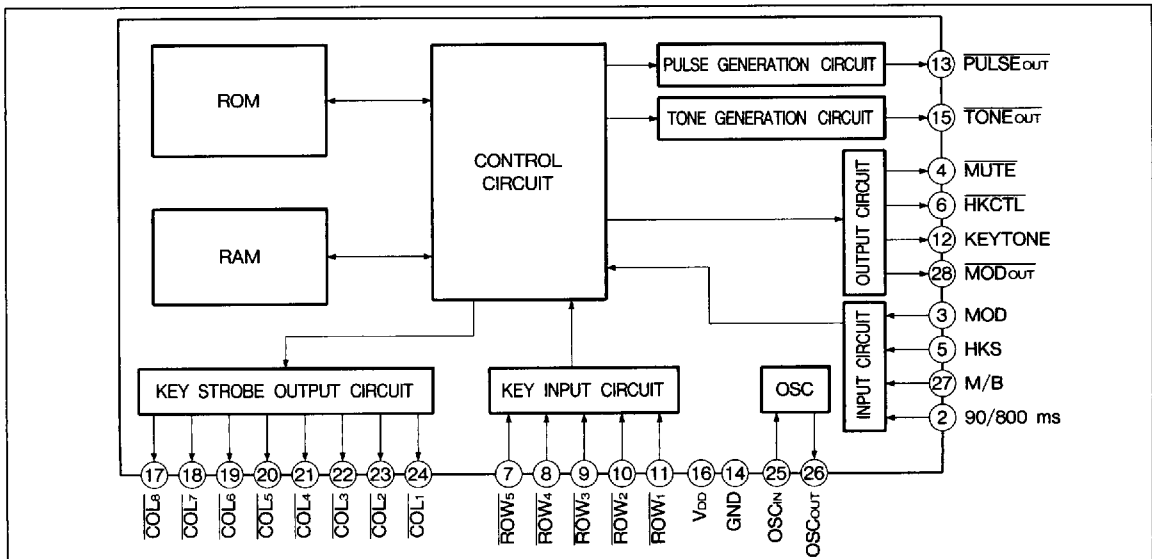
FEATURES

- 32-digit redial memory and 20 one-touch repertory memories of 16-digit each
- Make ratio : 33/39% pin-selectable
- Key-tone output (1 kHz)
- Allows switching from pulse mode to tone mode for mixed-mode dialing by the key entry
- ARD (Automatically Repeated Dialing) function
- Flash time : 90/800 ms pin-selectable
- Pulse/tone dialer operation can be selected by the pin
- Flash function
- Pause capability for PABX
- Internal crystal oscillator using external a 3.579 545 MHz crystal resonator for color burst
- CMOS process
- Package : 28-pin DIP(DIP028-P-0600)

PIN CONNECTIONS



BLOCK DIAGRAM



8180798 0014274 709

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
	V _{IN2}	+0.3	V	4

NOTES :

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

DC CHARACTERISTICS

(T_a = 25°C, GND = 0 V)

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT	NOTE
Supply voltage	V _{DD}	Pulse mode	2.0		5.5	V	
		Tone mode	2.0		5.5		
Standby current	I _{ST}	V _{DD} = 3.5 V			0.3	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		
Input voltage	V _{IL}		GND		0.2V _{DD}	V	3
	V _{IH}		0.8V _{DD}		V _{DD}		
Sink current	I _{OL}	V _{DD} = 2.0 V, V _{OL} = 0.5 V	1.0	2.0		mA	4
KEYTONE 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 _{OL} = 1.5 V	1.0	2.0			
Output leakage current	I _{LXG}	V _{DD} = 5.5 V, V _{OH} = 5.5 V			1.0	μA	4
COLUMN output current	I _{CL}	V _{DD} = 3.5 V, V _{OL} = 0.5 V		100		μA	
	I _{CH}	V _{DD} = 3.5 V, V _{OH} = 3.0 V		5			
ROW input current	I _P	V _{DD} = 3.5 V, V _{IL} = 0 V		35		μA	
HKS input current	I _{HP}	V _{DD} = 3.5 V, V _{IL} = 0 V		5		μA	
TEST input current	I _{TP}	V _{DD} = 3.5 V, V _{IL} = 0 V		5		μA	
Memory retention voltage	V _R		1.0			V	

NOTES :

1. Current required to back up memories, with all outputs unloaded in on-hook mode.
2. Operating current with all outputs unloaded.
3. Applicable to all input pins.
4. Applicable to the MUTE, MOD_{OUT}, HKCTL, and PULSE_{OUT} pins.

TONE OUTPUT CHARACTERISTICS

(Ta=25°C, GND=0 V)

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT	NOTE
Tone output voltage	ROW	$R_L = 10\text{ k}\Omega$, $V_{DD} = 4.0\text{ V}$	130	175	220	mVrms	
	COLUMN	$R_L = 10\text{ k}\Omega$, $V_{DD} = 4.0\text{ V}$	160	210	270		
Output distortion	Dis	$R_L = 10\text{ k}\Omega$, $V_{DD} \geq 2.0\text{ V}$			-23	dB	1
Pre-emphasis	PEHB	$R_L = 10\text{ k}\Omega$, $V_{DD} \geq 2.0\text{ V}$	1.0	2.0	3.0	dB	
Inter-digit pause	tIDP		102	102	104	ms	2
Tone duration	tCD		100	100	102	ms	
Tone output rate	tCR		202	202	206	ms	

NOTES :

1. Distorting frequency components in the range of 20 Hz to 80 kHz are contained in the fundamental ROW and COLUMN tone signals.
2. For redialing and repertory dialing.

AC CHARACTERISTICS

(Ta=25°C, GND=0 V)

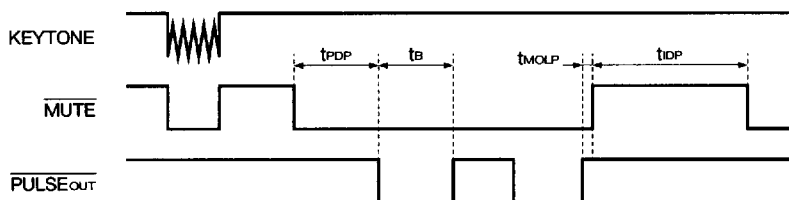
PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT	NOTE
Oscillation start-up time	tOS				8.0	ms	1
Pulse output rate	PR			10		pps	
Break time	tB	Pin 27=GND		67		ms	
		Pin 27=VDD		61			
Inter-digit pause	tIDP	Pin 27=GND		850		ms	
Mute overlap	tMOLP			2		ms	
	tMOLT			2			
Pre-digit pause	tPDP	Pin 27=GND		33		ms	
		Pin 27=VDD		39			
Flash time	tFLASH	Pin 2=GND	780	800	820		
		Pin 2=VDD	80	90	100		

NOTE :

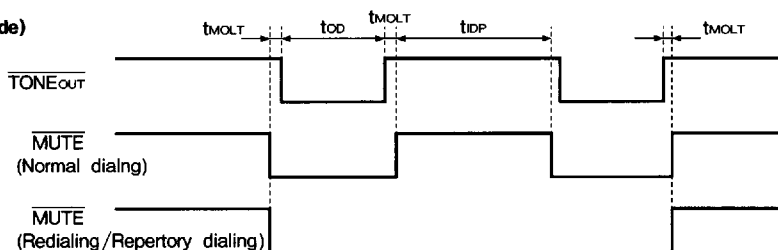
1. Crystal resonator parameters : $R_s = 100\text{ }\Omega$, $L_M = 96\text{ mH}$, $C_M = 0.02\text{ pF}$, $C_h = 5\text{ pF}$, $f = 3.579\text{ 545 MHz}$

Use a 68 μ F capacitor across V_{DD} and GND for supply voltage smoothing and latch-up prevention. And connect the $\overline{\text{TEST}}$ pin to V_{DD} .

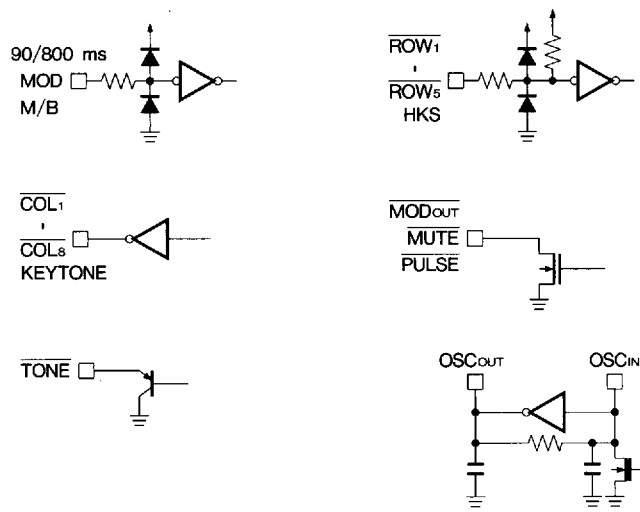
(Pulse mode)



(Tone mode)



INPUT/OUTPUT CIRCUITS



PIN FUNCTION

SYMBOL	I/O	FUNCTION
COL ₁ - COL ₈	O	Key strobe outputs
OSC _{IN}	I	Crystal resonator pin
OSC _{OUT}	O	Crystal resonator pin
M/B	I	Make/break ratio selection pin
MOD _{OUT}	O	Pulse/Tone mode output pin
TEST	I	Test input pin
90/800 ms	I	Flash time selection pin
MOD	I	Pulse/Tone mode selection input pin
MUTE	O	Mute signal output pin
HKS	I	Hook switch input pin
HKCTL	O	Hook control signal output pin
ROW ₁ - ROW ₅	I	Key input pins
KEYTONE	O	Key-tone output pin
PULSE _{OUT}	O	Pulse output pin
TONE _{OUT}	O	Tone output pin
V _{DD}	I	Power supply pin
GND	I	Ground pin

PIN DESCRIPTIONS

90/800 ms (Pin 2)

This pin sets the flash time.

90/800 ms PIN	FLASH TIME
GND	800 ms
V _{DD}	90 ms

M/B (Pin 27)

This pin selects make/break ratio in the Pulse mode.

M/B PIN	MAKE/BREAK RATIO
GND	33/67
V _{DD}	39/61

MOD (Pulse/Tone mode selection; Pin 3)

This pin selects mode following On-Hook or Off-Hook. If the MOD key is pressed during dialing in Pulse mode, the remaining digits are dialed in Tone mode. Like other data keys, the MOD key code is stored to memory. If the MOD pin is switched from Pulse to Tone mode during dialing, the remaining digits are also dialed in Tone mode. In this case, the same code as the MOD key code is stored to memory. The selected mode information appears at the MOD_{OUT} pin (pin 28; N-channel open drain).

MOD PIN	INITIAL MODE
GND	Tone mode
V _{DD}	Pulse mode

HOOKS STATUS	MODE	MOD _{OUT} OUTPUT
Off-hook	Pulse mode	High impedance
	Tone mode	LOW
On-hook	—	High impedance

MUTE (Pin 4)

The MUTE pin is an N-channel open drain output. It is set to a Low level when a pulse or tone dial signal is being output or a key tone is being output by a data key in Pulse mode. It is set to high impedance during a pause.

HKS (Pin 5)

This is the hook switch input, and has a pull-up resistor to V_{DD}.

HKS PIN	MODE
GND	Off - hook
V _{DD}	On - hook

KEYTONE (Pin 12)

The KEYTONE is a CMOS output. It yields a 1 kHz square-wave signal while a key is pressed, after the key data becomes valid.

PULSE_{OUT} (Pin 13)

The PULSE_{OUT} is an N-channel open-drain output. During dialing in Pulse mode, it outputs a pulse signal. This pin also yields the Flash signal.

TONE_{OUT} (Pin 15)

In the Tone mode, this pin yields the DTMF signal. Fig. 3 shows the output circuit.

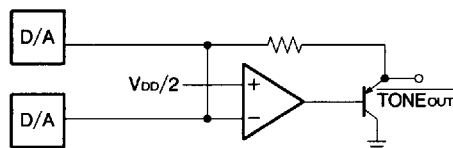


Fig. 3 Tone Output Circuit

HKCTL (Pin 6)

The HKCTL is N-channel open-drain output. It is controlled by the ON/OFF key to be used for hook control. During ARD operation, this pin is Low.

PRESENT 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)

This is the reset and test input pin. It is pulled up to V_{DD}.

TEST PIN	ROW _S	MODE
GND	GND	Single tone
	Open or V _{DD}	Reset
V _{DD}	—	Normal

A Low input to this pin resets the entire system, upon which all memory contents are cleared. Use a reset switch to prepare for uncertain memory contents resulting from supply voltage drop.

KEY FUNCTION

KEY	FUNCTION
0 - 9	Numeric keys
*	Pulse mode : Pause key
	Tone mode : Data key
#	Pulse mode : Redial key
	Tone mode : Data key
M ₁ - M ₂₀	Single-push memory keys
FLASH	Flash key
ON/OFF	Hook control ON/OFF key
STORE	Store to memory key
REDIAL	Redial key
PAUSE	Pause key
MOD	Pulse/Tone mode switching key
RD/ARD	Redial/Auto repeat dial key
CLR	Memory clear key

	COL1	COL2	COL3	COL4	COL5	COL6	COL7	COL8
ROW1	1	2	3	FLASH	M1	M6	M11	M16
ROW2	4	5	6	STORE	M2	M7	M12	M17
ROW3	7	8	9	CLR	M3	M8	M13	M18
ROW4	*	0	#	REDIAL	M4	M9	M14	M19
ROW5	MOD	PAUSE	ON/OFF	RD/ARD	M5	M10	M15	M20

Fig. 4 Key Matrix

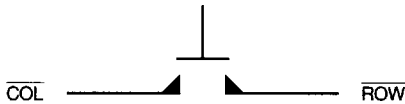


Fig. 5 Single Contact Key

Key Signal Specifications

While a key tone is being output, no other key entry is accepted. Also during flash output, no key entry is accepted.

Table 1 Key Signal Specifications

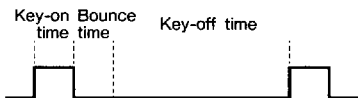
PARAMETER	SPECIFICATION
Double key operation	Only one key code is accepted according to the specified priority order. (NOTE 1)
Bounce time	24 ms
Key on time	30 ms (Min.) needed (NOTE 2)
Key off time	100 ms (Min.) needed (NOTE 2)

NOTES :

1. Priority order among keys :

Keys in the COL1 column have the highest priority, while those in the COL8 have the lowest. Keys in the ROW5 row have the highest priority, while those in the ROW1 row have the lowest. Columns have higher priority than rows.

2. If the key-on or key-off time is less than these, the key entry may not be accepted.



FUNCTIONAL DESCRIPTION

Output Frequencies in Tone Mode

Table 2 lists the DTMF frequencies. The device yields the DTMF signal while a data key in COL1-COL3 and ROW1-ROW4 is pressed. In Normal mode, the signal is output while the key is pressed and held. If a key is pressed and

held for less than 100 ms, the signal output continues for 100 ms. Table 3 lists the output frequencies in the Single Tone Test mode.

NOTE :

If a key is pressed during tone output, the last tone at that point is output as long as the key is pressed and held. When the key is released, the following tone is output.

Table 2 DTMF Output Frequencies

		STANDARD DTMF(Hz)	LR48251 (Hz)	DEVIATION (%)
Lower-group frequencies	ROW1	697	692.6	-0.63
	ROW2	770	774.1	+0.54
	ROW3	852	849.0	-0.35
	ROW4	941	940.0	-0.11
Higher-group frequencies	COL1	1209	1214.2	+0.43
	COL2	1336	1335.7	-0.03
	COL3	1477	1484.1	-0.48

NOTE :

The frequencies given in the LR48251 column are when the internal oscillator is oscillating at 3.579 545 MHz. Deviation in the oscillation frequency affects tone output frequency.

Table 3 Output Frequencies in Test Mode

Key	HIGH FREQUENCY (Hz)	LOW FREQUENCY (Hz)
7	1214.2	—
2	1335.7	—
6	1484.1	—
3	—	692.6
4	—	774.1
8	—	849.0
0	—	940.0

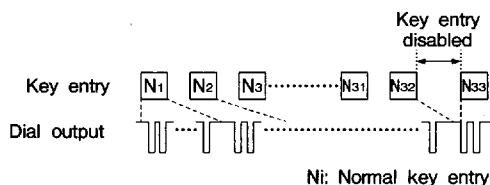
Normal Dialing

If data keys (0-9 in Pulse mode; 0-9, *, and # in Tone mode) are used for off-hook dialing, the device performs normal dialing operation. In the Tone mode, the device outputs the DTMF signal while a key is pressed and held. Up to 32 digits of input data are stored in a buffer memory. Key entries in excess of 32 digits are accepted when all of the 32 digits data stored in the buffer memory are dialed. Once the 33rd digit is accepted, the entire buffer memory is cleared, and an additional 32 digits beginning with the 33th digit can be stored in the buffer.

INPUT	DIAL OUTPUT	BUFFER MEMORY CONTENTS
↓ <P> ↑ 07436 5 1321	0743651321	(R)=last number dialed (R)=0743651321
↓ <T> ↑ 07436 5 1321 #*	0743651321 #*	(R)=last number dialed (R)=0743651321 #*
↓ <P> ↑ 12345...012 32 digits 3456789 ↓ ↑	12345...012 32 digits 3456789	(R)=last number dialed (R)=12345...012 32 digits (R)=3456789 (R)=3456789

NOTE :

↓ : On-hook, ↑ : Off-hook, < > : MOD pin status,
 #* : DTMF output, (R) : Buffer memory

**Fig. 6 Normal Mode Dialing Sequence****Redialing Feature**

If the REDIAL or RD/ARD key is pressed following off-hook, the contents of the buffer memory are dialed (in Pulse mode, the # key also acts as the REDIAL key). Redialing corresponds to 32 digits of normal dialing.

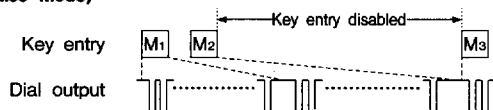
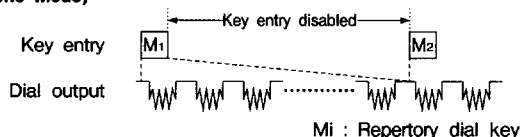
ENTRY	DIAL OUTPUT	MEMORY CONTENTS
↓ <P> ↑ 1234567890	1234567890	(R)=last number dialed (R)=1234567890
↓ ↑ REDIAL(RD/ARD) or #	1234567890	(R)=1234567890

Repertory Dialing

The LR48251 has 20 memories of 16 digits each. These memories allow one-touch repertory dialing using the M₁ to M₂₀ keys. In the Pulse mode, two repertory dial keys may be pressed consecutively. The dialed data are stored in the buffer memory. When in the Tone mode, one memory key can be pressed, and the dialed data are stored in the buffer memory. The number assigned to the second repertory dial key is dialed after the number assigned to the first repertory dial key has been dialed. A third repertory dial

key is accepted after all the numbers assigned to the first and second keys have been dialed. When the third key is pressed, the buffer memory is cleared and only the number for the third key is stored in the buffer. Each memory has a length of 16 digits.

KEY OPERATION	DIAL OUTPUT	MEMORY CONTENTS
↓ <P>		(M ₁)=07436, (M ₂)=51321, (M ₃)=12345 (R)=last number dialed
↑ M ₁	07436	(R)=07436
M ₂	51321	(R)=0743651321
↓ ↑ M ₃	12345	(R)=12345

(Pulse Mode)**(Tone Mode)****Fig.7 Repertory Dialing Sequences****Storing Numbers To Memories**

Numbers can be stored to memories in either On-Hook or Off-Hook mode.

KEY ENTRY	MEMORY CONTENTS
↓ STORE M ₁	(R)=last number dialed
STORE 07436 M ₂	(M ₁)=(R)=last number dialed (M ₂)=(R)=07436

NOTE :

Up to 16 digits can be stored to each memory. For a number exceeding 16 digits, only the first 16 digits are stored and the remaining digits are ignored.

Mixed-mode Dialing

The user can switch to Tone mode with the MOD key.

KEY ENTRY	DIAL OUTPUT	
MODpin = V _{DD} Off-Hook 07436MOD51321	07436(Pause)[51321]	(R)=07436MOD51321

The MOD key is stored in the memory similar to a data key, and occupies the space of a single digit. A pause is automatically inserted when switching from the Tone mode to the Pulse mode. (Refer to "Pause Feature".)

Pause Feature

The PAUSE key allows the user to insert a pause of about 4 seconds into a stored dialing sequence. During pause, the MUTE output is set to high impedance. Like other data keys, the PAUSE key data can also be stored in memory. The pause can be cleared by pressing the REDIAL key during pause. In the Pulse mode, the # key can also be used to clear the pause.

KEY ENTRY	DIALING SEQUENCE	MEMORY CONTENTS
↑ 012 PAUSE 3456	012 (PAUSE) 3456	(R)=012PAUSE3456

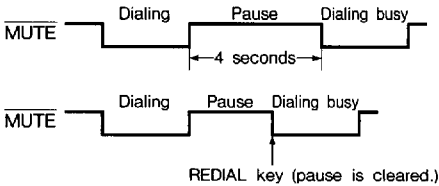


Fig. 8 Pause Feature

Repertory Dialing Plus Normal Dialing

In off-hook mode, normal dialing can follow repertory dialing. A number of up to 16 digits can be stored in buffer memory following the repertory number. When the number stored in the buffer has been dialed, the device is ready to accept subsequent key entry. In this case, all previous contents of the buffer are cleared before the 17th digit is stored.

KEY ENTRY	DIAL OUTPUT	MEMORY CONTENTS
↑ M1 1234...456 16 digits 7890	07436 1234...456 16 digits 7890	(M1)=07436 (R)=07436 (R)=074361234...456 16 digits (R)=7890
<P> ↑ M1 7890	123 (PAUSE) 456 7890	(R)=last number dialed (M1)=123MOD456 (R)=123MOD456 (R)=123MOD4567890

NOTE:
DTMF : DTMF output

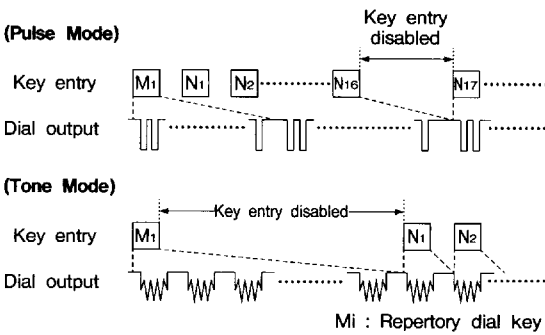


Fig. 9 Repertory Dialing Plus Normal Dialing

Normal Dialing Plus Repertory Dialing

In Off-Hook mode, repertory dialing can follow normal dialing. After normal dialing up to 16 digits, a repertory dial key can be entered. All numbers dialed with data and repertory keys are stored in a buffer. After all numbers in the buffer have been dialed, the device is ready to accept subsequent data key entry. When a new data key entry is accepted, the previous contents of the buffer are cleared. If a number 17 to 32 digits length is dialed with data keys in Off-Hook mode, a repertory dial key can be entered after the entire number is dialed normally. The previous contents of the buffer are cleared when the repertory dial key is entered.

KEY ENTRY	DIAL OUTPUT	MEMORY CONTENTS
↑ 07436 M1 2416	07436 51321 2416	(M1)=51321 (R)=07436 (R)=0743651321 (R)=2416
↑ 1234...4567 17 digits M1 2416	1234...4567 17 digits 51321 2416	(M1)=51321 (R)=1234...4567 17 digits (R)=51321 (R)=513212416

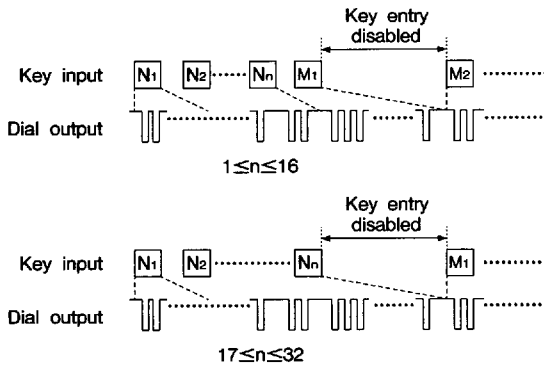


Fig. 10 Normal Dialing Plus Repertory Dialing

Flash Feature

- i) If the FLASH key is pressed in Off-Hook mode, the device outputs the flash signal pulses shown in Fig. 11 from its PULSE_{OUT} and MUTE pins. The Flash signal is output at the exact timing of FLASH key operation even if dialing is busy. Once the flash signal is output, the device is placed in the same state as that in the temporary On-Hook mode. In this case, the flash signal is not stored in buffer. The Flash signal width may be set to 90 or 800 ms with the 90/800 ms pin.

90/800 ms pin	T _{FLASH}
GND	800 ms
V _{DD}	90 ms

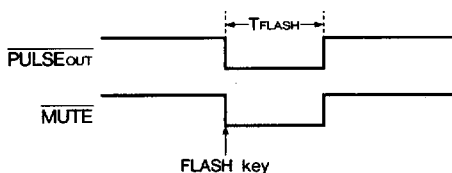


Fig. 11 Flash Signal Pulses

- ii) FLASH key operations can be stored in the repertory memories. A stored FLASH key causes the flash pulses shown in Fig. 12 to be output. When a repertory memory containing the FLASH key is recalled, the stored number including the FLASH key is transferred to the buffer. A subsequent REDIAL key operation causes any of the following dialing sequences, depending on the position where the FLASH key is inserted :

- i) When a flash is placed at the last digit of the data in the buffer :
The first digit through the digit just before the flash in the buffer are redialed.
- ii) When a flash is placed in the middle of data in the buffer :
The digit following the flash through the last digit are redialed.
- iii) When a flash is placed at the first digit of the buffer :
The second digit through the last digit are redialed.

In any of the three cases above, the flash signal itself is not redialed.

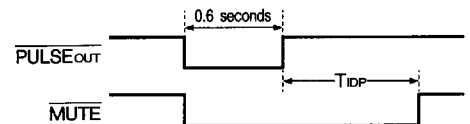


Fig. 12 Flash Signal

Table 4 Flash Function

KEY ENTRY	DIAL OUTPUT	MEMORY CONTENTS
<P> ↑ 123 FLASH 456 ↓ ↑ REDIAL	123 FLASH 456	(R)=last number dialed (R)= 123 (R)= 123 (R)= 456 (R)= 456
<P> ↑ 123 FLASH ↓ ↑ REDIAL	123 FLASH 123	(R)=last number dialed (R)= 123 (R)= 123 (R)= 123
		(M ₁)= 123FLASH456, (M ₂)= 123FLASH (M ₃)= FLASH789
↑ M ₁ ↓ ↑ REDIAL	123FLASH456 456	(R)=last number dialed (R)= 123FLASH456 (R)= 123FLASH456
↑ M ₂ ↓ ↑ REDIAL	123FLASH 123	(R)=last number dialed (R)= 123FLASH (R)= 123FLASH
↑ M ₃ ↓ ↑ REDIAL	FLASH789 789	(R)=last number dialed (R)= FLASH789 (R)= FLASH789