



13-MEMORY TONE/PULSE SWITCHABLE DIALER WITH LCD DRIVER

GENERAL DESCRIPTION

The W91550/A is a monolithic integrated circuit. It contains 15 number memories which can perform Tone/Pulse switchable dialing functions and 10 digits LCD display driver for telephone numbers & calling time.

It is fabricated in CMOS technology thus has good performance in low voltage, low power operations.

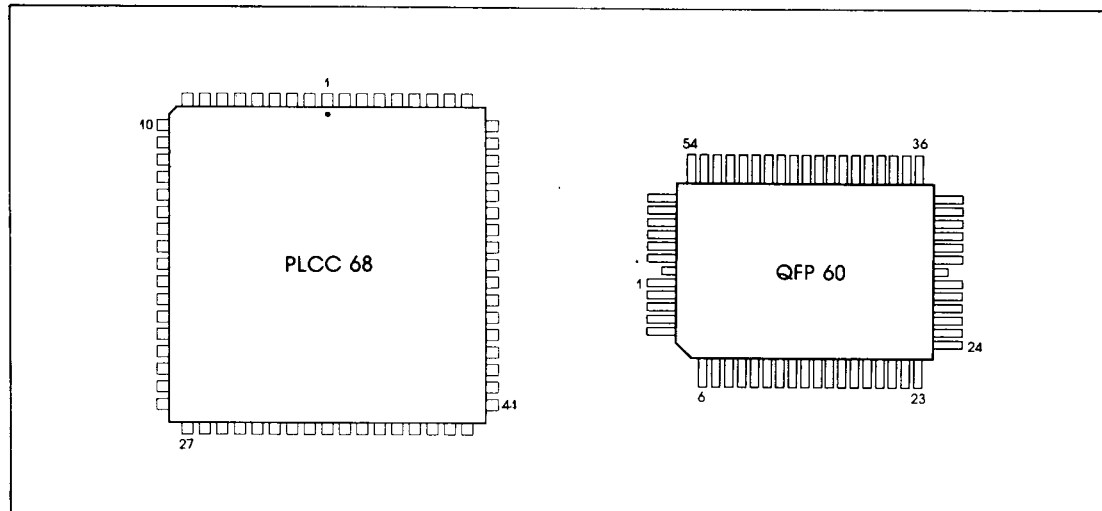
FEATURES

- 2 number by 32 digits for Redial and Save memory.
- 3 number by 16 digits for one touch direct repertory memory.
- 10 number by 16 digits for two touch indirect repertory memory.
- Fully key-ined & key-released debounced 4 × 6 keyboard.
- Pause, P-T can be stored as a digit in memory.
- Minimum tone output duration : 100 mS.
Minimum inter tone pause : 100 mS.
- Tone/Pulse mode is selectable by pin option.
- Break/Make ratio is selectable by pin option.
- Dial rate 10 or 20 pps is selectable by pin option.
- Pause time 2.0, 3.6 or 4.0 sec is selectable by mask option.
- Flash time 100 or 600 mS is selectable by keypad option.
- A built-in 10 (or 8) digits LCD driver for telephone numbers and calling time. (1/3 duty, 1/2 bias), by mask option.
- Built-in timer from [00 : 00] up to [59 : 59].
- Memory Check Function
- Power on reset and clear LCD on chip.
- Uses 3.579545 MHz TV quartz crystal or ceramic resonator.
- 60 pins QFP plastic package.
68 pins PLCC package.

ORDERING INFORMATION

TYPE NO	PACKAGE	FUNCTION
W91550F	60 QFP	OFF-HOOK Show Redial Buffer Content
W91550AF	60 QFP	OFF-HOOK Show Cursor
W91550P	68 PLCC	OFF-HOOK Show Redial Buffer Content
W91550AP	68 PLCC	OFF-HOOK Show Cursor

PIN CONFIGURATION

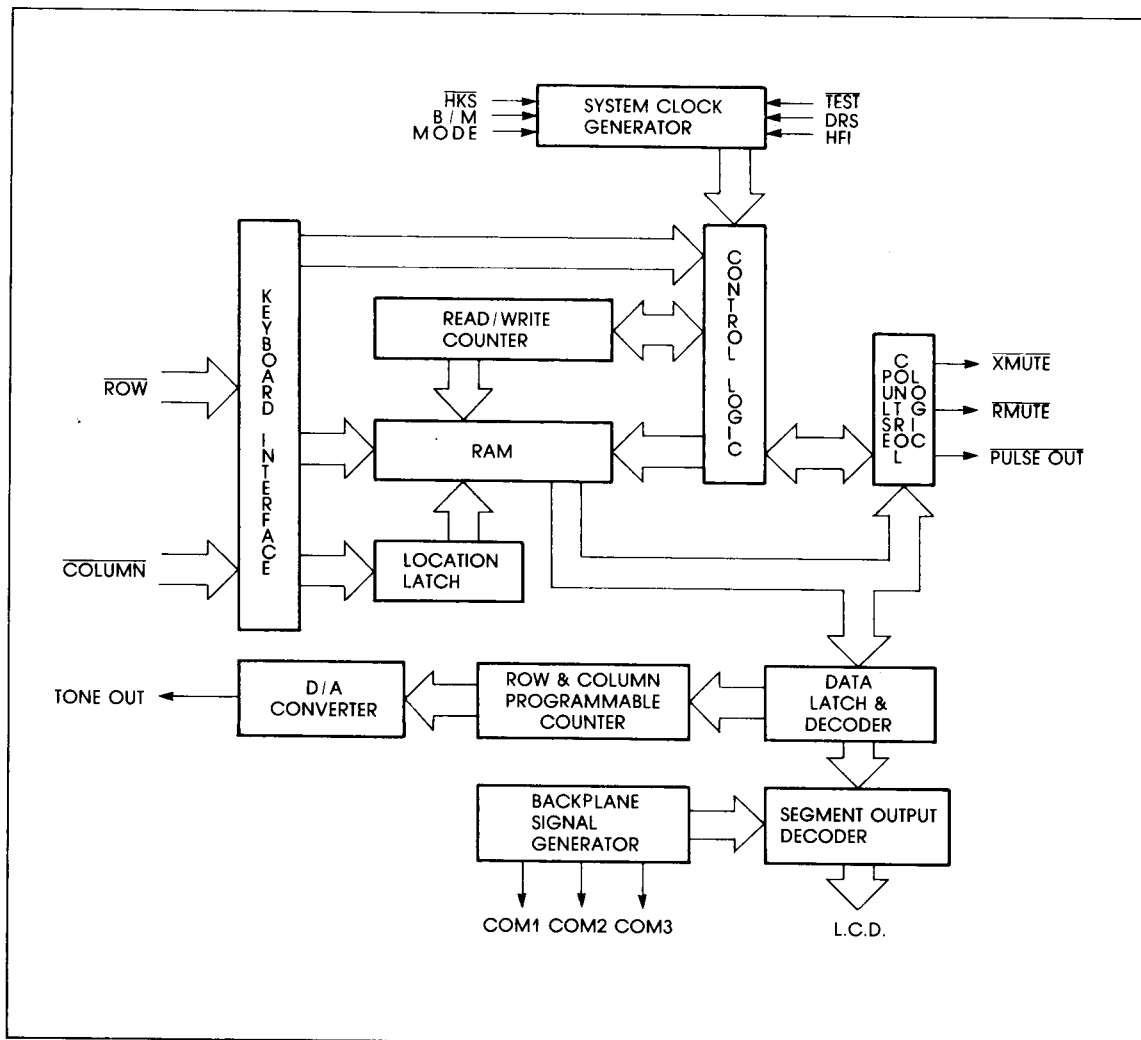


DESCRIPTION	PLCC	QFP
1A	11	7
1B	12	8
1C	13	9
2A	14	10
2B	15	11
2C	16	12
3A	17	13
3B	18	14
3C	19	15
4A	20	16
4B	21	17
4C	22	18
5A	23	19
5B	24	20
5C	25	21
6A	28	22
6B	29	23
6C	30	24
7A	31	25
7B	32	26

DESCRIPTION	PLCC	QFP
7C	33	27
8A	34	28
8B	35	29
8C	36	30
9A	37	31
9B	38	32
9C	39	33
10A	40	34
10B	41	35
10C	42	36
VSS	45	37
DTMF	46	38
B/M	47	39
TEST	48	40
VDD	49	41
RMUTE	50	42
XMUTE	51	43
DRS	52	44
PULSE	53	45
MODE	54	46

DESCRIPTION	PLCC	QFP
COL1	55	47
COL2	56	48
COL3	57	49
COL4	58	50
COL5	59	51
COL6	62	52
ROW1	63	53
ROW2	64	54
ROW3	65	55
ROW4	66	56
XT	67	57
XT	68	58
HKS	1	59
HFI	2	60
VLCD	3	1
CP	4	2
CN	5	3
COM1	6	4
COM2	7	5
COM3	8	6

BLOCK DIAGRAM



PIN / FUNCTIONAL DESCRIPTION

A. ROW - COLUMN inputs (pins 47 - 52 & 53 - 56)

The keyboards input is compatible with the standard 4 × 6 keyboard, the inexpensive single contact (Form A) keyboard, and electronic input.

In normal operation, any single button is pushed to produce dual tone, pulses or functions. Activation of two or more buttons will result in no response, except for single tone.

B. XT, $\overline{XT}$ (Pin 57 & 58)

An built in inverter provides oscillation with an inexpensive 3.579545MHz TV color burst crystal. Most crystals do not vary more than $\pm 0.02\%$.

The oscillator oscillates in OFF HOOK or handfree mode active but oscillator ceases in ON HOOK or handfree mode released.

C. $\overline{XMUTE}$ (pin 43)

The $\overline{XMUTE}$ is a conventional CMOS N-Channel open drain output.

The output transistor is switched on during dialing sequence (both Pulse and Tone mode). Otherwise, it is switched off.

D. $\overline{RMUTE}$ (pin 42)

The $\overline{RMUTE}$ is a conventional CMOS N-Channel open drain output.

The output transistor is switched on only during pulse dialing sequence. Otherwise, it is switched off.

E. $\overline{HKS}$ (pin 59)

The $\overline{HKS}$ (HOOK SWITCH) input is used to sense the state of handset in ON HOOK or OFF HOOK. In ON HOOK state, $\overline{HKS}=1$, or open the keyboard input is disabled, there is not any operation for any keyboard en-

try, to avoid the energy lose stored in capacitor.

In OFF HOOK state, $\overline{HKS}=0$, all of the function work.

$\overline{HKS}$ pin is pulled to V_{DD} by interal resistor.

F. $\overline{TEST}$ (pin 40)

In normal operation, pull the $\overline{TEST}$ pin to V_{DD} , the single tone is inhibited and dial pulse rate is 10 or 20 pps.

In testing operation, pull the $\overline{TEST}$ pin to V_{SS} , the single tone can be created with two key operation and all of the time parameters in pulse dialing are faster.

G. $\overline{PULSE}$ (pin 45)

This pin is a CMOS inverter output. The output is low in the ON HOOK or during dial pulse "Break" operation. Otherwise, this output is high.

In DTMF mode, the pulse out keeps high regardless of keyboard entry.

In Pulse mode, the output sends a chain of pulses to correspond the address keypad input, but keep open level for * and # entry. Fig. 1(a,b) shows the timing diagram in pulse mode. The pulse rate and inter digit pause are fixed, to be 10 pps (800 mS) and 20 pps (500 mS) respectively.

H. DTMF (pin 38)

This pin is used to output DTMF address signals.

During pulse dialing, it always keep at low state regardless of keypad input.

In tone mode, it will output dual or single tone.

The detail timing diagram of tone mode is shown in Fig. 2(a,b).

OUTPUT FREQUENCY (Hz)			% ERROR
SPECIFIED		ACTUAL	
R1	697	699	+0.28
R2	770	766	-0.52
R3	852	848	-0.47
R4	941	948	+0.74
C1	1209	1216	+0.57
C2	1336	1332	-0.30
C3	1477	1472	-0.34

I. HFI (pin 60)

HFI pin is a toggle flip-flop input. This system can be triggered enable or disable by logic high. The detail timing is shown in fig. 3.

The handfree dialing feature can be implemented by this input operation.

J. DRS (pin 44)

DRS pin is Dial pulse Rate select pin.

If DRS=0, the pulse rate is 10 pps and inter digit pause is 800 mS.

If DRS=1, the pulse rate is 20 pps and inter digit pause is 500 mS.

DRS pin is pulled to V_{SS} by internal resistor.

K. MODE (pin 46)

Pulls pin 40 to V_{DD} the system is in pulse mode, the pulse rate is 10 pps or 20 pps.

Pulls pin 40 to V_{SS}, it is in DTMF mode.

L. B/M (pin 39)

B/M pin is pulse output Break : Make ratio select pin.

If B/M=1, the B/M ratio is 60% : 40 %.

If B/M=0, the B/M ratio is 66.7% : 33.3%.

B/M pin is pulled to V_{DD} by internal resistor.

M. VLCD (pin 1)

VLCD is the power supply pin for LCD driver. A 1 μ F capacitor is connected between

VLCD and V_{SS}.

N. CP, CN (pin 2, 3)

CP is the voltage control capacitor positive pin. CN is the voltage control capacitor negative pin. A 1 μ F capacitor is connected between these two pins.

O. COM1 - COM3 (pin 4 - 6)

COM1 - COM3 are COMMON signal output terminal for 1/3 duty LCD.

P. 1 (A,B,C) - 10 (A,B,C) (pin 7 - 36)

1 (A,B,C) - 10 (A,B,C) are 10-digit SEGMENT signal output terminal.

Q. V_{DD}, V_{SS} (pin 41, 37)

These are the power input pins for the Tone/Pulse with LCD driver dialer.

KEYBOARD FUNCTION

C1	C2	C3	C4	C5	C6	
1	2	3	E	M1	TIM	R1
4	5	6	P-T	M2	CHK	R2
7	8	9	AUTO	M3	F1	R3
*	0	#	R / P	SAVE	F2	R4

TONE/PULSE
 DIALER

KEYBOARD OPERATION

Note:

1. All the keyboard operations. should be under OFF HOOK condition or press "HFI" switch.
2. D1 - Dn : 0 - 9, *, #.
3. Mn : M1 - M3
4. Ln : Memory location 0 - 9
5. The number D1, D2, - - -, Dn will be dialed out in Pulse or Tone mode as mode selected.

A. Normal Dialing

OFF HOOK [D1], [D2], - - -, [Dn]

- D1, D2, - - -, Dn will be dialed out.
- Dialing length is unlimit, but if dialing length overstep 32 digits the Redial is inhibited.

B. Redialing

OFF HOOK [D1], [D2], - - -, [Dn],
BUSY ON HOOK

Come OFF HOOK [R / P]

- The [R / P] key can execute Redial function only in first key in after OFF HOOK, otherwise will be Pause function.
- Redial memory can be check in memory check mode.
- If dialing length overstep 32 digits that Redialing is inhibited and "R/P" key will be changed to Pause function.

C. Number Entry

a. OFF HOOK [D1], [D2], - - -, [Dn], [E],
[E], [Mn or Ln], ON HOOK

- D1, D2, - - -, Dn will be stored in Mn memory location and they will be dialed out.

b.

1. OFF HOOK [E], [D1], [D2], [Dn], [E], [Mn]
or [Ln] ON HOOK

2. OFF HOOK [E], [D1], [D2], - - -, [Dn],
[Mn] ON HOOK

- D1, D2, - - -, Dn will be stored in Mn memory location but they will not be dialed out.

- [R/P] and [P-T] keys can be stored as a digit in memory, but [R/P] key can not be occupied in first digit.

- The store mode can be released after the store function is executed or the present state of hook switch is changed or flash function is executed.

3. OFF HOOK [E], [E], [Mn or Ln]

- The Redial content will copy to memory location.

D. Repertory Dialing

a. OFF HOOK [Mn]

b. OFF HOOK [AUTO] [Ln]

E. Access Pause

OFF HOOK [D1], [D2], [R/P], [D3], - - -, [Dn],
BUSY ON HOOK

Come OFF HOOK [R/P]

- The Pause function is executed in Redialing or Memory dialing.
- Auto Pause 2.0, 3.6 or 4.0 sec per Pause, that selects by mask option.
- The Pause function timing diagram is shown in Fig. 4.

F. Pulse to Tone

OFF HOOK [D1], [D2], - - -, [Dn], [P-T],
[D1'], [D2'], [Dn]

- If the mode switch is set in Pulse mode, then the output signal will be:

D1, D2, - - -, Dn, Pause (2.0s/3.6s/4.0s),
(Pulse)

D1', D', - - -, Dn'
(Tone)

- If the mode switch is set in Tone mode, then the output signal will be:

D1, D2, - - -, Dn, Pause (2.0s/3.6s/4.0s),
(Tone)

D1', D2', - - -, Dn'
(Tone)

- It can be reset to Pulse mode only in operation of ON HOOK, because it's still in Tone mode when the digits have been dialed out.
- The P-T function timing diagram is shown in Fig. 5.

G. Flash

OFF HOOK F

- It will execute ON HOOK 600 mS (F1) or 100mS (F2), and flash pause for 600 mS (or 100mS) before the next digit is dialed out.
- Flash key can't be stored as a digit in memory and that has the first priority of the keyboard function.
- The keyboard function is inhibited during Flash and Flash pause is executing.
- The Flash function timing diagram is shown in Fig. 6.

H. SAVE Key

a. OFF HOOK D1, D2, - - -, Dn,
SAVE ON HOOK

Come OFF HOOK SAVE

- D1, D2, - - -, Dn will be dialed out after SAVE key is keyed.

- If key in D1, D2, - - -, Dn, SAVE, SAVE, that D1, D2, - - -, Dn will copy to SAVE memory and D1, D2, - - -, Dn will be dialing out again.

b. OFF HOOK D1, D2, - - -, Dn

CONVERSATION

E, D1' D2', - - -, Dn', SAVE

- D1', D2', - - -, Dn' will be stored in SAVE memory, but they will not be dialed out.

I. Mix Dialing

a. Normal dialing + Memory dialing +
Normal dialing

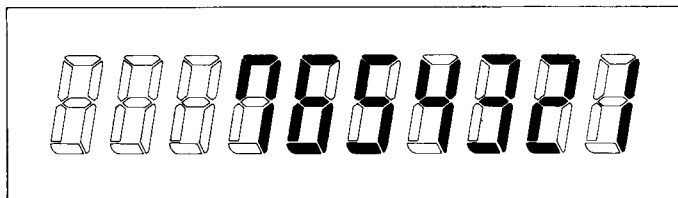
b. Memory dialing + Normal dialing +
Memory dialing

c. Redialing + Normal dialing +
Memory dialing

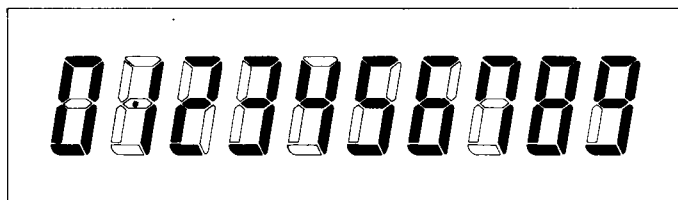
- Redialing valid just for first key-in.

LCD DISPLAY FORMAT

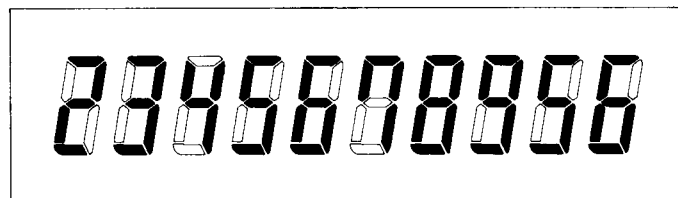
A. Normal Dialing



; OFF HOOK or
press "HFI" switch
LCD display Redial content
(Redial="7654321")

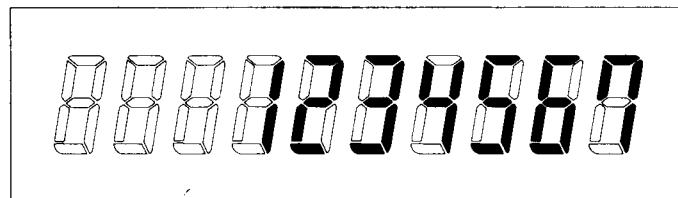


; Dial "0123456789"



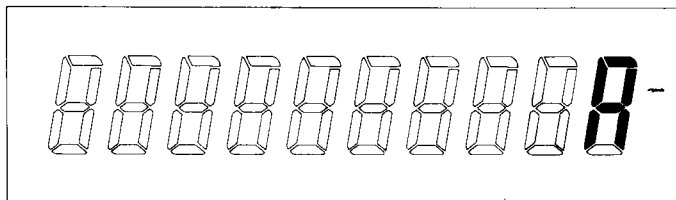
; and "56".

B. Redialing, SAVE dialing, One touch dialing

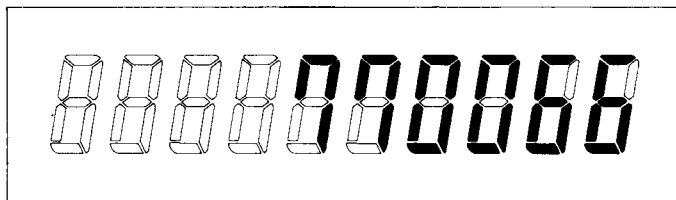


; press "R" or "SAVE" or "Mn" key.

C. Abbreviated Auto Dialing



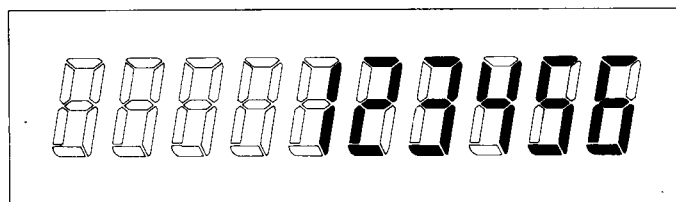
; press "AUTO" key
(L5 = "770066")



; press "5" key.

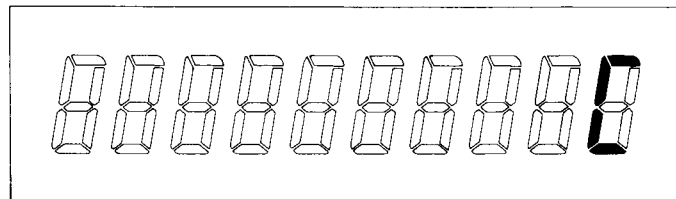
D. Memory check

a.

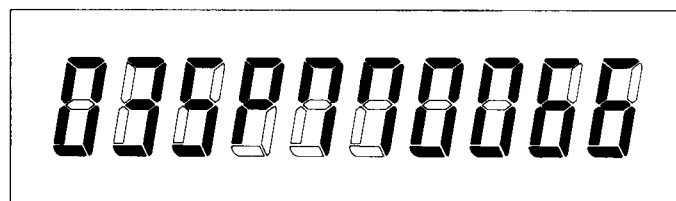


; OFF HOOK or
press "HFI" switch
(L6 = "035P770066")

Redial content

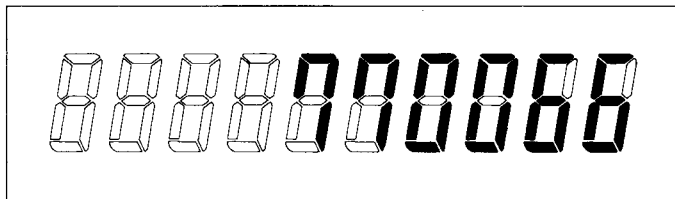


; press "CHK" key.



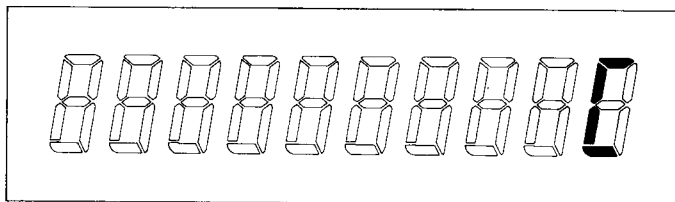
; press "6" key

b.

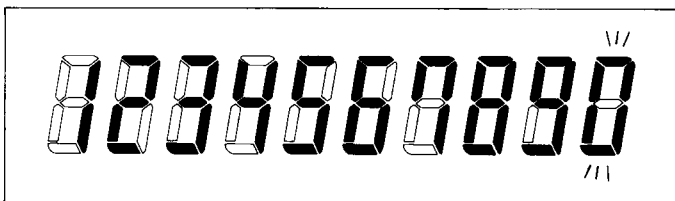


Redial content

; OFF HOOK or
press "HFI" switch
(M₁="1234567890 123456")

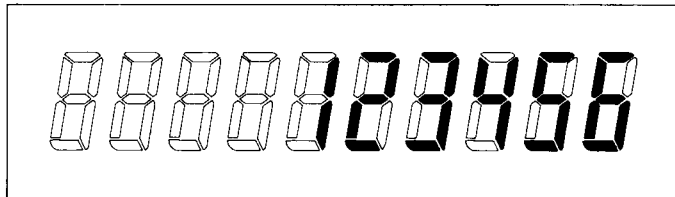


; press "CHK" key



Flash

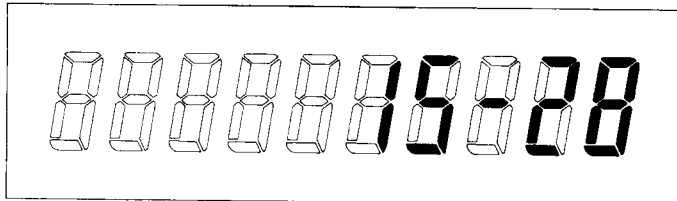
; Press "M₁" Key.
(Display 1 ~ 10 digits)



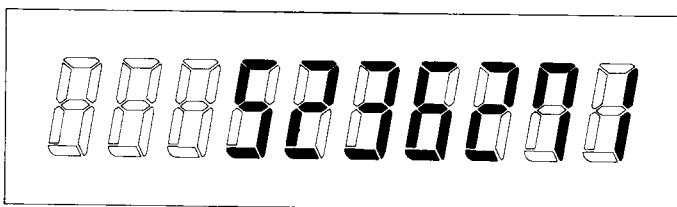
; press "Any key"
except "F1 & F2" keys
(Display 11 ~ 16 digits)

E. Timer Function

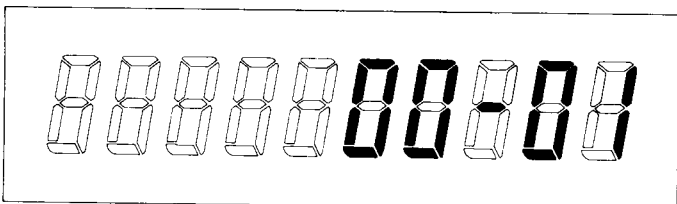
a.



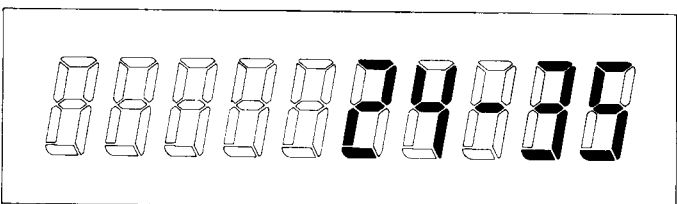
; OFF HOOK or
press "HFI" switch
press "TIM" key
(Display last calling time)



; Dial "5236271"

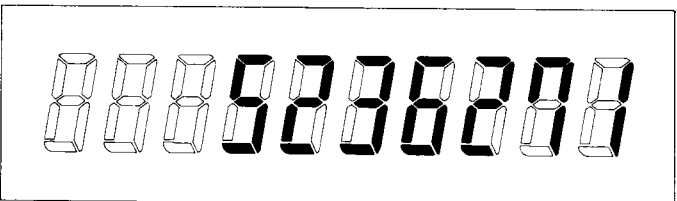


; If "5236271" is dialed completed.
press "TIM" key
(Timer will start counting up)

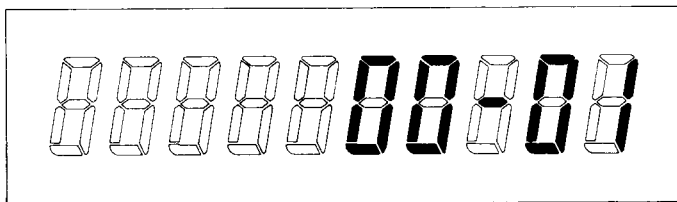


; ON HOOK or press "TIM" key
(Timer will stop)

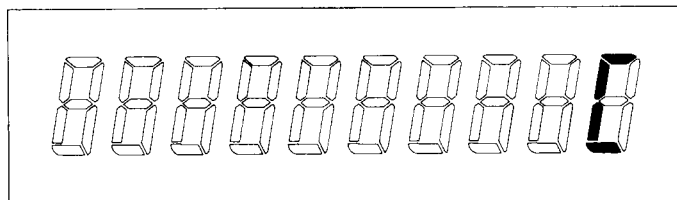
b.



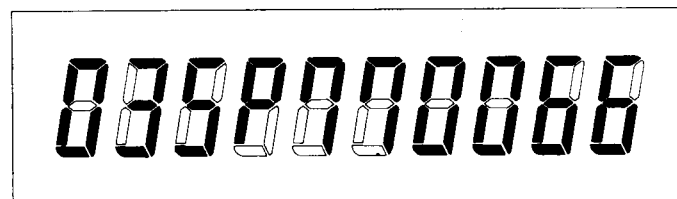
; OFF HOOK or Press "HFI" Key
Dial "5236271"



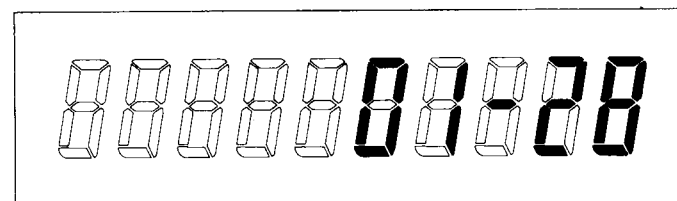
; If "5236271" is dialed completed.
; press "TIM" key
(Timer will start counting up)



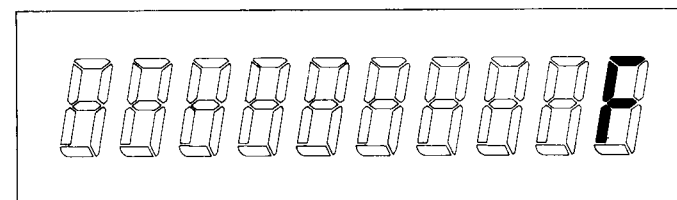
; press "CHK" key
(L6 = "035P770066")



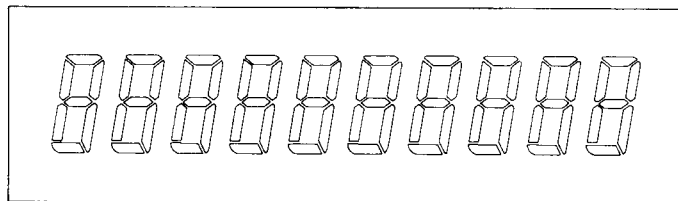
; press "6" key



; The system will back to
timer mode after 5 seconds.
(Timer count up continuously.)

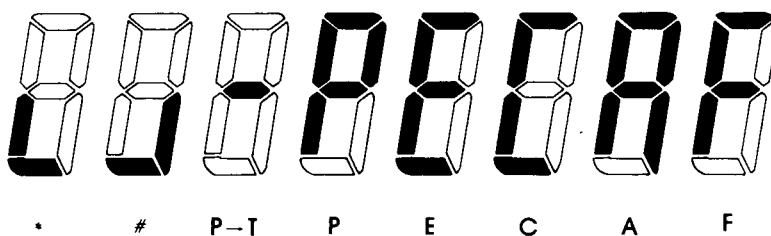
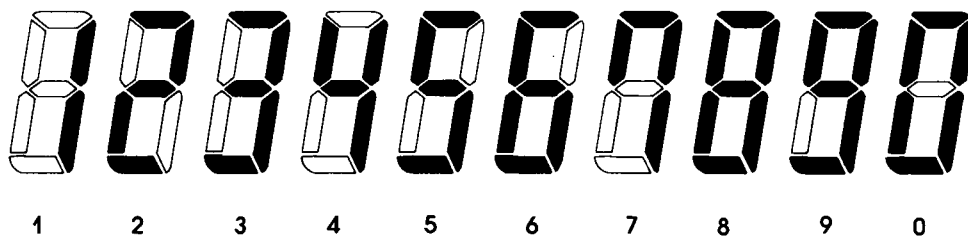


; press "F" key

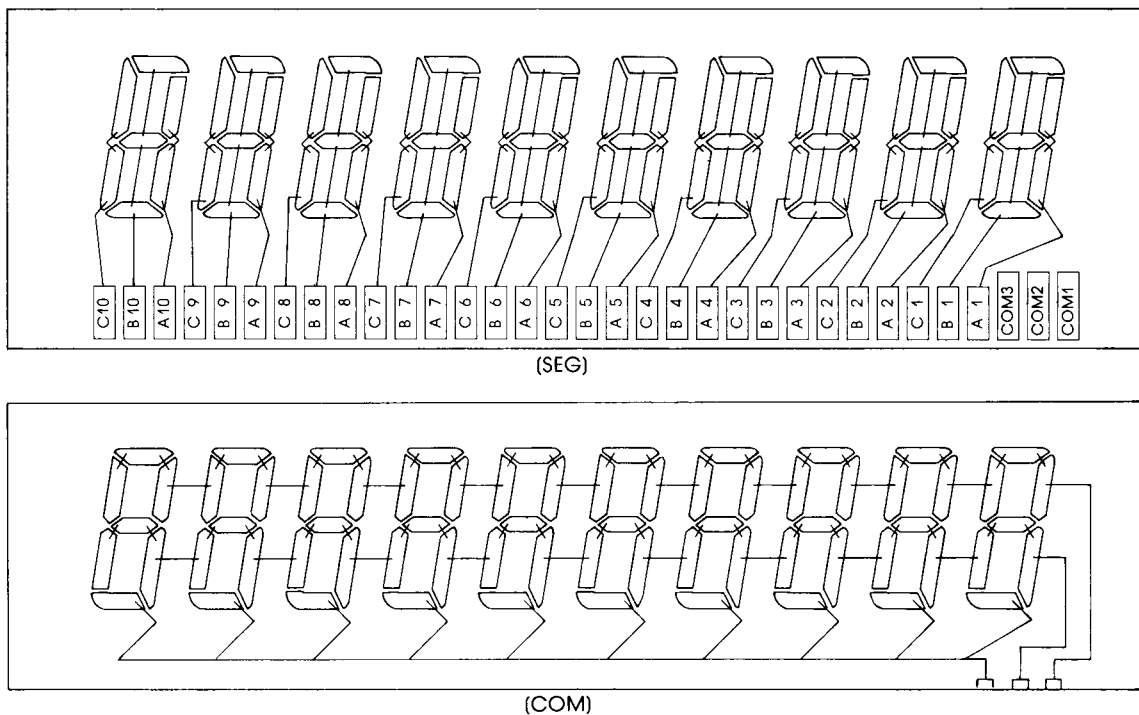


; If flash function is executed,
the timer will stop and LCD
display will be cleared.

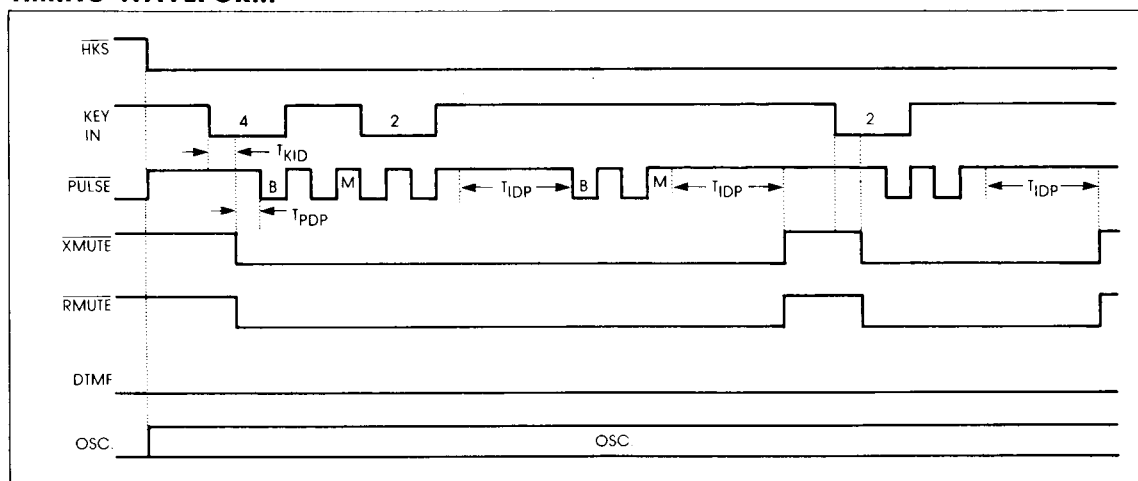
LCD PATTERN FOR DATA



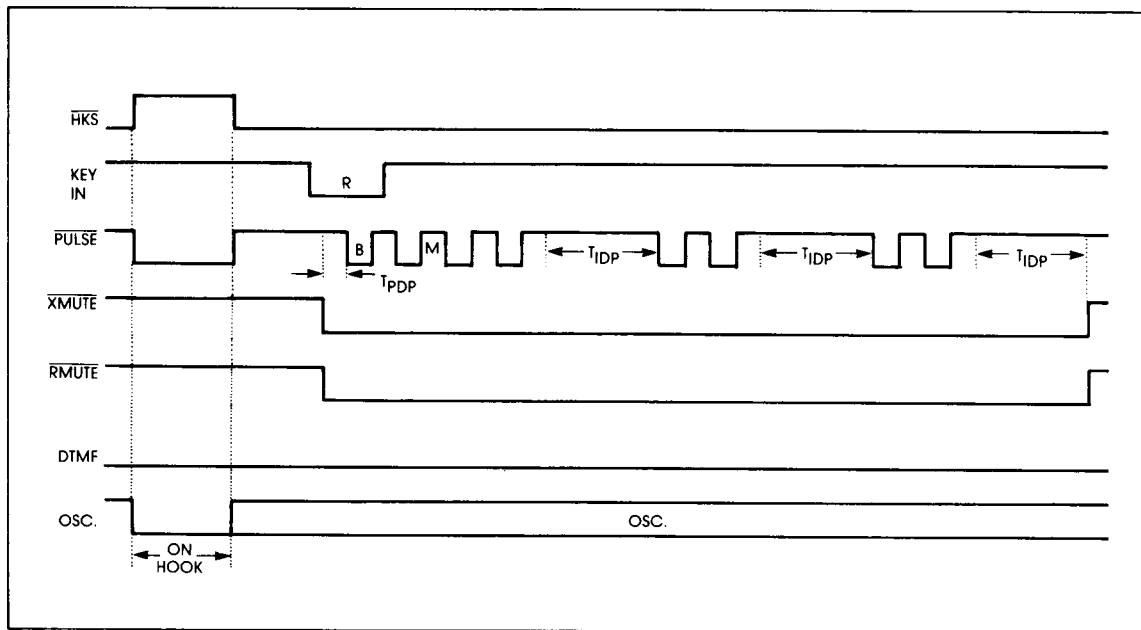
LCD PANEL PATTERN



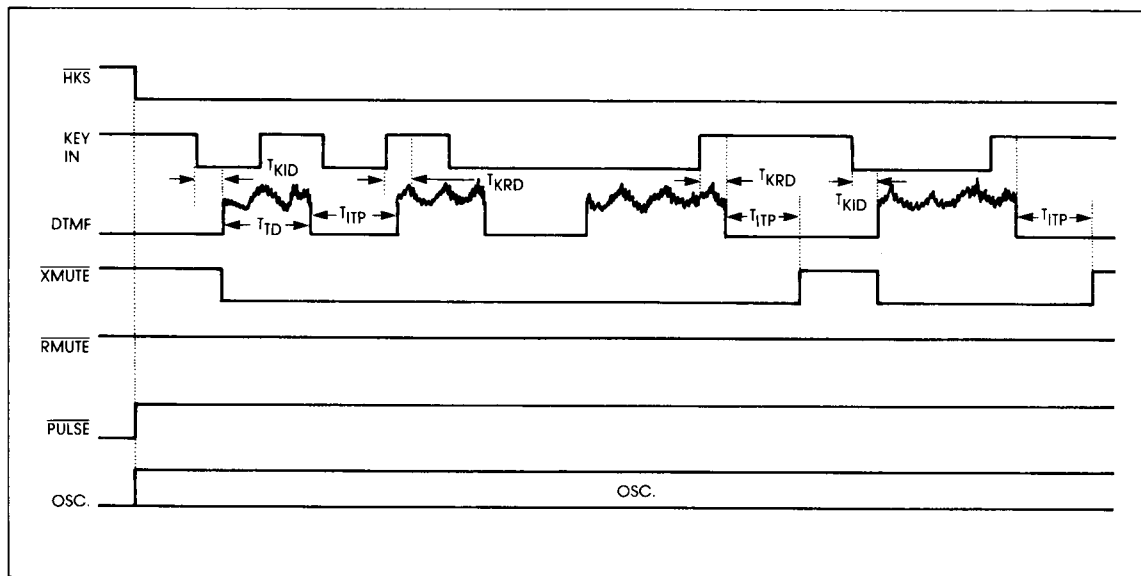
TIMING WAVEFORM



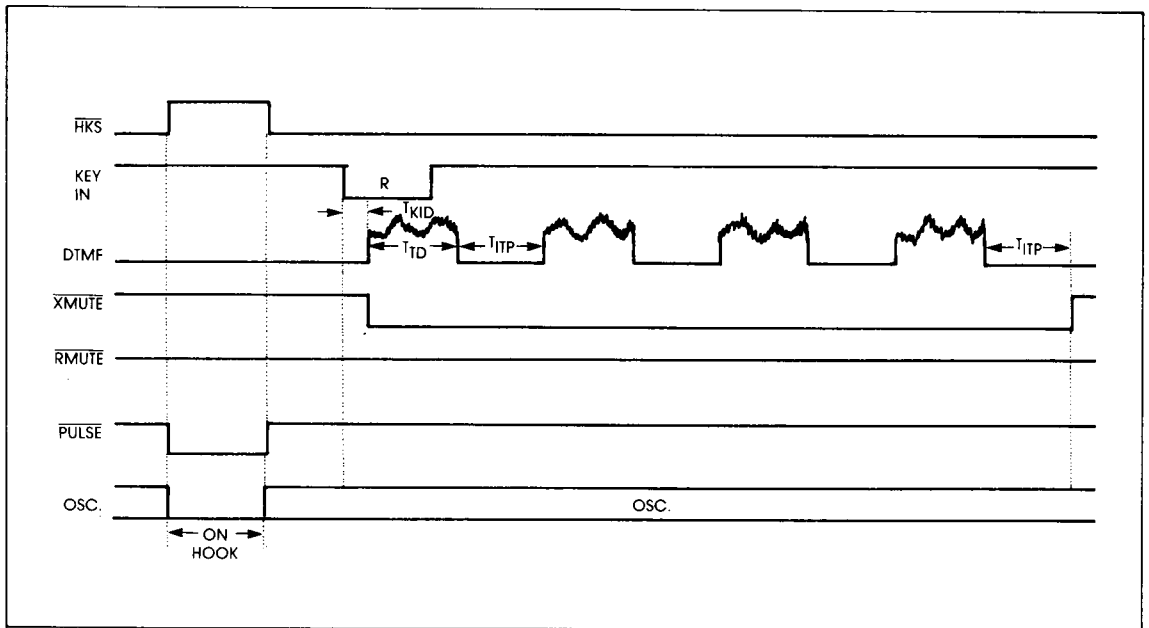
NORMAL DIALING
FIG.1-(a) PULSE MODE



AUTO DIALING
FIG. 1-(b) PULSE MODE



NORMAL DIALING
FIG. 2-(a) TONE MODE



AUTO DIALING
FIG. 2 -(b) TONE MODE

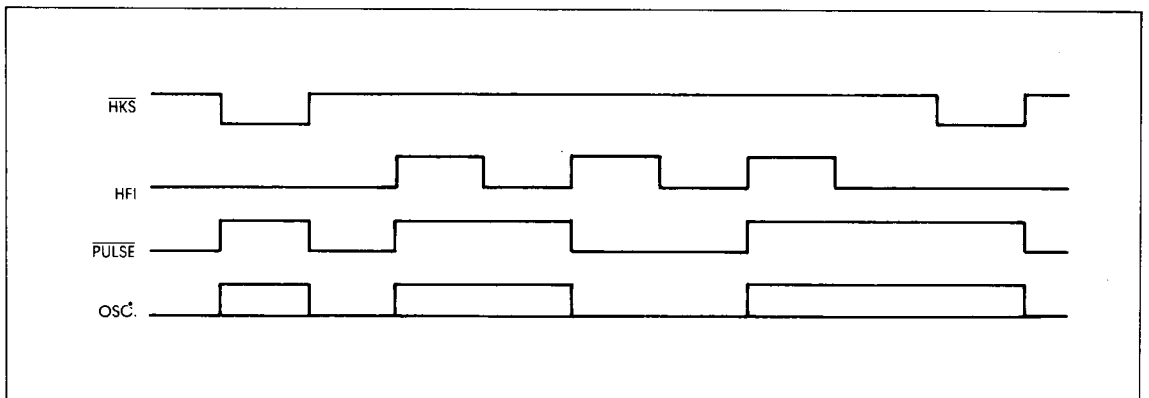


FIG. 3

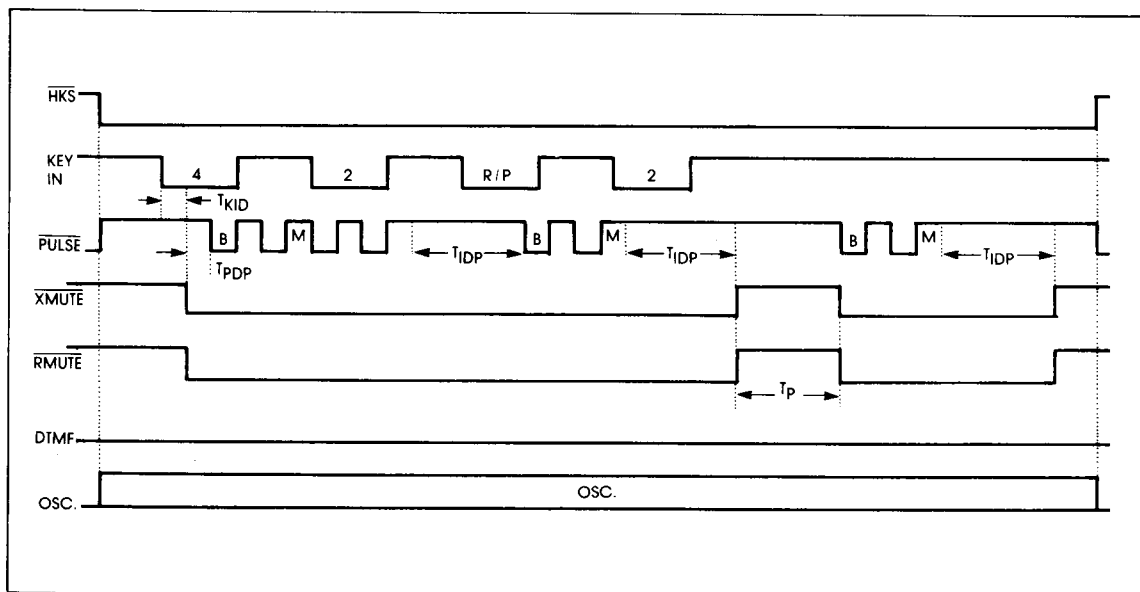


FIG.4 PAUSE FUNCTION

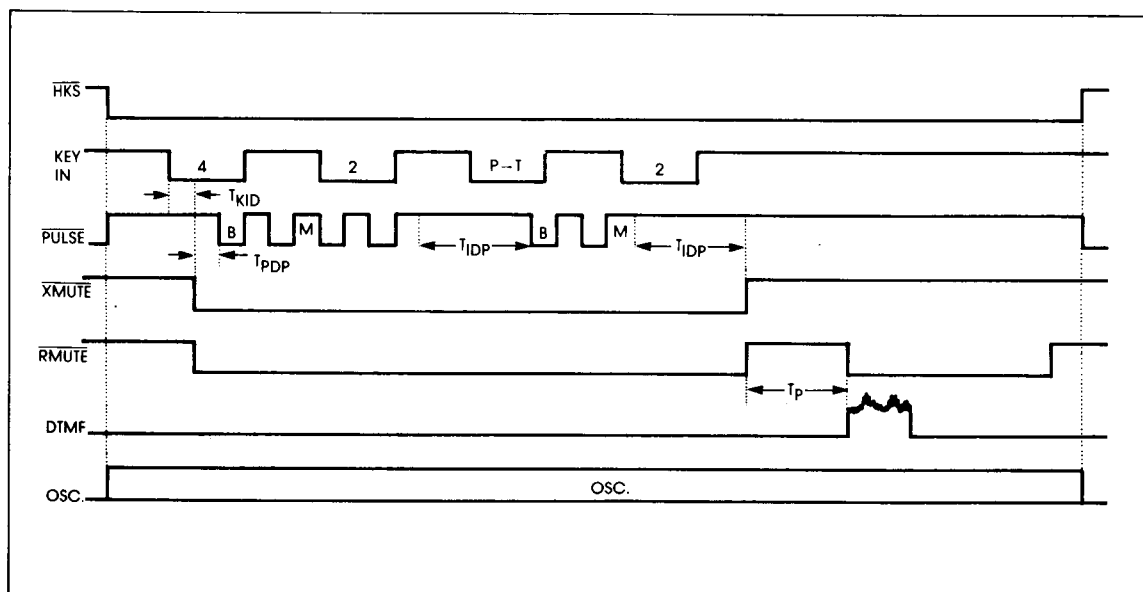


FIG.5 PULSE TO TONE FUNCTION

TONE / PULSE
DIALER

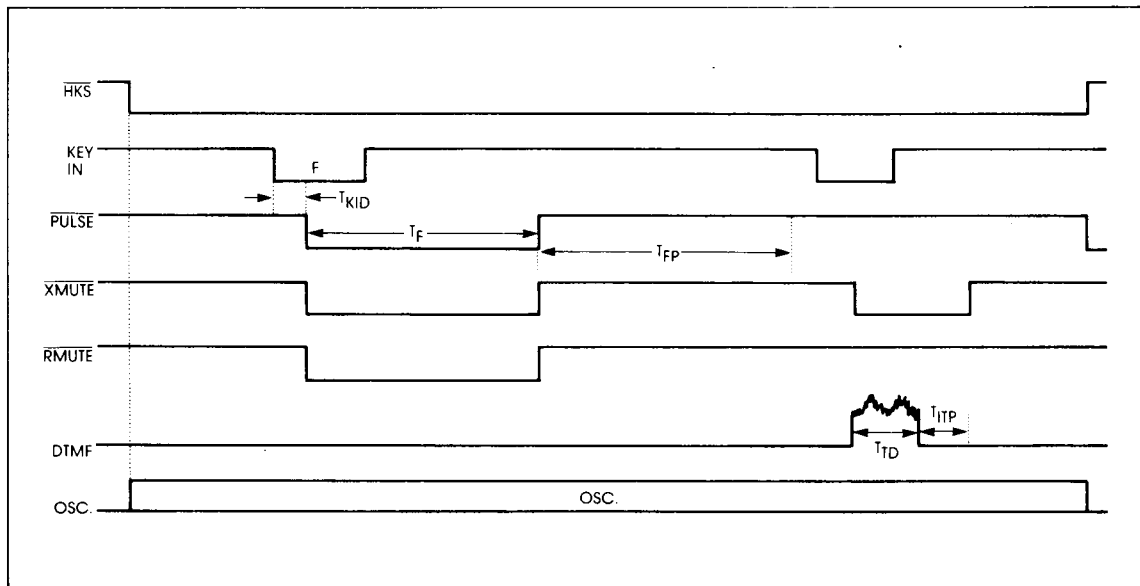


FIG.6 FLASH FUNCTION

ABSOLUTE MAXIMUM RATINGS

PARAMETER	RATING	UNIT
DC Supply Voltage	7.0	V
Power Dissipation per Package	120	mW
Input Voltage Range	-0.3 - V+0.3	V
Operation Temperature	0 - +70	°C
Storage Temperature	-55 - +150	°C

D.C. CHARACTERISTICS

(V_{DD}-V_{SS}=3.0V, Fosc.=3.58MHz, T_A=25°C, All output unloaded)

PARAMETER	SYM.	TEST	CONDITIONS	MIN.	TYP.	MAX.	UNIT
OP. Voltage	V _{DD}		—	2.0	—	5.5	V
OP. Current	I _{OP}	A	Tone	—	—	1.5	mA
			Pulse	—	—	0.5	
Memory Retention Current	I _{MR}	C	HKS=1, V _{DD} =1.0V	—	—	0.5	μA

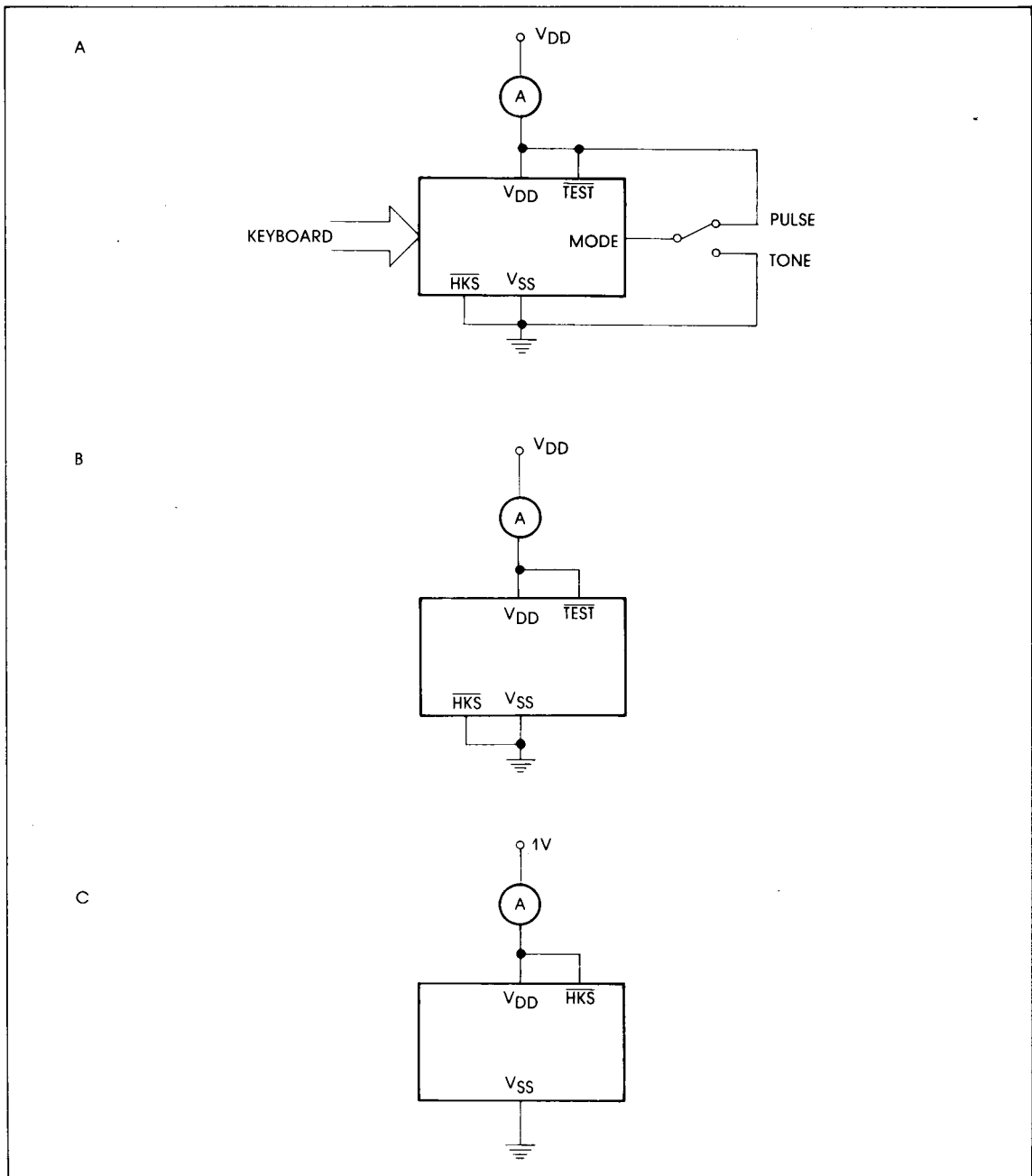
PARAMETER	SYM.	TEST	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Tone Output Voltage	V _{TO}	D	Row group, R _L = 10K Ω	130	150	170	mVrms
Pre-emphasis		E	Col / Row 2.0 - 5.5V	1	2	3	dB
DTMF Distortion	T _{HD}	E	R _L = 10K Ω 2.0 - 5.5V	—	-30	-23	dB
Common Output Voltage	V _{CH}	H		2.8	3.0	3.2	V
	V _{CL}	H		—	0	0.2	
Common Output Current	I _{CH}	F		-20	—	—	μ A
	I _{CL}	F		20	—	—	
Segment Output Voltage	V _{SH}	H		2.8	3.0	3.2	V
	V _{SL}	H		—	0	0.2	
Segment Output Current	I _{SH}	F		-5	—	—	μ A
	I _{SL}	F		5	—	—	
RMS Voltage Across a Segment	V _{ON}			2.2	—	—	Vrms
	V _{OFF}			—	—	1.2	
Average DC Offset Voltage	V _{DC}			—	—	100	mV
Tone Output DC Level	V _{TDC}	E	2.0 ~ 0.5V	1.1	—	2.8	V
Tone Output Sink Current	I _{TL}	G	V _{TO} = 0.5V	0.2	—	—	mA
Pulse Output Drive Current	I _{PH}	F	V _{PO} = 2.0V	0.5	—	—	mA
Pulse Output Sink Current	I _{PL}	F	V _{PO} = 0.5V	0.5	—	—	mA
XMute Output Sink Current	I _{XML}	F	V _{XMO} = 0.5V	0.5	—	—	mA
RMute Output Sink Current	I _{RML}	F	V _{RMO} = 0.5V	0.5	—	—	mA
Control Input Pull Up (down) Resister	R _{IH}	I J		100	—	—	K Ω
Keypad Input Drive Current	I _{KD}	F	V _I = 0V	4	10	—	μ A
Keypad Input Sink Current	I _{KS}	F	V _I = 2.5V	200	400	—	
Keypad Resistance	K _R	F		—	—	5	K Ω

A.C. CHARACTERISTICS

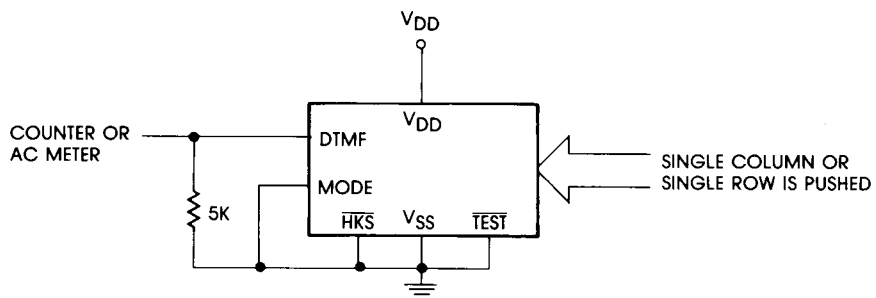
(VDD-VSS = 3.0 V, Fosc. = 3.58 MHz, Ta = 25°C All output unloaded)

PARAMETER	SYM.	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Key in Debounce	T _{KID}		—	15	—	mS
Key Release Debounce	T _{KRD}		—	15	—	mS
Pre-digit-Pause (1) 10 pps	T _{PDP1}	B/M=1	—	40	—	mS
		B/M=0	—	33.3	—	
Pre-digit-Pause (2) 20 pps	T _{PDP2}	B/M=1	—	20	—	mS
		B/M=0	—	16.7	—	
Pulse Rate (1)	F _{PR1}	DRS=0	—	10	—	pps
Pulse Rate (2)	F _{PR2}	DRS=1	—	20	—	
Inter Digit Paues	T _{IDP1}	10 pps	—	800	—	mS
	T _{IDP2}	20 pps	—	500	—	
Break / Make Ratio	B:M	B/M=1	—	60:40	—	%
		B/M=0	—	67:33	—	
Tone Output Duration	T _{TD}		—	100	—	mS
Inter Tone Pause	T _{ITP}		—	100	—	mS
Flash Time	T _F	F1	—	600	—	mS.
		F2	—	100	—	
Flash Pause	T _{FP}	F1	—	600	—	mS
		F2	—	100	—	
Pause Time	T _p	Mask option	—	2.0	—	S
			—	3.6	—	
			—	4.0	—	
LCD Frame Frequency	F _{LCD}		—	50	—	Hz
Row Group Frequency	F1	ROW 1	—	697	—	Hz
	F2	ROW 2	—	770	—	
	F3	ROW 3	—	852	—	
	F4	ROW 4	—	941	—	
Column Group Frequency	F5	COL 1	—	1209	—	Hz
	F6	COL 2	—	1336	—	
	F7	COL 3	—	1477	—	

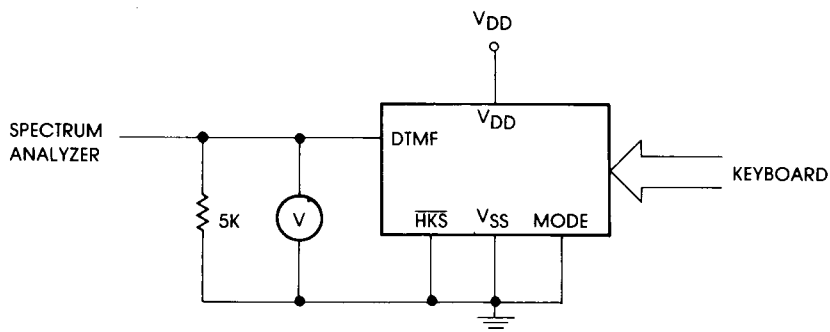
TEST CIRCUIT



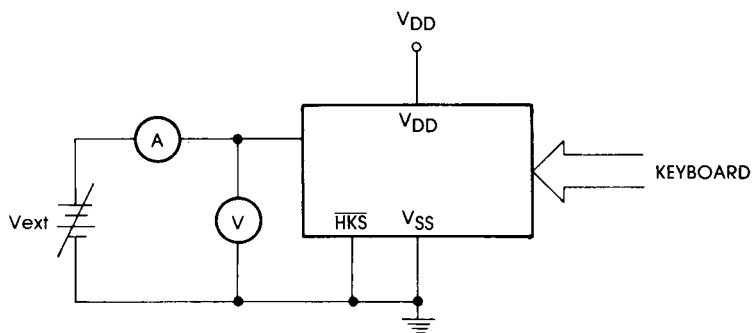
D



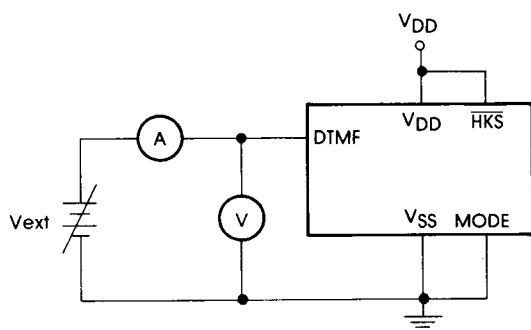
E



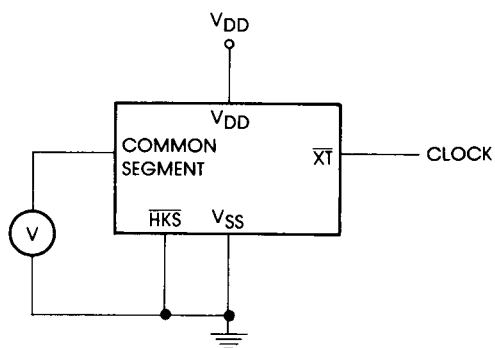
F



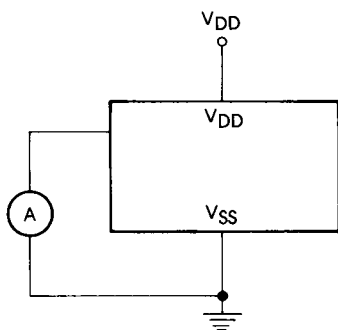
G



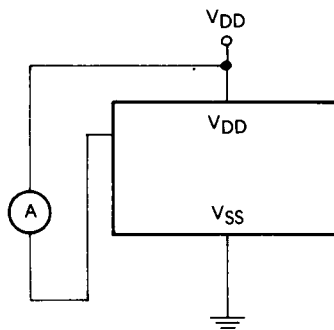
H



I



J



APPLICATION CIRCUIT DIAGRAM

