13-MEMORY TONE/PULSE DIALER WITH LCD AND LOCK FUNCTIONS

GENERAL DESCRIPTION

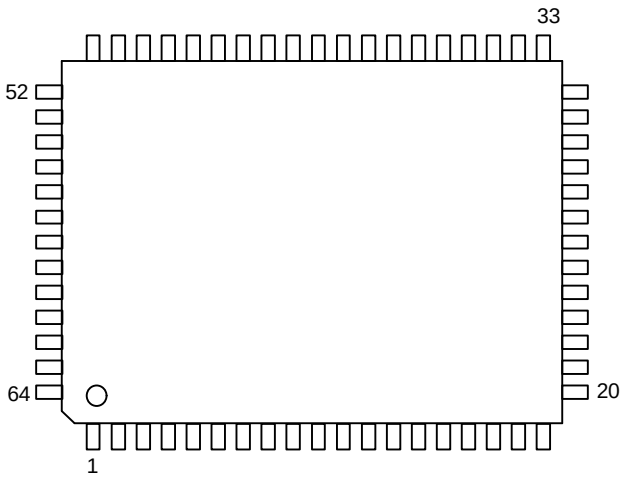
The W91550DN series are Si-gate CMOS IC tone/pulse switchable dialers containing 13 number memories and a 10-digit LCD driver for displaying telephone numbers and calling time, including a 16-digit × 3 one-touch memory, 16-digit × 10 two-touch memory dialing, and 32-digit × 2 redial and save memory. These dialers also provide a secrecy key, flash, two-way handfree dialing, one-key redial, hold and lock functions.

FEATURES

- Tone/pulse switchable dialer
- Two by 32-digit redial and save memory (or mercury memory)
- Three by 16-digit one-touch direct repertory memory
- Ten by 16-digit two-touch indirect repertory memory
- Memory check function
- Save/mercury function selected by pin option
- Typical interdigit pause (IDP): 800 msec (10 ppS) in pulse mode
- Uses 4 × 7 keyboard
- Mute key for secrecy control
- Minimum tone output duration/inter-tone pause: 87/87 mS
- Flash pause time: 1.2 sec.
- Flash break time (98, 300, 600 msec) selectable by keypad
- Pause time (2.0, 3.6, 4.0 sec.) selectable by mask option
- Pulse-to-tone (*/T) keypad for long distance call operation
- 0 or 9 dialing inhibition pin for PABX system or long distance dialing lock out
- Make/break ratio selected by pin option
- Built-in 10-digit LCD driver for telephone number display and calling time (1/3 duty, 1/2 bias)
- Built-in calling time from (00:00) to (59:59)
- On-chip power-on reset and clear LCD
- On hook debounce: 250 msec in normal mode (20 msec in lock mode)
- First key-in delay: 300 msec in lock mode
- Uses 3.579545 MHz crystal or ceramic resonator
- Packaged in 64-pin QFP
- The different dialers in the W91550DN series are shown in the following table:

TYPE NO.	FUNCTION	PACKAGE
W91550DNF	Default pause time is 3.6 sec. and all F1, F2, F3 are first priority.	QFP
W91550DNF-1	Same as W91550DN except F3 can be stored as a digit.	QFP
W91550DNH	Default pause time is 3.6 sec. and all F1, F2, F3 are first priority.	Chip
W91550DNH-1	Same as W91550DN except F3 can be stored as a digit.	Chip

PIN CONFIGURATION



NO.	NAME	NO.	NAME	NO.	NAME	NO.	NAME
1	$\overline{\text{KMUTE}}$	17	5C	33	10C	49	C6
2	COM3	18	6A	34	V_{SS}	50	R1
3	1A	19	6B	35	DTMF	51	R2
4	1B	20	6C	36	B/M	52	R3
5	1C	21	7A	37	$\overline{\text{TEST}}$	53	R4
6	2A	22	7B	38	V_{DD}	54	XT
7	2B	23	7C	39	HPM MUTE	55	$\overline{\text{XT}}$
8	2C	24	8A	40	T/P $\overline{\text{MUTE}}$	56	$\overline{\text{HKS}}$
9	3A	25	8B	41	ATS	57	$\overline{\text{HFI}}$
10	3B	26	S/$\overline{\text{M}}$	42	$\overline{\text{DP}}$	58	HFO
11	3C	27	8C	43	MODE	59	V_{LCD}
12	4A	28	9A	44	C1	60	CP
13	4B	29	9B	45	C2	61	CN
14	4C	30	9C	46	C3	62	COM1
15	5A	31	10A	47	C4	63	COM2
16	5B	32	10B	48	C5	64	$\overline{\text{LOCK}}$

PIN DESCRIPTION

SYMBOL	PIN	I/O	FUNCTION
Column, Row Inputs	44–49 & 50–53	I	The keyboard input may be used with either the standard 4 × 7 keyboard, an inexpensive single contact (form A) keyboard or electronic input. A valid key entry is defined by a single row being connected to a single column.
XT, $\overline{XT}$	54, 55	I, O	A built-in inverter provides oscillation with an inexpensive 3.579545MHz crystal. Most crystals do not vary by more than 0.02%. The oscillator oscillates in off-hook or handfree mode but oscillation ceases in on-hook mode or when the handfree mode is released.
T/P $\overline{MUTE}$	40	O	The T/P $\overline{MUTE}$ is a conventional CMOS N-channel open drain output. The output transistor is switched on during pulse and tone mode dialing sequences and flash breaks. Otherwise, it is switched off.
HPM MUTE	39	O	The HPM MUTE is a conventional CMOS inverter output. During pulse dialing, flash break, hold, and mercury mute functions, this pin will output an active high. Otherwise, it remains in a low state.
$\overline{KMUTE}$	1	O	The $\overline{KMUTE}$ is a CMOS N-channel open drain output. The output transistor is switched on only during the mute function. Otherwise, it is switched off.
MODE	43	I	Pulling mode pin to V_{SS} places the dialer in tone mode. Pulling mode pin to V_{DD} places the dialer in pulse mode. Pulse or tone mode can be selected any time.
$\overline{HKS}$	56	I	Hook switch input. $\overline{HKS}$ = V_{DD}: On-hook state. Chip in sleeping mode, no operation. $\overline{HKS}$ = V_{SS}: Off-hook state. Chip enable for normal operation. $\overline{HKS}$ pin is pulled to V_{DD} by internal resistor.
$\overline{DP}$	42	O	This pin is a CMOS inverter output. The timing diagram is shown as Figure 1(a), 1(b), 1(c), 1(d). Flash key will cause $\overline{DP}$ to go active in either pulse mode or tone mode.

Pin Description, continued

<table>
<tr><th>SYMBOL</th><th>PIN</th><th>I/O</th><th>FUNCTION</th></tr>
<tr><td>DTMF</td><td>35</td><td>O</td><td>In pulse mode, this pin remains in low state at all times.
In tone mode, it will output a dual or single tone. A detailed timing diagram for tone mode is shown in Figure 2(a), 2(b), 2(c) 2(d).
<table>
<tr><th colspan="4">Output Frequency</th></tr>
<tr><th></th><th>Specified</th><th>Actual</th><th>Error %</th></tr>
<tr><td>R1</td><td>697</td><td>699</td><td>+0.28</td></tr>
<tr><td>R2</td><td>770</td><td>766</td><td>-0.52</td></tr>
<tr><td>R3</td><td>852</td><td>848</td><td>-0.47</td></tr>
<tr><td>R4</td><td>941</td><td>948</td><td>+0.74</td></tr>
<tr><td>C1</td><td>1209</td><td>1216</td><td>+0.57</td></tr>
<tr><td>C2</td><td>1336</td><td>1332</td><td>-0.30</td></tr>
<tr><td>C3</td><td>1477</td><td>1472</td><td>-0.34</td></tr>
</table></td></tr>
<tr><td>V_{DD}, V_{SS}</td><td>38, 34</td><td>I</td><td>Power input pins.</td></tr>
<tr><td>B/M</td><td>36</td><td>I</td><td>Make: Break ratio select pin.
If B/M = V_{DD}, the M/B ratio is 40:60.
If B/M = V_{SS}, the M/B ratio is 33.3:66.7.
B/M pin is pulled to V_{DD} by internal resistor.</td></tr>
<tr><td>S/$\overline{M}$</td><td>26</td><td>I</td><td>Save and mercury select pin.
If S/$\overline{M}$ = V_{DD}, the save function is selected.
If S/$\overline{M}$ = V_{SS}, the mercury function is selected.
S/$\overline{M}$ pin is pulled to V_{DD} by internal resistor.</td></tr>
<tr><td>ATS</td><td>41</td><td>I</td><td>If ATS = V_{DD}, the auto timer function is enabled.
If ATS = V_{SS}, the auto timer function is disabled.
ATS pin is pulled to V_{DD} by internal resistor.</td></tr>
</table>

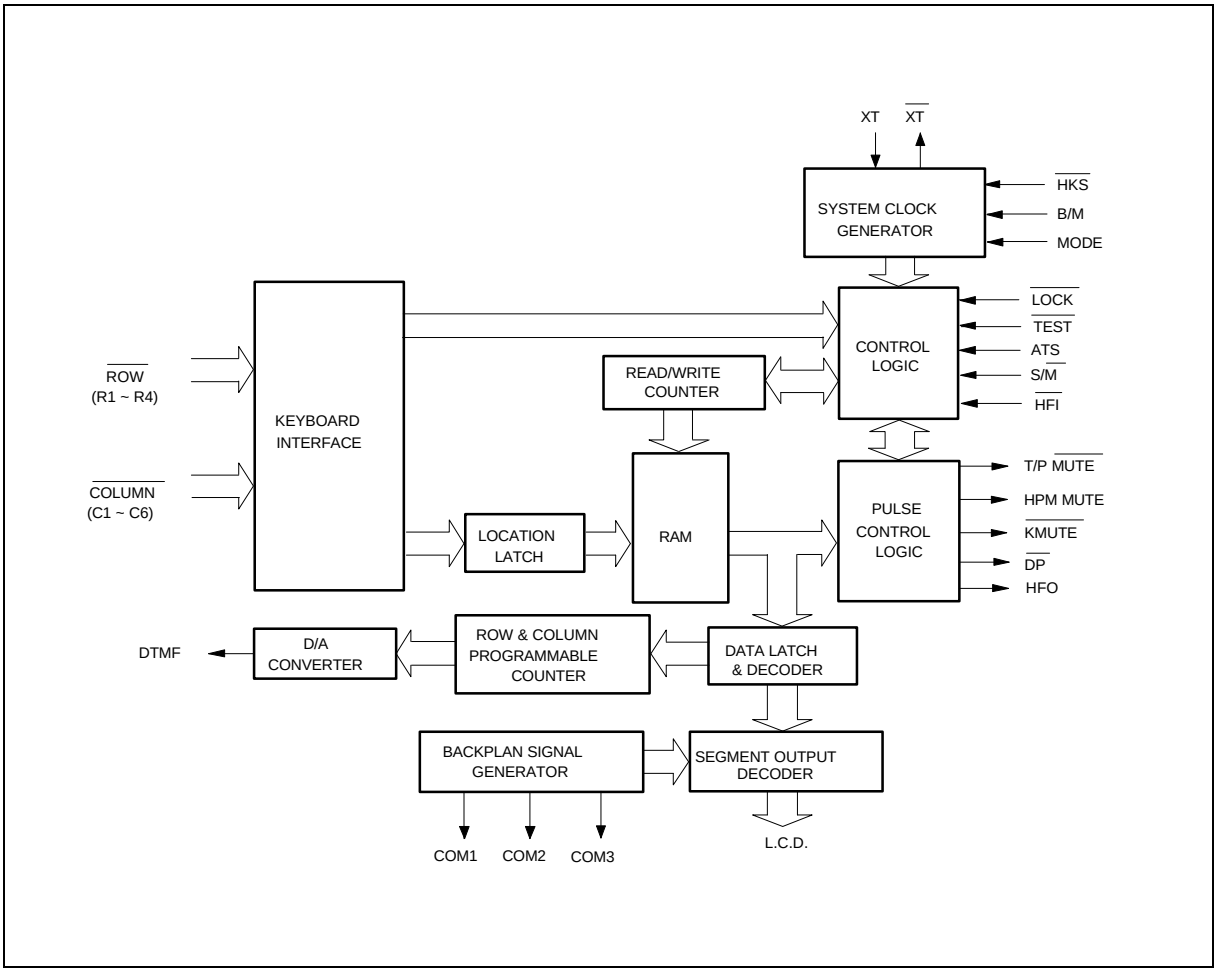
Pin Description, continued

<table>
<tr><th>SYMBOL</th><th>PIN</th><th>I/O</th><th>FUNCTION</th></tr>
<tr><td>$\overline{HFI}$, HFO</td><td>57, 58</td><td>I, O</td><td>Handfree control pins. A low pulse on the $\overline{HFI}$ input pin toggles the handfree control state.
Status of the handfree control is listed in the following table:
<table>
<tr><th colspan="2">CURRENT STATE</th><th colspan="3">NEXT STATE</th></tr>
<tr><th>Hook SW.</th><th>HFO</th><th>Input</th><th>HFO</th><th>Dialing</th></tr>
<tr><td>_</td><td>Low</td><td>$\overline{HFI}$ ↓</td><td>High</td><td>Yes</td></tr>
<tr><td>On Hook</td><td>High</td><td>$\overline{HFI}$ ↓</td><td>Low</td><td>No</td></tr>
<tr><td>Off Hook</td><td>High</td><td>$\overline{HFI}$ ↓</td><td>Low</td><td>Yes</td></tr>
<tr><td>On Hook</td><td>_</td><td>Off Hook</td><td>Low</td><td>Yes</td></tr>
<tr><td>Off Hook</td><td>Low</td><td>On Hook</td><td>Low</td><td>No</td></tr>
<tr><td>Off Hook</td><td>High</td><td>On Hook</td><td>High</td><td>Yes</td></tr>
</table>
$\overline{HFI}$ pin is pulled to V_{DD} by internal resistor.
Detailed timing diagram is shown in Figure 4.</td></tr>
<tr><td>$\overline{LOCK}$</td><td>64</td><td>I</td><td>The $\overline{LOCK}$ pin is used to prevent "0" or "9" dialing under PABX system long distance call control. When the first key input after reset is "0" or "9", all the key inputs, including "0" or "9" key, become invalid, and the chip generates no output.
The telephone is reinitialized by a reset.
The following table describes the functions of the $\overline{LOCK}$ pin:
<table>
<tr><th>$\overline{LOCK}$ PIN</th><th>FUNCTION</th></tr>
<tr><td>Floating</td><td>Normal dialing</td></tr>
<tr><td>V_{DD}</td><td>"0", "9" dialing inhibited</td></tr>
<tr><td>V_{SS}</td><td>"0" dialing inhibited</td></tr>
</table></td></tr>
<tr><td>$\overline{TEST}$</td><td>37</td><td>I</td><td>In normal operation, pulling the $\overline{TEST}$ pin to V_{DD} inhibits the single tone. In testing operation, pulling the $\overline{TEST}$ pin to V_{SS} enables a single tone to be created by pressing two keys simultaneously, and all of the timing parameters for pulse dialing are faster than in normal operation.</td></tr>
<tr><td>V_{LCD}</td><td>59</td><td>I</td><td>Power supply pin for LCD driver.
A 1μF capacitor is connected between V_{LCD} and V_{SS}.</td></tr>
<tr><td>CP, CN</td><td>60, 61</td><td>I</td><td>CP is the voltage control capacitor positive pin.
CN is the voltage control capacitor negative pin.
A 1 μF capacitor is connected between these two pins.</td></tr>
</table>

Pin Description, continued

SYMBOL	PIN	I/O	FUNCTION
COM1–COM3	62, 63, 2	O	COM1–COM3 are common signal output terminals for the 1/3 duty LCD.
1(A, B, C)–10(A, B, C)	3–33 (unless 26-pin)	O	1(A, B, C) –10(A, B, C) are 10-digit segment signal output terminals.

BLOCK DIAGRAM



FUNCTIONAL DESCRIPTION

Keyboard Operation

C1	C2	C3	C4	C5	C6	Vss	
1	2	3	E	M1	TIM		R1
4	5	6	CHK	M2	F1	MUTE	R2
7	8	9	A	M3	F2	H	R3
∗/T	0	#	R/P	∗SAVE	F3	R	R4

- E: Store digit
- CHK: a. Check dialing number
  b. Memory check (except mercury)
- A: Indirect repertory memory dialing function key
- R/P: Redial and pause function key
- ∗/T: ∗ in tone mode and P→T in pulse mode
- M1 to M3: One touch memory
- *SAVE: Save function key, If the S/$\overline{M}$ pin = V_{DD}
  MER, Mercury code dialing, If the S/$\overline{M}$ pin = V_{SS}
- TIM: Timer display key
- F1, F2, F3: Flash keys
- MUTE: Secrecy control key
- H: Hold function key
- R: One-key redial function

Notes:

D1, ..., Dn, D1', ..., Dn': 0, ..., 9, ∗/T, #
Mn: Direct memory location M1, M2, M3
Lm, Ln, Lp: Indirect memory location 0, ..., 9

Normal Dialing

OFF HOOK (or ON HOOK & $\overline{HFI}$), D1 , D2 , ..., Dn

1. D1, D2, ..., Dn will be dialed out.
2. Dialing length is unlimited, but redial is inhibited if length oversteps 32 digits in normal dialing.
3. The dialing mark (the dot of digit_1) will be lit until dialing is finished.

Redialing

1. OFF HOOK (or ON HOOK & $\overline{HFI}$), D1 , D2 , ..., Dn Busy
   Come ON HOOK , OFF HOOK (or ON HOOK & $\overline{HFI}$), R/P

a. The [R/P] key can execute the redial function only as the first key-in after off-hook; otherwise, it will invoke the pause function.

b. The redial memory content will be D1, D2, D3, ..., Dn.

c. If redialing length oversteps 32 digits, the redialing function will be inhibited.

2. [OFF HOOK] (or [ON HOOK] & [HFI ïõ]), [D1] , [D2] , ..., [Dn] , Busy, [R]

a. The one key redialing function timing diagram is shown in Figure 3.

b. If the dialing of [D1] to [Dn] is finished, pressing the [R] key will cause the pulse output pin $\overline{DP}$ to go low for 2.2 seconds break time and 0.6 seconds pause time will be added automatically.

c. If the pulses of the dialed digits [D1] to [Dn] have not finished, [R] will be ignored.

Number Store

1. [OFF HOOK] , (or [ON HOOK] & [HFI ïõ]), [D1] , [D2] , ..., [Dn] , [E] (many times same as one time), [Mn] (or [A] , [Ln] , or [Ln]), [ON HOOK]

D1, D2, ..., Dn will be stored in memory location Mn (or Ln) and will be dialed out.

2. [OFF HOOK] , (or [ON HOOK] & [HFI ïõ]), [E] , [D1] , [D2] , ..., [Dn] , [E] (could be skipped), [Mn] , [ON HOOK]

[OFF HOOK] (or [ON HOOK] & [HFI ïõ]), [E] , [D1] , [D2] , ..., [Dn] , [E] [A] (could be skipped), [Ln] , [ON HOOK]

a. D1, D2, ..., Dn will be stored in memory location Mn (or Ln) but will not be dialed out.

b. [R/P] and [*/T] keys can be stored as a digit in memory, but [R/P] key cannot be the first digit. In store mode, [R/P] is the pause function key.

c. The store mode is released after the store function is executed or when the state of the hook switch changes or the flash function is executed.

3. [OFF HOOK] , [E] , [Mn] , (or [A] , [Ln] , or [Ln])

The redial content will be copied to memory location Mn (or Ln).

Save

If the S/$\overline{M}$ pin = V_{DD}, the save function is selected:

1. [OFF HOOK] , (or [ON HOOK] & [HFI ïõ]), [D1] , [D2] , ..., [Dn] , CONVERSATION, [E] , [D1'] , [D2'] , ..., [Dn'] , [SAVE]

D1', D2', ..., Dn' will be stored in save memory but will not be dialed out.

2. [OFF HOOK] , (or [ON HOOK] & [HFI]), [D1] , [D2] , ..., [Dn] , [SAVE]

   a. D1, D2, ..., Dn will be dialed out before the SAVE key is pressed.

   b. The D1, D2, ..., Dn will be copied to save memory when the SAVE key is pressed after D1, D2, ..., Dn dialing is finished.

3. [OFF HOOK] , (or [ON HOOK] & [HFI]), [SAVE]

   a. D1, D2, ..., Dn will be dialed out when the SAVE key is pressed.

   b. All of the sequences will be displayed on the LCD.

Mercury

If the S/$\overline{M}$ pin = Vss, the mercury function is selected:

1. [OFF HOOK] , (or [ON HOOK] & [HFI]), [D1] , [D2] , ..., [Dn] , CONVERSATION, [E] , [D1'] , [D2'] , ..., [Dn'] , [MER]

   D1', D2', ..., Dn' will be stored in mercury memory but will not be dialed out.

2. MERCURY memory content = D1', D2', ..., Dn'

   a. [OFF HOOK] , (or [ON HOOK] & [HFI]), [D1] , [D2] , ..., [Dn] , [MER]

   D1, D2, ..., Dn will be dialed out but the MER's contents can't be dialed out.

   b. [OFF HOOK] , (or [ON HOOK] & [HFI]), [MER]

   D1', D2', ..., Dn' will be dialed out, and the mercury mark (the dot of digit_10) will be blinking during mercury dialing. Detailed timing diagram is shown in Figure 5.

   c. The MER key can be used to execute the mercury function only when it is the first key-in in dialing mode after off-hook state or first priority flash operation (except W91550DN-1's F3).

   d. With the exception of the mercury mark, the contents of mercury memory will not be displayed on the LCD.

   e. Mercury memory cannot be checked in memory check mode.

Repertory Dialing

1. One-touch direct repertory dialing.

   a. [OFF HOOK] , (or [ON HOOK] & [HFI]), [Mn]

   b. [OFF HOOK] , (or [ON HOOK] & [HFI]), [SAVE] (or [MER])

2. Two-touch indirect repertory dialing.

   [OFF HOOK] , (or [ON HOOK] & [HFI]), [A] , [Ln]

Access Pause

OFF HOOK (or ON HOOK & HFI), D1 , D2 , R/P , D3 , ..., Dn

1. The pause function can be stored in memory.
2. The pause function is executed in normal dialing, redialing, or memory dialing.
3. The pause function timing diagram is shown in Figure 6.

Pulse-to-tone (*/T)

OFF HOOK (or ON HOOK & HFI), D1 , D2 , ..., Dn , */T , D1' , D2 , ..., Dn'

1. If the mode switch is set to pulse mode, then the output signal will be:

   D1, D2, ..., Dn, Pause (3.6 sec), D1', D2', ..., Dn'
   (Pulse) (Tone)

2. If the mode switch is set to tone mode, then the output signal will be:

   D1, D2, ..., Dn, * , D1', D2', ..., Dn'
   (Tone) (Tone)

3. The dialer remains in tone mode when the digits have been dialed out and can be reset to pulse mode only by going on-hook.
4. The pulse-to-tone function timing diagram is shown in Figure 7.

TIM

OFF HOOK , (or ON HOOK & HFI), D1 , D2 , ..., Dn (or Redialing or Repertory dialing), CONVERSATION, TIM

1. If no key is pressed after dialing and ATS pin = 1, the LCD will automatically display counting time after 6 seconds.
2. The timer will count after the TIM key is pressed from 00:00.

Flash (F = F1, F2, F3)

OFF HOOK , (or ON HOOK & HFI), F

1. The dialer will execute flash break times of 600 mS (F1), 300 mS (F2), or 98 mS (F3) and a pause time of 1.2 sec. before the next digit is dialed out.
2. The flash key cannot be stored as a digit in memory and it has the first priority among keyboard functions (except for the F3 key of W91550DN-1).
3. The system will return to the initial state after pause time is finished.
4. Keyboard functions are inhibited during flash and when flash break is being executed.
5. The flash timing diagram is shown in Figure 8 and 12.

Mute

OFF HOOK , (or ON HOOK & $\overline{\text{HFI}}$), MUTE

The MUTE is switched on and off by the mute key. The function timing diagram is shown in Figure 9.

Hold Key

OFF HOOK , (or ON HOOK & $\overline{\text{HFI}}$), H

1. The HOLD function is switched on and off by the hold key. When the hold function is toggled on, the hold mark (dot of digit_6) will be lit. The function timing diagram is shown in Figure 10(a, b).
2. The HOLD key will be ignored during dialing.

Cascaded and Mixed Dialing

Cascaded Dialing

1. Definition of cascaded dialing:

   In cascaded dialing, a new sequence may be pressed before the previous sequence has been sent out completely. The following are examples of cascaded dialing:

   Example 1: Normal dialing + Repertory dialing 1 + Repertory dialing 2 +...

   Example 2: Repertory dialing 1 + Normal dialing + Repertory dialing 2 +...

   Example 3: Redialing + Normal dialing + Repertory dialing +...

2. Normal dialing, redialing, or repertory dialing as represented by each rectangle above is treated as one sequence.
3. At most 32 digits are allowed in cascaded dialing, but there is no limitation on the number of sequences.
4. The content of cascaded dialing may a combination of normal dialing, redialing, and repertory dialing. Redialing is valid only as the first key-in, however.
5. If ON HOOK , OFF HOOK , R is entered, then the cascaded dialing sequence described in the examples above will be dialed out only if the total number of digits does not exceed 32. If the sequence exceeds 32 digits then redialing is inhibited.

Mixed Dialing

1. Definition of mixed dialing:

   The examples of cascaded dialing given above are also examples of mixed dialing except that in mixed dialing a new sequence may be accepted only when the previous sequence has been dialed out completely.

2. There is no limitation on the number of digits and sequences in the mixed dialing.
3. The content of mixed dialing may be a combination of normal dialing, memory dialing, or one-key redialing.

4. If [ON HOOK] , [OFF HOOK] , [R] is entered, then the mixed dialing sequence described in the above examples will be dialed out only if the total number of digits does not exceed 32. If the total exceeds 32 digits, then redialing is inhibited.

Combining Cascaded and Mixed Dialing

1. Cascaded dialing and mixed dialing may be combined, and each follows the rules described above.
2. To apply redialing to combinations of cascaded and mixed dialing:

   [ON HOOK] , [OFF HOOK] , [R] , then redialing will be executed only if the total number of digits does not exceed 32. Otherwise, the redialing is inhibited.
3. If there had been n cascaded sequences with a total of 30 digits dialed, then for the (n+1)th cascaded sequence, one 2-digit normal dialing sequence or one complete repertory dialing sequence (length up to 32 digits) can be dialed. The (n+2)th sequence will not be accepted for cascaded dialing.
4. After a total of 32 digits of cascaded dialing have been completed, mixed dialing can be added.

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATING	UNIT
DC Supply Voltage	V_{DD}–V_{SS}	-0.3 to +7.0	V
Input/output Voltage	V_{IL}	V_{SS} -0.3	V
	V_{IH}	V_{DD} +0.3	V
	V_{OL}	V_{SS} -0.3	V
	V_{OH}	V_{DD} +0.3	V
Power Dissipation	P_D	120	mW
Operating Temperature	T_{OPR}	-20 to 70	°C
Storage Temperature	T_{STG}	-55 to 125	°C

Note: Exposure to conditions beyond those listed under Absolute Maximum Ratings may adversely affect the life and reliability of the device.

DC CHARACTERISTICS

(V_{DD}–V_{SS} = 3V, $F_{OSC.}$ = 3.58 MHz, T_A = 25° C, all output unloaded)

PARAMETER	SYM.	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Operating Voltage	V_{DD}	-	2.0	-	5.5	V
Operating Current	I_{OP}	Tone, Unloaded	-	0.6	1.0	mA
		Pulse, Unloaded	-	0.4	0.8	
Memory Retention Current	I_{MR}	$\overline{HKS}$ = V_{DD}, V_{DD} = 1.0V	-	-	0.5	µA

DC Characteristics, continued

PARAMETER	SYM.	CONDITIONS	MIN.	TYP.	MAX.	UNIT
DTMF Output Voltage	V_{TO}	Row group, R_L = 5 KΩ	130	150	170	mVrms
Pre-emphasis		Col/Row, V_{DD} = 2.0–5.5V	1	2	3	dB
DTMF Distortion	THD	R_L = 5 KΩ, V_{DD} = 2.0–5.5V	-	-30	-23	dB
DTMF Output DC Level	V_{TDC}	R_L = 5 KΩ, V_{DD} = 2.0–5.5V	1.0	-	3.0	V
DTMF Output Sink Current	I_{TL}	V_{TO} = 0.5V	0.2	-	-	mA
$\overline{DP}$ Output Drive Current	I_{PH}	V_{PO} = 2.0V	0.5	-	-	mA
$\overline{DP}$ Output Sink Current	I_{PL}	V_{PO} = 0.5V	0.5	-	-	mA
Common Output Voltage	V_{CH}	-	2.8	3.0	3.2	V
	V_{CL}	-	-	0	0.2	
Common Output Current	I_{CH}	V_{COM} = 3.0V, V_O = V_{COM} -0.4V	-20	-	-	µA
	I_{CL}	V_{COM} = 0.0V, V_O = 0.4V	20	-	-	
Segment Output Voltage	V_{SH}	-	2.8	3.0	3.2	V
	V_{SL}	-	-	0	0.2	
Segment Output Current	I_{SH}	V_{SEG} = 3.0V, V_O = SEG -0.4V	-5	-	-	µA
	I_{SL}	V_{SEG} = 0.0V, V_O = 0.4V	5	-	-	
RMS Voltage Across a Segment	V_{ON}	-	2.0	2.12	-	Vrms
	V_{OFF}	-	-	1.225	1.35	
Average DC Offset Volatge	V_{DC}	-	-	-	100	mV
T/P $\overline{MUTE}$ Output Sink Current	I_{TML}	V_{TPM} = 0.5V	0.5	-	-	mA
HPM MUTE Output Sink Current	I_{HML}	V_{HPM} = 0.5V	0.5	-	-	mA
$\overline{KMUTE}$ Output Sink Current	I_{KML}	V_{KM} = 0.5V	0.5	-	-	mA
Control Input Pull-up/Down Resistor	R_{CIP}	S/$\overline{M}$, B/M, $\overline{TEST}$, ATS, MODE, $\overline{HFI}$	100	-	-	KΩ
$\overline{HKS}$ Input Pull-up Resistor	R_{HK}	$\overline{HKS}$	-	300	500	KΩ
Keypad Input Drive Current	I_{KD}	V_I = 0V	30	-	-	µA
Keypad Input Sink Current	I_{KS}	V_I = 2.5V	200	400	-	µA
Keypad Resistance	R_K	-	-	-	5.0	KΩ

AC CHARACTERISTICS

PARAMETER	SYM.	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Key-in Debounce	T_{KID}	-	-	20	-	mS
Key Release Debounce	T_{KRD}	-	-	20	-	mS
Off-hook Delay	T_{OFD}	Lock only	-	300	-	mS
First Key-in Delay	T_{FKD}	Lock only	-	300	-	mS
On-hook Debounce	T_{OHD}	Normal mode	-	250	-	mS
		Lock mode	-	20	-	
Pulse Mute Delay	T_{MD}	B/M = V_{DD}	-	40	-	mS
		B/M = V_{SS}	-	33.3	-	
Pre-digit-pause (10 ppS)	T_{PDP}	B/M = V_{DD}	-	40	-	mS
		B/M = V_{SS}	-	33.3	-	
Interdigit Pause (Auto dialing)	T_{IDP}	10 ppS	-	800	-	mS
Make/Break Ratio	M:B	B/M = V_{DD}	-	40:60	-	%
		B/M = V_{SS}	-	33:67	-	
Tone Output Duration	T_{TD}	Auto dialing	-	87	-	mS
Intertone Pause	T_{ITP}	Auto dialing	-	87	-	mS
Flash Break Time	T_{FB}	F1	-	600	-	mS
		F2	-	300	-	
		F3	-	98	-	
Flash Pause Time	T_{FP}	F1, F2, F3	-	1.2	-	S
Pause Time	T_P	Mask option	-	2.0	-	S
		(default 3.6S)	-	3.6	-	
			-	4.0	-	
One-key Redialing Break Time	T_{RB}	-	-	2.2	-	S
One-key Redialing Pause Time	T_{RP}	-	-	0.6	-	S
LCD Frame Frequency	F_{LCD}	-	-	50	-	Hz

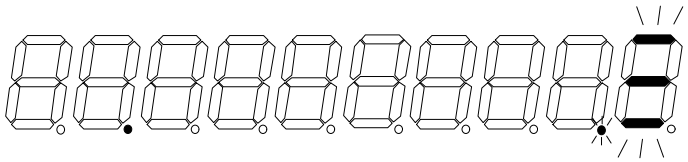
Notes:

1. Crystal parameters suggested for proper operation are $R_S < 100\ \Omega$, $L_m = 96$ mH, $C_m = 0.02$ pF, $C_n = 5$ pF, $C_l = 18$ pF, and $F_{OSC.} = 3.579545$ MHz ±0.02%

2. Crystal oscillator accuracy directly affects these times.

LCD DISPLAY FORMAT

A. Normal Dialing



Blinking

Off hook (or press "$\overline{\text{HFI}}$" switch) (Here tone mode was selected).

Dial "0123456789"

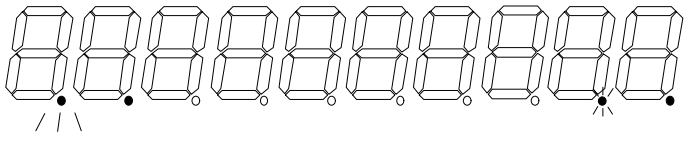
and "56".

Note: In tone mode the tone mark (the dot of digit_9) will be lit.

B. Redialing, Save Dialing, One Touch Dialing

Press the "R/P" or "R" or "SAVE" or "Mn" key. (Redial or SAVE or Mn = "1234567")

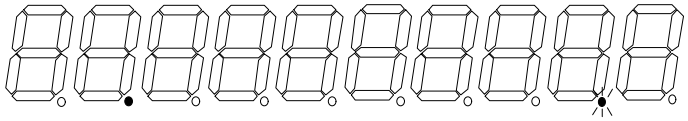
C. Mercury Dialing



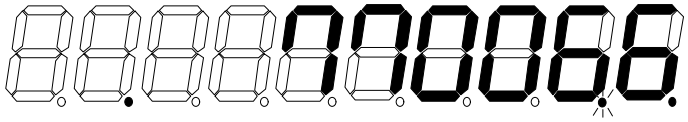
Blinking

Press the "MER" key, the mercury mark (the dot of digit_10) will be blinking.

D. Abbreviated Auto Dialing



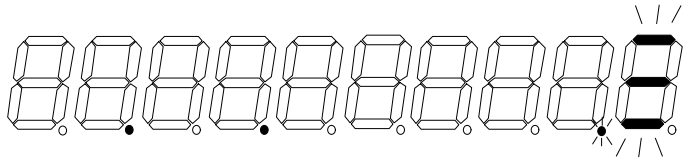
Press the "A" key (L5 = "770066") in handset mode.



Press the "5" key.

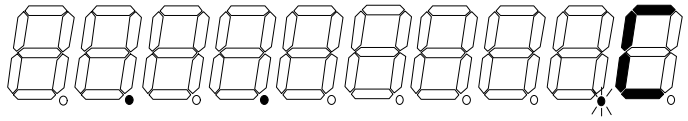
E. Memory Check

a.

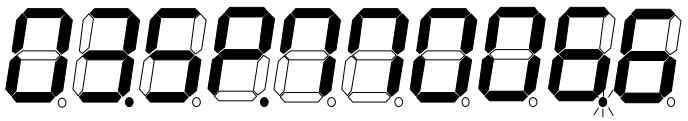


Blinking

Off hook or press the "$\overline{\text{HFI}}$" switch (In which case the handfree mode is selected, and M3 = "035P770066").



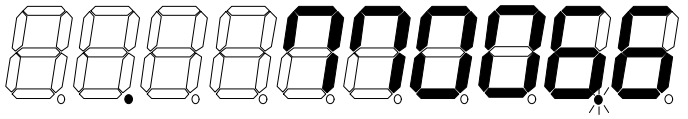
Press the "CHK" key.



Press the "M3" key.

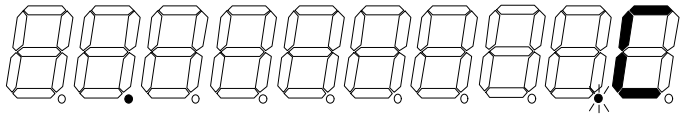
Note: In handfree mode the handfree mark (the dot of digit_7) will be lit.

b.



Redial content

Off hook (or press "$\overline{\text{HFI}}$" switch) press "R/P" or "R".
(M1 = "1234567890123456")



Press the "CHK" key.

Continued

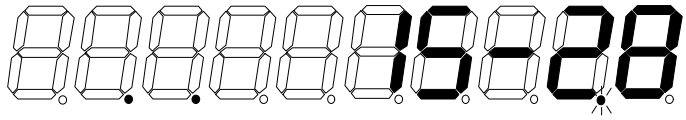
Blinking

"M1" key.
(Display 1–10 digits)

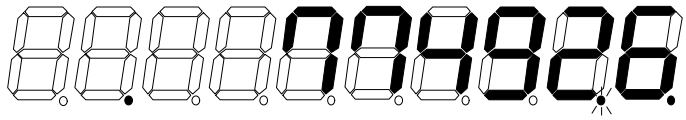
"Any key" except "F1", "F2" and "F3" keys.
(Display 11–16 digits)

F. Timer Function

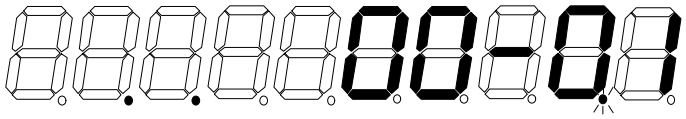
a.



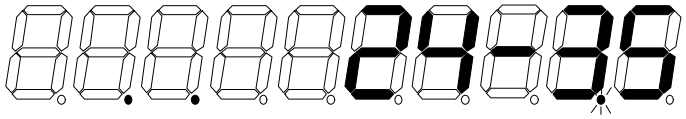
Off hook (or press "$\overline{\text{HFI}}$" switch), then press the "TIM" key.
(Display last calling time)



"774926"

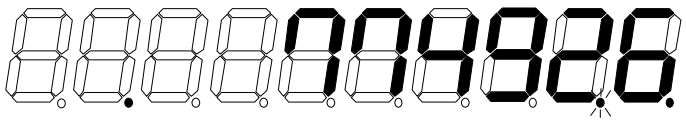


After dialing "774926", press the "TIM" key.
(Timer will start counting up)



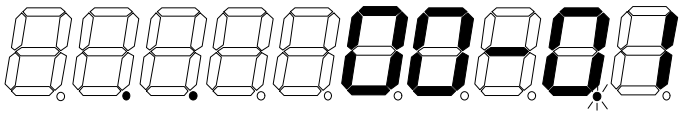
Press the "TIM" key (Timer will stop)

b.

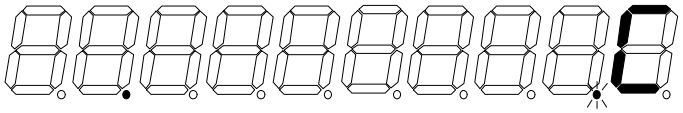


Off hook (or press the "$\overline{\text{HFI}}$" key) dial "774926"

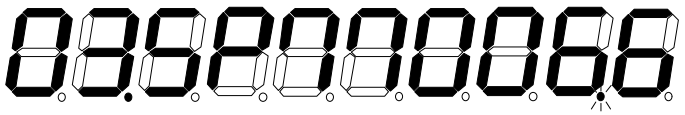
Continued



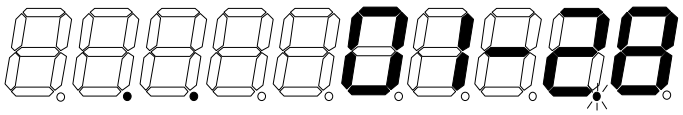
After dialing "774926" press the "TIM" key.
(Timer will start counting up)



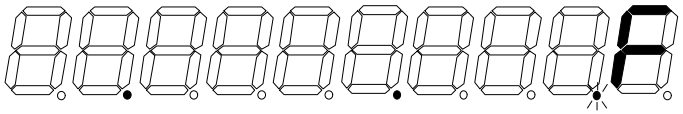
Press the "CHK" key.
(M3 = "035P770066")



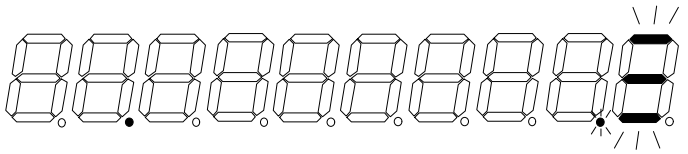
Press the "M3" key.



The system will return to timer mode after 6 seconds.
(Timer counts up continuously)



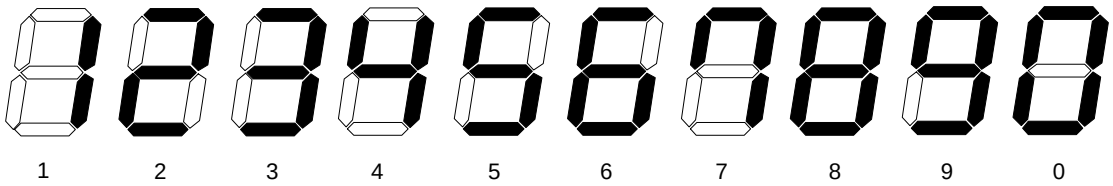
Press the "F1", "F2" or "F3" key.

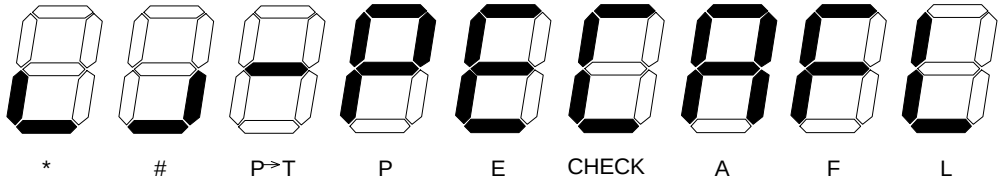


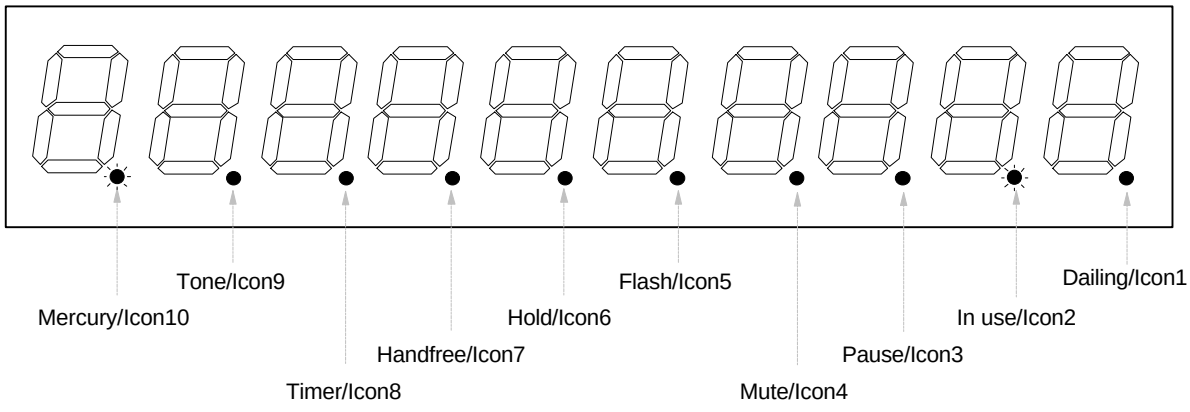
Blinking

If the flash function is selected, the timer will stop and the LCD will display a blinking cursor.

LCD PATTERN FOR DATA



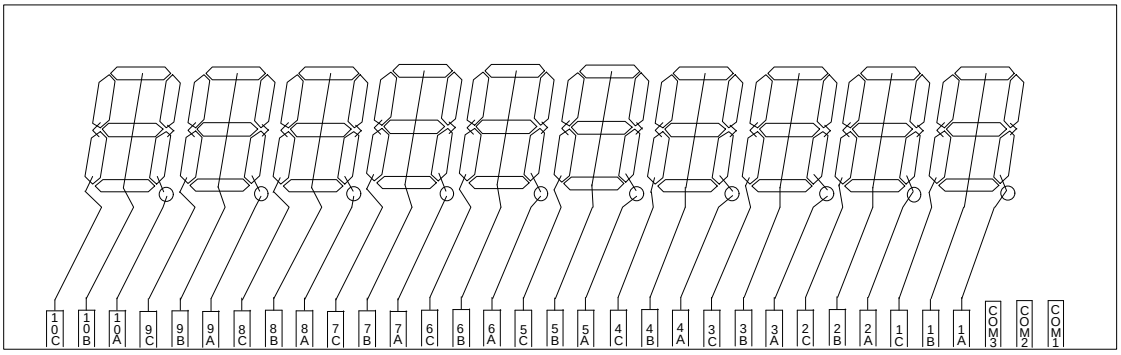




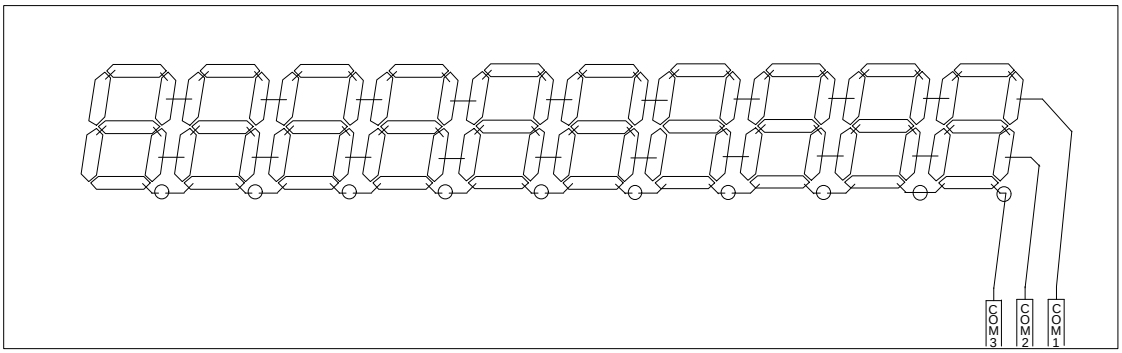
Notes:

1. The icon1 to icon10 are controlled by function operation.
2. The "In use/Icon2" always blinks after power on.

LCD PANEL PATTERN



(SEG)



(COM)

TIMING WAVEFORMS

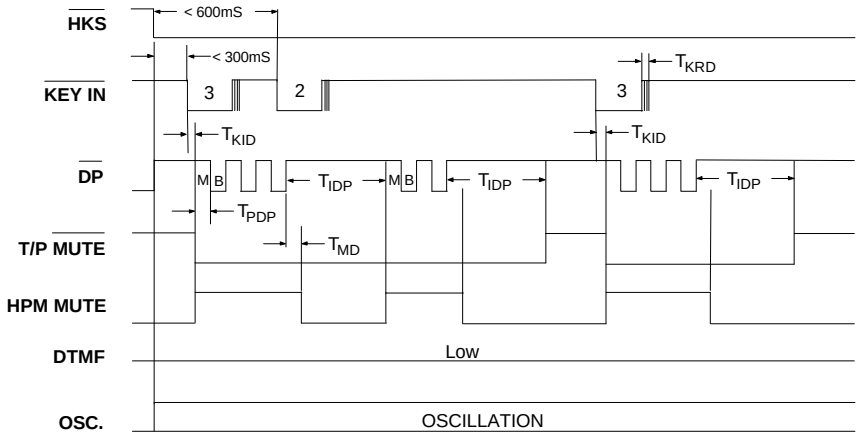


Figure 1(a). Normal Dialing Timing Diagram (Pulse Mode without Lock Function)

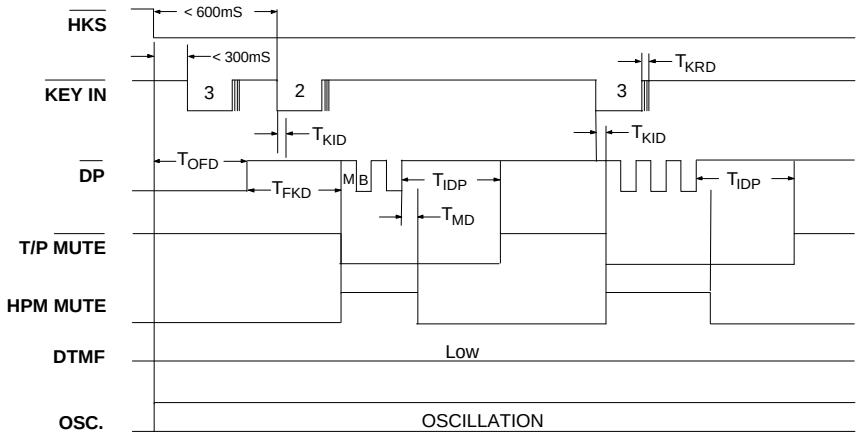


Figure 1(b). Normal Dialing Timing Diagram (Pulse Mode with Lock Function)

Timing Waveforms, continued

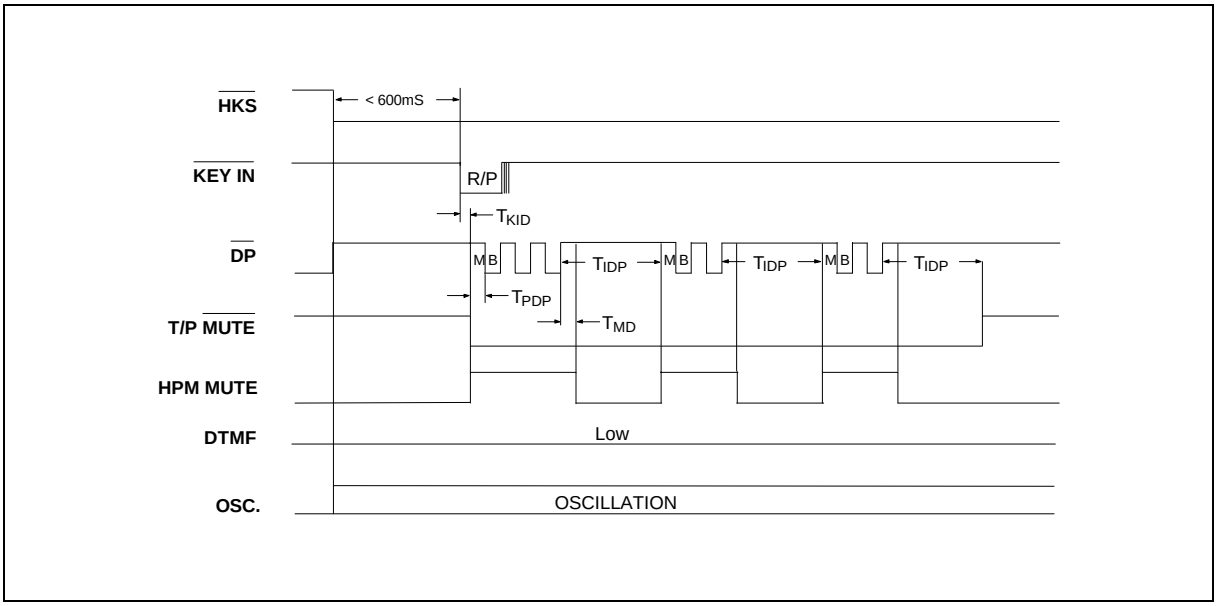


Figure 1(c). Auto Dialing Timing Diagram (Pulse Mode without Lock Function)

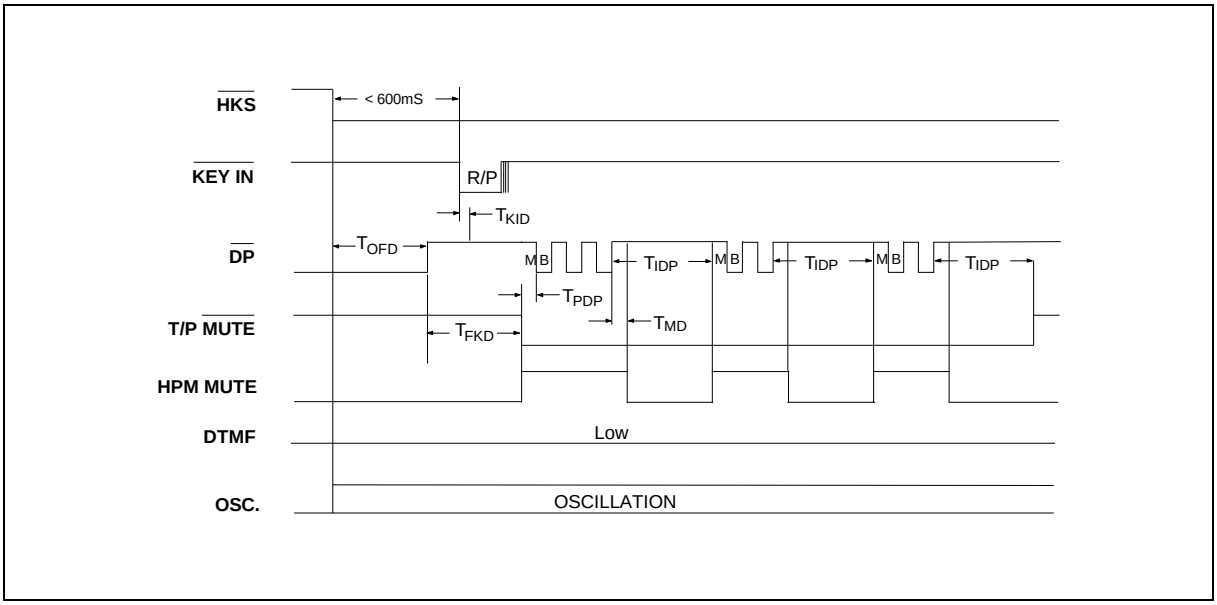


Figure 1(d). Auto Dialing Timing Diagram (Pulse Mode with Lock Function)

Timing Waveforms, continued

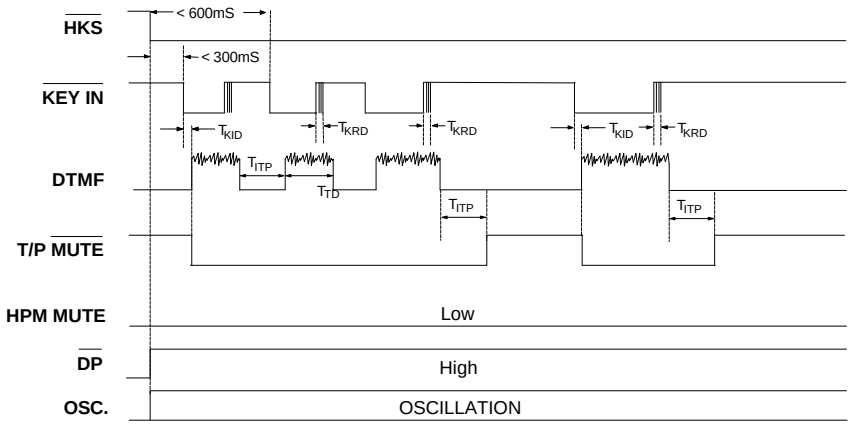


Figure 2(a). Normal Dialing Timing Diagram (Tone Mode without Lock Function)

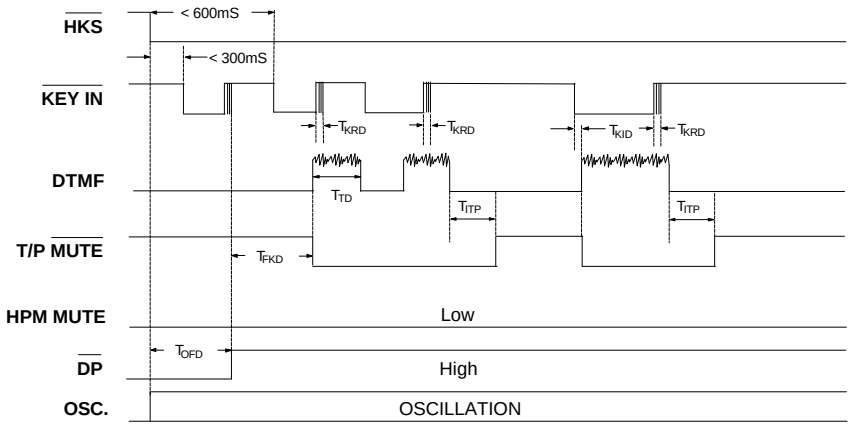


Figure 2(b). Normal Dialing Timing Diagram (Tone Mode with Lock Function)

Timing Waveforms, continued

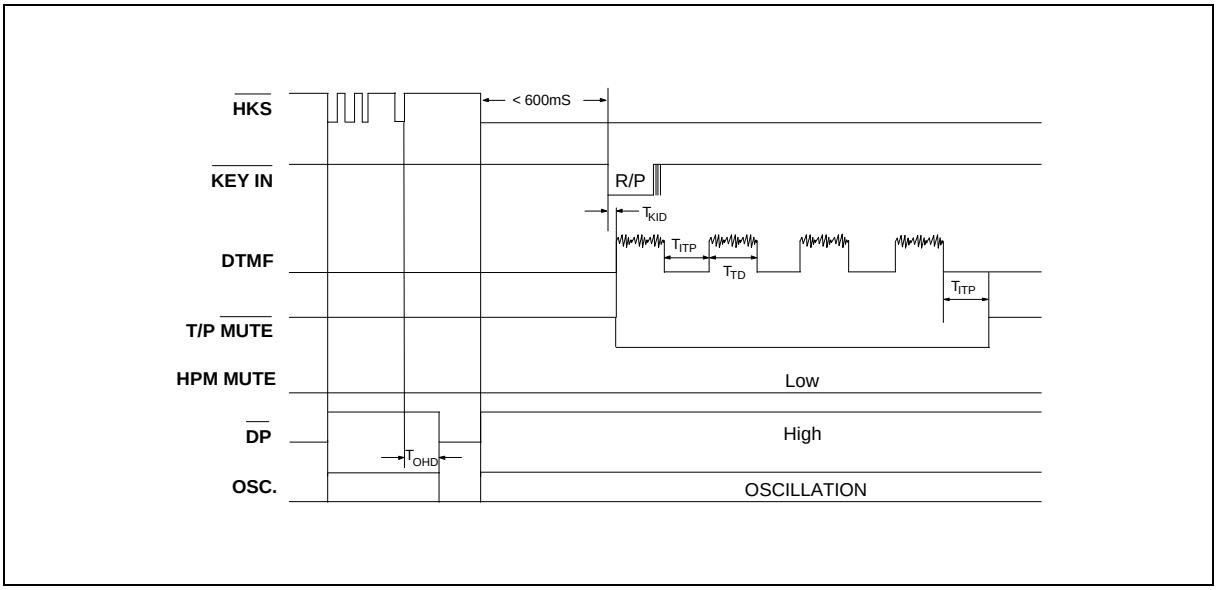


Figure 2(c). Auto Dialing Timing Diagram (Tone Mode without Lock Function)

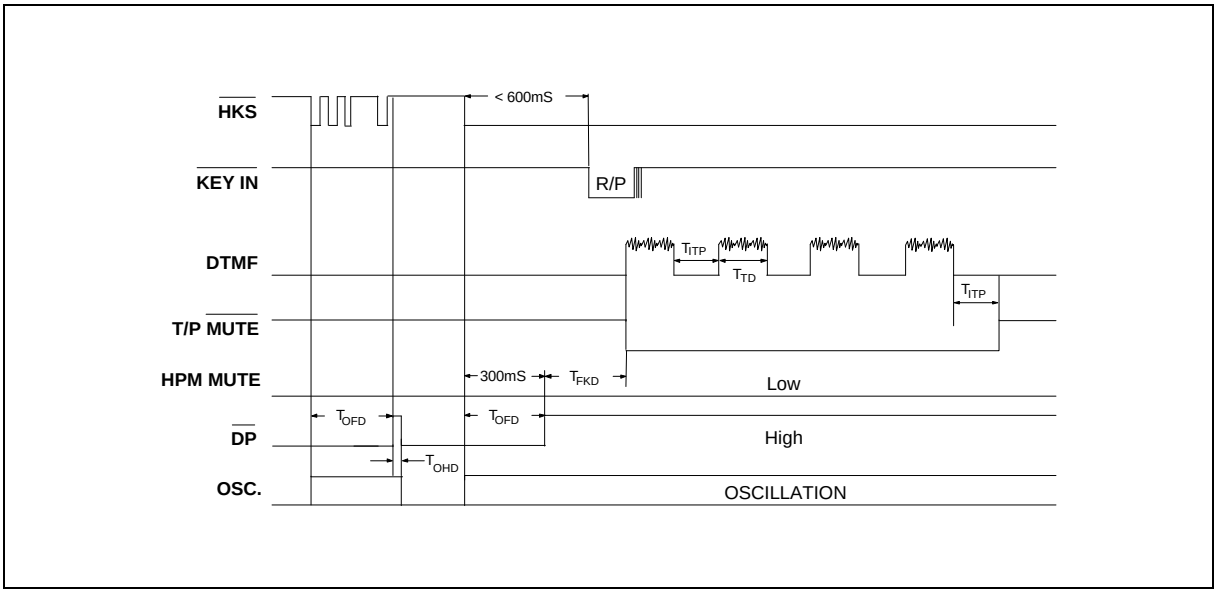


Figure 2(d). Auto Dialing Timing Diagram (Tone Mode with Lock Function)

Timing Waveforms, continued

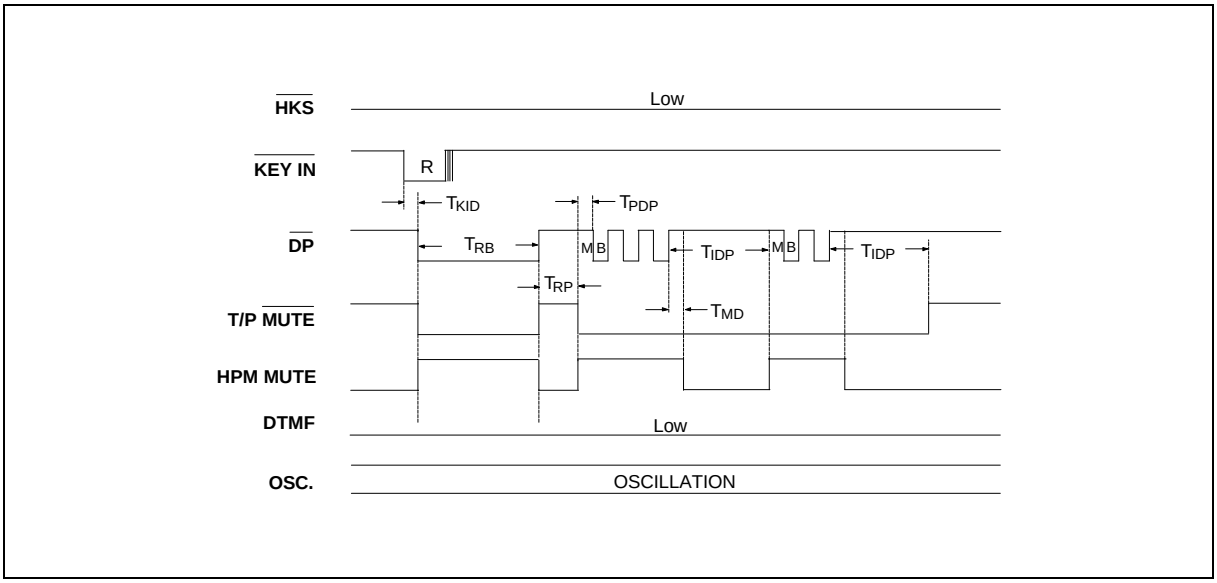


Figure 3. One-key Redial Timing Diagram

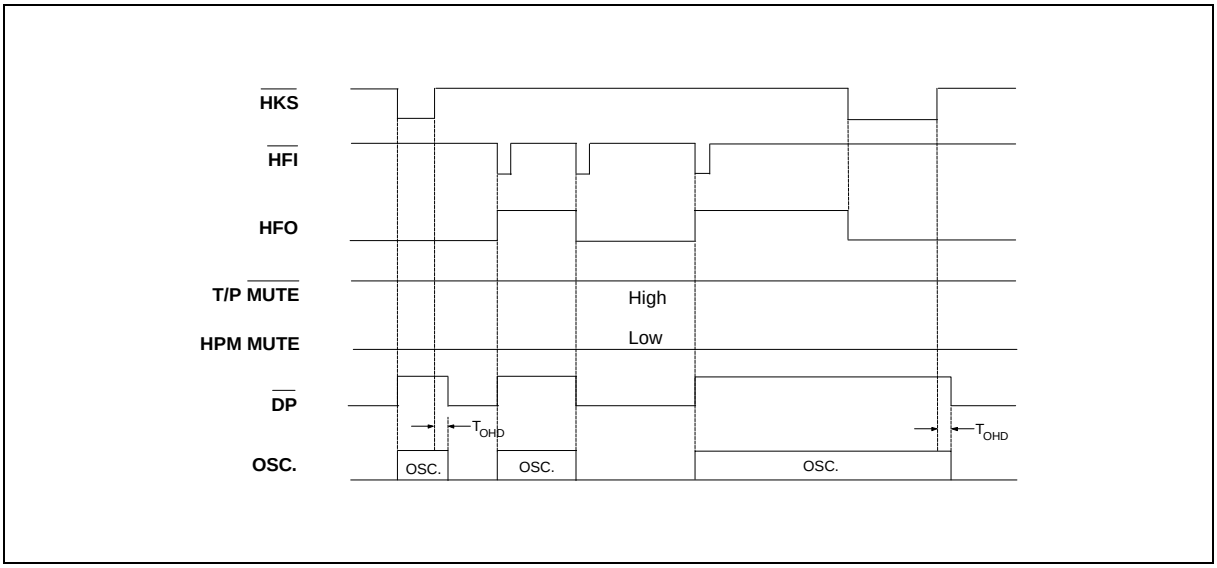


Figure 4. Handfree Timing Diagram

Timing Waveforms, continued

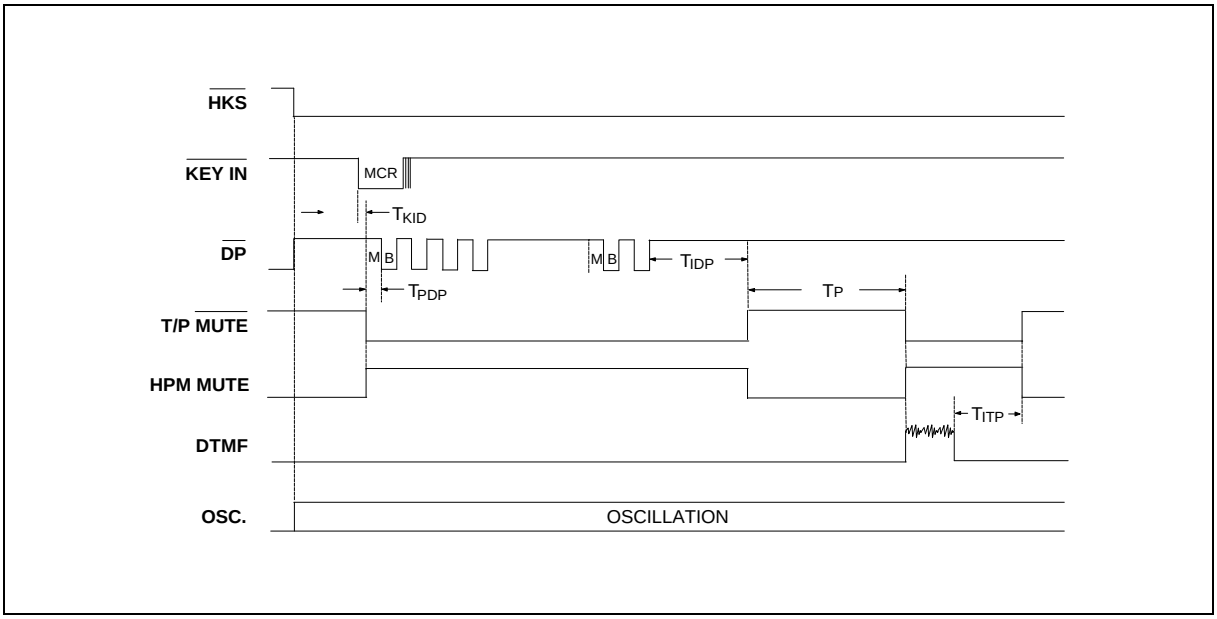


Figure 5. Mercury Function Timing Diagram

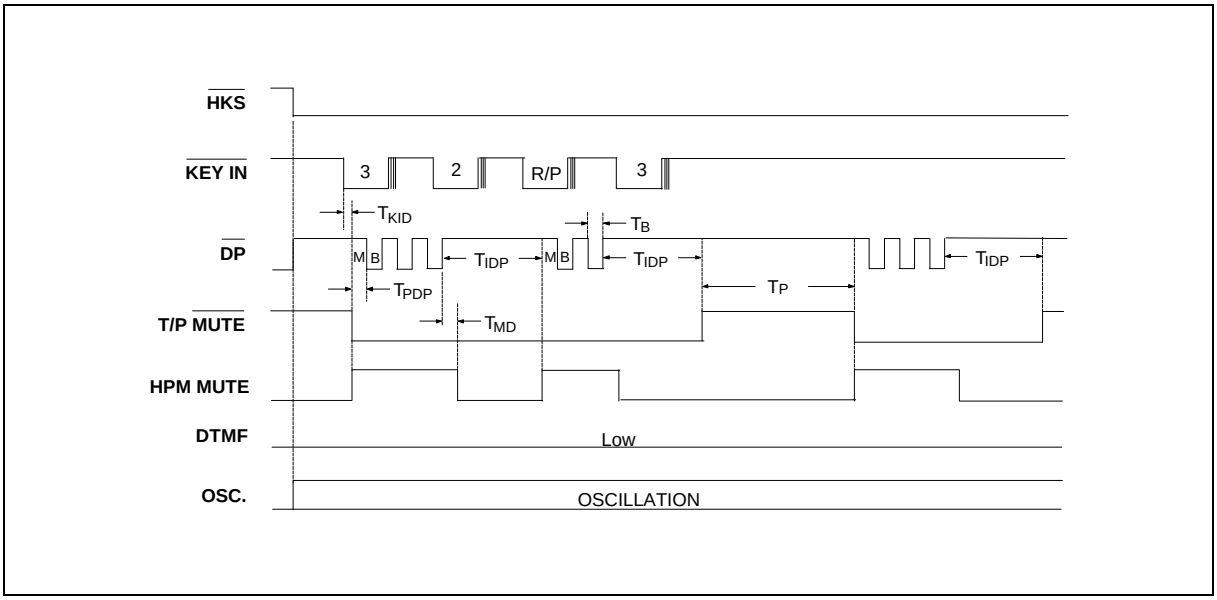


Figure 6. Pause Function Timing Diagram (Pulse Mode)

Timing Waveforms, continued

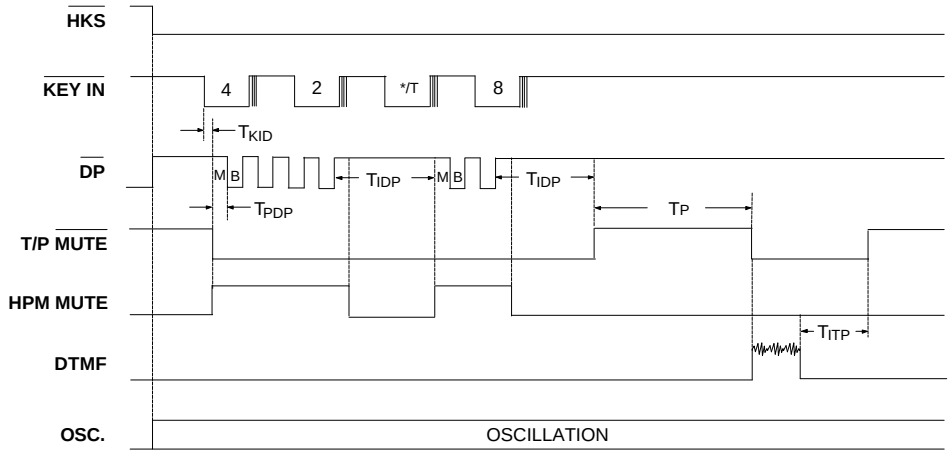


Figure 7. Pulse-to-tone Timing Diagram

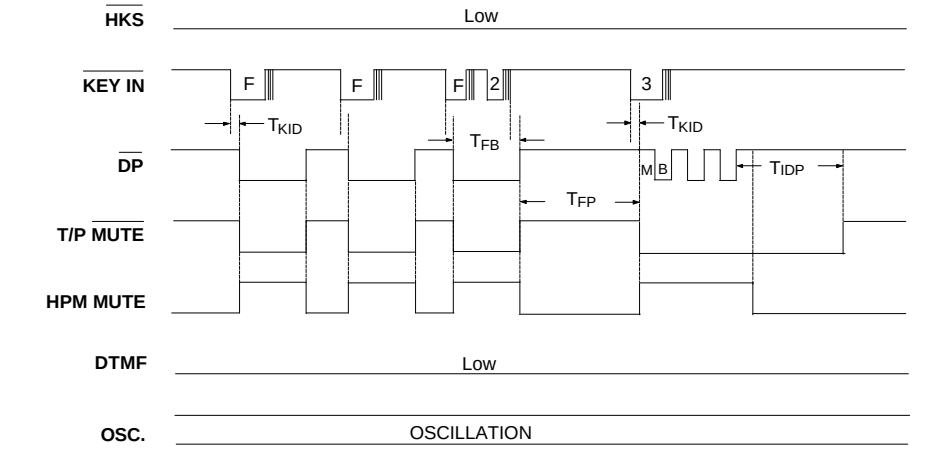


Figure 8. First Priority Flash Timing Diagram

Timing Waveforms, continued

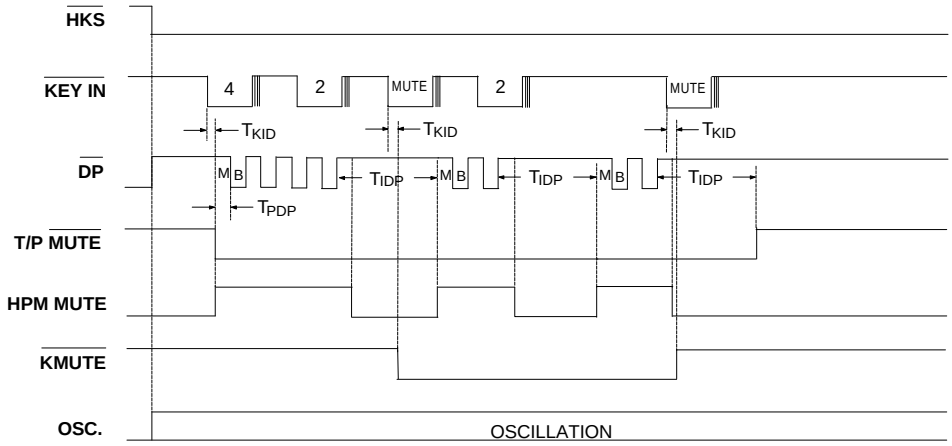


Figure 9. Mute Timing Diagram

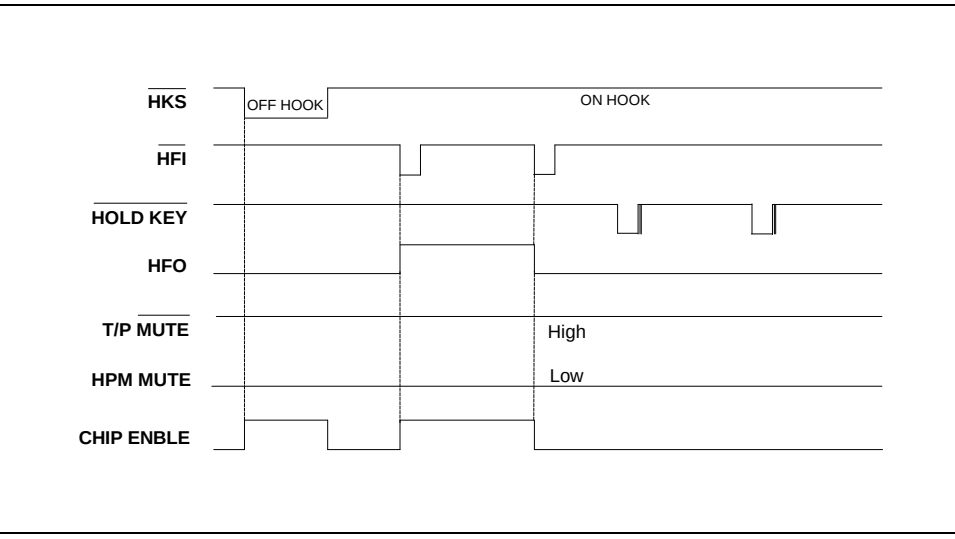


Figure 10(a). Hold Timing Diagram

Note: The $\overline{\text{HOLD KEY}}$ cannot be enabled when the chip is disabled.

Timing Waveforms, continued

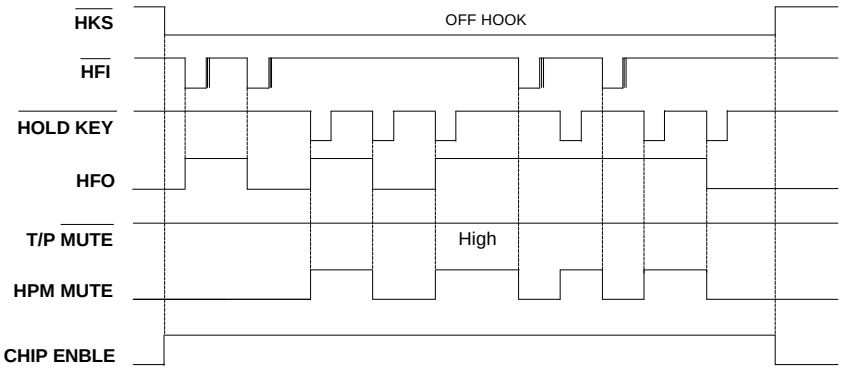


Figure 10(b). Hold Timing Diagram

Note: The $\overline{\text{HFI}}$ and HOLD KEY inputs will toggle the HFO signal; as soon as either $\overline{\text{HFI}}$ or HOLD KEY is activated, the HFO signal will go high and previous activated inputs will be ignored.

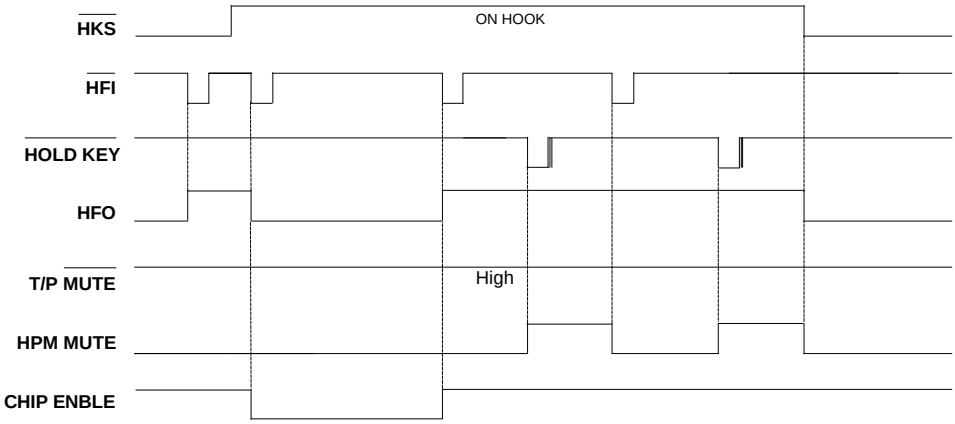


Figure 10(c). Hold Timing Diagram

Note: Changing the state of the $\overline{\text{HKS}}$ signal from high to low will initialize the HFO and HPM MUTE signals.

Timing Waveforms, continued

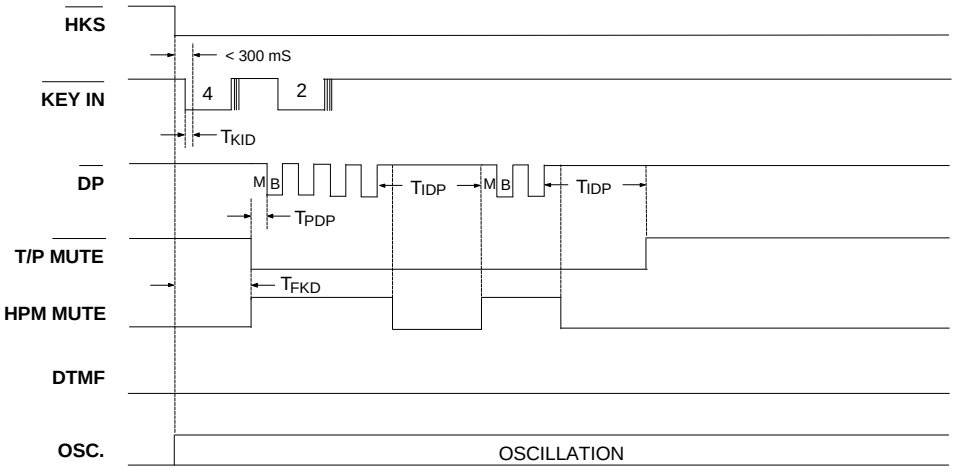


Figure 11. First Key-in Delay Timing Diagram

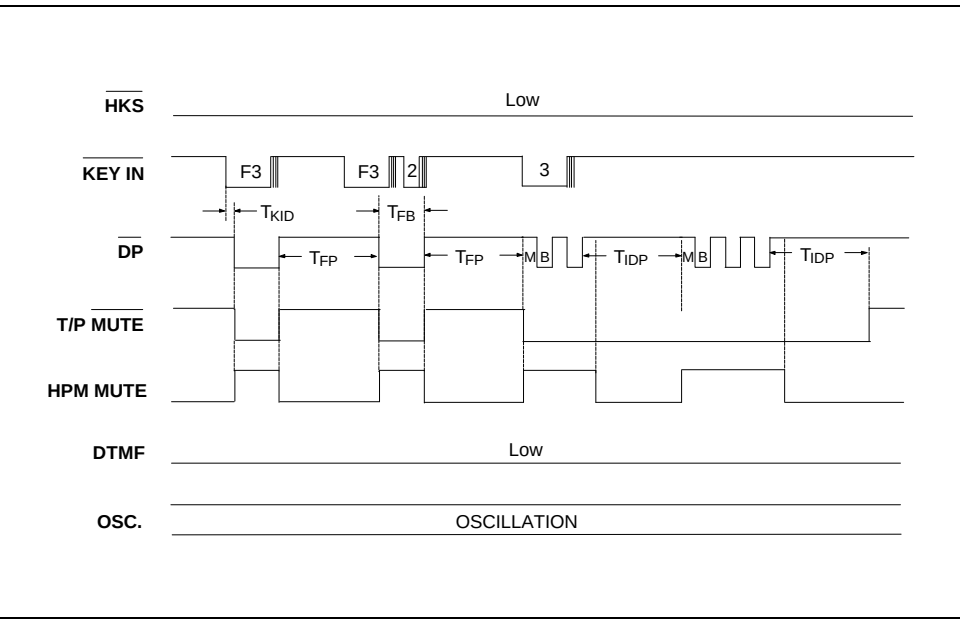
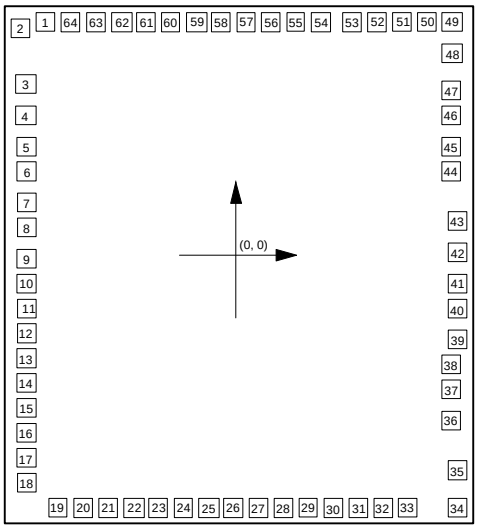


Figure 12. Flash Timing Diagram for the F3 Key of W91550DN-1

BONDING PAD DIAGRAM



Notes:

1. The substrate must be connected to Vss.
2. The chip size is 3010.00 × 3060.00 μm^2

Unit: μm

PAD NO.	PAD NAME	X	Y	PAD NO.	PAD NAME	X	Y
1	$\overline{\text{KMUTE}}$	-1234.60	1369.20	17	5C	-1359.60	-1127.00
2	COM3	-1374.60	1322.70	18	6A	-1359.60	-1281.50
3	1A	-1359.60	1052.80	19	6B	-1117.60	-1384.60
4	1B	-1359.60	905.20	20	6C	-970.00	-1384.60
5	1C	-1359.60	741.40	21	7A	-811.00	-1384.60
6	2A	-1359.60	593.80	22	7B	-658.60	-1384.60
7	2B	-1359.60	430.00	23	7C	-494.80	-1384.60
8	2C	-1359.60	282.40	24	8A	-342.40	-1384.60
9	3A	-1359.60	118.60	25	8B	-183.40	-1384.60
10	3B	-1359.60	-29.00	26	S/$\overline{\text{M}}$	-28.90	-1384.60
11	3C	-1359.60	-192.80	27	8C	128. 00	-1384.60
12	4A	-1359.60	-340.40	28	9A	280.40	-1384.60
13	4B	-1359.60	-504.20	29	9B	439.40	-1384.60
14	4C	-1359.60	-651.80	30	9C	587.00	-1384.60
15	5A	-1359.60	-810.80	31	10A	746.00	-1384.60
16	5B	-1359.60	-963.20	32	10B	898.40	-1384.60

Continued

PAD NO.	PAD NAME	X	Y	PAD NO.	PAD NAME	X	Y
33	10C	1062.20	-1384.60	49	C6	1333.60	1338.10
34	VSS	1346.40	-1375.50	50	R1	1034.10	1337.60
35	DTMF	1350.30	-1127.00	51	R2	878.10	1337.60
36	B/M	1333.80	-819.50	52	R3	705.10	1337.60
37	$\overline{\text{TEST}}$	1328.80	-659.90	53	R4	549.10	1337.60
38	VDD	1328.70	-519.90	54	XT	363.00	1344.00
39	HPM MUTE	1340.90	-373.60	55	$\overline{\text{XT}}$	217.80	1354.20
40	T/P $\overline{\text{MUTE}}$	1340.90	-215.40	56	$\overline{\text{HKS}}$	72.50	1352.90
41	ATS	1340.90	-79.30	57	$\overline{\text{HFI}}$	-67.50	1352.90
42	$\overline{\text{DP}}$	1340.90	99.70	58	HFO	-202.50	1369.20
43	MODE	1340.90	270.70	59	VLCD	-337.50	1369.20
44	C1	1333.60	524.10	60	CP	-447.50	1369.20
45	C2	1333.60	680.10	61	CN	-617.50	1369.20
46	C3	1333.60	853.10	62	COM1	-757.50	1369.20
47	C4	1333.60	1009.10	63	COM2	-908.20	1369.20
48	C5	1333.60	1182.10	64	$\overline{\text{LOCK}}$	-1052.60	1369.20

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Note: All data and specifications are subject to change without notice.