**Preliminary W91310N SERIES**

Winbond
Electronics Corp.

# TONE/PULSE DIALER WITH FLASH TIME STOREABL AND SAVE FUNCTIONS

## GENERAL DESCRIPTION

The W91310N series are monolithic Ics that provide the necessary signals for either pulse or tone dialing. The W91310N series feature a redial memory, Handsfree, auto redial function, and flash time storeable.
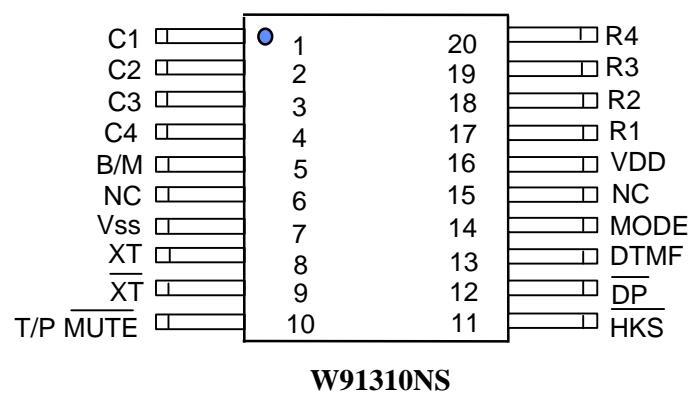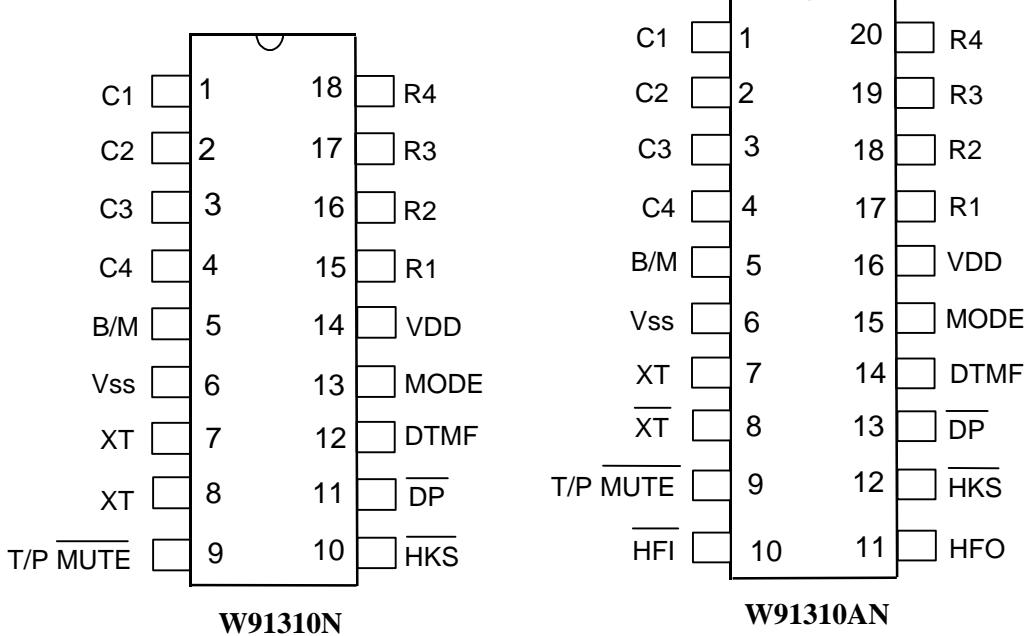
## FEATURES

- DTMF/Pulse switchable dialer

- 32 digits for redial memory

- Pulse-to-tone (P→T) keypad for long distance call operation

- Break/Make ratio is selectable by pin option

- Uses $5 \times 5$ keyboard

- Easy operation with redial, flash, pause, and P→T keypads

- Flash, pause, P→T (pulse-to-tone) can be stored as a digit in memory

- Minimum tone output duration: 93 mS

- Minimum intertone pause: 93 mS

- On-chip power-on reset

- One flash time storeable

- Uses 3.579545 MHz crystal or ceramic resonator

- Packaged in 18-pin plastic DIP, and 300 mil 20-pin SOP.

- The dialer in the W91310N series are shown in the following table:

| TYPE NO. | PULSE (ppS) | FLASH (Ms) | FLASH PAUSE (S) | PAUSE (S) |
|---|---|---|---|---|
| W91310N | 10/20 | 600/300/100/73 | 1.0 | 2.0/3.6 |
| W91310AN | 10/20 | 600/300/100/73 | 1.0 | 2.0/3.6 |

## PIN CONFIGURATIONS

| | W91310N | |
|---|---|---|
| C1 | 1 | 18 | R4 |
| C2 | 2 | 17 | R3 |
| C3 | 3 | 16 | R2 |
| C4 | 4 | 15 | R1 |
| B/M | 5 | 14 | VDD |
| Vss | 6 | 13 | MODE |
| XT | 7 | 12 | DTMF |
| XT | 8 | 11 | $\overline{DP}$ |
| T/P $\overline{MUTE}$ | 9 | 10 | $\overline{HKS}$ |

**W91310N**

| C1 | 1 | 20 | R4 |
| C2 | 2 | 19 | R3 |
| C3 | 3 | 18 | R2 |
| C4 | 4 | 17 | R1 |
| B/M | 5 | 16 | VDD |
| Vss | 6 | 15 | MODE |
| XT | 7 | 14 | DTMF |
| $\overline{XT}$ | 8 | 13 | $\overline{DP}$ |
| T/P $\overline{MUTE}$ | 9 | 12 | $\overline{HKS}$ |
| $\overline{HFI}$ | 10 | 11 | HFO |

**W91310AN**

| C1 | 1 | 20 | R4 |
| C2 | 2 | 19 | R3 |
| C3 | 3 | 18 | R2 |
| C4 | 4 | 17 | R1 |
| B/M | 5 | 16 | VDD |
| NC | 6 | 15 | NC |
| Vss | 7 | 14 | MODE |
| XT | 8 | 13 | DTMF |
| $\overline{XT}$ | 9 | 12 | $\overline{DP}$ |
| T/P $\overline{MUTE}$ | 10 | 11 | $\overline{HKS}$ |

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## PIN DESCRIPTION

| SYMBOL | PIN DIP | PIN SSOP | I/O | FUNCTION |
|---|---|---|---|---|
| Column-Row Inputs | 1−4 & 15−18 (17-20)/ (AN) | 1−4 & 17−20 | I | The keyboard input may be from either the standard 4 × 4 keyboard or an inexpensive single contact (form A) keyboard. Electronic input from a µC can also be used. A valid key entry is defined as a single row being connected to a single column. |
| XT, $\overline{XT}$ | 7, 8 | 8, 9 | I, O | A built-in inverter provides oscillation with an inexpensive 3.579545 MHz crystal or ceramic resonator. |
| T/P $\overline{MUTE}$ | 9 | 10 | 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 sequence and flash break. Otherwise, it is switched off. |
| MODE | 13 15(AN) | 14 | 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 (10 ppS). Leaving mode pin floating places the dialer in pulse mode (20 ppS). |
| $\overline{HKS}$ | 10 12(AN) | 11 | I | Hook switch input. $\overline{HKS}$ = 1: On-hook state. Chip in sleeping mode, no operation. $\overline{HKS}$ = 0: Off-hook state. Chip enabled for normal operation. The $\overline{HKS}$ pin is pulled to $V_{DD}$ by an internal resistor. |
| $\overline{DP}$ | 11 13(AN) | 12 | O | N-channel open drain dialing pulse output (Figure 1). Flash key will cause $\overline{DP}$ to go active in both pulse mode and tone mode. |
| DTMF | 12 14(AN) | 13 | O | In pulse mode, remains in low state at all times. In tone mode, outputs a dual or single tone. Detailed timing diagram for tone mode is shown in Figure 2(a, b). |
| $V_{DD}$, $V_{SS}$ | 14, 6 16, 6 (AN) | 16, -7 | I | Power input pins. |
| B/M | 5 | 5 | I | The break make ratio is 60:40 if B/M = 1 and is 66.6:33.3 if B/M = 0. This pin has no function in DTMF mode. |

**OUTPUT FREQUENCY** (within DTMF row)

| | Specified | Actual | Error % |
|---|---|---|---|
| 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 |

Pin Description, continued

| SYMBOL | PIN DIP | PIN SSOP | I/O | FUNCTION |
|--------|---------|----------|-----|----------|
| $\overline{HFI}$, HFO | 11, 12 (AN Only) | - | I, O | Handfree control pins.<br><br>A low pulse on the $\overline{HFI}$ input pin toggles the handfree control state. The status of the handfree control state is listed in the following table: |

| CURRENT STATE | | NEXT STATE | | |
|---------------|-----|-----|-----|--------|
| HOOK SW. | HFO | INPUT | HFO | DIALING |
| - | Low | $\overline{HFI}$ ⌐ | High | Yes |
| On Hook | High | $\overline{HFI}$ ⌐ | Low | No |
| Off Hook | High | $\overline{HFI}$ ⌐ | Low | Yes |
| On Hook | - | Off Hook | Low | Yes |
| Off Hook | Low | On Hook | Low | No |
| Off Hook | High | On Hook | High | Yes |

The $\overline{HFI}$ pin is pulled to $V_{DD}$ by an internal resistor.

A detailed timing diagram is shown in Figure 3.

## BLOCK DIAGRAM
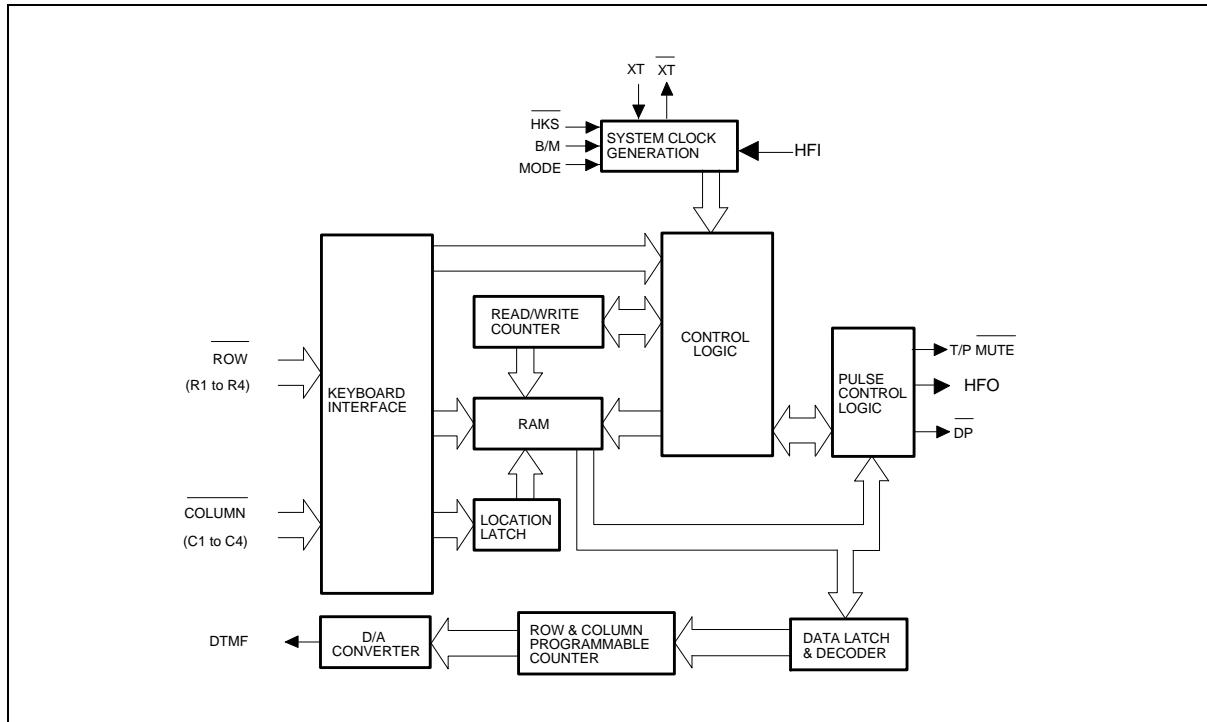
## FUNCTIONAL DESCRIPTION

### Keyboard Operation

| C1 | C2 | C3 | C4 | $\overline{DP}/\overline{C5}$ | |
|---|---|---|---|---|---|
| 1 | 2 | 3 | SAVE | MEM | R1 |
| 4 | 5 | 6 | F1 | | R2 |
| 7 | 8 | 9 | F2 | | R3 |
| */T | 0 | # | R/P1 | RD | R4 |
| R/P2 | RD | F3 | F4 | | $V_{DD}$ |

- R/P: Redial and pause function key
- */T: * in tone mode and P→T: Pulse mode to tone mode
- S: Store function
- MEM: With the same memory location as SAVE memory
- SAVE: Save function memory
- R/P1, R/P2: Redial and pause function key, P1 is 3.6 sec, and P2 is 2.0 sec.
- F1, .,.F4: Flash key
- RD: One key redial.

### Normal Dialing

| OFF HOOK | , (or | ON HOOK | & | $\overline{HFI}$ ⁱ_ᶜ | ), | 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.

### Redialing

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

Busy, come | ON HOOK | , | OFF HOOK | (or | ON HOOK | & | $\overline{HFI}$ ⁱ_ᶜ | ), | R/P |

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

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

### Save

| OFF HOOK | or | ON HOOK | , | $\overline{HFI}$ ⁱ_ᶜ | , | D1 | , | D2 | , ..., | Dn | , | SAVE | .

1. D1, D2, .., Dn will be dialed out .

2. If the sequence of the dialed digits D1, D2, …, Dn has not finished, | SAVE | will be ignored; otherwise, D1, D2, …, Dn will be duplicated to SAVE memory.

## Repertory Dialing

One-touch direct repertory dialing:

1. | OFF HOOK | (or | ON HOOK | , | HFI ī_ĉ | , | MEN | .

2. | OFF HOOK | (or | ON HOOK | , | HFI ī_ĉ | , | SAVE | .

Press | MEM | will dial out the same as pressing | SAVE | .

## Access Pause

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

1. The pause function can be stored in memory.

2. The pause function is executed in normal dialing or memory dialing.

3. The pause function timing diagram is shown in Figure 5.

## Pulse-to-tone (P®T)

| OFF HOOK | (or | ON HOOK | , | HFI ī_ĉ | ) | D1 | , | D2 | , ..., | Dn | , | P→T | , | D1' | , | D2' | , ..., | Dn' |

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

   D1, D2, ..., Dn, Pause, D1', D2', ..., Dn'

   (Pulse)          (Tone)

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

   D1, D2, ..., Dn, | P→T | D1, D2, ..., Dn,

   (Tone)       (Pause)   (Tone)

1. 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 P→T function timing diagram is shown in Figure 6.

## Flash

| OFF HOOK | , (or | ON HOOK | , | HFI ī_ĉ | ), | Fn |

1. Flash key can be stored as a digit in memory.

2. Only one flash key can be released to end user.

3. The system will return to the initial state after the break time is finished.

4. If the mode switch is set in pulse mode, after the dialing sequence D1, D2. */T, D3, Fn, D4, the dialer will keep in tone mode.

5. The flash function timing diagram is shown in Figure 7.

## Mixed Dialing

1. Definition of mixed dialing:

In mixed dialing, a new sequence may be accepted only when the previous sequence has been dialed out completely. The following are examples of mixed dialing:

Example 1: | Normal dialing | + | Repertory dialing 1 | + | Repertory dialing 2 | + ....
(1st sequence)    (2nd sequence)    (3rd sequence)

Example 2: | Repertory dialing 1 | + | Normal dialing | + | Repertory dialing 2 | + .....
(1st sequence)    (2nd sequence)    (3rd sequence)

Example 3: | Redialing | + | Normal dialing | + | Repertory dialing 1 | + .....
(1st sequence)    (2nd sequence)    (3rd sequence)

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 | (or | ON HOOK | & | HFI ĭ_ɕ | ), | RD | 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.

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## 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

($V_{DD}$-$V_{SS}$ = 2.5V, Fosc. = 3.58 MHz, $T_A$ = 25° C, all outputs unloaded)

| PARAMETER | SYM. | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Operating Voltage | $V_{DD}$ | | 2.0 | - | 5.5 | V |
| Operating Current | $I_{OP}$ | Tone, Unloaded | - | 0.4 | 0.6 | mA |
| | | Pulse, Unloaded | - | 0.2 | 0.4 | mA |
| Standby Current | $I_{SB}$ | $\overline{HKS}$ = 0, No load, & No key entry | - | - | 15 | μA |
| Memory Retention Current | $I_{MR}$ | $\overline{HKS}$ = 1, $V_{DD}$ = 1.0V | - | - | 0.2 | μA |
| DTMF Output Voltage | $V_{TO}$ | Row group, $R_L$ = 5 KΩ | 130 | 150 | 170 | mVrms |
| Pre-emphasis | | Col/Row, $V_{DD}$ = 2.0 to 5.5V | 1 | 2 | 3 | dB |
| DTMF Distortion | $T_{HD}$ | $R_L$ = 5 KΩ, $V_{DD}$ = 2.0 to 5.5V | - | -30 | -23 | dB |
| DTMF Output DC Level | $V_{TDC}$ | $R_L$ = 5 KΩ, $V_{DD}$ = 2.0 to 5.5V | 1.0 | - | 3.0 | V |
| DTMF Output Sink Current | $I_{TL}$ | $V_{TO}$ = 0.5V | 0.2 | - | - | mA |
| $\overline{DP}$ Output Sink Current | $I_{PL}$ | $V_{PO}$ = 0.5V | 0.5 | - | - | mA |
| T/P $\overline{MUTE}$ Output Sink Current | $I_{ML}$ | $V_{MO}$ = 0.5V | 0.5 | - | - | mA |
| $\overline{HKS}$ I/P Pull-high Resistor | $R_{KH}$ | | - | 300 | - | KΩ |
| HFO Drive/Sink Current | $I_{HFH}$ | $V_{HFH}$ = 2.0 V | 0.5 | - | - | mA |
| | $I_{HFL}$ | $V_{HFL}$ = 0.5 V | 0.5 | - | - | mA |

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DC Characteristics, continued

| PARAMETER | SYM. | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| 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 | | | - | - | 5.0 | KΩ |

## AC CHARACTERISTICS

| PARAMETER | SYMBOL | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Keypad Active in Debounce | $T_{KID}$ | | - | 20 | - | mS |
| Key Release Debounce | $T_{KRD}$ | | - | 20 | - | mS |
| Pre-digit Pause[1] | $T_{PDP1}$ | B/M = 1 | - | 40 | - | mS |
| | 10 ppS | B/M = 0 | - | 33.3 | - | |
| Pre-digit Pause[2] | $T_{PDP2}$ | B/M = 1 | - | 20 | - | mS |
| | 20 ppS | B/M = 0 | - | 16.7 | - | |
| Interdigit Pause (Auto dialing) | $T_{IDP}$ | 10 ppS | - | 800 | - | mS |
| | | 20 ppS | - | 500 | - | |
| Make/Break Ratio | M/B | B/M = 1 | - | 40:60 | - | % |
| | | B/M = 0 | - | 33:67 | - | |
| DTMF Output Duration | $T_{TD}$ | Auto Dialing | - | 93 | - | mS |
| Intertone Pause | $T_{ITP}$ | Auto Dialing | - | 93 | - | mS |
| Flash Break Time | $T_{FB}$ | F1 | - | 600 | - | mS |
| | | F2 | - | 100 | - | |
| | | F3 | - | 300 | - | |
| | | F4 | - | 73 | - | |
| Flash Pause Time | $T_{FP}$ | F1, F2, F3, F4 | - | 1.0 | - | S |
| One Key Redial Break Time | $T_{RB}$ | - | - | 2.2 | - | S |
| One Key Redial Pause Time | $T_{RP}$ | - | - | 0.6 | - | S |
| Pause Time | $T_P$ | R/P1 | - | 3.6 | - | S |
| | | R/P2 | - | 2.0 | - | |

Notes:

1. Crystal parameters suggested for proper operation are Rs < 100 Ω, Lm = 96 mH, Cm = 0.02 pF, Cn = 5 pF, Cl = 18 pF, $F_{OSC.}$ = 3.579545 MHz ±0.02%.

2. Crystal oscillator accuracy directly affects these times.

1. Pause Time selectable.

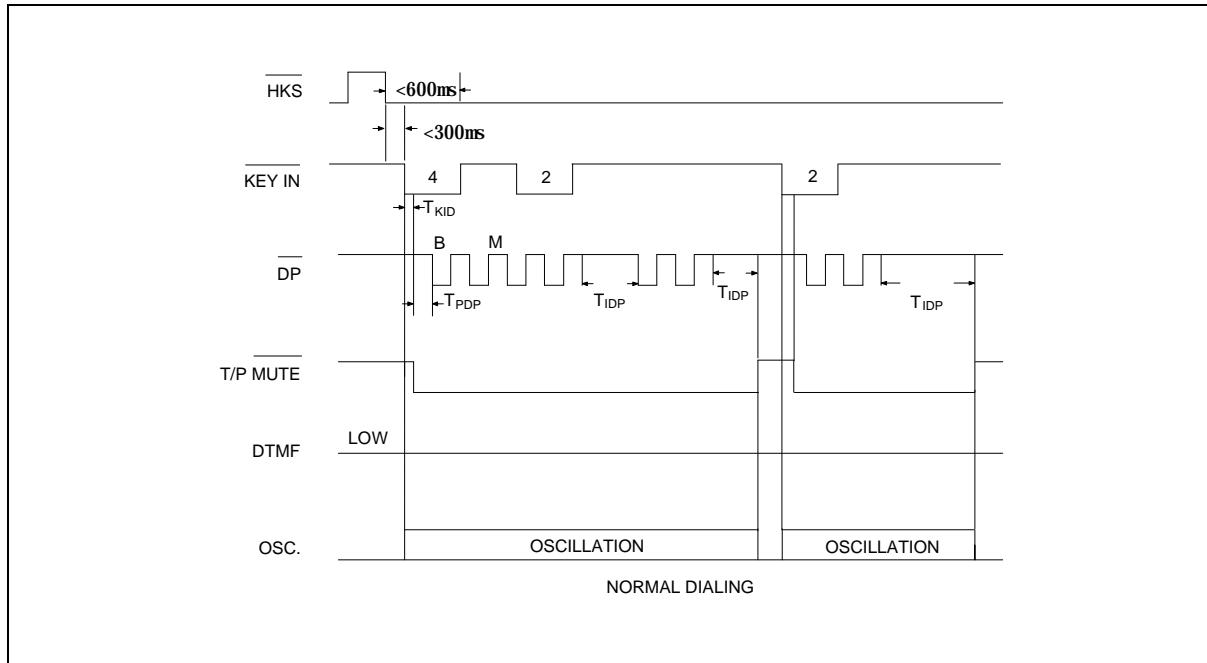2. Flash time only can be use any one in any same time.

## TIMING WAVEFORMS
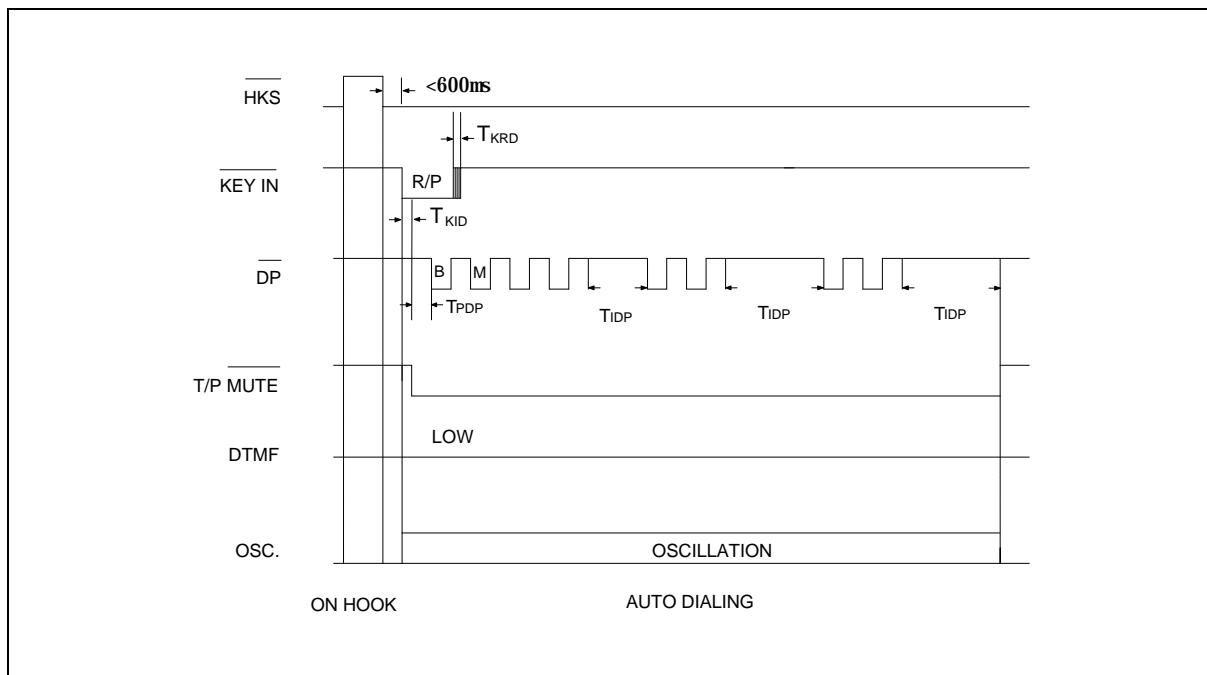


Figure 1(a). Normal Dialing Timing Diagram (Pulse Mode Timing Diagram)



Figure 1(b). Auto Dialing Timing Diagram (Pulse Mode Timing Diagram)
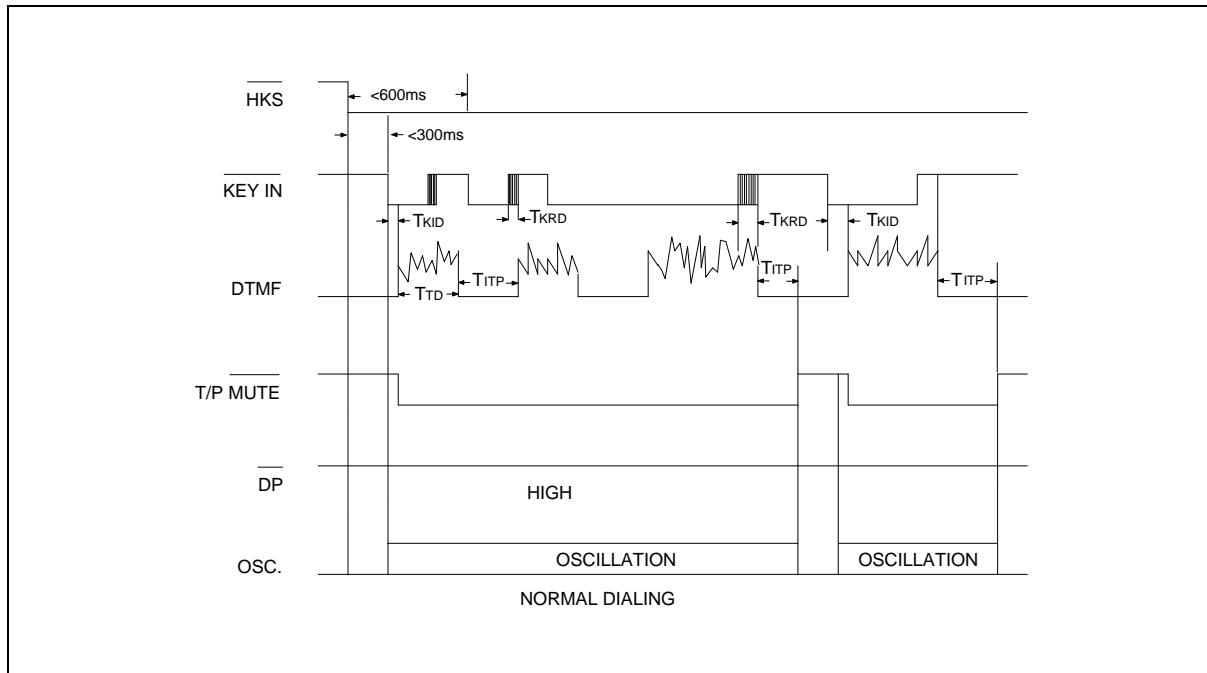
Timing Waveforms, continued
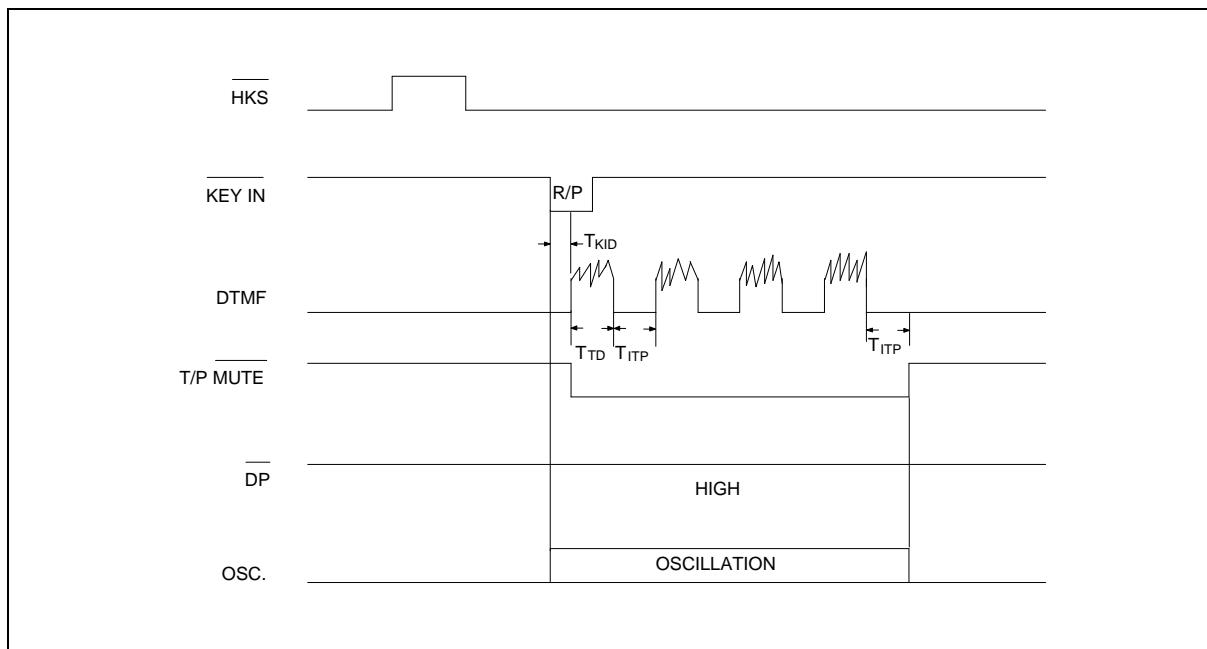


Figure 2(a). Normal Dialing Timing Diagram (Tone Mode Timing Diagram)



Figure 2(b). Auto Dialing Timing Diagram (Tone Mode Auto Dialing Timing Diagram)

Timing Waveforms, continued



Figure 3. Handfree Timing Diagram
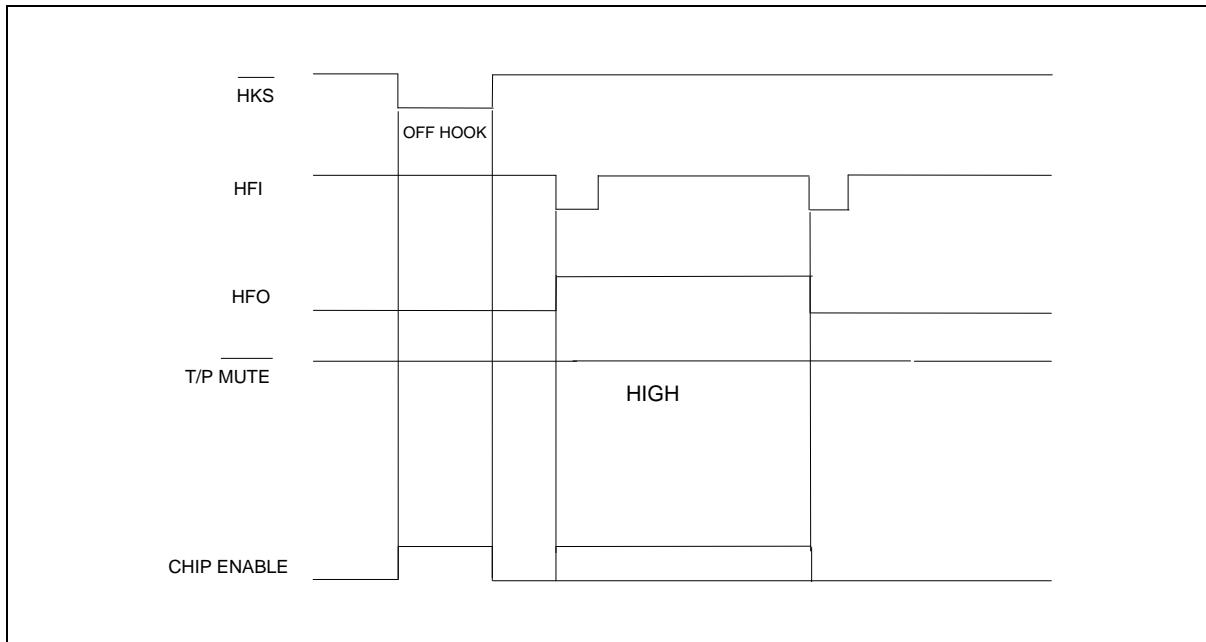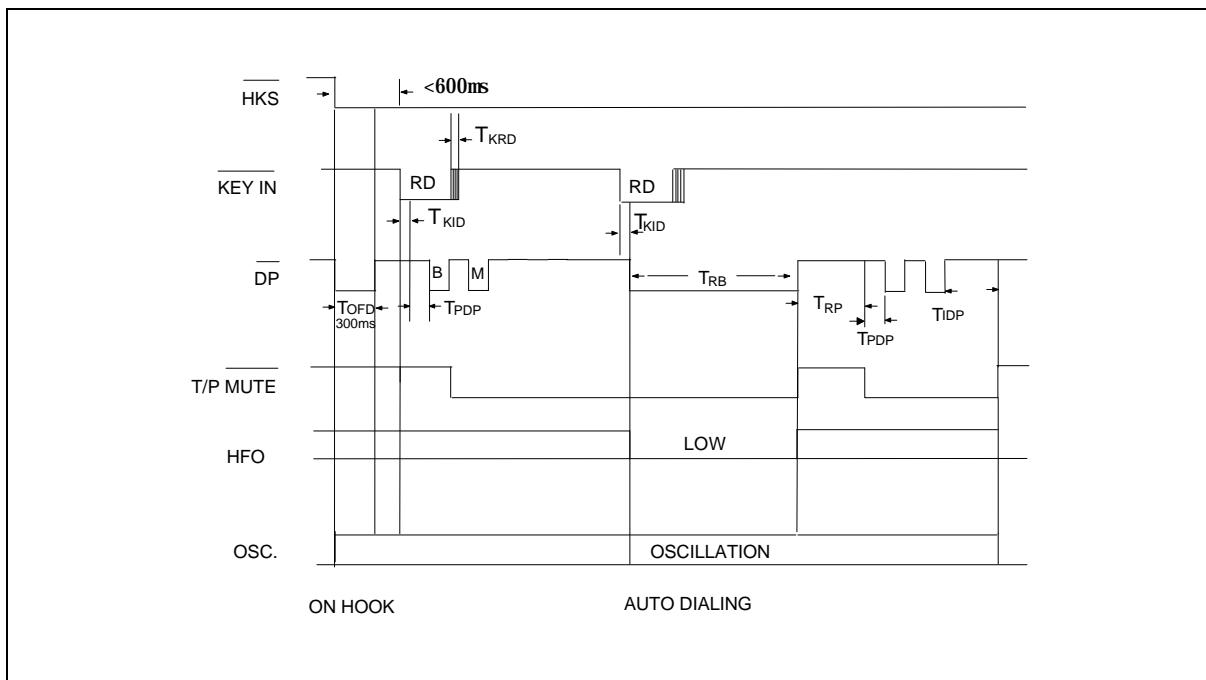


Figure 4 One –key redial Timing Diagram (Pulse mode)

Timing Waveforms, continued
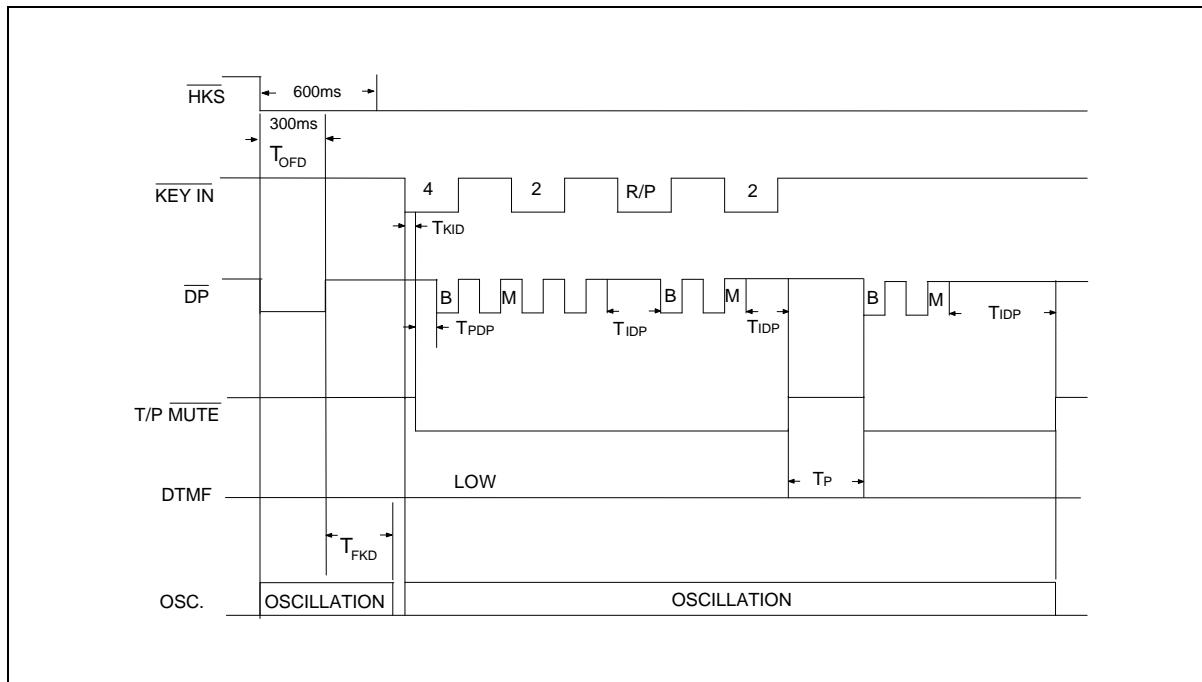


Figure 5. Pause Function Timing Diagram



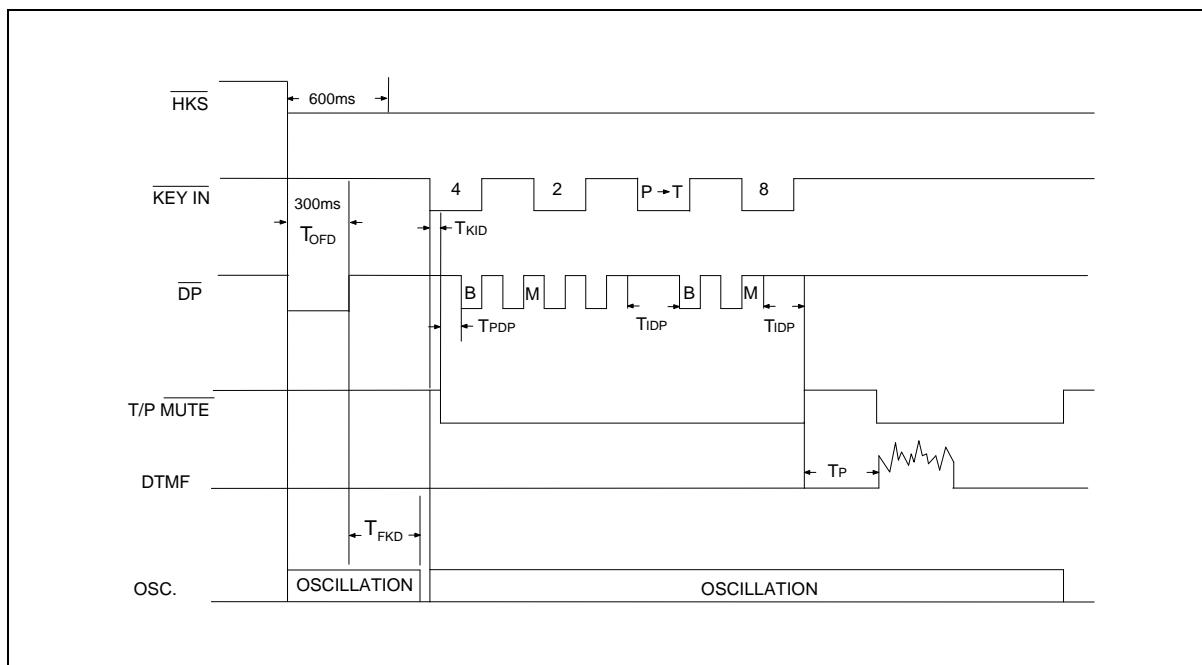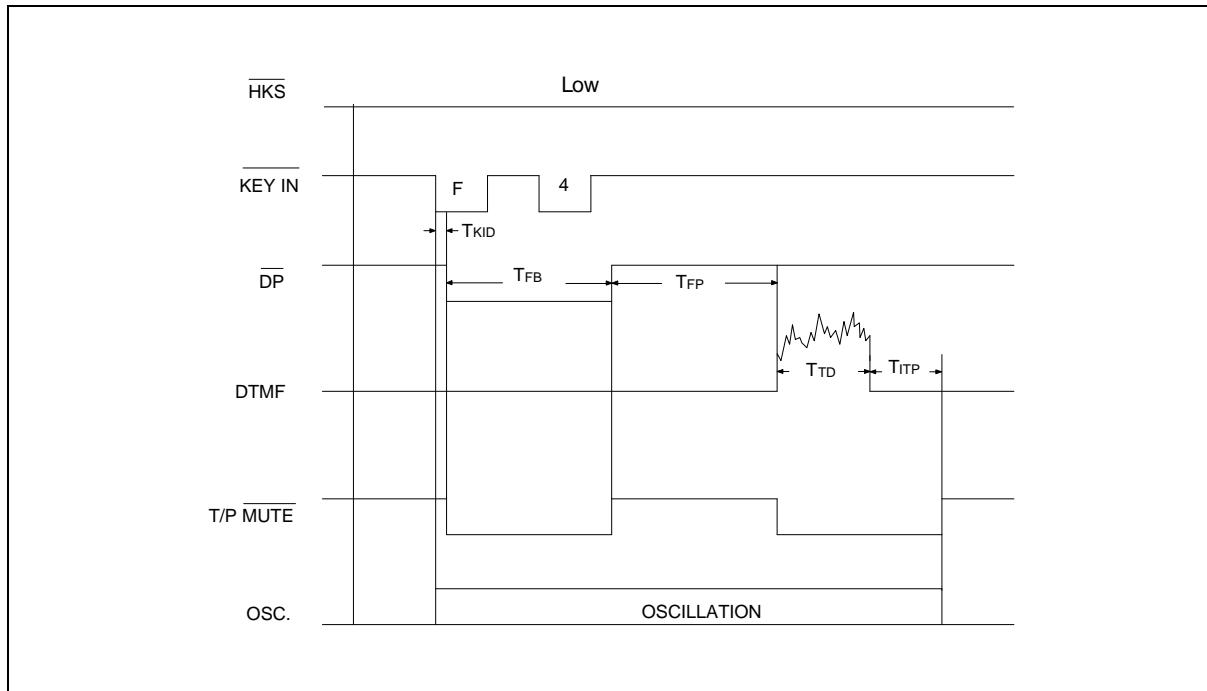Figure 6. Pulse-to-tone Function Timing Diagram

Timing Waveforms, continued



Figure 7. Flash Function Timing Diagram
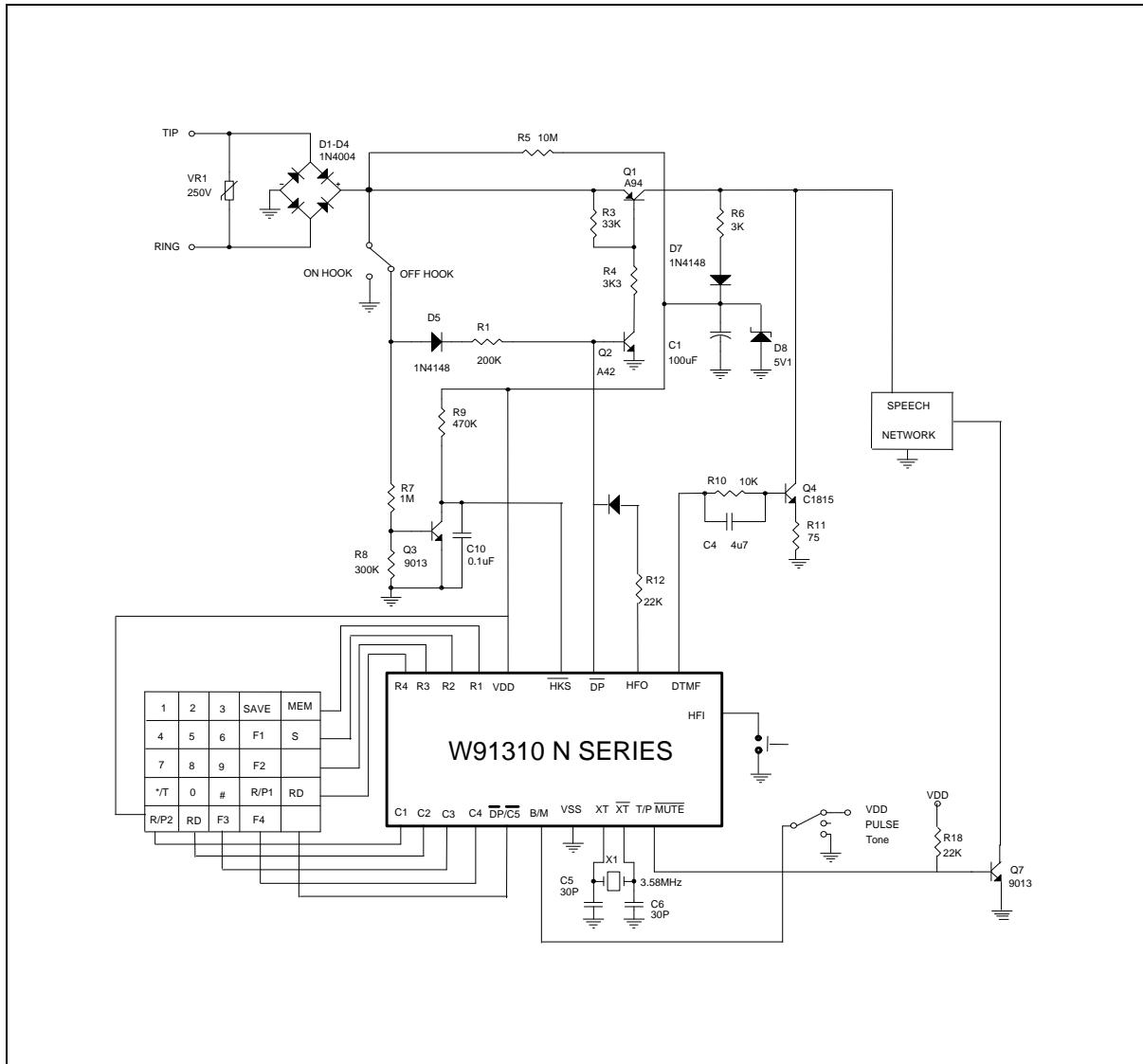
## APPLICATION CIRCUIT

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Note: All data and specifications are subject to change withou t notice.