HT93214 Series
1-memory Tone/Pulse Dialer

Patent Number: 86474, 84545(R.O.C)

Features

- Operating Voltage: 2.0V~5.5V
- Low standby current
- Low memory retention current: 0.1μA (Typ.)
- Tone/Pulse switchable
- 32 (pulse)/31 (tone) digits for redialing
- Pause and P → T key for PBX
- 4×4 keyboard matrix
- 3.58MHz crystal or ceramic resonator
- Hand-free control
- Pause, P → T can be saved for redialing
- One-key redialing
- Keytone output
- Pause time: 2.2s
- Cascadable manual dialing after redialing
- Calibrated DTMF timing for redialing
- HT93214A: 16-pin DIP package
  HT93214B/AT: 18-pin DIP package

General Description

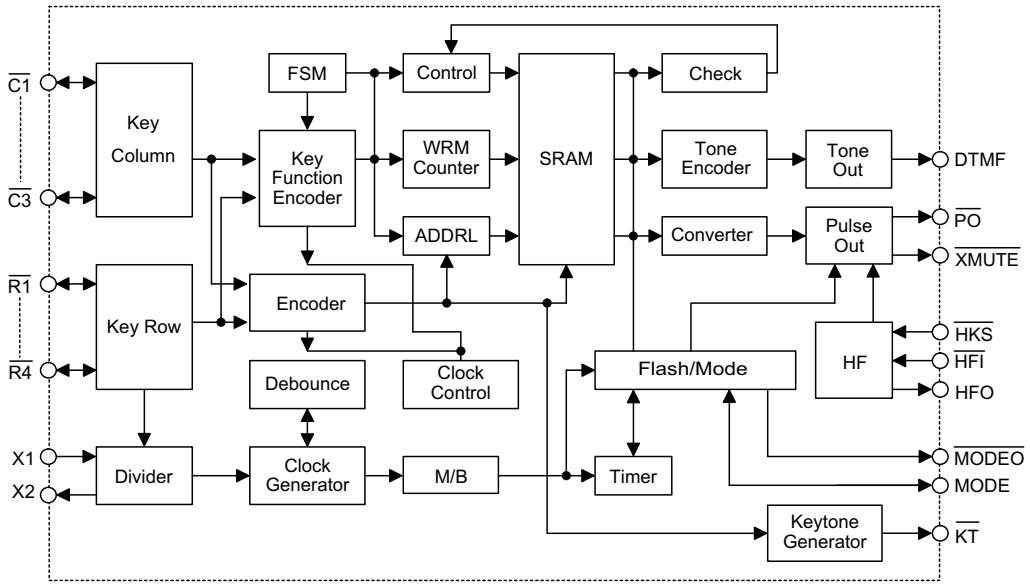
The HT93214 are dialer series designed for low cost telephone set applications with expandable features such as Lock function, keytone and LCD display interface. With a 4×4 keyboard, it performs normal tone/pulse switchable dialing, and provides one-key redialing function with a 32-digit memory for speed dialing. An on-chip oscillator is built-in to work with an external 3.58Mhz crystal or ceramic resonator for accurate timing. The HT93214 provides 300ms (F1 key) and 600ms (F2 key) of flash time; Tone dialing and 10pps, 20pps selection with 1/2 M/B ratio for pulse dialing.

Selection Table

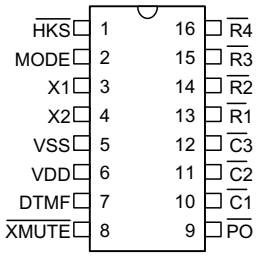
HT93214 series

Function / Part No.	Hand-Free	Key Tone	Flash	Flash Time (ms)	Pulse No.	Tone Duration (ms)	Inter Tone Pause (ms)	PPS	M/B	PKG DIP 300mil
HT93214A			Control	300/600	N	94	96	10/20	1/2	16
HT93214B	√		Control	300/600	N	94	96	10/20	1/2	18
HT93214AT		√	Control	300/600	N	94	96	10/20	1/2	18

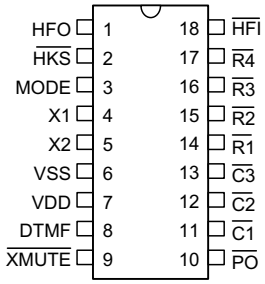
Block Diagram



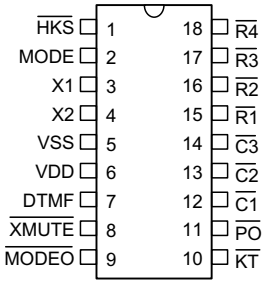
Pin Assignment



HT93214A
− 16 DIP-A

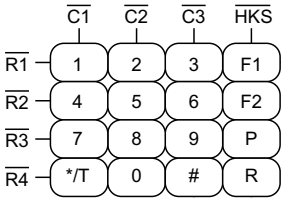


HT93214B
− 18 DIP-A



HT93214AT
− 18 DIP-A

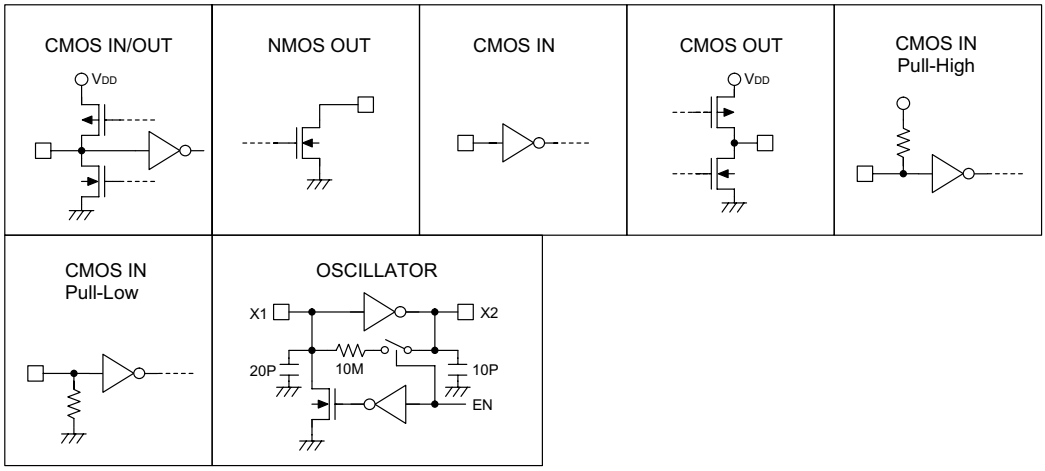
Keyboard Information



Pin Description

Pin Name	I/O	Internal Connection	Description
$\overline{C1}$~$\overline{C3}$ $\overline{R1}$~$\overline{R4}$	I/O	CMOS I/O	These pins along with the $\overline{HKS}$ form a 4×4 keyboard matrix which can perform keyboard input detection. When on-hook ($\overline{HKS}$=high) all the pins are set high. While off-hook the column group ($\overline{C1}$~$\overline{C3}$) is set low and the row group ($\overline{R1}$~$\overline{R4}$) remains high for input detection. Pressing a key connects a single row to a single column $\overline{HKS}$ and actuates the system oscillator that results in a dialing signal output. If more than two keys are pressed at the same time, no response occurs. The key-in debounce time is 20ms.
X1	I	OSC	The system oscillator consists of an inverter, a bias resistor and the necessary load capacitor on chip. Connecting a standard 3.579545MHz crystal or ceramic resonator to the X1 and X2 terminals can implement the oscillator function. The oscillator is turned off in the standby mode, and is actuated whenever a keyboard entry is detected.
X2	O		
$\overline{XMUTE}$	O	NMOS Open Drain	NMOS open drain structure pulled to VSS during dialing signal transmission. Otherwise, it is an open circuit. This pin is used to mute the speech circuit when transmitting the dial signal.
$\overline{HKS}$	I	CMOS	This pin is used to monitor the status of the hook-switch and its combination with $\overline{HFI}$ can control the $\overline{PO}$ pin output to make or break the line. $\overline{HKS}$=VDD: On-hook state ($\overline{PO}$=low). Except for $\overline{HFI}$ (hand-free control input), other functions are all disabled. $\overline{HKS}$=VSS: Off-hook state ($\overline{PO}$=high). The chip is in the stand-by mode and ready to receive the key input.
$\overline{PO}$	O	NMOS	NMOS open drain output structure, which by receiving the $\overline{HKS}$ and HFO signals, control the dialer so as to connect or disconnect the telephone line. $\overline{PO}$ is pulled to VSS when $\overline{HKS}$ is high (on-hook) and HFO is low. $\overline{PO}$ is an open circuit which make the line connection when $\overline{HKS}$ is low (off-hook) or HFO is high. During the off-hook state, this pin also outputs the dialing pulse train in pulse mode dialing. While in the tone mode, this pin is always an open circuit.
MODE	I/O	CMOS	This is a tri-state input/output pin, used for dialing mode selection, either Tone mode or Pulse mode, 10pps/20pps MODE=VDD: Pulse, 10pps, M/B=1/2 MODE=Floating: Pulse, 20pps, M/B=1/2 MODE=VSS: Tone. The MODE selection is checked each time a key input is received.
DTMF	O	CMOS	This pin is active only when the chip transmits tone dialing signals. Otherwise, it always outputs a low. The pin outputs tone signals to drive the external transmitter amplifier circuit. The load resistor (to V_{SS}) should not be less than 5kΩ and any DC load connected to V_{DD} is not allowed.
$\overline{KT}$	O	NMOS	NMOS open drain structure for keytone output. It outputs 34ms of 600Hz tone burst when any key is pressed in the pulse mode or when a function key is pressed in the tone mode.
$\overline{HFI}$	I	CMOS	Pulled-high, this pin is a Schmitt trigger input structure. Active low. Applying a negative going pulse to $\overline{HFI}$ can toggle the HFO once and hence control the hand-free function. The pull-high resistance of $\overline{HFI}$ is about 200kΩ typ. An external RC network is recommended for input debouncing.
HFO	O	CMOS	The HFO pin is a CMOS output structure. Its output is toggle- controlled by a negative transition on $\overline{HFI}$ pin. When HFO is high, the hand-free function is enabled and $\overline{PO}$ outputs a high to connect the line. The hand-free function can be released by an on-off-hook operation or by another $\overline{HFI}$ input. Refer to the functional description for the hand-free functional operation.
VDD	—	—	Positive power supply, 2.0V~5.5V for normal operation
VSS	—	—	Negative power supply, ground
$\overline{MODEO}$	O	NMOS	NMOS open drain output pin pulled to VSS during tone output and is an open circuit during pulse output.

Approximate internal connection circuits



Absolute Maximum Ratings

Supply Voltage .....–0.3V to 6V

Input Voltage.....V_{SS}–0.3V to V_{DD}+0.3V

Storage Temperature.....–50°C to 125°C

Operating Temperature.....–20°C to 75°C

Note: These are stress ratings only. Stresses exceeding the range specified under "Absolute Maximum Ratings" may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

Electrical Characteristics

F_{OSC}=3.5795MHz, Ta=25°C

Symbol	Parameter	Test Conditions			Min.	Typ.	Max.	Unit
		V_{DD}	Conditions					
V_{DD}	Operating Voltage	—	—		2	—	5.5	V
I_{DD}	Operating Current	2.5V	Pulse	Off-hook Keypad entry	—	0.2	1	mA
			Tone		—	0.6	2	mA
I_{STB}	Standby Current	1V	On-hook, no load No entry		—	—	1	μA
V_R	Memory Retention Voltage	—	—		1	—	5	V
I_R	Memory Retention Current	1V	On-hook		—	0.1	0.2	μA
V_{IL}	Input Low Voltage	—	—		V_{SS}	—	$0.2V_{DD}$	V
V_{IH}	Input High Voltage	—	—		$0.8V_{DD}$	—	V_{DD}	V
I_{XMO}	$\overline{XMUTE}$ Leakage Voltage	—	$V_{\overline{XMUTE}}$=12V No entry		—	—	1	μA
I_{OLXM}	$\overline{XMUTE}$ Sink Current	2.5V	$V_{\overline{XMUTE}}$=0.5V		1	—	—	mA
$I_{\overline{HKS}}$	$\overline{HKS}$ Pin Input Current	2.5V	$V_{\overline{HKS}}$=2.5V		—		0.1	μA
R_{HFI}	$\overline{HFI}$ Pull- High Resistance	2.5V	$V_{\overline{HFI}}$=0V		—	200	—	kΩ
I_{OH1}	Keypad Pin Source Current	2.5V	V_{OH}=0V		–4	—	–40	μA
I_{OL1}	Keypad Pin Sink Current	2.5V	V_{OL}=2.5V		200	400	—	μA
I_{OH2}	HFO Pin Source Current	2.5V	V_{OH}=2V		–1	—	—	mA
I_{OL2}	HFO Pin Sink Current	2.5V	V_{OL}=0.5V		1	—	—	mA
I_{OL3}	$\overline{MODEO}$ Sink Current	2.5V	V_{OL}=0.5V		0.6	3.5	—	mA

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V_{DD}	Conditions				
T_{FP}	Pause Time After Flash	2.5V	—	—	800	—	ms
T_{RP}	One-key Redialing Pause Time	2.5V	—	—	800	—	ms
F_{OSC}	System Frequency	—	—	—	3.58	—	MHz
T_{DB}	Key-in Debounce Time	2.5V	—	—	20	—	ms
T_{BRK}	Break Time For One-key Redialing	2.5V	—	—	2.2	—	s
T_{HKDL}	Off-hook Delay Time	2.5V	10pps	—	800	—	ms
			20pps	—	500	—	

Pulse Mode Electrical Characteristics

F_{OSC}=3.5795MHz, Ta=25°C

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V_{DD}	Conditions				
I_{POH}	$\overline{PO}$ Output Source Current	2.5V	V_{OH}=2V	–0.2	—	—	mA
I_{POL}	$\overline{PO}$ Output Sink Current	2.5V	V_{OL}=0.5V	0.2	0.6	—	mA
P_R	Pulse Rate	—	MODE pin is connected to V_{DD}	—	10	—	pps
			MODE pin is opened	—	20	—	
M/B	Make/Break Ratio	—	—	—	33:66	—	%
T_{PDP}	Pre-digit-pause Time	—	M/B=33:66 (10 pps)	—	33	—	ms
			M/B=33:66 (20 pps)	—	17	—	
T_{IDP}	Inter-digit-pause Time	—	10 pps	—	800	—	ms
			20 pps	—	500	—	
T_M	Pulse Make Duration	—	10 pps, M/B=1/2	—	33.3	—	ms
			20 pps, M/B=1/2	—	16.7	—	
T_B	Pulse Break Duration	—	10 pps, M/B=1/2	—	66.6	—	ms
			20 pps, M/B=1/2	—	33.3	—	
T_P	Pause Time	—	—	—	2.2	—	s

Tone Mode Electrical Characteristics

F_{OSC}=3.5795MHz, Ta=25°C

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V_{DD}	Conditions				
V_{TDC}	DTMF Output DC Level	—	No load	$0.45V_{DD}$	—	$0.7V_{DD}$	V
I_{TOL}	DTMF Sink Current	2.5V	V_{DTMF}=0.5V	0.1	—	—	mA
V_{TAC}	DTMF Output AC Level	—	Row group, R_L=5kΩ	0.12	0.155	0.18	Vrms
R_L	DTMF Output Load	2.5V	THD≤–23dB	5	—	—	kΩ
A_{CR}	Column Pre-emphasis	2.5V	Row group=0dB	1	2	3	dB
THD	Tone Signal Distortion	2.5V	R_L=5kΩ	—	–30	–23	dB
T_{TMIN}	Minimum Tone Duration	—	Auto-redial	—	94	—	ms
T_{ITPM}	Minimum Inter-Tone Pause	—	Auto-redial	—	96	—	ms

THD (Distortion) (dB) = 20 log ($\sqrt{V1^2 + V2^2 + ... + Vn^2}$ / $\sqrt{Vi^2 + Vh^2}$)

Vi, Vh: Row group and column group signals

V1, V2, ... Vn: Harmonic signals (BW=300Hz~3500Hz)

Functional Description

Keyboard matrix

$\overline{C1}$~$\overline{C3}$, $\overline{HKS}$ and $\overline{R1}$~$\overline{R4}$ form a keyboard matrix. Together with a standard 4×4 keyboard, the keyboard matrix is used for dialing entries. The keyboard arrangement of the HT93214 series is shown in the **Keyboard Information**.

Tone frequency

Tone Name	Output Frequency (Hz)		% Error
	Specified	Actual	
$\overline{R1}$	697	699	+0.29%
$\overline{R2}$	770	766	–0.52%
$\overline{R3}$	852	847	–0.59%
$\overline{R4}$	941	948	+0.74%
$\overline{C1}$	1209	1215	+0.50%
$\overline{C2}$	1336	1332	–0.30%
$\overline{C3}$	1477	1472	–0.34%

Note: % Error does not contain the crystal frequency drift

Dialing specification selection

- The specifications are selected by the MODE pin.

MODE	Tone/Pulse	Dial Rate	M/B Ratio
VDD	Pulse	10pps	1/2
VSS	Tone	—	—
Floating	Pulse	20pps	1/2

- The MODE pin status is checked whenever a digit key is pressed, however the M/B and pulse rate are determined at the first key entry.

Hand-free function operation

- When HFO is low, a falling edge triggers the $\overline{HFI}$, enabling the Hand-free function (HFO becomes high).
- Reset Hand-free function
  When HFO is high, the Hand-free function is enabled and can be reset by:
  - Off-hook
  - Applying a falling edge to $\overline{HFI}$
- Hand-free function 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	—	of off-hook	Low	Yes
Off-hook	Low	on-hook	Low	No
Off-hook	High	on-hook	High	Yes

Flash

Two flash keys are provided, namely F1, F2 for both series. All the flash key function as control key with different break duration. Whenever a flash key is pressed the $\overline{PO}$ pin will be forced low for a T_F duration and the transmission of the new digit key inputs will be further delayed for a T_{FP} after T_F. See the following table for flash duration selection.

Item	F1	F2
HT93214	300ms	600ms

Key definition

- 0,1,2,3,4,5,6,7,8,9 keys
  These are dialing number input keys for both the pulse mode and the tone mode operation.
- */T
  This key executes the P→T function and waits a $T_{P\rightarrow T}$ duration in the pulse mode. On the other hand, the */T key executes the * function in the tone mode. The */T key will occupy one memory digit in either tone or pulse mode.
- #
  This is a dialing signal key for the tone mode only, no response in the pulse mode.
- F1, F2
  Pressing one of the flash keys will force the $\overline{PO}$ pin to become low for the T_F duration. To transmit the dial signals of the key input that are entered after the F key, a wait period T_{FP} (sec) after $\overline{PO}$ pin returns from low is provided.
- P
  Pause key. The execution of this key pauses the output for the T_P duration (2.2s).
- R
  Redial key. It executes redialing as well as one-key redial function.

Keyboard Operation

The following operations are described under an on-off- hook or on-hook condition with the hand-free active condition.

- Normal dialing

  – Pulse mode

  (a) without */T

  Keyboard input: [D1] [D2] ... [Dn]

  Dialing output: D1 D2 ... Dn

  RM: D1 D2 ... Dn

  (b) with */T

  Keyboard input: [D1] [D2] ... [Dn] [*/T] [Dn+1] ... [Dm]

  Dialing output: D1 D2 ... Dn ($T_{P\rightarrow T}$) Dn+1 ... Dm (Pulse / Tone)

  RM: D1 D2 ... Dn */T Dn+1 ... Dm

  – Tone mode

  (a) without */T

  Keyboard input: [D1] [D2] ... [Dn]

  Dialing output: D1 D2 ... Dn

  RM: D1 D2 ... Dn

  (b) with */T

  Keyboard input: [D1] [D2] ... [Dn] [*/T] [Dn+1] ... [Dm]

  Dialing output: D1 D2 ... Dn * Dn+1 ... Dm

  RM: D1 D2 ... Dn * Dn+1 ... Dm

  Note: The maximum capacity of the RM memory is 32 digits. When more than 32 digits are entered, the signal is transmitted but the redial function is inhibited.

- Redial

  – Pulse mode

  (a) without */T

  RM content: D1 D2 ... Dn

  Keyboard input: [R]

  Dialing output: D1 D2 ... Dn

  RM: Unchanged

  (b) with */T

  RM content: D1 D2 ... Dn */T Dn+1 ... Dm

  Keyboard input: [R]

  Dialing output: D1 D2 ... Dn ($T_{P\rightarrow T}$) Dn+1 ... Dm (Pulse / Tone)

  RM: Unchanged

  – Tone mode

  (a) without */T

  RM content: D1 D2 ... Dn

  Keyboard input: [R]

  Dialing output: D1 D2 ... Dn

  RM: Unchanged

  (b) with */T

  RM content: D1 D2 ... Dn */T Dn+1 ... Dm

  Keyboard input: [R]

  Dialing output: D1 D2 ... Dn * Dn+1 ... Dm

  RM: Unchanged

- One-key redial

  – Pulse mode

  (a) without */T

  Keyboard input: [D1] [D2] ... [Dn] [R]

  Dialing output: D1 D2 ... Dn T_{BRK} T_{RP} D1 D2 ... Dn

  RM: D1 D2 ... Dn

  (b) with */T

  Keyboard input: [D1] [D2] ... [Dn] [*/T] [Dn+1] ... [Dm] [R]

  Dialing output: D1 D2 ... Dn $T_{P\rightarrow T}$ Dn+1 ... Dm
  (D1 D2 ... Dn: Pulse; Dn+1 ... Dm: Tone)
  T_{BRK} T_{RP} D1 D2 ... Dn $T_{P\rightarrow T}$ Dn+1 ... Dm
  (D1 D2 ... Dn: Pulse; Dn+1 ... Dm: Tone)

  RM: D1 D2 ... Dn */T Dn+1 ... Dm

  – Tone mode

  (a) without */T

  Keyboard input: [D1] [D2] ... [Dn] [R]

  Dialing output: D1 D2 ... Dn T_{BRK} T_{RP} D1 D2 ... Dn

  RM: D1 D2 ... Dn

  (b) with */T

  Keyboard input: [D1] [D2] ... [Dn] [*/T] [Dn+1] ... [Dm] [R]

  Dialing output: D1 D2 ... Dn * Dn+1 ... Dm T_{BRK} T_{RP} D1 D2 ... Dn * Dn+1 ... Dm

  RM: D1 D2 ... Dn * Dn+1 ... Dm

  Note: If the dialing number exceeds 32 digits, redialing is inhibited and $\overline{PO}$=open

- Flash

  – Flash as a control key

  Keyboard input: [D1] [D2] ... [Dn] [F] [Dn+1] ... [Dm]

  Dialing output: D1 D2 ... Dn T_F T_{FP} Dn+1 ... Dm

  RM: Dn+1 ... Dm

  Note: T_F: break a flash time

- Pause

  Keyboard input: [D1] [D2] ... [Dn] [P] [Dn+1] ... [Dm]

  Dialing output: D1 D2 ... Dn T_P Dn+1 ... Dm

  RM: D1 D2 ... Dn P Dn+1 ... Dm

- Note

  RM: Redial memory

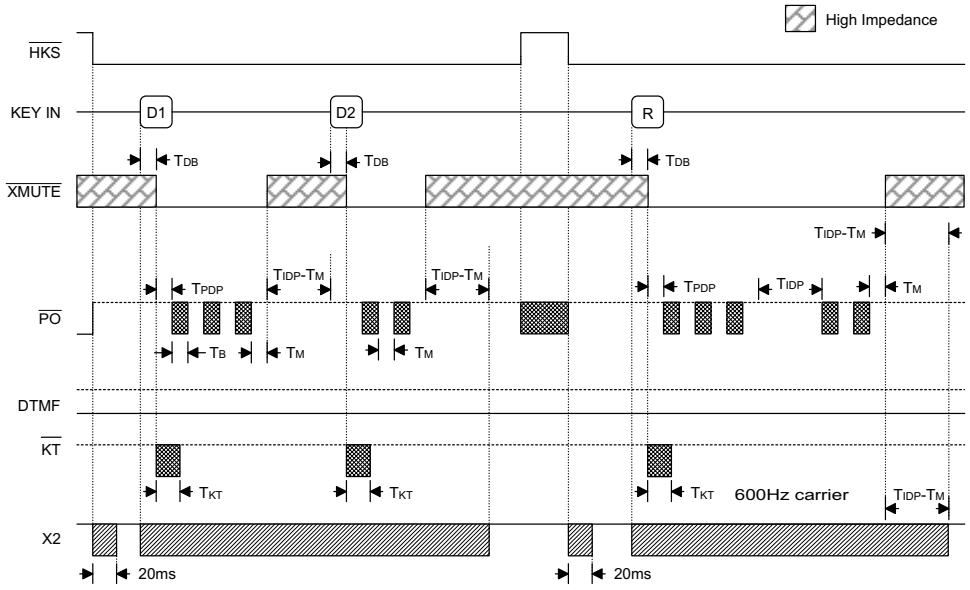
  D1 D2 ... Dn: 0~9

  Dn+1 ... Dm: 0~9, *, #

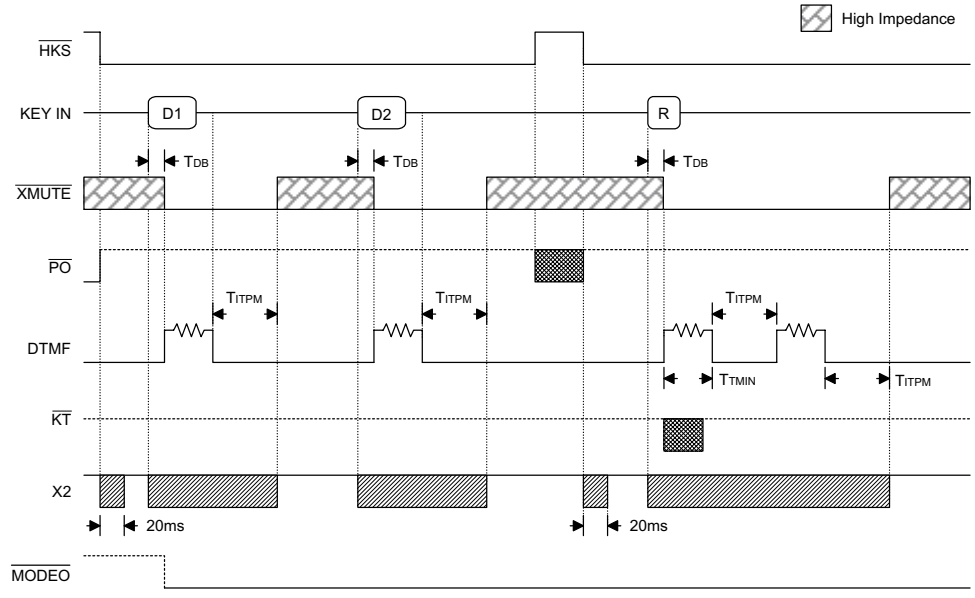
Timing Diagrams

Normal dialing

- Pulse mode

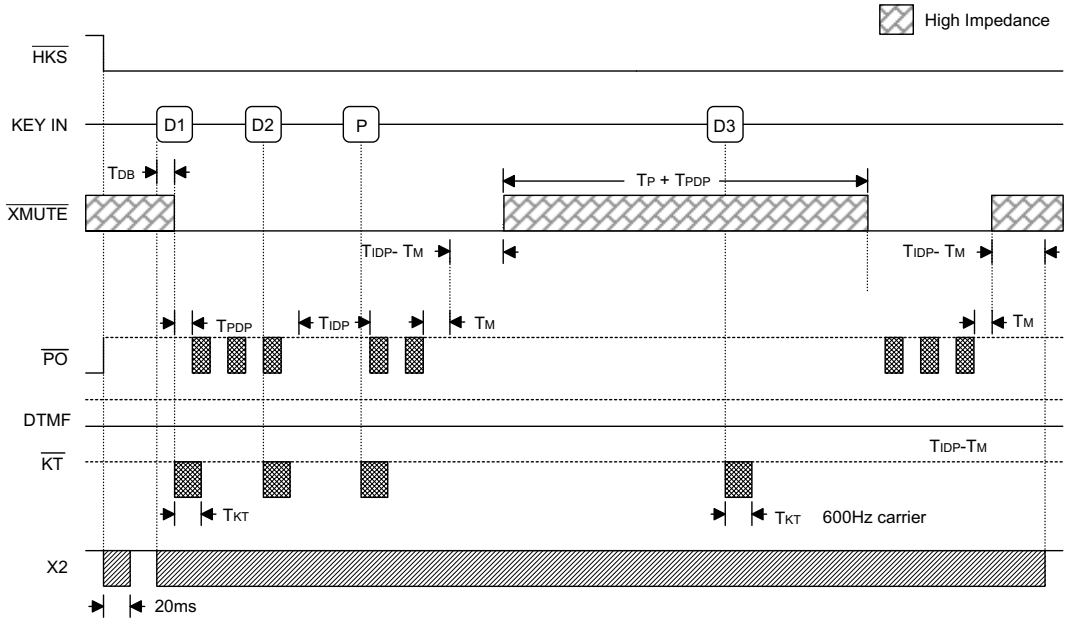


- Tone mode

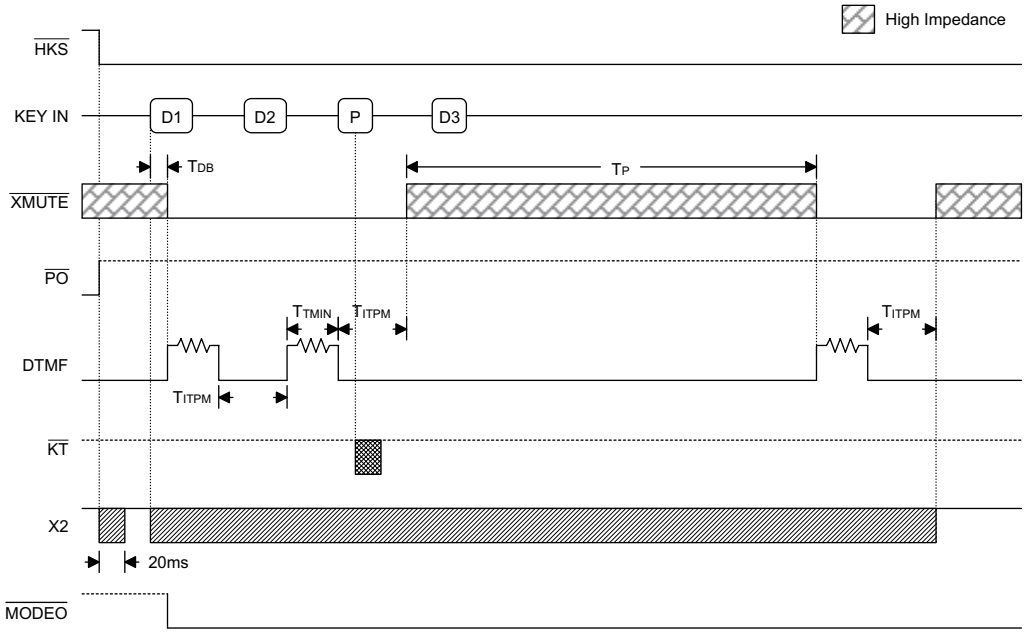


Dialing with PAUSE key

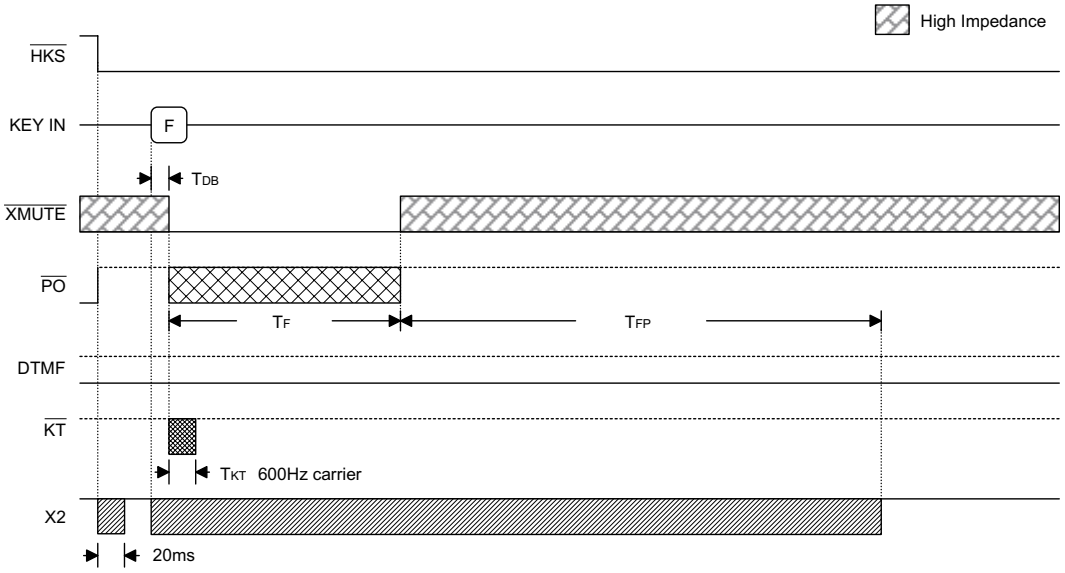
- Pulse mode



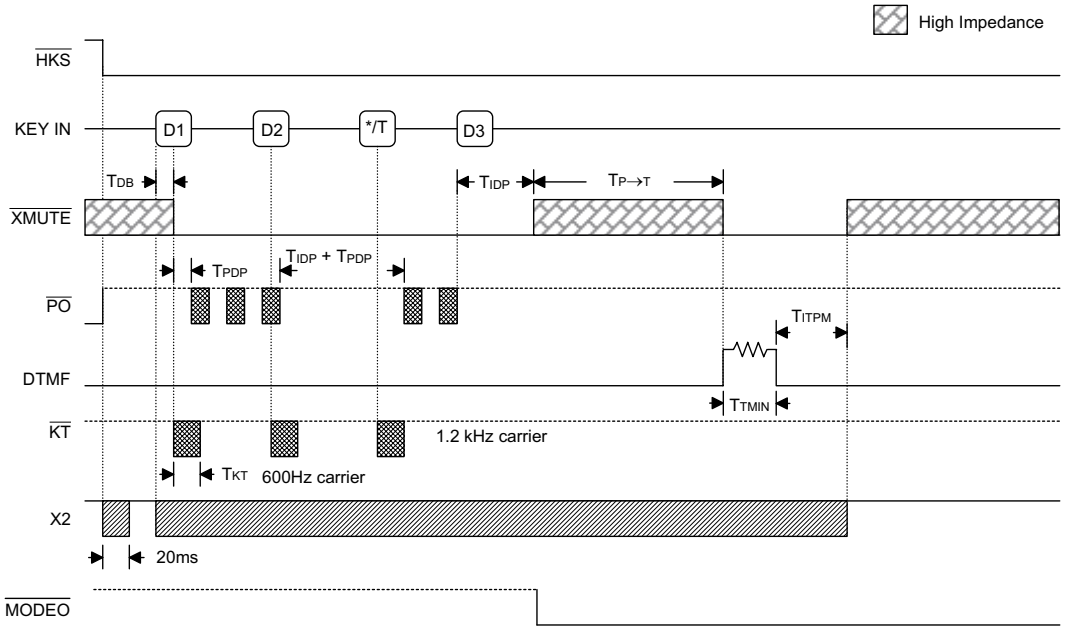
- Tone mode



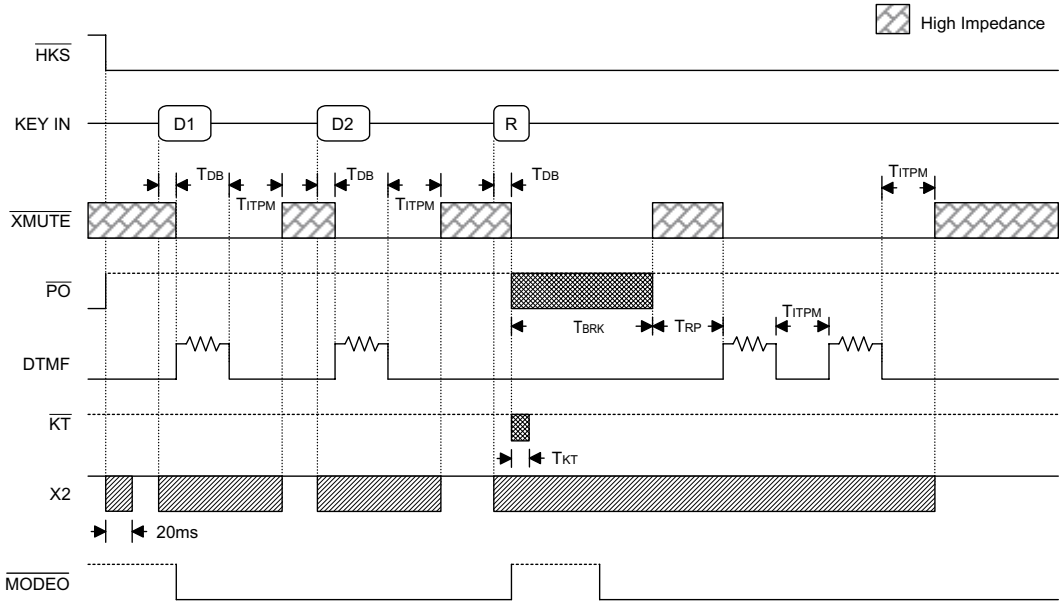
- Flash key operation



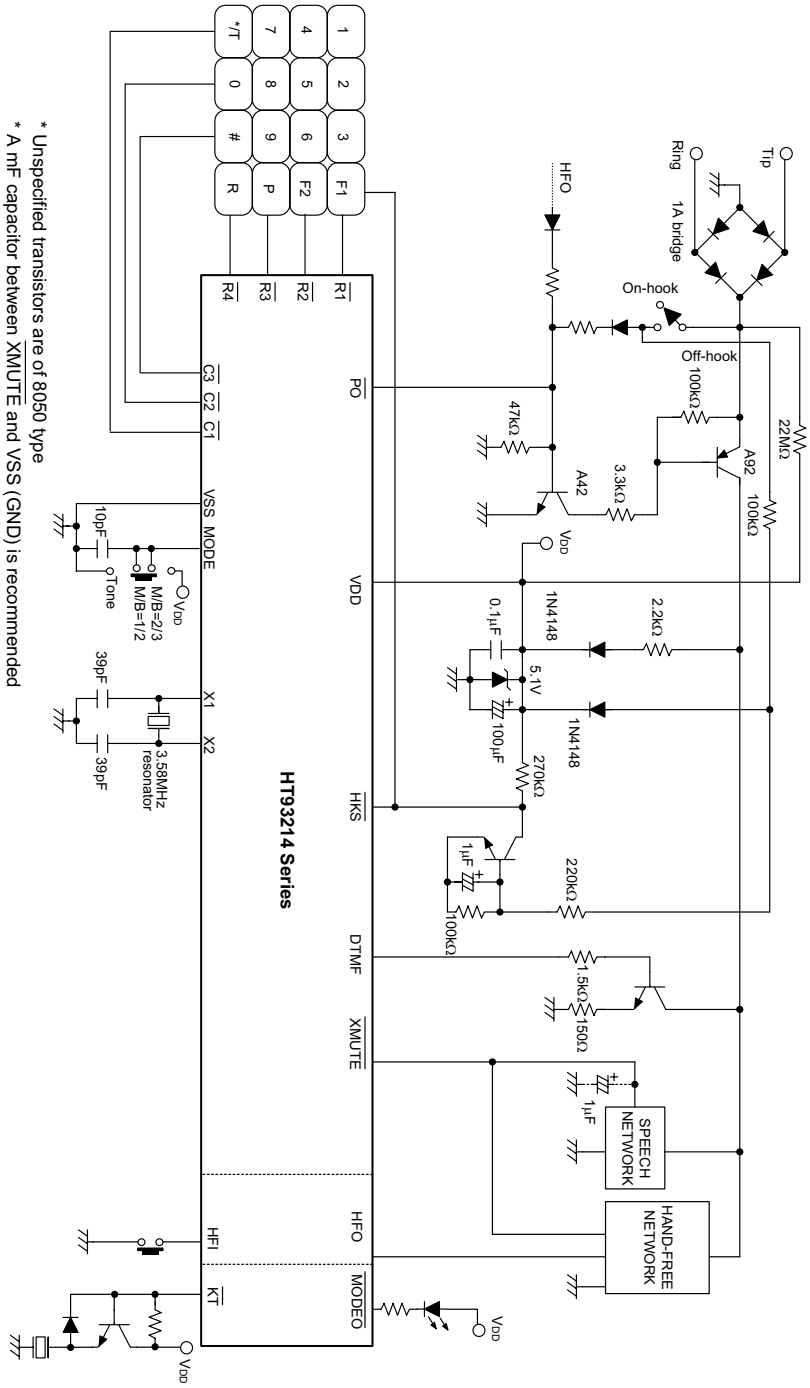
- Pulse to Tone operation



- One key redial operation

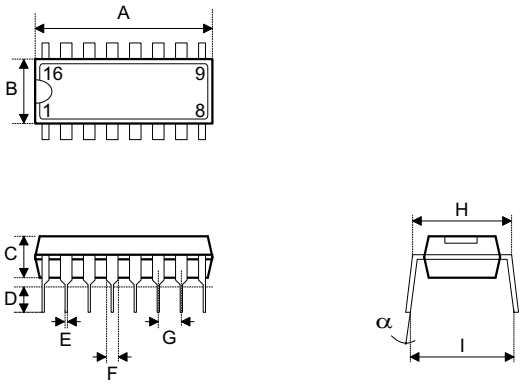


Application Circuits



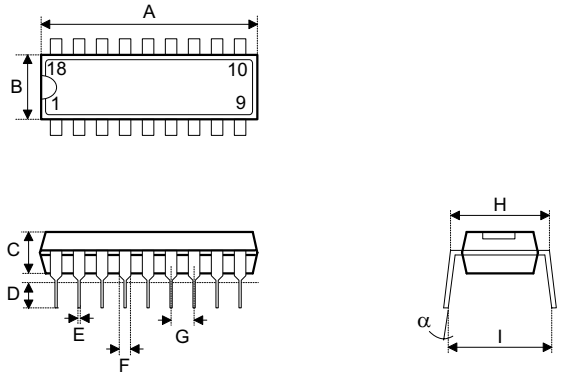
Package Information

16-pin DIP (300mil) outline dimensions



Symbol	Dimensions in mil		
	Min.	Nom.	Max.
A	745	—	775
B	240	—	260
C	125	—	135
D	125	—	145
E	16	—	20
F	50	—	70
G	—	100	—
H	295	—	315
I	335	—	375
α	0°	—	15°

18-pin DIP (300mil) outline dimensions



Symbol	Dimensions in mil		
	Min.	Nom.	Max.
A	895	—	915
B	240	—	260
C	125	—	135
D	125	—	145
E	16	—	20
F	50	—	70
G	—	100	—
H	295	—	315
I	335	—	375
α	0°	—	15°

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