HT9320 Series

22-Memory Tone/Pulse Dialer

Features

Patent Number: 64097, 86474, 113235(R.O.C.), 5424740(U.S.A.)

- Universal specification
- Operating voltag0e: 2.0V~5.5V
- Low standby current
- Low memory retention current: 0.1μA(typ.)
- Tone/pulse switchable
- Interface with LCD driver
- 32 digits for redialing
- 32 digits for the SA memory dialing
- One-key redialing
- Pause and P→T key for PBX
- 3.58MHz crystal or ceramic resonator
- Hand-free control
- Hold-line control
- Pause, P→T can be saved for redialing
- On-hook store function
- Keytone function
- Lock function
- Resistor options
  - M/B ratio
  - Flash function and flash time
  - Pause and P→T duration
  - Pulse number
  - Inter-digit pause time for 10pps
- Memory number: 22 memories

General Description

The HT9320 series tone/pulse dialers are CMOS LSI for telecommunication systems. They are designed to meet various dialing specifications through resistor option matrix.

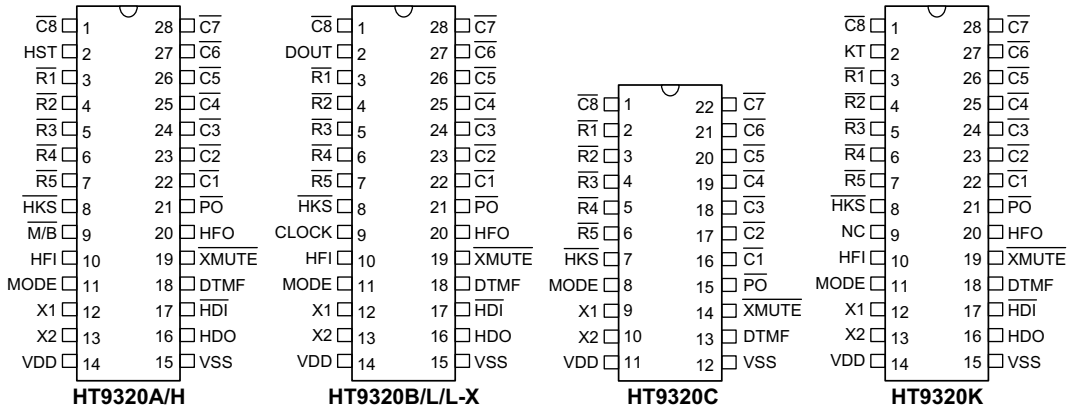
The HT9320 series are offered in six different versions. The different functions of the six versions are listed in the selection table. The HT9320A, HT9320H versions provide the on-hook store function; the HT9320B version provides the LCD interface function; the HT9320K version provides the keytone function; the HT9320L version provides both the LCD interface function and IDD lock function. The six versions also supply the hold-line and hand-free functions, which are suitable for feature phone applications.

HT9320 series provide SA, Redial and 20 one-touch/two-touch memory dialing. If the keyboard includes M1~M20 keys it can be used as one-touch memory dialing. Otherwise, it works as two-touch (PAGE→M1~M10) or three-touch(A→PAGE→0~9) memory dialing for speed dialing in either pulse or tone mode.

Selection Table

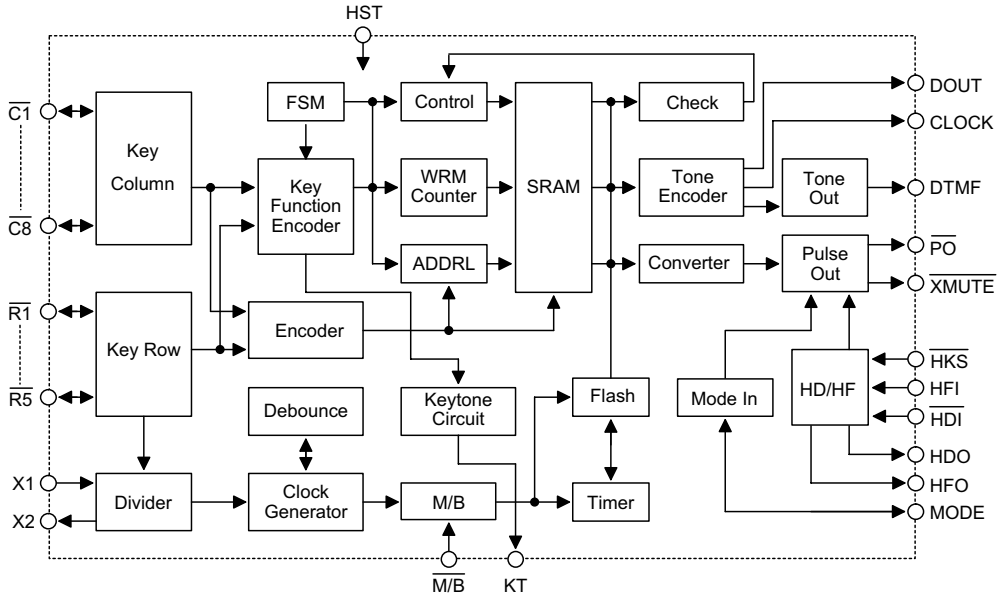
Function / Part No.	Memory Dialing	Hold-Line	Hand-Free	LCD Interface	Flash Function	Flash Time (ms)	Pulse No.	Tone Duration (ms)	Inter-Tone-Pause (ms)	$\overline{M/B}$ Pin	IDD Lock	Key-Tone Output	On-Hook Store	Package
HT9320A	SA, R M1~M20	√	√	—	Control	600	N, N+1 10–N	82.5	85.5	√	—	—	√	28 DIP
					Digit	600/300/98								
HT9320B	SA, R M1~M20	√	√	√	Control	600	N, N+1 10–N	82.5	85.5	—	—	—	—	28 DIP
					Digit	600/300/98								
HT9320C	SA, R M1~M20	—	—	—	Control	600	N, N+1 10–N	82.5	85.5	—	—	—	—	22SKDIP
					Digit	600/300/98								
HT9320H	SA, R M1~M20	√	√	—	Digit	600/100	N	82.5	82.5	√	—	—	√	28 DIP
HT9320K	SA, R M1~M20	√	√	—	Control	600	N, N+1 10–N	82.5	85.5	—	—	√	—	28 DIP
					Digit	600/300/98								
HT9320L	SA, R M1~M20	√	√	√	Control	600	N, N+1 10–N	82.5	85.5	—	√	—	—	28 DIP
					Digit	600/300/98								
HT9320L-X	The same as HT9320L, but the voltage polarity of the row group and the column group are reversed.													

Pin Assignment



HT9320A/H – 28 DIP | **HT9320B/L/L-X – 28 DIP** | **HT9320C –22 SKDIP** | **HT9320K – 28 DIP**

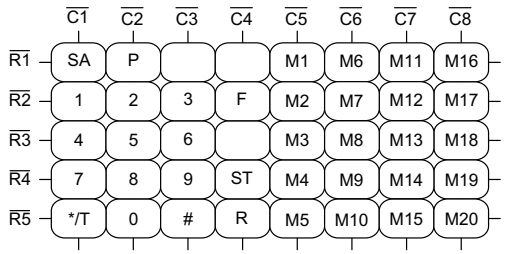
Block Diagram



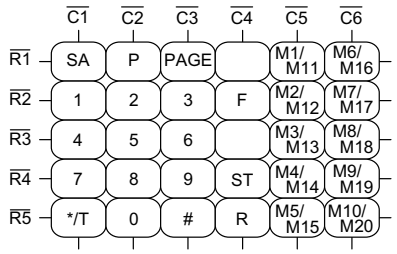
Keyboard Information

HT9320A/B/C/K/L

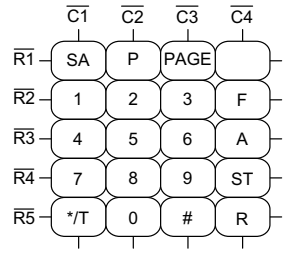
• One-touch memory keyboard



• Two-touch memory keyboard

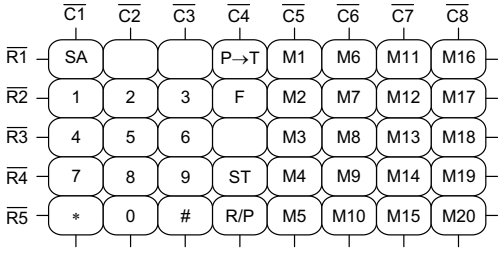


• Three-touch memory keyboard

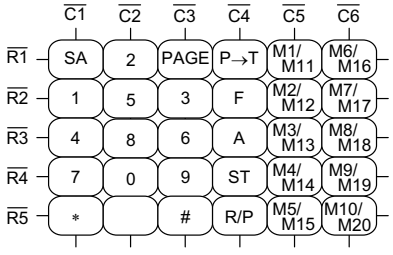


HT9320H

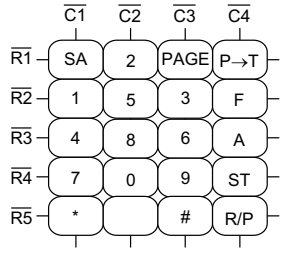
• One-touch memory keyboard



• Two-touch memory keyboard



• Three-touch memory keyboard



Memory dialing vs. keyboard form table

Dialing Output	One-Touch Memory Keyboard	Two-Touch Memory Keyboard	Three-Touch Memory Keyboard
M1~M10	[M1] ~ [M10]	[A] [a] (a=1~9, 0)	
M11~M20	[M11] ~ [M20]	[PAGE] [Ma] (Ma=M1~M10)	[A] [PAGE] [a] (a=1~9, 0)

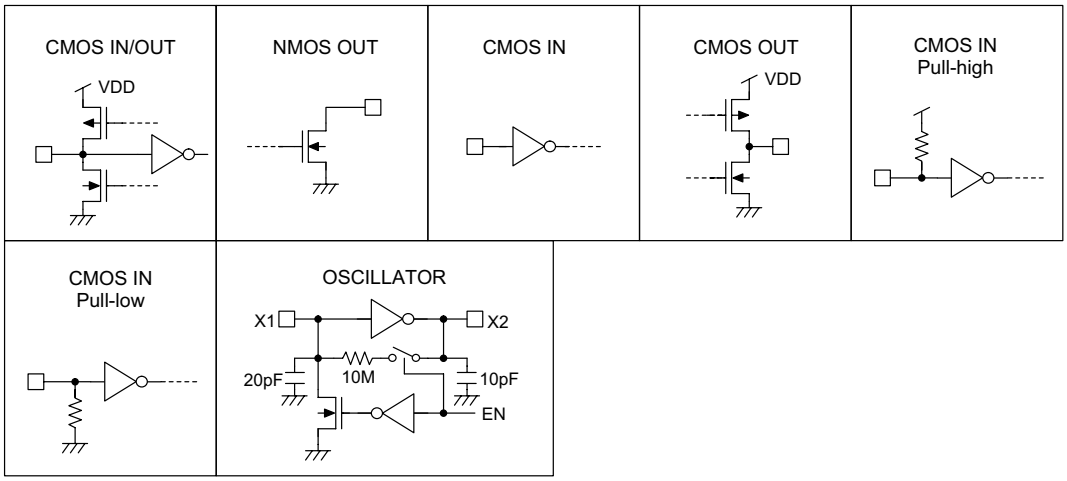
Pin Description

Pin Name	I/O	Internal Connection	Description
$\overline{C1}$~$\overline{C8}$ $\overline{R1}$~$\overline{R5}$	I/O	CMOS IN/OUT	These pins form a 5×8 keyboard matrix which can perform keyboard input detection and dialing specification setting functions. When on-hook ($\overline{HKS}$=high) all the pins are set high. While off-hook the column group ($\overline{C1}$~$\overline{C8}$) remains low and the row group ($\overline{R1}$~$\overline{R5}$) is set high for key input detection. For the HT9320L-X, the column group remains high and the row group is set low for key input detection. An inexpensive single contact 5×8 keyboard can be used as an input device. Pressing a key connects a single column to a single row, 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. Refer to the keyboard information for keyboard arrangement and to the functional description for dialing specification selection.
X1	I	OSCILLATOR	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 OUT	$\overline{XMUTE}$ is an NMOS open drain structure pulled to VSS during dialing signal transmission. Otherwise, it is an open circuit. $\overline{XMUTE}$ is used to mute the speech circuit when transmitting the dial signal.
$\overline{HKS}$	I	CMOS IN	This pin is used to monitor the status of the hook-switch and its combination with HFI/$\overline{HDI}$ can control the $\overline{PO}$ pin output to make or break the line. $\overline{HKS}$=VDD: On-hook state ($\overline{PO}$=low). Except for HFI/$\overline{HDI}$ (hand-free/hold-line control input), other functions are all disabled. 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	CMOS OUT	This pin is a CMOS output structure which by receiving the $\overline{HKS}$ and HFO/HDO signals, control the dialer to connect or disconnect the telephone line. $\overline{PO}$ outputs a low to break line when $\overline{HKS}$ is high (on-hook) and HFO/HDO is low. $\overline{PO}$ outputs a high to make line when $\overline{HKS}$ is low (off-hook) or HFO is high or HDO 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 high.

Pin Name	I/O	Internal Connection	Description
MODE	I/O	CMOS IN/OUT	This is a three-state input/output pin, used for dialing mode selection, either Tone mode or Pulse mode, 10pps/20pps MODE=VDD: Pulse mode, 10pps MODE=OPEN: Pulse mode, 20pps MODE=VSS: Tone mode During the pulse mode dialing, switching this pin to the tone mode changes the subsequent digit entry to the tone mode. When the chips are in tone mode, switching to the pulse mode will also be recognized.
DTMF	O	CMOS OUT	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 should not be less than 5kΩ.
$\overline{\text{HDI}}$	I	CMOS IN Pull-high	This pin is a schmitt trigger input structure. Active low. Applying a negative going pulse to this pin can toggle the HDO output once. An external RC network is recommended for input debouncing. The pull-high resistance is 200kΩ typ.
HDO	O	CMOS OUT	The HDO is a CMOS output structure. Its output is toggle- controlled by a negative transition on $\overline{\text{HDI}}$. When HDO is toggled high, $\overline{\text{PO}}$ keeps high to hold the line. The hold function can be released by setting HFO high or by an on-off hook operation or by another $\overline{\text{HDI}}$ input. The HDO pin can directly drive the HT3810 series melody generator to produce a hold-line background melody. Refer to the functional description for the hold-line function.
HFI	I	CMOS IN Pull-low	This pin is a schmitt trigger input structure. Active high. Applying a positive going pulse to HFI can toggle the HFO once and hence control the hand-free function. An external RC network is recommended for input debouncing. The pull-low resistance of HFI is 200kΩ typ.
HFO	O	CMOS OUT	The HFO is a CMOS output structure. Its output is toggle-controlled by a positive transition on the HFI pin. When HFO is high, the hand-free function is enabled and $\overline{\text{PO}}$ outputs a high to connect the line. The hand-free function can be released by an on-off-hook operation or by another HFI input or by setting HDO high. Refer to the functional description for the hand-free function operation.
DOUT	O	NMOS OUT	NMOS open drain output pin. It outputs the BCD code of the dialing digits to the LCD driver chip (HT16XX series) or μC for dialing number display. Refer to the functional description for the detailed timing.

Pin Name	I/O	Internal Connection	Description
CLOCK	O	NMOS OUT	NMOS open drain output. When dialing, it outputs a series of pulse trains for DOUT data synchronization. DOUT data is valid at the falling edge of clock.
VDD	I	—	Positive power supply, 2.0V~5.5V for normal operation
VSS	I	—	Negative power supply
HST	I	CMOS IN Pull-low (HT9320A) CMOS IN (HT9320H)	On-hook store enable input HST=VDD: On-hook store (HT9320A/H) HST=Floating: Off-hook store (HT9320A) HST=VSS: Off-hook store (HT9320H) The Pull-low resistance is 200kΩ typ.
$\overline{M/B}$	I	CMOS IN Pull-high (HT9320A) CMOS IN (HT9320H)	Make/Break ratio selection $\overline{M/B}$=VSS: 33.3/66.6 (HT9320A) $\overline{M/B}$=Floating: 40/60 (HT9320A) $\overline{M/B}$=VDD: 33.3/66.6 (HT9320H) $\overline{M/B}$=VSS: 40/60 (HT9320H) The pull-high resistance is 200kΩ typ.
KT	O	CMOS OUT	Keytone output pin. Outputs a 1.2kHz tone carrier for 34ms each time a key is pressed in the pulse mode.

Approximate internal connection circuits



Absolute Maximum Ratings

Supply Voltage .....–0.3V to 6V
Input Voltage ..... V_{SS}–0.3 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	—	0.2	1	mA
			Tone	Keypad entry No load	—	0.6	2	mA
I_{STB}	Standby Current	1V	On-hook, no load No entry		—	—	1	μA
V_R	Memory Retention Voltage	—	—		1	—	5.5	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 Current	—	$V_{\overline{XMUTE}}$=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}	HFI Pull-low Resistance	2.5V	V_{HFI}=2.5V		—	200	—	kΩ
$R_{\overline{HDI}}$	$\overline{HDI}$ Pull-high Resistance	2.5V	$V_{\overline{HDI}}$=0V		—	200	—	kΩ
$R_{\overline{M/B}}$	$\overline{M/B}$ Pull-high Resistance	2.5V	$V_{\overline{M/B}}$=0V		—	200	—	kΩ
R_{HST}	HST Pull-low Resistance	2.5V	V_{HST}=2.5V		—	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_{OH3}	HDO Pin Source Current	2.5V	V_{OH}=2V		–1	—	—	mA
I_{OL3}	HDO Pin Sink Current	2.5V	V_{OL}=0.5V		1	—	—	mA
I_{OH4}	KT Pin Source Current	2.5V	V_{OH}=2V		–1	—	—	mA
I_{OL4}	KT Pin Sink Current	2.5V	V_{OL}=0.5V		1	—	—	mA

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V_{DD}	Conditions				
T_{FP}	Pause Time After Flash	—	Control key	—	0.2	—	s
			Digit key	—	1	—	s
T_{RP}	Pause Time for One-key Redialing	—	One-key redialing	—	1	—	s
T_{DB}	Key-in Debounce Time	—	—	—	20	—	ms
T_{BRK}	Break Time for One-key Redialing	—	One-key redialing	—	1.2	—	s
f_{OSC}	System Frequency	—	Crystal=3.5795MHz	3.5759	3.5795	3.5831	MHz

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
PR	Pulse Rate	—	MODE pin is connected to V_{DD}	—	10	—	pps
			MODE pin is opened	—	20	—	
M/B	Make/Break Ratio	—	A resistor is linked between $\overline{R2}$ and $\overline{C1}$ (HT9320B/C/K/L)	—	33:66	—	%
			$\overline{M/B}$=VSS (HT9320A)				
			$\overline{M/B}$=VDD (HT9320H)				
			No resistor is linked between $\overline{R2}$ and $\overline{C1}$ (HT9320B/C/K/L)	—	40:60	—	
			$\overline{M/B}$=Floating (HT9320A)				
			$\overline{M/B}$=VSS (HT9320H)				
T_{PDP}	Pre-digit-pause Time	—	M/B ratio=40:60	—	40 (10pps) 20 (20pps)	—	ms
			M/B ratio=33:66	—	33 (10pps) 17 (20pps)	—	

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V_{DD}	Conditions				
T_{IDP}	Inter-digit-pause Time	—	Pulse rate=10pps. No resistor is linked between $\overline{R1}$ and $\overline{C5}$ (HT9320A/B/C/K)	—	800	—	ms
			Pulse rate=10pps (HT9320H/L)				
			Pulse rate=10pps. A resistor is linked between $\overline{R1}$ and $\overline{C5}$ (HT9320A/B/C/K)	—	400	—	
			Pulse rate=20pps	—	500	—	
T_M	Pulse Make Duration	—	A resistor is linked between $\overline{R2}$ and $\overline{C1}$ (HT9320B/C/K/L)	—	33 (10pps) 17 (20pps)	—	ms
			$\overline{M/B}$=VSS (HT9320A)				
			$\overline{M/B}$=VDD (HT9320H)				
			No resistor is linked between $\overline{R2}$ and $\overline{C1}$ (HT9320B/C/K/L)	—	40 (10pps) 20 (20pps)	—	
			$\overline{M/B}$=Floating (HT9320A)				
			$\overline{M/B}$=VSS (HT9320H)				
T_B	pulse Break Duration	—	A resistor is linked between $\overline{R2}$ and $\overline{C1}$ (HT9320B/C/K/L)	—	66 (10pps) 33 (20pps)	—	ms
			$\overline{M/B}$=VSS (HT9320A)				
			$\overline{M/B}$=VDD (HT9320H)				
			No resistor is linked between $\overline{R2}$ and $\overline{C1}$ (HT9320B/C/K/L)	—	60 (10pps) 30 (20pps)	—	
			$\overline{M/B}$=Floating (HT9320A)				
			$\overline{M/B}$=VSS (HT9320H)				
T_{KT}	Keytone Duration	—	Pulse mode (HT9320K)	—	34	—	ms
F_{KTC}	Keytone Carrier	—	Pulse mode (HT9320K)	—	1.2	—	kHz

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	—	—	$0.45V_{DD}$	—	$0.7V_{DD}$	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

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V_{DD}	Conditions				
THD	Tone Signal Distortion	2.5V	R_L=5kΩ	—	–30	–23	dB
T_{TMIN}	Minimum Tone Duration	—	Auto-redial	—	82.5	—	ms
T_{ITPM}	Minimum Inter-tone Pause	—	Auto-redial	—	85.5	—	ms

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

Vi, Vh: Row group and column group signals

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

Functional Description

Keyboard matrix

$\overline{C1}$~$\overline{C8}$ and $\overline{R1}$~$\overline{R5}$ form a keyboard matrix. Together with a standard 5×8 keyboard, the keyboard matrix is used for dialing entries. In addition, the keyboard matrix also provides resistor options for different dialing specification selections. The keyboard arrangement for the HT9320 series are shown in the ***Keyboard Information***.

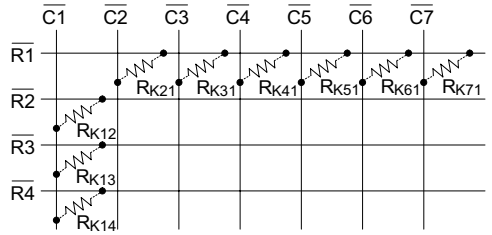
Tone frequency

Tone Name	Output Frequency (Hz)		% Error
	Specified	Actual	
$\overline{R2}$	697	699	+0.29%
$\overline{R3}$	770	766	–0.52%
$\overline{R4}$	852	847	–0.59%
$\overline{R5}$	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

Various dialing specifications can be selected by adding resistors across keyboard matrix pins. The allowable option resistor connections are shown on the table.



All the resistors are 330kΩ. The resistor option functions and the default specifications (without option resistors) are listed below (HT9320A/B/C/K/L).

Option Resistor	Option Function	Default (No Resistor)
R_{K12} (HT9320B/C/K/L)	Ratio Selection	40:60
R_{K13}	Flash Function /Time Selection	Flash= control function Flash time= 600ms
R_{K14}		
R_{K21}	Pause & P→T Duration Selection	T_P= 3.6s $T_{P\rightarrow T}$= 3.6s
R_{K31}	Pulse Number Selection	N
R_{K41}		
R_{K51} (HT9320A/B/C/K)	Inter-digit-Pause Time for 10pps	800ms

Option Resistor	Option Function	Default (No Resistor)
R_{K51} R_{K61} R_{K71} (HT9320L)	International Direct Dialing Lock Selection	Normal dialing (unlock)

M/B ratio selection table

• HT9320A

$\overline{M/B}$ Pin	M/B Ratio (%)
VSS	33.3:66.6
Floating	40:60

• HT9320B/C/K/L

R_{K12}	M/B Ratio (%)
No	40:60
Yes	33.3:66.6

• HT9320H

$\overline{M/B}$ Pin	M/B Ratio (%)
VDD	33.3:66.6
VSS	40:60

Flash function/time (duration) selection table

• HT9320A/B/C/K/L

R_{K13}	R_{K14}	Flash Function	Flash Time (T_F)
No	No	Control	600ms
No	Yes	Digit	600ms
Yes	No	Digit	98ms
Yes	Yes	Digit	300ms

• HT9320H

M/B Pin	Flash Function	Flash Time (T_F)
VSS	Digit	600ms
VDD	Digit	100ms

Pause and P→T duration selection table

• HT9320A/B/C/K/L

R_{K21}	T_P (sec)	$T_{P\rightarrow T}$ (sec)
No	3.6	3.6
Yes	2	1

• HT9320H

T_P (sec)	$T_{P\rightarrow T}$ (sec)
3.6	3.6

Pulse number selection table

• HT9320A/B/C/K/L

R_{K31}	R_{K41}	Pulse Number
No	No	N
No	Yes	N+1
Yes	No	10-N
Yes	Yes	—

• HT9320H

Pulse Number
N

Inter-digit-pause time for 10pps

• HT9320A/B/C/K

R_{K51}	Inter-digit pause time
No	800ms
Yes	400ms

• HT9320H/L

Inter-digit pause time
800ms

Pulse number table

Keypad	Output Pulse Number		
Digit Key	N	10–N	N+1
1	1	9	2
2	2	8	3
3	3	7	4
4	4	6	5
5	5	5	6
6	6	4	7
7	7	3	8
8	8	2	9
9	9	1	10
0	10	10	1
*/T	P→T	P→T	P→T
#	Ignored	Ignored	Ignored

DOUT BCD code

When dialing, the corresponding 4-bit BCD codes are serially presented on DOUT from MSB to LSB. The data of DOUT is valid at the falling edge of the CLOCK pin. The following table lists the BCD codes corresponding to the keyboard input.

Key-In	BCD Code	Key-In	BCD Code
1	0001	8	1000
2	0010	9	1001
3	0011	0	1010
4	0100	*/T	1101
5	0101	#	1100
6	0110	F	1011
7	0111	P	1110

On hook store (HT9320A/H)

When the external power supply (2V~5.5V) is used and the HST pin is connected to VDD, the user can store dialing numbers to the memories (M1~M20) during on-hook state.

On/Off hook store selection table

HST Pin	Hook Store Mode
VDD (HT9320A/H)	On-hook store
Floating (HT9320A)	Off-hook store
VSS (HT9320H)	Off-hook store

Lock function (HT932L)

This function aims to detect lock dialing numbers to prevent from an unauthorized long distance call. The dialing output of this chip is disabled if the first input key after on-off hook is the lock number when the lock function is enabled.

International direct dialing lock (IDD lock) selection table

R_{K51}	R_{K61}	R_{K71}	Lock Function
No	No	No	Normal dialing without lock function
No	No	Yes	To lock 0
No	Yes	—	To lock 0, 9
Yes	—	—	IDD lock operation by the telephone keyboard. (See keyboard operation)

Note: "—" stands for "don't care"

Hand-free function operation

- Hand-free function execution

  When HFO is low, a rising edge triggers the 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 rising edge to HFI
  - Changing the HDO pin from low to high

• Hand-free function table

Current State			Input			Next State	
$\overline{HKS}$	HFO	HDO	$\overline{HDI}$	HFI	$\overline{HKS}$	HFO	HDO
H	L	X	H	L	An	L	An
H	L	X	H	↑	An	H	L
H	H	X	H	↑	An	L	An
H	X	L	H	L	L	L	L
L	L	X	H	L	An	L	An
L	L	X	H	↑	An	H	L
L	H	L	H	↑	An	L	An
L	X	X	H	L	H	An	An
X	X	L	↓	L	An	L	H

H: Logic HIGH X: Don't care ↑: Rising edge
L: Logic LOW An: Unchanged ↓: Falling edge

• Hold-line function table

Current State			Input			Next State	
$\overline{HKS}$	HDO	HFO	HFI	$\overline{HDI}$	$\overline{HKS}$	HDO	HFO
H	L	X	L	H	An	L	An
H	L	X	L	↓	An	H	L
H	H	L	L	↓	An	L	An
H	X	X	L	H	L	L	L
L	L	X	L	H	An	L	An
L	L	X	L	↓	An	H	L
L	H	L	L	↓	An	L	An
L	X	X	L	H	H	An	An
X	X	L	↑	H	An	L	H

H: Logic HIGH X: Don't care ↑: Rising edge
L: Logic LOW An: Unchanged ↓: Falling edge

Hold-line function operation

• Hold-line function execution

When HDO is low, a falling edge triggers the $\overline{HDI}$, enabling the Hold-line function (HDO becomes high). The $\overline{XMUTE}$ remains low when HDO is high.

• Reset Hold-line function

When HDO is high, the Hold-line function is enabled and can be reset by:

- Off-hook
- Applying a falling edge to $\overline{HDI}$
- Changing the HFO pin from low to high

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 operations.

• */T

This key executes the P→T function and wait a $T_{P\rightarrow T}$ duration in the pulse mode. On the other hand, the */T key executes the * function in the tone mode.

• * (HT9320H)

The * key executes the * tone output function in the tone mode. No response in the pulse mode.

• P→T

The key executes the P→T function in the pulse mode. No response in the tone mode.

• #

This is a dialing signal key for the tone mode only, no response in the pulse mode.

- SA

  Pressing this key can save the preceding dialing telephone numbers. The saved number is redialed if it is pressed again. SA will also redial the saved number if it is the first key pressed at the off-hook state. During the dialing signal transmission, the SA key is inhibited.

- F

  The flash key can be selected as a digit or as a control key by the option resistors R_{K13} & R_{K14}. Pressing the flash key will force the $\overline{PO}$ pin to be "low" for the T_F duration and is then followed by T_{FP} (sec). T_F can also be selected by R_{K13}, R_{K14}.

- P

  Pause key. The execution of this key can pause the output for the T_P duration. T_P can be selected by R_{K21}.

- R

  Redial key. Executes redialing as well as one-key redial function.

- R/P

  Redial and pause function key. If it is pressed as the first key after off-hook, this key executes the redial function. Otherwise, it works as the pause key.

- ST

  Store key. The execution of this key actuates the store memory function with (or without) dialing output. During the dialing signal transmission, the ST key is inhibited.

- A

  Auto key. When this key is pressed before pressing any one of the digital keys (0~9) it executes the two-touch/ three-touch memory dialing function.

- PAGE

  M11~M20 are represented by pressing the PAGE key an.d the digital keys (0~9) or M1~M10. That is to say, A PAGE digit key (0~9) or PAGE→M1~M10 executes M11~M20 memory dialing.

- M1~M20

  One-touch memory dialing for speed-dialing in either pulse or tone mode.

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

  SAM: Unchanged

  (b) with */T

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

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

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

  SAM: Unchanged

  – Tone mode

  (a) without */T

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

  Dialing output: D1 D2 ... Dn

  RM: D1 D2 ... Dn

  SAM: Unchanged

  (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

  SAM: Unchanged

  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, P→T

  RM content: D1 D2 ... Dn

  Keyboard input: [R]

  Dialing output: D1 D2 ... Dn

  RM: Unchanged

  SAM: Unchanged

  (b) with */T

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

  Keyboard input: [R] or [R/P]

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

  RM: Unchanged

  SAM: Unchanged

  – Tone mode

  (a) without */T, P→T

  RM content: D1 D2 ... Dn

  Keyboard input: [R]

  Dialing output: D1 D2 ... Dn

  RM: Unchanged

  SAM: Unchanged

  (b) with */T

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

  Keyboard input: [R] or [R/P]

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

  RM: Unchanged

  SAM: Unchanged

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

- One-key redial

  – Pulse mode

  (a) without */T

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

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

  RM: D1 D2 ... Dn

  SAM: Unchanged

  (b) with */T

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

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

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

  SAM: Unchanged

  – 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

  SAM: Unchanged

  (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

  SAM: Unchanged

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

- Pause

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

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

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

  SAM: Unchanged

- SA copy

  – Pulse mode

  (a) without */T

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

  Dialing output: D1 D2 ... Dn

  RM: D1 D2 ... Dn

  SAM: D1 D2 ... Dn

  (b) with */T

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

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

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

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

  – Tone mode

  (a) without */T

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

  Dialing output: D1 D2 ... Dn

  RM: D1 D2 ... Dn

  SAM: D1 D2 ... Dn

  (b) with */T

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

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

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

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

  Note: The maximum capacity of the RM memory is 32 digits. When more than 32 digits plus the "SA" key are entered, the SAVE function will not be executed, and all the existing data in the save memory will not be changed.

- SA dialing
  - Pulse mode
    (a) without */T
    SAM content: D1 D2 ... Dn
    Keyboard input: [SA]
    Dialing output: D1 D2 ... Dn
    RM: Unchanged
    SAM: Unchanged
    (b) with */T
    SAM content: D1 D2 ... Dn */T Dn+1 ... Dm
    Keyboard input: [SA]
    Dialing output: D1 D2 ... Dn (Pulse) $T_{P\rightarrow T}$ Dn+1 ... Dm (Tone)
    RM: Unchanged
    SAM: Unchanged
  - Tone mode
    (a) without */T
    SAM content: D1 D2 ... Dn
    Keyboard input: [SA]
    Dialing output: D1 D2 ... Dn
    RM: Unchanged
    SAM: Unchanged
    (b) with */T
    SAM content: D1 D2 ... Dn * Dn+1 ... Dm
    Keyboard input: [SA]
    Dialing output: D1 D2 ... Dn * Dn+1 ... Dm
    RM: Unchanged
    SAM: Unchanged

- Memory store
  - One-touch memory store without dialing output
    Keyboard input: [ST] [D1] [D2] ... [Dn] [ST] [Ma]
    Dialing output:
    Ma: D1 D2 ... Dn
    RM: D1 D2 ... Dn
    SAM: Unchanged
  - One-touch memory store with dialing output
    Keyboard input: [D1] [D2] ... [Dn] [ST] [ST] [Ma]
    Dialing output: D1 D2 ... Dn
    Ma: D1 D2 ... Dn
    RM: D1 D2 ... Dn
    SAM: Unchanged
  - Two-touch memory store without dialing output
    (M1~M10)
    Keyboard input: [ST] [D1] [D2] ... [Dn] [ST] [[b] or [Mb]]
    (M11~M20)
    Keyboard input: [ST] [D1] [D2] ... [Dn] [ST] [PAGE] [[b] or [Mb]]
    Dialing output:
    Mb: D1 D2 ... Dn
    Ma: D1 D2 ... Dn (a=b+10, M10=M0)
    RM: D1 D2 ... Dn
    SAM: Unchanged
  - Two-touch memory store with dialing output
    (M1~M10)
    Keyboard input: [D1] [D2] ... [Dn] [ST] [ST] [[b] or [Mb]]
    (M11~M20)
    Keyboard input: [D1] [D2] ... [Dn] [ST] [ST] [PAGE] [[b] or [Mb]]
    Dialing output: D1 D2 ... Dn
    Mb: D1 D2 ... Dn
    Ma: D1 D2 ... Dn (a=b+10, M10=M0)
    RM: D1 D2 ... Dn
    SAM: Unchanged
  - Three-touch memory store without dialing output
    (M11~M20)
    Keyboard input: [ST] [D1] [D2] ... [Dn] [ST] [PAGE] [[b] or [Mb]]
    Dialing output:
    Ma: D1 D2 ... Dn (a=b+10, M10=M0)
    RM: D1 D2 ... Dn
    SAM: Unchanged
  - Three-touch memory store with dialing output
    (M11~M20)
    Keyboard input: [D1] [D2] ... [Dn] [ST] [ST] [PAGE] [[b] or [Mb]]
    Dialing output: D1 D2 ... Dn
    Ma: D1 D2 ... Dn (a=b+10, M10=M0)
    RM: D1 D2 ... Dn
    SAM: Unchanged

Note: If the dialing number exceeds 32 digits, the memory store is inhibited.
However, if the dialing number is not more than 32 digits the memory will store a max. of 16 digits.
Ma=M1~M20, Mb=M1~M10, a=1~20, b=1~9, 0

- Memory dialing
  - One-touch memory dialing (M1~M20)
    Ma content: D1 D2 ... Dn
    Keyboard input: [Ma]
    Dialing output: D1 D2 ... Dn
    Ma: Unchanged
    RM: D1 D2 ... Dn
    SAM: Unchanged
  - Two-touch memory dialing (M1~M10)
    Mb content: D1 D2 ... Dn
    Keyboard input: [A] [[b] or [Mb]]
    Dialing output: D1 D2 ... Dn
    Mb: Unchanged
    RM: D1 D2 ... Dn
    SAM: Unchanged
  - Three-touch memory dialing (M11~M20)
    M11 content: D1 D2 ... Dn
    Keyboard input: [A] [PAGE] [[Mb] or [b]]
    Dialing output: D1 D2 ... Dn
    Ma: Unchanged (a=b+10, M10=M0)
    RM: D1 D2 ... Dn
    SAM: Unchanged

  Note: a=1~20, Ma=M1~M20
  Mb=M1~M10, b=1~9, 0

- Chain dialing

  M1 content: D1 D2 ... Dn
  M2 content: Dn+1 ... Dm
  Keyboard input: [D1] [D2] [D3] [[M1] or [A] [1]] [[M2] or [A] [2]]
  Dialing output: D1 D2 D3 D1 D2 ... Dn Dn+1 ... Dm
  M1/M2: Unchanged
  RM: D1 D2 D3 D1 D2 ... Dn Dn+1 ... Dm
  SAM: Unchanged

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

- Flash

  Flash as a digital key

  (a) The intervenient key
  Keyboard input: [D1] [D2] ... [Dn] [F] [Dn+1] ... [Dm]
  Dialing output: D1 D2 ... Dn T_F T_{FP} Dn+1 ... Dm
  RM: D1 D2 ... Dn
  SAM: Unchanged

  (b) The first key
  Keyboard input: [F] [D1] [D2] ... [Dn]
  Dialing output: T_F T_{FP} D1 D2 Dn
  RM: Unchanged
  SAM: Unchanged

  - 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
    SAM: Unchanged

  Note: T_F: break a flash time

- IDD lock operation by the keyboard (2 lock numbers, 3 digits/number at maximum)
  (A 330kΩ resistor is connected between $\overline{C5}$ and $\overline{R1}$)

  Personal/Lock No.1/Lock No.2 input operation

  (a) Personal code doesn't exist

  Stores Personal Code: ST D1 D2 D3 ST * 0

  Stores Lock No.1: ST D4 D5 D6 ST * 1

  Stores Lock No.2: ST D7 D8 D9 ST * 2

  (b) Personal code exist

  Changes Personal Code: ST D1 D2 D3 ST # ST D4 D5 D6 ST * 0
  (Old personal code) (New personal code)

  Changes Lock No.1: ST D1 D2 D3 ST # ST D4 D5 D6 ST * 1
  (Personal code) (Lock No.1)

  Changes Lock No.2: ST D1 D2 D3 ST # ST D7 D8 D9 ST * 2
  (Personal code) (Lock No.2)

  Changes Personal Code, Lock No.1 and Lock No.2 at one time

  ST D1 D2 D3 ST # ST D4 D5 D6 ST * 0 (continued)
  (Old personal code) (New personal code)
  ST D7 D8 D9 ST * 1 ST D10 D11 D12 ST * 2
  (Lock No.1) (Lock No.2)

  – Personal/Lock No.1/Lock No.2 cancel operation

  Cancels Personal code: ST D1 D2 D3 ST # ST # 0

  Cancels Lock No.1: ST D1 D2 D3 ST # ST # 1

  Cancels Lock No.2: ST D1 D2 D3 ST # ST # 2

  – Temporary release both of the lock numbers (Lock No.1, Lock No.2):
  ST D1 D2 D3 ST # Dm Dm+1 Dm+2 Dl ... Dn
  (Personal code)

  Note: D1~D12 = 0~9
  Dm Dm+1 Dm+2 = 0~9
  Dl ... Dn = 0~9, *, #

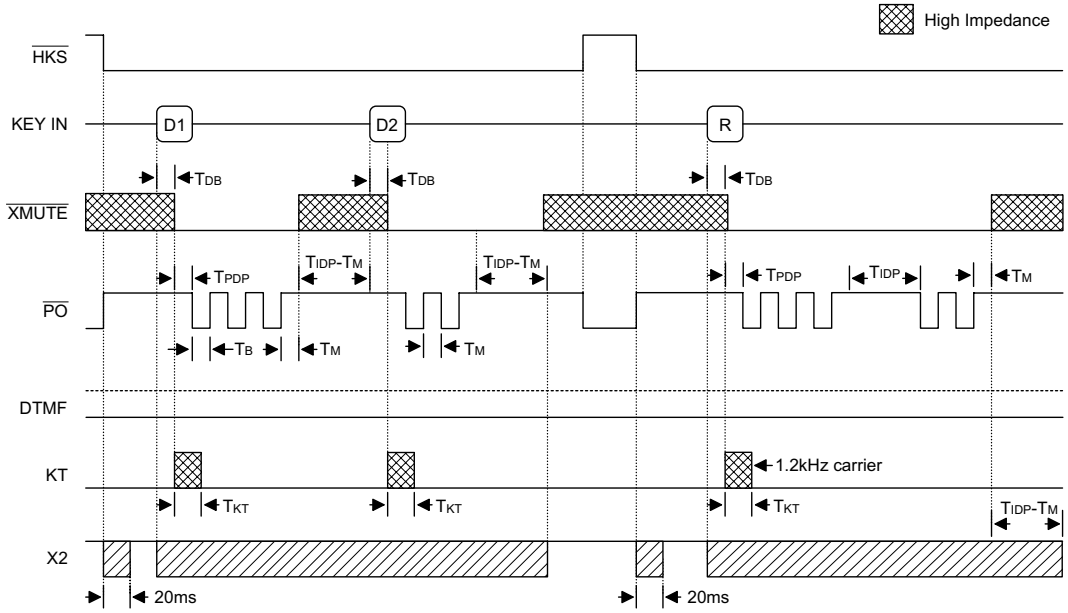
- Note:

  RM: Redial memory
  SAM: Save dialing memory
  D1 D2 ... Dn: 0~9
  Dn+1 ... Dm: 0~9, *, #
  Dm+1 ... Dl: 0~9, *, #
  Dl+1 ... DK: 0~9, *, #

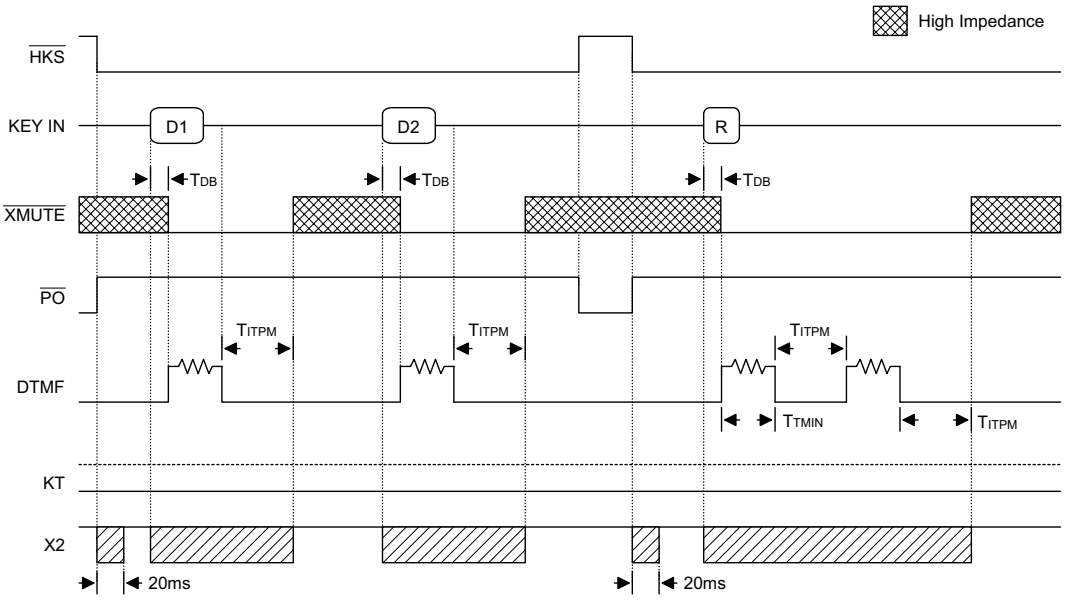
Timing Diagrams

Normal dialing

• Pulse mode

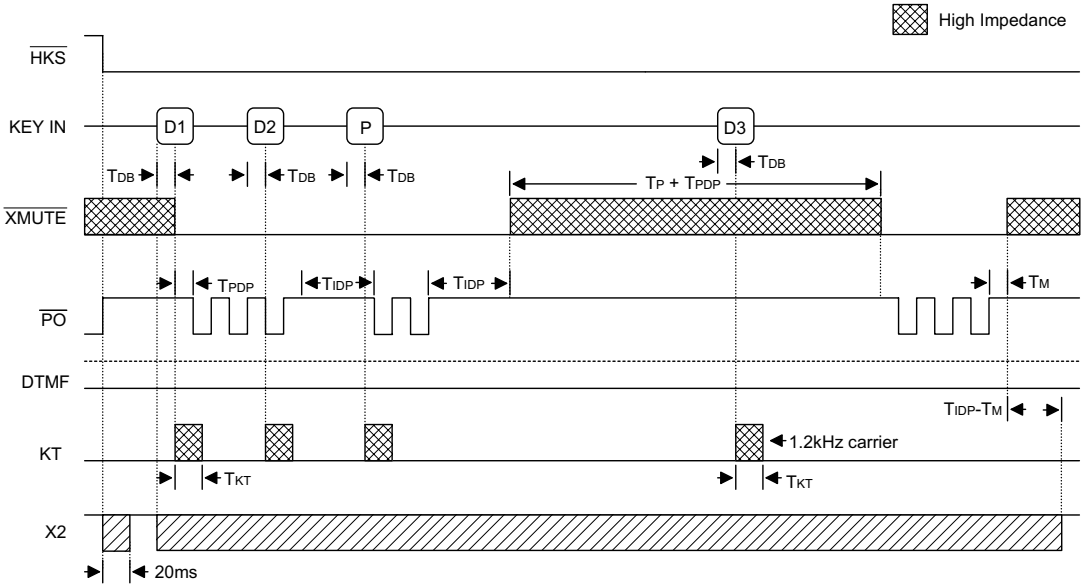


• Tone mode

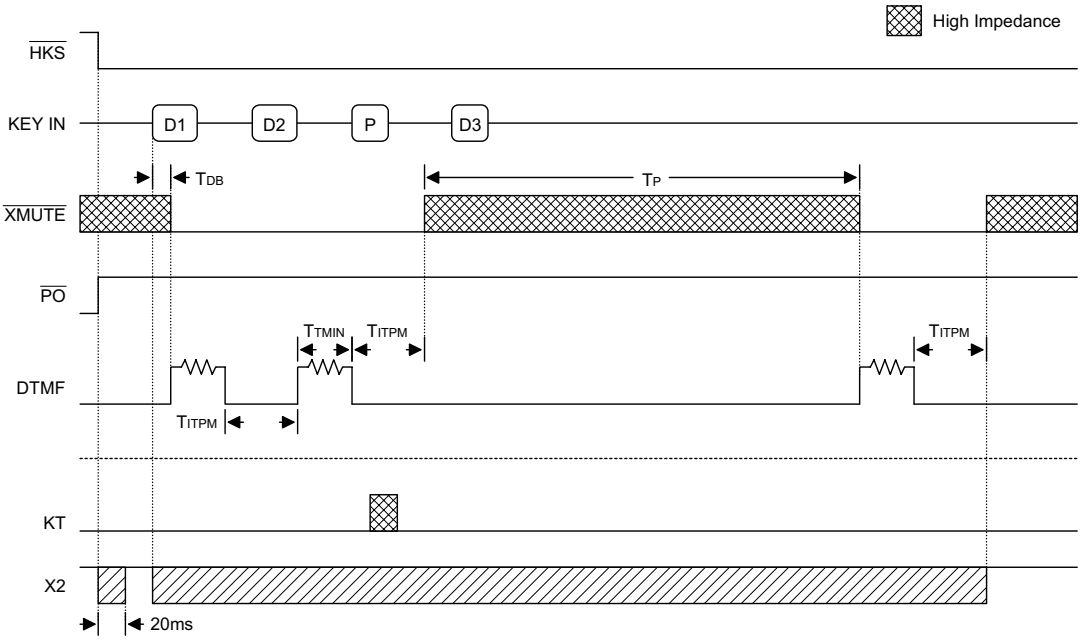


Dialing with Pause key

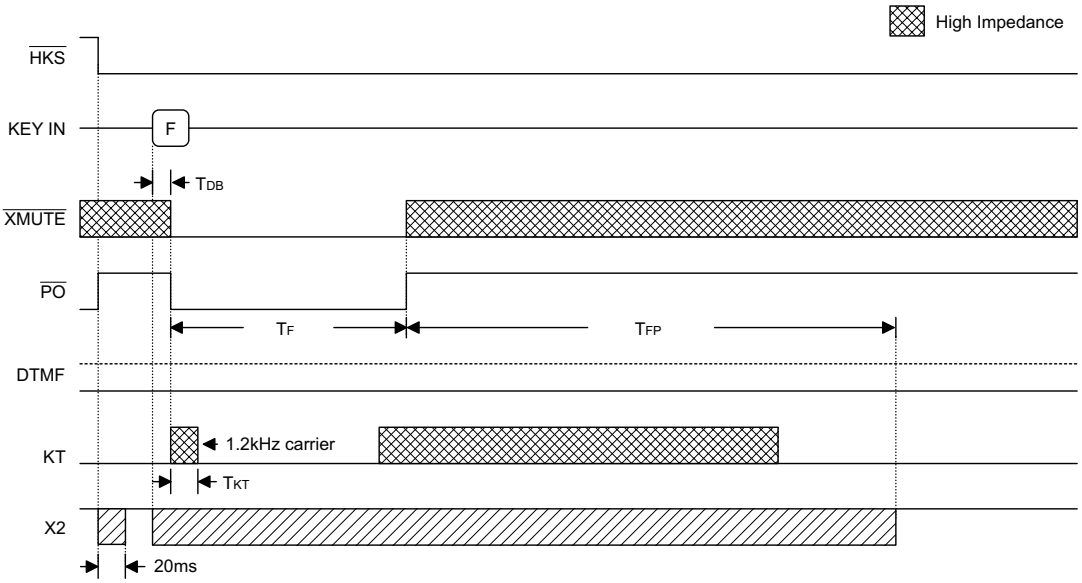
• Pulse mode



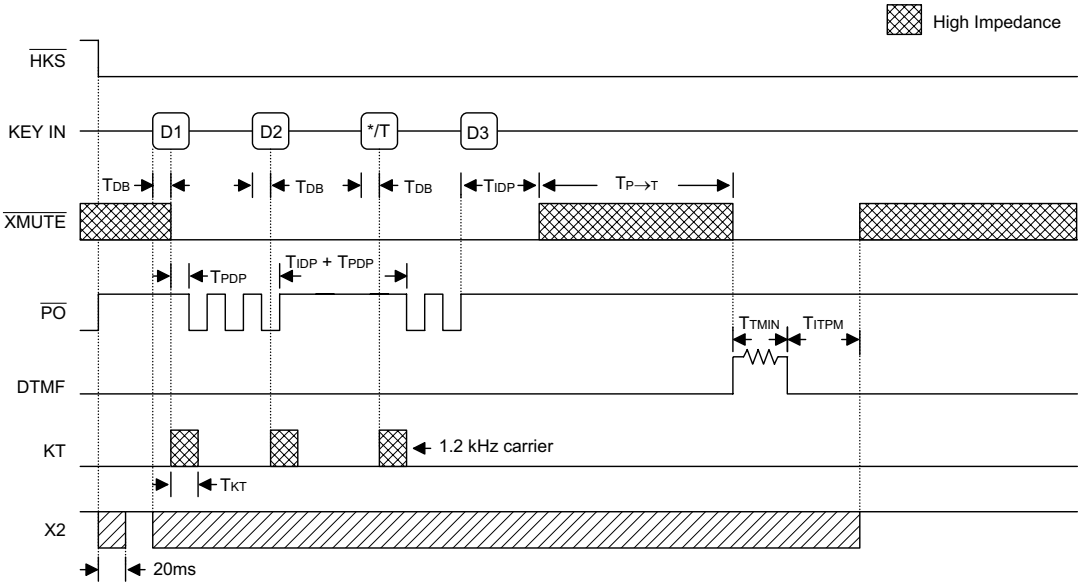
• Tone mode



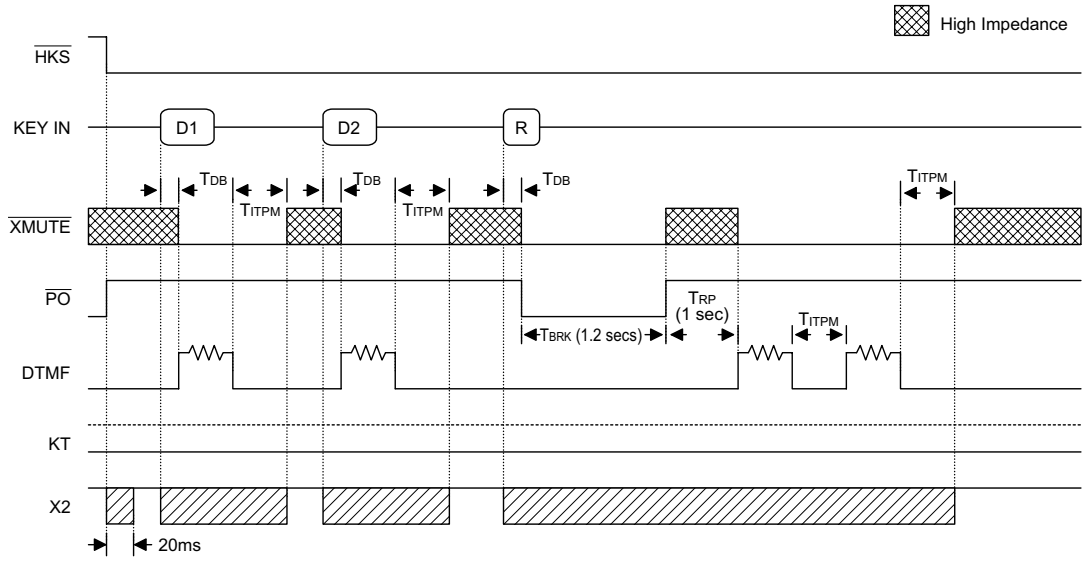
Flash key operation



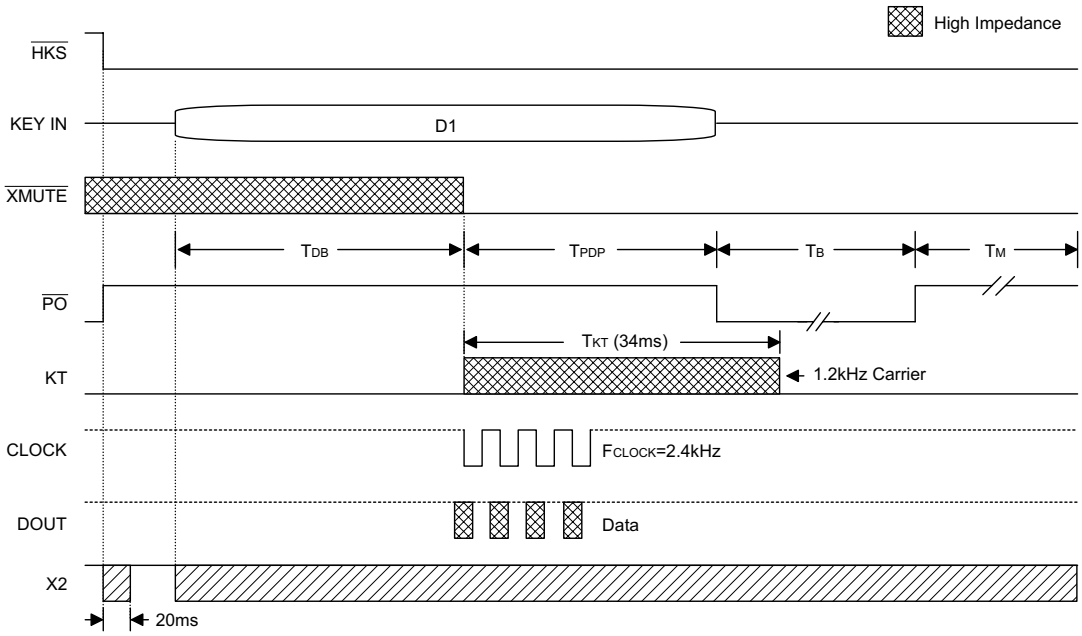
Pulse → Tone operation



One key redial operation



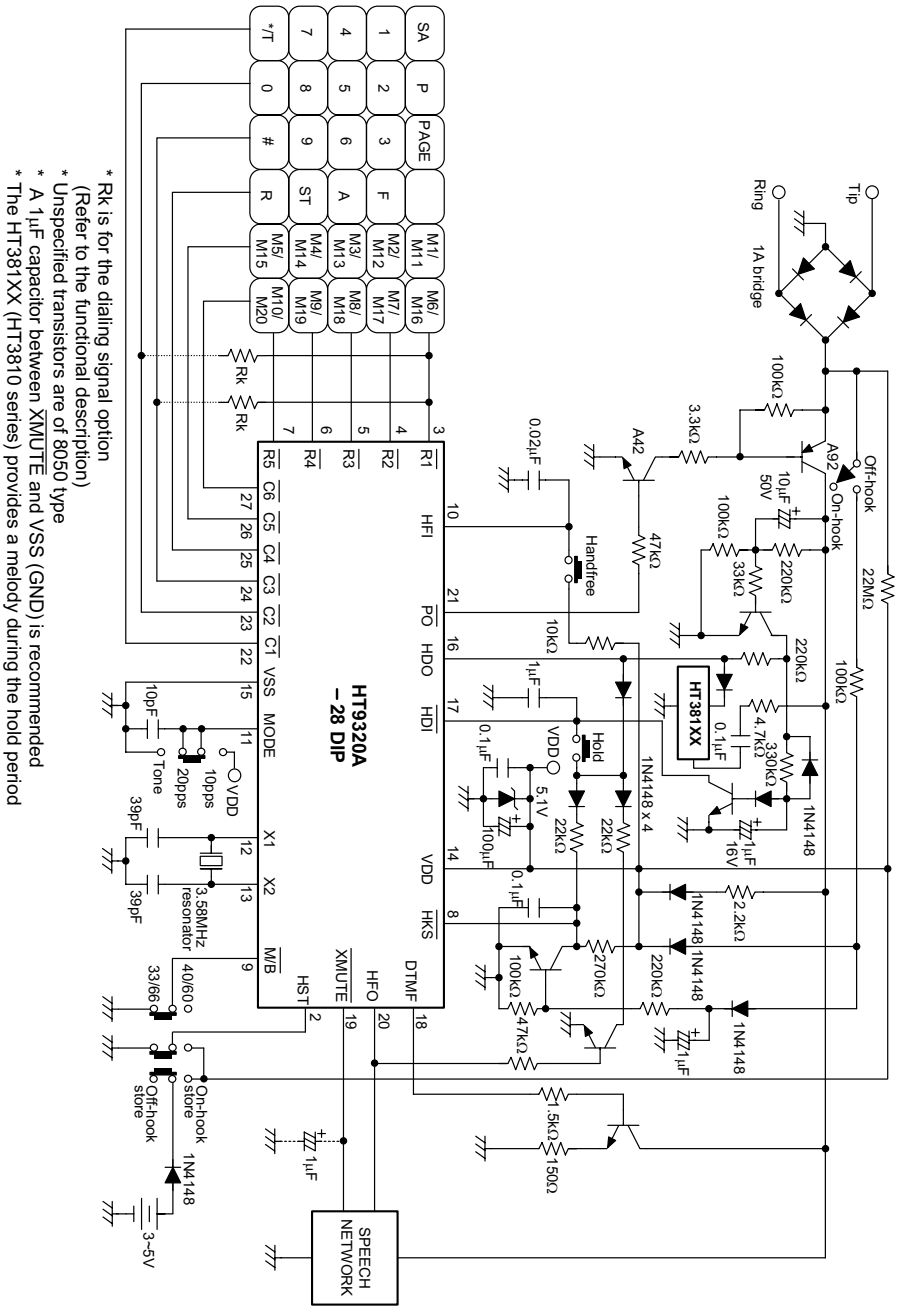
CLOCK & DOUT operating



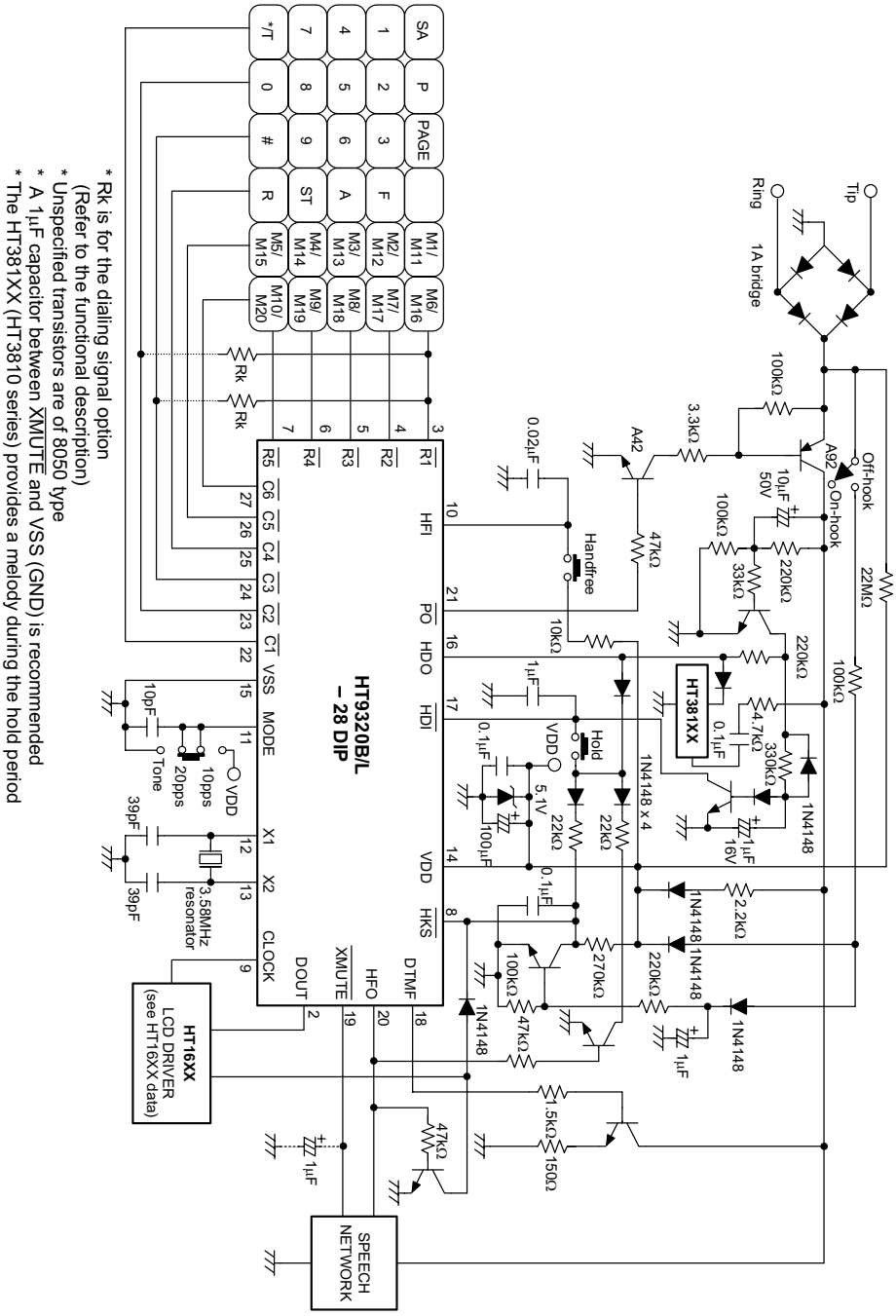
Note: D1=D3=3
D2=2

Application Circuits

Application circuit 1

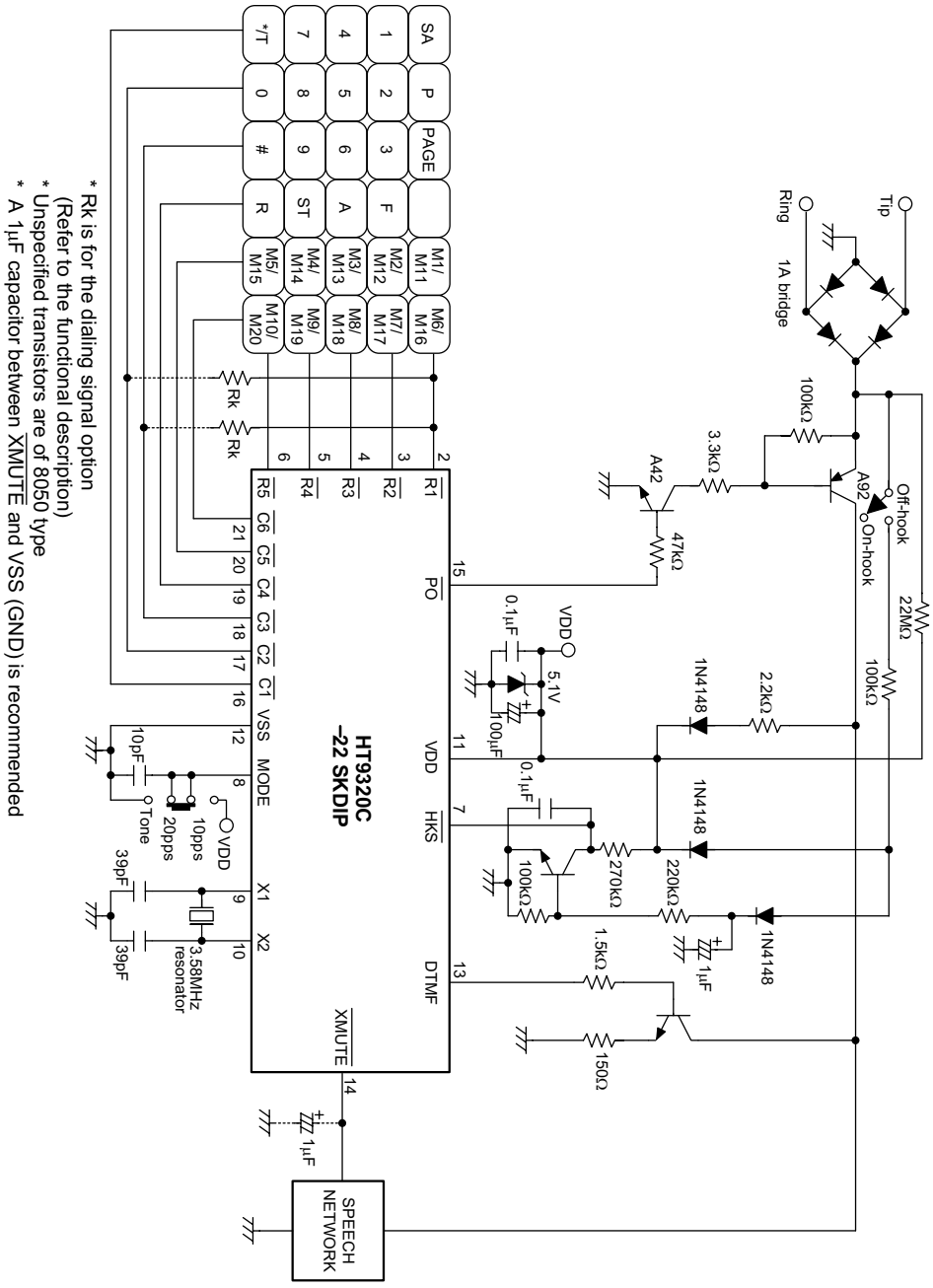


Application circuit 2



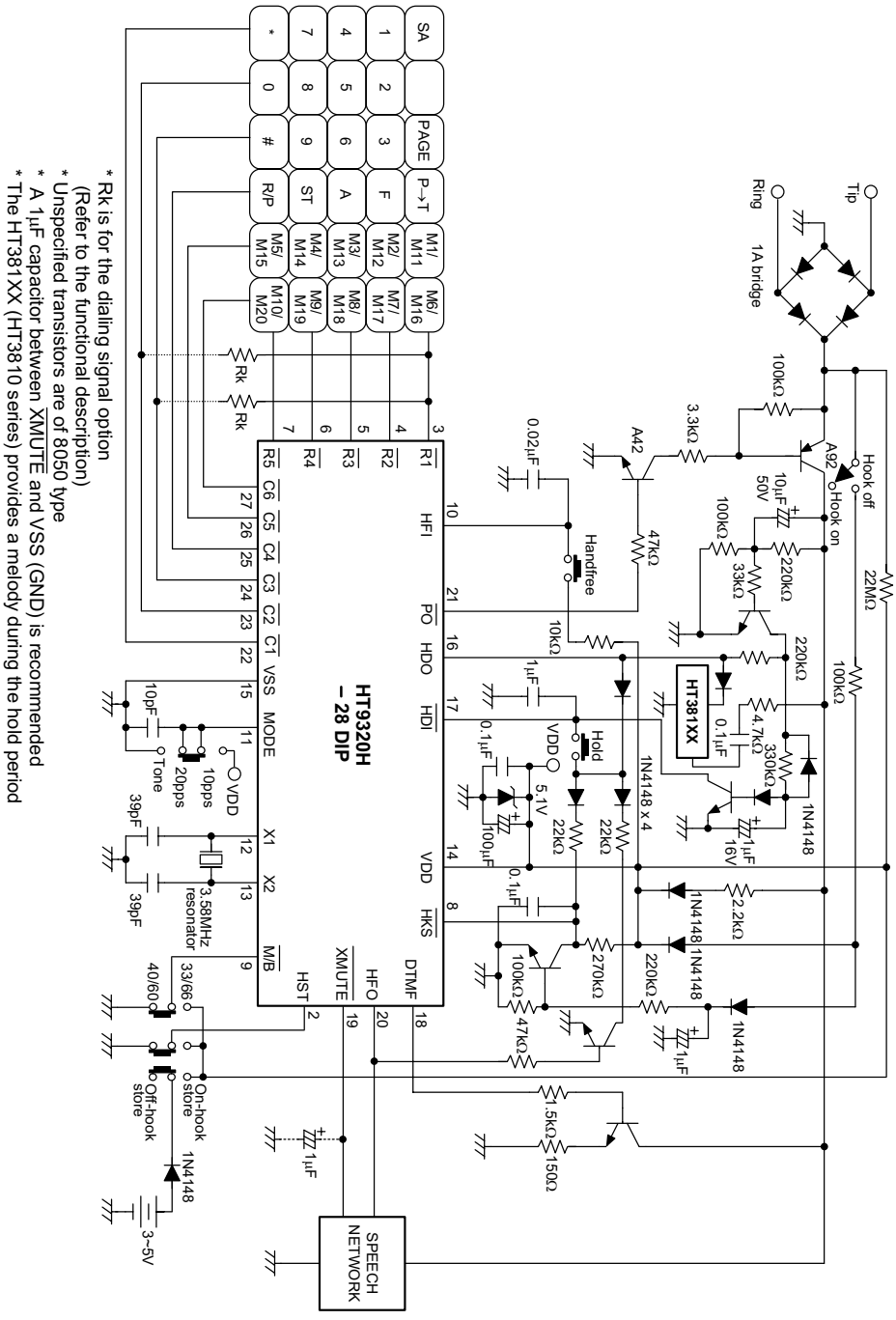
* Rk is for the dialing signal option
(Refer to the functional description)
* Unspecified transistors are of 8050 type
* A 1μF capacitor between XMUTE and VSS (GND) is recommended
* The HT381XX (HT3810 series) provides a melody during the hold period

Application circuit 3



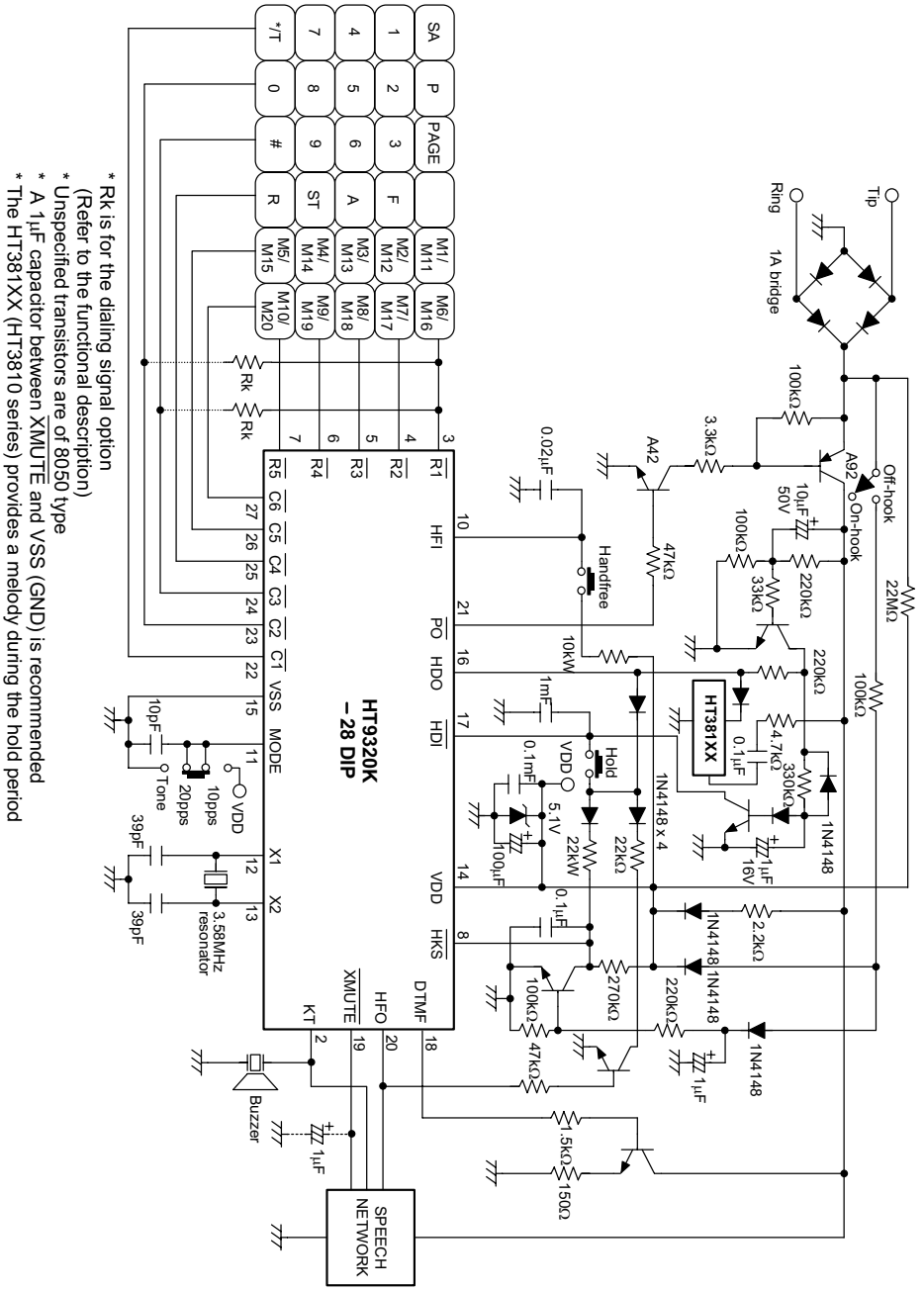
* Rk is for the dialing signal option
(Refer to the functional description)
* Unspecified transistors are of 8050 type
* A 1μF capacitor between $\overline{\text{XMUTE}}$ and VSS (GND) is recommended

Application circuit 4



* Rk is for the dialing signal option
(Refer to the functional description)
* Unspecified transistors are of 8050 type
* A 1μF capacitor between XMUTE and VSS (GND) is recommended
* The HT381XX (HT3810 series) provides a melody during the hold period

Application circuit 5



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