

Features

- Universal specification
- Operating voltage: 2.0V~5.5V
- Low stand-by 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 for the HT9220A/H
- Key-tone function for the HT9220K
- Lock function for the HT9220L
- 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 HT9220 series tone/pulse dialers are CMOS LSIs for the telecommunication system. They are designed to meet various dialing specifications through resistor options matrix.

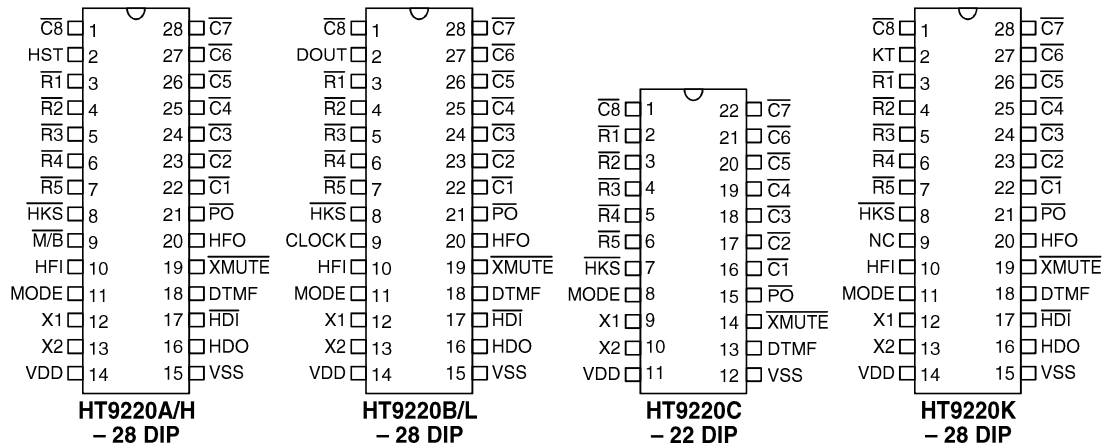
The HT9220 offers versatile functions such as: Hold-line, Hand-free and LCD dialing number display interface, all of which are suitable for feature phone applications.

The HT9220 provides SA, Redial (R/P), 20 one-touch/two-touch/three-touch memory (M1~M20) 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.

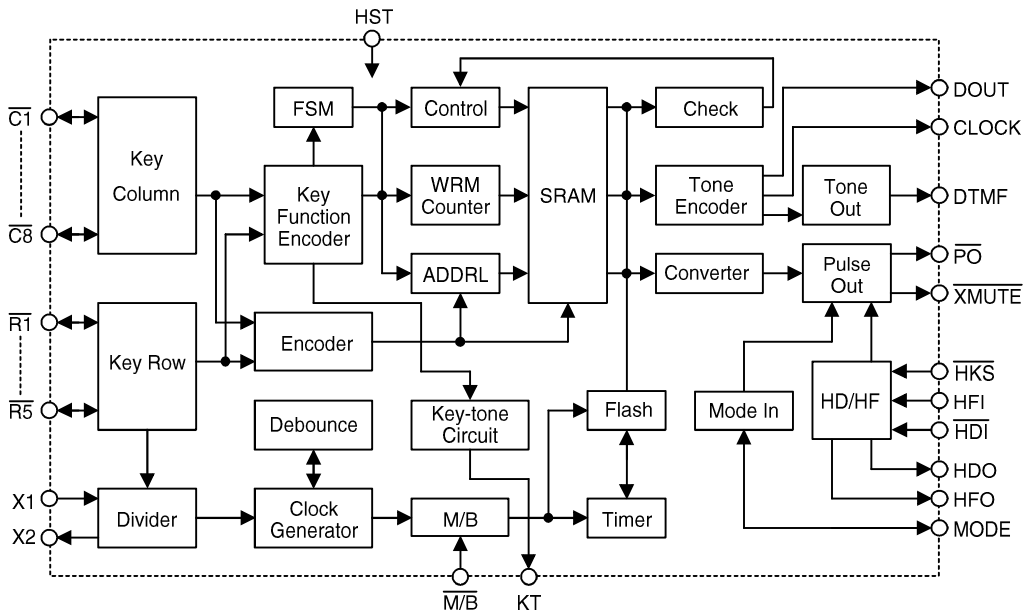
Selection Table

Function Item	Memory No.	Memory Dialing	Hold-Line	Hand-Free	LCD Interface	Flash Function	Flash Time (ms)	Pulse No.	Tone Duration (ms)	Inter-Tone-Pause (ms)	M/B Pin	IDD Lock	Key-Tone Output	On-Hook Store
HT9220A - 28 DIP	22	SA,R M1~M20	√	√	—	Control	600	N,N+1 10-N	82.5	85.5	√	—	—	√
						Digit	600/300/98							
HT9220B - 28 DIP	22	SA,R M1~M20	√	√	√	Control	600	N,N+1 10-N	82.5	85.5	—	—	—	—
						Digit	600/300/98							
HT9220C - 22 DIP	22	SA,R M1~M20	—	—	—	Control	600	N,N+1 10-N	82.5	85.5	—	—	—	—
						Digit	600/300/98							
HT9220H - 28 DIP	22	SA,R/P M1~M20	√	√	—	Digit	600/100	N	82.5	85.5	√	—	—	√
HT9220K - 28 DIP	22	SA,R M1~M20	√	√	—	Control	600	N,N+1 10-N	82.5	85.5	—	—	√	—
						Digit	600/300/98							
HT9220L - 28 DIP	22	SA,R M1~M20	√	√	√	Control	600	N,N+1 10-N	82.5	85.5	—	√	—	—
						Digit	600/300/98							

Package Information



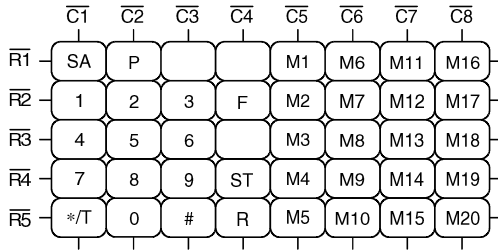
Block Diagram



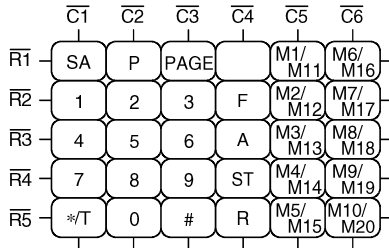
Keyboard Information

HT9220A/B/C/K/L

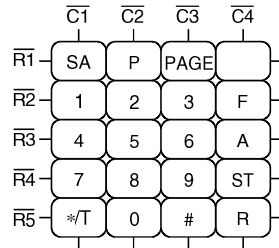
- One-touch memory keyboard



- Two-touch memory keyboard

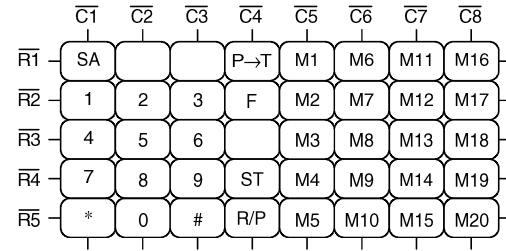


- Three-touch memory keyboard

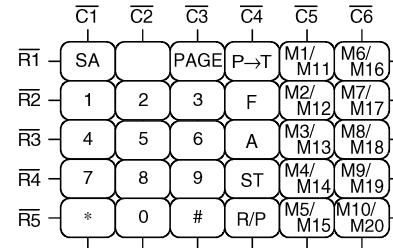


HT9220H

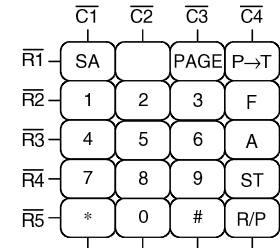
- One-touch memory keyboard



- 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	M1 ~ M10	A a (a=1~9,0)
M11~M20	M11 ~ M20	PAGE Ma (Ma=M1~M10)	A PAGE a (a=1~9,0)

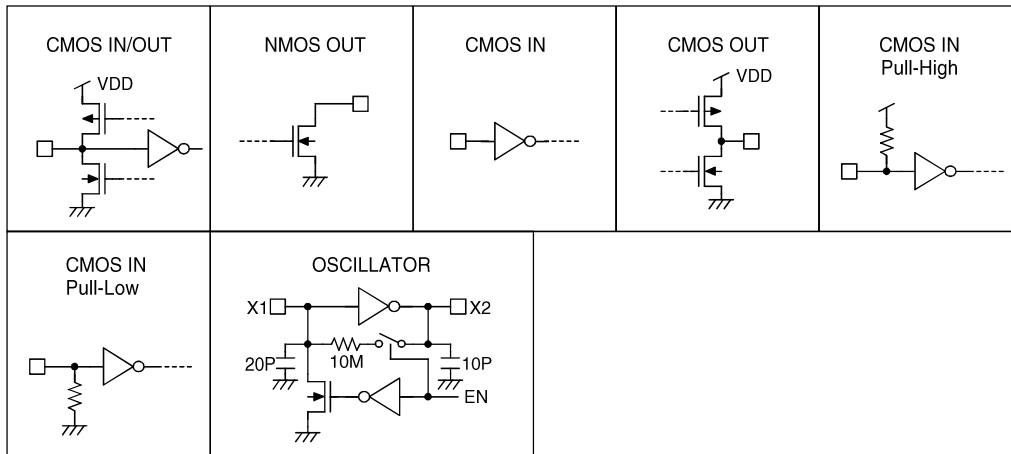
Pin Description

Pin Name	I/O	Internal Connection	Description
$\overline{C1}\sim\overline{C8}$ $\overline{R1}\sim\overline{R5}$	I/O	CMOS IN/OUT	These pins construct a 5×8 keyboard matrix to perform the keyboard input detecting and dialing specification setting functions. When on-hook (\overline{HKS} =high) all the pins are set to high. While off-hook the column group ($\overline{C1}\sim\overline{C8}$) stays low and the row group ($\overline{R1}\sim\overline{R5}$) is set to high for key input detecting. 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 to result in a dialing signal output. If more than two keys are pressed at the same time, no response can be brought about. The key-in debounce time is 20ms. Refer to the keyboard table 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 X1 and X2 terminals can implement the oscillator function. The oscillator is turned off in the stand-by mode, and is actuated whenever a keyboard entry is detected.
X2	O		
\overline{XMUTE}	O	NMOS OUT	The \overline{XMUTE} is an NMOS open drain structure pulled to VSS during dialing signal transmitting. Otherwise, it is an open circuit. The \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 can control the \overline{PO} pin output to make or break the line. \overline{HKS} =VDD: On-hook state (\overline{PO} =low). Except HFI/ \overline{HDI} (hand-free/hold-line 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	CMOS OUT	This pin is a CMOS output structure which receives \overline{HKS} and HFO signals to control the dialer so as to connect or disconnect the telephone line. \overline{PO} outputs low to break line when \overline{HKS} is high (on-hook) and HFO is low (hand-free inactive). \overline{PO} outputs high to make line when \overline{HKS} is low (off-hook) or HFO is high or HDO is high. During the off-hook state, the 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, provided to the user for selecting a dialing mode among Tone/20pps/10pps. 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 following entrance of digits to the tone mode. When the chips are working in the tone mode, the switching from tone to the pulse mode will be recognized.
DTMF	O	CMOS OUT	This pin is active only when the chip transmits tone dialing signals. Otherwise, it always outputs low. The pin outputs tone signals to drive the external transmitter amplifier circuit. The load resistor should not be less than 5K Ω .
$\overline{\text{HDI}}$	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 to use for the input debouncing. The pull-high resistance is 200K Ω typically.
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 to 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 hold-line back ground 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 to use for the input debouncing. The pull-low resistance of HFI is 200K Ω typically.
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 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 functional operation.
DOUT	O	NMOS OUT	This is an 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 the DOUT data synchronization. The 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 (HT9220A) CMOS IN (HT9220H)	On-hook store enable input HST=VDD: On-hook store (HT9220A/H) HST=Floating: Off-hook store (HT9220A) HST=VSS: Off-hook store (HT9220H) The pull-low resistance is 200KΩ typically.
$\overline{M/B}$	I	CMOS IN Pull-High (HT9220A) CMOS IN (HT9220H)	Make/Break ratio selection $\overline{M/B}$ =VSS: 33.3/66.6 (HT9220A) $\overline{M/B}$ =Floating: 40/60 (HT9220A) $\overline{M/B}$ =VDD: 33.3/66.6 (HT9220H) $\overline{M/B}$ =VSS: 40/60 (HT9220H) The pull-high resistance is 200KΩ typically.
KT	O	CMOS OUT	Key-tone output pin. It outputs 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 Storage Temperature -50°C to 125°C
 Input Voltage $V_{SS}-0.3$ to $V_{DD}+0.3V$ Operating Temperature -20°C to 75°C

Electrical Characteristics

 (F_{OSC}=3.5795MHz, T_a=25°C)

Symbol	Parameter	Test Condition		Min.	Typ.	Max.	Unit	
		V _{DD}	Condition					
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}	Stand-by 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}	$\overline{\text{XMUTE}}$ Leakage Current	—	V _{$\overline{\text{XMUTE}}$} =12V No entry	—	—	1	μA	
I _{OLXM}	$\overline{\text{XMUTE}}$ Sink Current	2.5V	V _{$\overline{\text{XMUTE}}$} =0.5V	1	—	—	mA	
I _{HKS}	$\overline{\text{HKS}}$ Pin Input Current	2.5V	V _{$\overline{\text{HKS}}$} =2.5V	—	—	0.1	μA	
R _{HFI}	HFI Pull-Low Resistance	2.5V	V _{HFI} =2.5V	—	200	—	KΩ	
R _{HDI}	$\overline{\text{HDI}}$ Pull-High Resistance	2.5V	V _{$\overline{\text{HDI}}$} =0V	—	200	—	KΩ	
R _{M/B}	$\overline{\text{M/B}}$ Pull-High Resistance	2.5V	V _{$\overline{\text{M/B}}$} =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 _{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	
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	—	2	—	s	
F _{OSC}	System Frequency	—	Crystal=3.5795MHz	3.5759	3.5795	3.5831	MHz	

Pulse Mode Electrical Characteristics

 (F_{OSC}=3.5795MHz, T_a=25°C)

Symbol	Parameter	Test Condition		Min.	Typ.	Max.	Unit
		V _{DD}	Condition				
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 $\overline{C1}$ (HT9220B/C/K/L).	—	33:66	—	%
			$\overline{M/B}$ =VSS (HT9220A)				
			$\overline{M/B}$ =VDD (HT9220H)				
			No resistor is linked between $\overline{R2}$ and $\overline{C1}$ (HT9220B/C/K/L).	—	40:60	—	
			$\overline{M/B}$ =Floating (HT9220A)				
			$\overline{M/B}$ =VSS (HT9220H)				
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)	—	
T _{IDP}	Inter-digit-pause Time	—	Pulse rate=10pps. No resistor is linked between $\overline{R1}$ and $\overline{C5}$ (HT9220A/B/C/K).	—	800	—	ms
			Pulse rate=10pps (HT9220H/L)				
			Pulse rate=10pps. A resistor is linked between $\overline{R1}$ and $\overline{C5}$ (HT9220A/B/C/K).	—	400	—	
			Pulse rate=20pps	—	500	—	
T _M	Pulse Make Duration	—	A resistor is linked between $\overline{R2}$ and $\overline{C1}$ (HT9220B/C/K/L).	—	33 (10pps) 17 (20pps)	—	ms
			$\overline{M/B}$ =VSS (HT9220A)				
			$\overline{M/B}$ =VDD (HT9220H)				
			No resistor is linked between $\overline{R2}$ and $\overline{C1}$ (HT9220B/C/K/L).	—	40 (10pps) 20 (20pps)	—	
			$\overline{M/B}$ =Floating (HT9220A)				
			$\overline{M/B}$ =VSS (HT9220H)				

Symbol	Parameter	Test Condition		Min.	Typ.	Max.	Unit
		V _{DD}	Condition				
T _B	Pulse Break Duration	—	A resistor is linked between R ₂ and C ₁ (HT9220B/C/K/L).	—	66 (10pps) 33 (20pps)	—	ms
			M/B=VSS (HT9220A)				
			M/B=VDD (HT9220H)				
			No resistor is linked between R ₂ and C ₁ (HT9220B/C/K/L).	—	60 (10pps) 30 (20pps)	—	
			M/B=Floating (HT9220A)				
			M/B=VSS (HT9220H)				
T _{KT}	Key-tone Duration	—	Pulse mode (HT9220K)	—	34	—	ms
F _{KTC}	Key-tone Carrier	—	Pulse mode (HT9220K)	—	1.2	—	KHz

Tone Mode Electrical Characteristics

 (F_{OSC}=3.5795MHz, T_a=25°C)

Symbol	Parameter	Test Condition		Min.	Typ.	Max.	Unit
		V _{DD}	Condition				
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	Vr.m.s
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	—	82.5	—	ms
T _{ITPM}	Minimum Inter-tone Pause	—	Auto-redial	—	85.5	—	ms

$$\text{THD (Distortion) (dB)} = 20 \log \left(\frac{\sqrt{V_1^2 + V_2^2 + \dots + V_n^2}}{\sqrt{V_i^2 + V_h^2}} \right)$$

 V_i, V_h: Row group and column group signals

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

Functional Description

Keyboard matrix

The $\overline{C1}\sim\overline{C8}$ and $\overline{R1}\sim\overline{R5}$ make up of a keyboard matrix. Together with a standard 5x8 keyboard, the keyboard matrix is used for dialing entrance. In addition, the keyboard matrix also provides resistor options for different dialing specification selections. The 6 forms keyboard arrangement for the HT9220 series are listed in **Keyboard Information**.

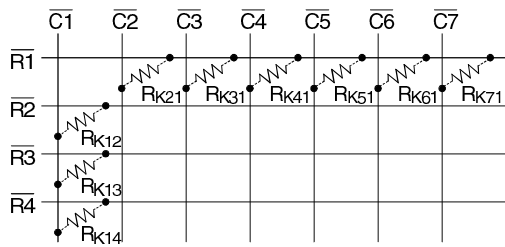
Tone frequency

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%

% Error does not contain the crystal frequency drift.

Dialing specification selection

By means of adding resistors across keyboard matrix pins, various dialing specifications can be selected. The allowable option resistor connections are shown below.



All the resistors are 330KΩ. The resistor option functions and the default specifications (without option resistors) are listed below (HT9220A/B/C/K/L).

Option Resistor	Option Function	Default (No Resistor)
R _{K12} (HT9220B /C/K/L)	Ratio Selection	40:60
R _{K13} R _{K14}	Flash Function /Time Selection	Flash= control function Flash time= 600ms
R _{K21}	Pause & P→T Duration Selection	T _P = 3.6s T _{P→T} = 3.6s
R _{K31} R _{K41}	Pulse Number Selection	N
R _{K51} (HT9220A /B/C/K)	Inter-digit-Pause Time for 10pps	800ms
R _{K51} R _{K61} R _{K71} (HT9220L)	International Direct Dialing Lock Selection	Normal dialing (unlock)

M/B ratio selection table

- HT9220A

M/B Pin	M/B Ratio (%)
VSS	33.3:66.6
Floating	40:60

- HT9220B/C/K/L

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

- HT9220H

M/B Pin	M/B Ratio (%)
VDD	33.3:66.6
VSS	40:60

Flash function/time (duration) selection table

- HT9220A/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

- HT9220H

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

Pause and P→T duration selection table

- HT9220A/B/C/K/L

R _{K21}	T _P (sec)	T _{P→T} (sec)
No	3.6	3.6
Yes	2	1

- HT9220H

T _P (sec)	T _{P→T} (sec)
3.6	3.6

Pulse number selection table

- HT9220A/B/C/K/L

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

- HT9220H

Pulse Number
N

Inter-digit-pause time for 10pps

- HT9220A/B/C/K

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

- HT9220H/L

Inter-digit pause time
800ms

Pulse number table

Keypad Digit Key	Output Pulse Number		
	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

Tone duration and pause in redial function

Parameter	Symbol	Typ.	Unit
Minimum Tone Duration	T _{TMIN}	82.5	ms
Minimum Inter-tone Pause	T _{ITPM}	85.5	ms
Cycle Time	T _C	168	ms

DOUT BCD code

When dialing, the corresponding 4-bit BCD codes are serially presented on DOUT from MSB to LSB. The data of the 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 (HT9220A/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) at the on-hook state.

On/Off hook store selection table

HST Pin	Hook Store Mode
VDD (HT9220A/H)	On-hook store
Floating (HT9220A)	Off-hook store
VSS (HT9220H)	Off-hook store

Lock function (IDD lock)

This function aims to detect lock dialing number 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: "—" is equal to "don't care".

Hand-free function operation

- Hand-free function execution
When HFO is low, a rising edge triggers the HFI, asserting 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	
HKS	HFO	HDO	HDI	HFI	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 operation

• **Hold-line function execution**

When HDO is low, a falling edge triggers the $\overline{\text{HDI}}$, asserting the Hold-line function (HDO becomes high). The $\overline{\text{XMUTE}}$ 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 $\overline{\text{HDI}}$
- Changing the HFO pin from low to high

• **Hold-line function table**

Current State			Input			Next State	
HKS	HDO	HFO	HFI	$\overline{\text{HDI}}$	HKS	HDO	HFO
H	L	X	L	H	An	L	An
H	L	X	L	\downarrow	An	H	L
H	H	L	L	\downarrow	An	L	An
H	X	X	L	H	L	L	L
L	L	X	L	H	An	L	An
L	L	X	L	\downarrow	An	H	L
L	H	L	L	\downarrow	An	L	An
L	X	X	L	H	H	An	An
X	X	L	\uparrow	H	An	L	H

H: Logic HIGH X: Don't care \uparrow : Rising edge
 L: Logic LOW An: Unchanged \downarrow : Falling edge

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.

• *** (HT9220H)**

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

• **P→T**

The key executes the P→T function in the pulse mode. No response will be brought out 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 depressed 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 a control key by the option resistors R_{K13} & R_{K14} . Pressing the flash key will force the $\overline{\text{PO}}$ 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 the pause key can pause the output for the T_P duration. T_P can be selected by R_{K21} .

• **R**

Redial key. It executes the 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 the key can actuate the store memory function with (or without) dialing output. During the dialing signal transmission, the ST key is inhibited.

• **A**

Auto key. When it is pressed before 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 and 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 all described under an on-off-hook or on-hook with the hand-free active condition.

• Normal dialing

– Pulse mode

(a) without */T

Keyboard input: $\boxed{D1} \boxed{D2} \dots \boxed{Dn}$

Dialing output: D1 D2 ... Dn

RM: D1 D2 ... Dn

SAM: Unchanged

(b) with */T

Keyboard input: $\boxed{D1} \boxed{D2} \dots \boxed{Dn} \boxed{*/T} \boxed{Dn+1} \dots \boxed{Dm}$

Dialing output: $\underbrace{D1 D2 \dots Dn}_{\text{Pulse}} \text{TP} \rightarrow \text{T} \underbrace{Dn+1 \dots Dm}_{\text{Tone}}$

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

SAM: Unchanged

– Tone mode

(a) without */T

Keyboard input: $\boxed{D1} \boxed{D2} \dots \boxed{Dn}$

Dialing output: D1 D2 ... Dn

RM: D1 D2 ... Dn

SAM: Unchanged

(b) with */T

Keyboard input: $\boxed{D1} \boxed{D2} \dots \boxed{Dn} \boxed{*/T} \boxed{Dn+1} \dots \boxed{Dm}$

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 over 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: \boxed{R}

Dialing output: D1 D2 ... Dn

RM: Unchanged

SAM: Unchanged

(b) with */T

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

Keyboard input: \boxed{R} (or $\boxed{R/P}$)

Dialing output: $\underbrace{D1 D2 \dots Dn}_{\text{Pulse}} \text{TP} \rightarrow \text{T} \underbrace{Dn+1 \dots Dm}_{\text{Tone}}$

RM: Unchanged

SAM: Unchanged

– Tone mode

(a) without */T, P→T

RM content: D1 D2 ... Dn

Keyboard input: \boxed{R}

Dialing output: D1 D2 ... Dn

RM: Unchanged

SAM: Unchanged

(b) with */T

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

Keyboard input: \boxed{R} (or $\boxed{R/P}$)

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

RM: Unchanged

SAM: Unchanged

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

• One-key redial

– Pulse mode

(a) without */T

Keyboard input: $\boxed{D1} \boxed{D2} \dots \boxed{Dn} \boxed{R}$

Dialing output: $\underbrace{D1 \ D2 \dots Dn}_{\text{Pulse}} \text{ TBRK TRP}$

$\underbrace{D1 \ D2 \dots Dn}_{\text{Pulse}}$

RM: D1 D2 ... Dn

SAM: Unchanged

(b) with */T

Keyboard input: $\boxed{D1} \boxed{D2} \dots \boxed{Dn} \boxed{*/T} \boxed{Dn+1} \dots \boxed{Dm} \boxed{R}$

Dialing output: $\underbrace{D1 \ D2 \dots Dn}_{\text{Pulse}} \text{ TP} \rightarrow \text{T} \underbrace{Dn+1 \dots Dm}_{\text{Tone}}$

$\text{TBRK TRP} \underbrace{D1 \ D2 \dots Dn}_{\text{Pulse}} \text{ TP} \rightarrow \text{T}$

$\underbrace{Dn+1 \dots Dm}_{\text{Tone}}$

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

SAM: Unchanged

– Tone mode

(a) without */T

Keyboard input: $\boxed{D1} \boxed{D2} \dots \boxed{Dn} \boxed{R}$

Dialing output: D1 D2 ... Dn TBRK TRP D1 D2 ... Dn

RM: D1 D2 ... Dn

SAM: Unchanged

(b) with */T

Keyboard input: $\boxed{D1} \boxed{D2} \dots \boxed{Dn} \boxed{*/T} \boxed{Dn+1} \dots \boxed{Dm} \boxed{R}$

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

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

SAM: Unchanged

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

• Pause

Keyboard input: $\boxed{D1} \boxed{D2} \dots \boxed{Dn} \boxed{P}$ (or $\boxed{R/P}$) $\boxed{Dn+1} \dots \boxed{Dm}$

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

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

SAM: Unchanged

• SA copy

– Pulse mode

(a) without */T

Keyboard input: $\boxed{D1} \boxed{D2} \dots \boxed{Dn} \boxed{SA}$

Dialing output: D1 D2 ... Dn

RM: D1 D2 ... Dn

SAM: D1 D2 ... Dn

(b) with */T

Keyboard input: $\boxed{D1} \boxed{D2} \dots \boxed{Dn} \boxed{*/T} \boxed{Dn+1} \dots \boxed{Dm} \boxed{SA}$

Dialing output: $\underbrace{D1 \ D2 \dots Dn}_{\text{Pulse}} \text{ TP} \rightarrow \text{T} \underbrace{Dn+1 \dots Dm}_{\text{Tone}}$

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

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

– Tone mode

(a) without */T

Keyboard input: $\boxed{D1} \boxed{D2} \dots \boxed{Dn} \boxed{SA}$

Dialing output: D1 D2 ... Dn

RM: D1 D2 ... Dn

SAM: D1 D2 ... Dn

(b) with */T

Keyboard input: $\boxed{D1} \boxed{D2} \dots \boxed{Dn} \boxed{*/T} \boxed{Dn+1} \dots \boxed{Dm} \boxed{SA}$

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 over 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: $\underbrace{D1 D2 \dots Dn}_{\text{Pulse}} \underbrace{TP \rightarrow T Dn+1 \dots Dm}_{\text{Tone}}$
 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

– Two-touch memory store without dialing output (M1~M10)

Keyboard input: **[ST] [D1] [D2] ... [Dn] [ST] [b]**
 Dialing output:
 Mb: D1 D2 ... Dn
 RM: D1 D2 ... Dn
 SAM: Unchanged

– Three-touch memory store without dialing output (M1~M20)

Keyboard input: **[ST] [D1] [D2] ... [Dn] [ST] [PAGE] [b]**
 Dialing output:
 Ma: D1 D2 ... Dn (a=b+10, M10=M0)
 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: **[D1] [D2] ... [Dn] [ST] [ST] [b]**
 Dialing output: D1 D2 ... Dn
 Mb: D1 D2 ... Dn
 RM: D1 D2 ... Dn
 SAM: Unchanged

– Three-touch memory store with dialing output (M1~M20)

Keyboard input: **[D1] [D2] ... [Dn] [ST] [ST] [PAGE] [b]**
 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 is over 32 digits, the memory store is inhibited.
 However, if the dialing number is not over 32 digits the memory will store 16 digits at maximum.
 Ma=M1~M20, 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

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

– 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

• 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 is over 32 digits, the 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 TF TFP Dn+1 ... Dm
 RM: D1 D2 ... Dn
 SAM: Unchanged

(b) The first key

Keyboard input: **[F] [D1] [D2] ... [Dn]**
 Dialing output: TF TFP 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 TF TFP Dn+1 ... Dm
 RM: Dn+1 ... Dm
 SAM: Unchanged

Note: TF: break a flash time

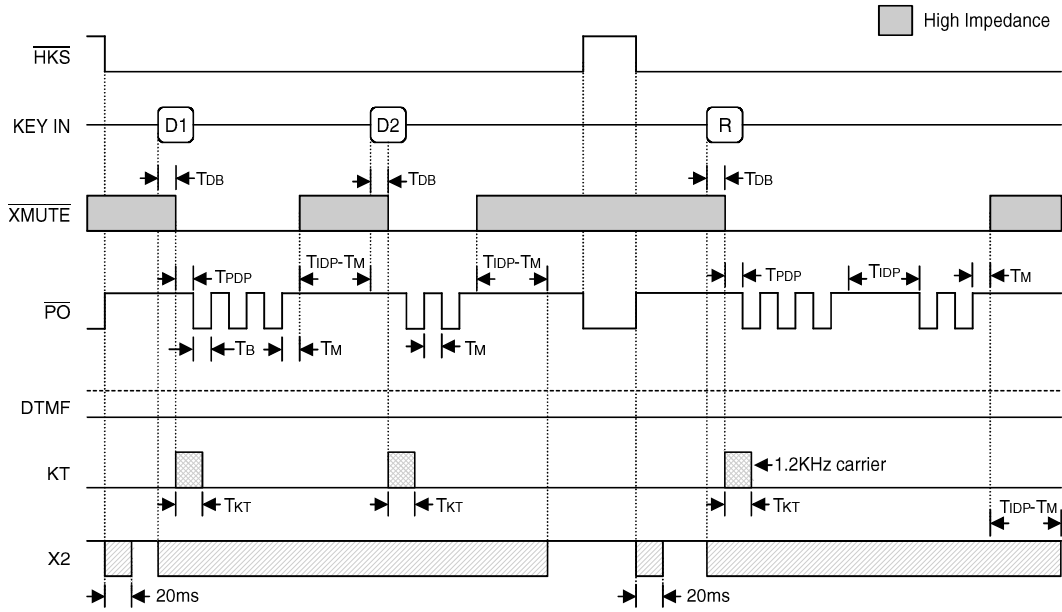
- IDD lock operation by the keyboard (2 lock numbers, 3 digits/number at maximum)
(A 330KΩ resistor is connected between $\overline{C5}$ and $\overline{R1}$.)
 - Personal/Lock No.1/Lock No.2 input operation
 - (a) Personal code doesn't exist
 - Stores Personal Code: ST D1 D2 D3 ST * 0
 - Stores Lock 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 DI ... Dn
 (Personal code)
- Note: D1~D12 = 0~9
 Dm Dm+1 Dm+2 = 0~9
 DI ... Dn = 0~9, *, #

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

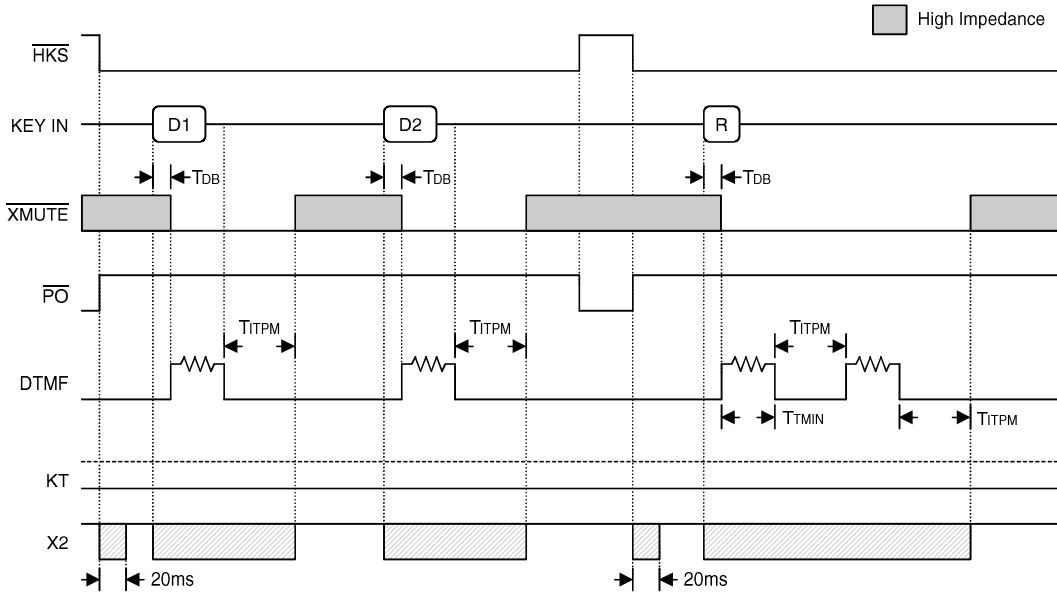
Operation Timing

Normal dialing

• Pulse mode

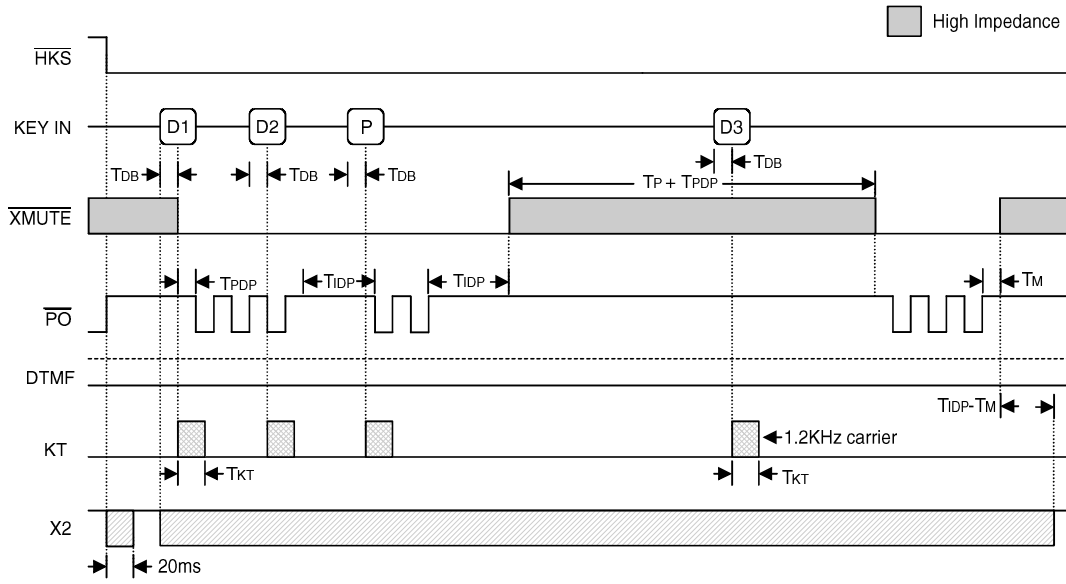


• Tone mode

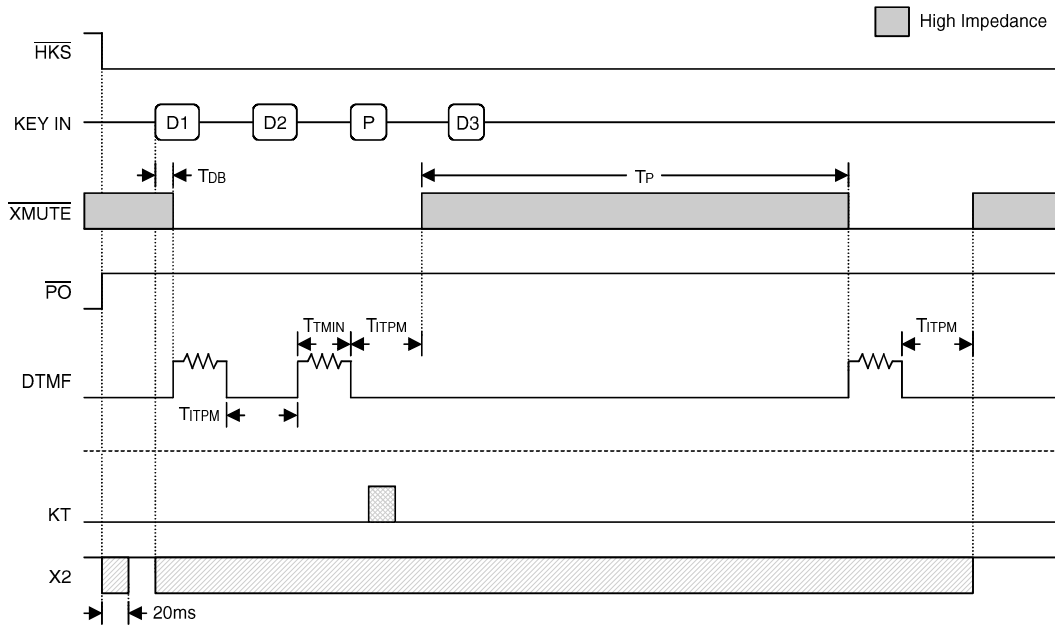


Dialing with Pause key

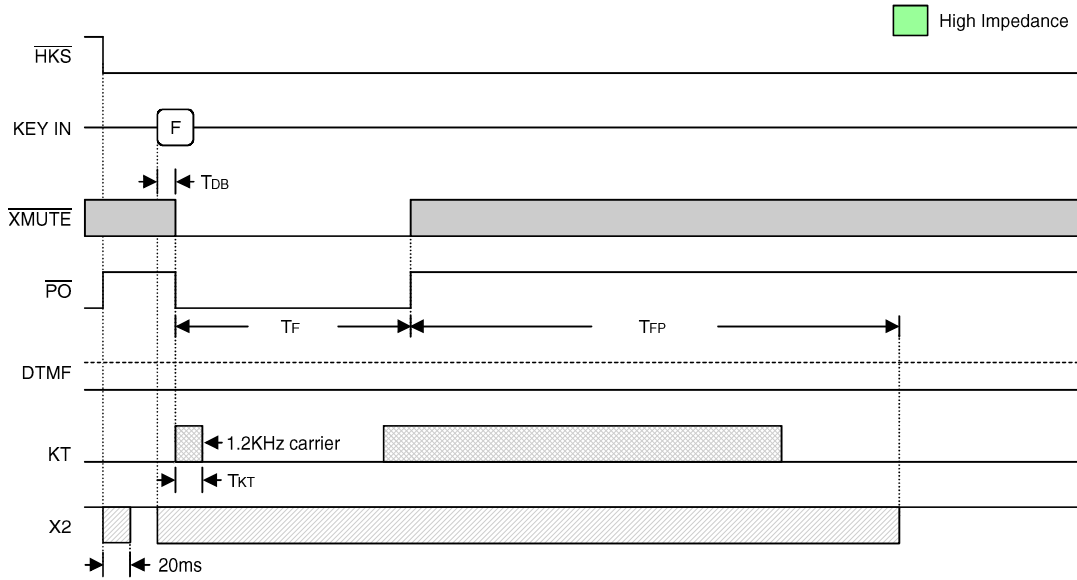
• Pulse mode



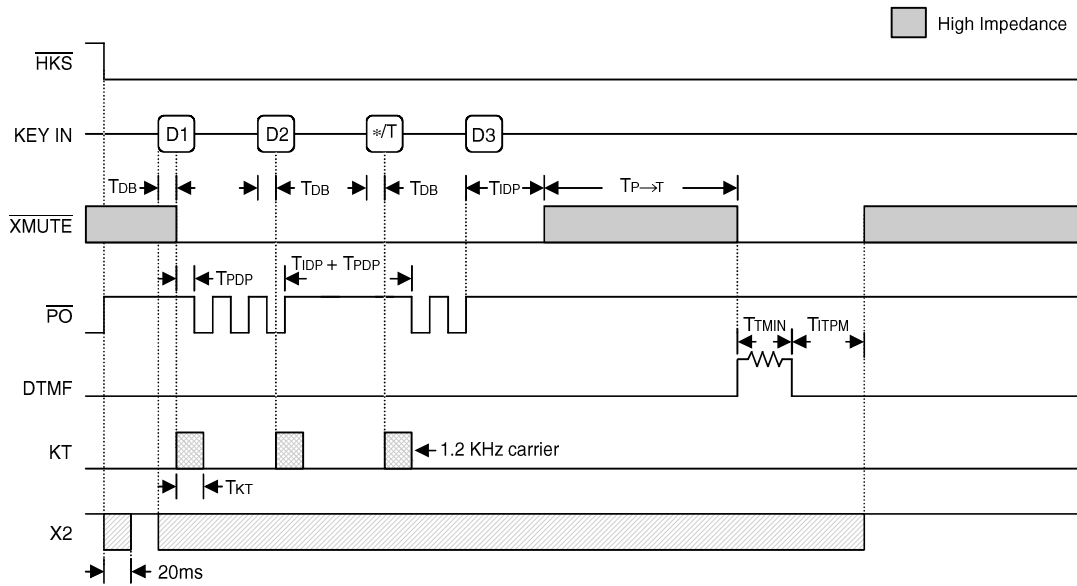
• Tone mode



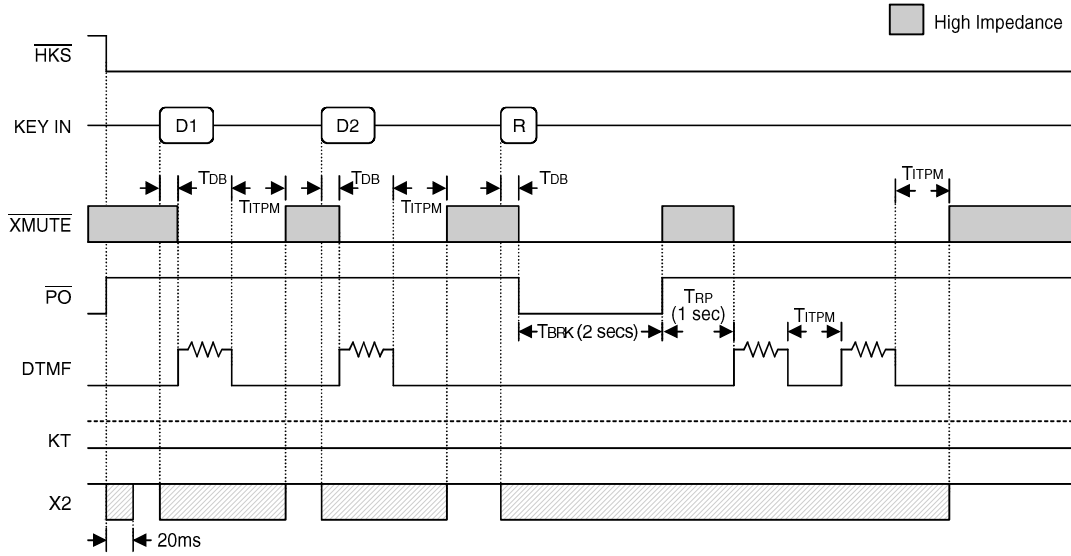
Flash key operation



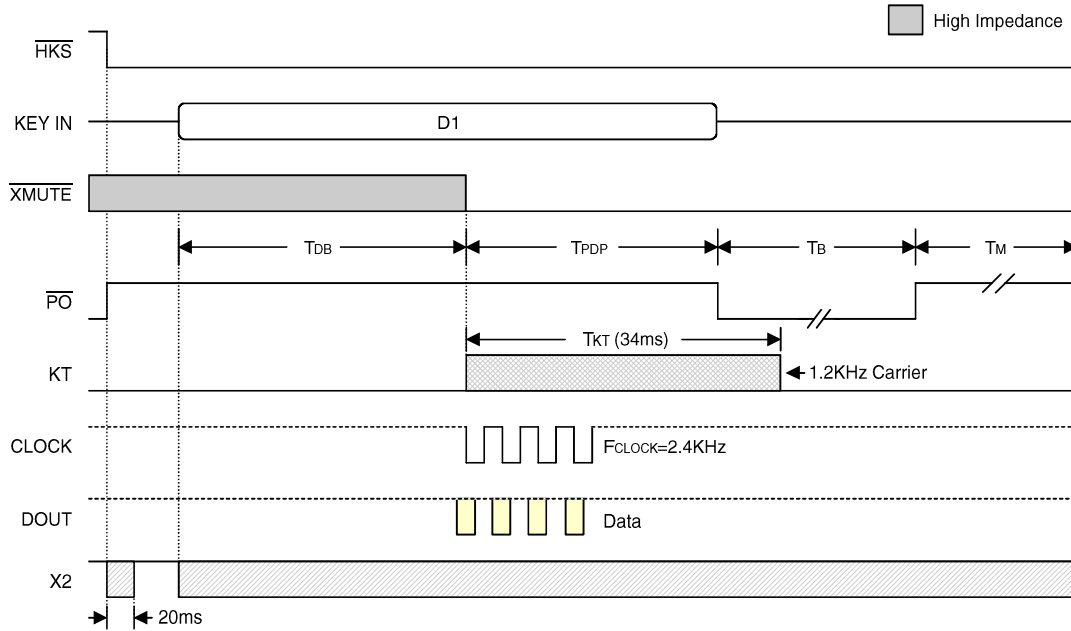
Pulse → Tone operation



One key redial operation



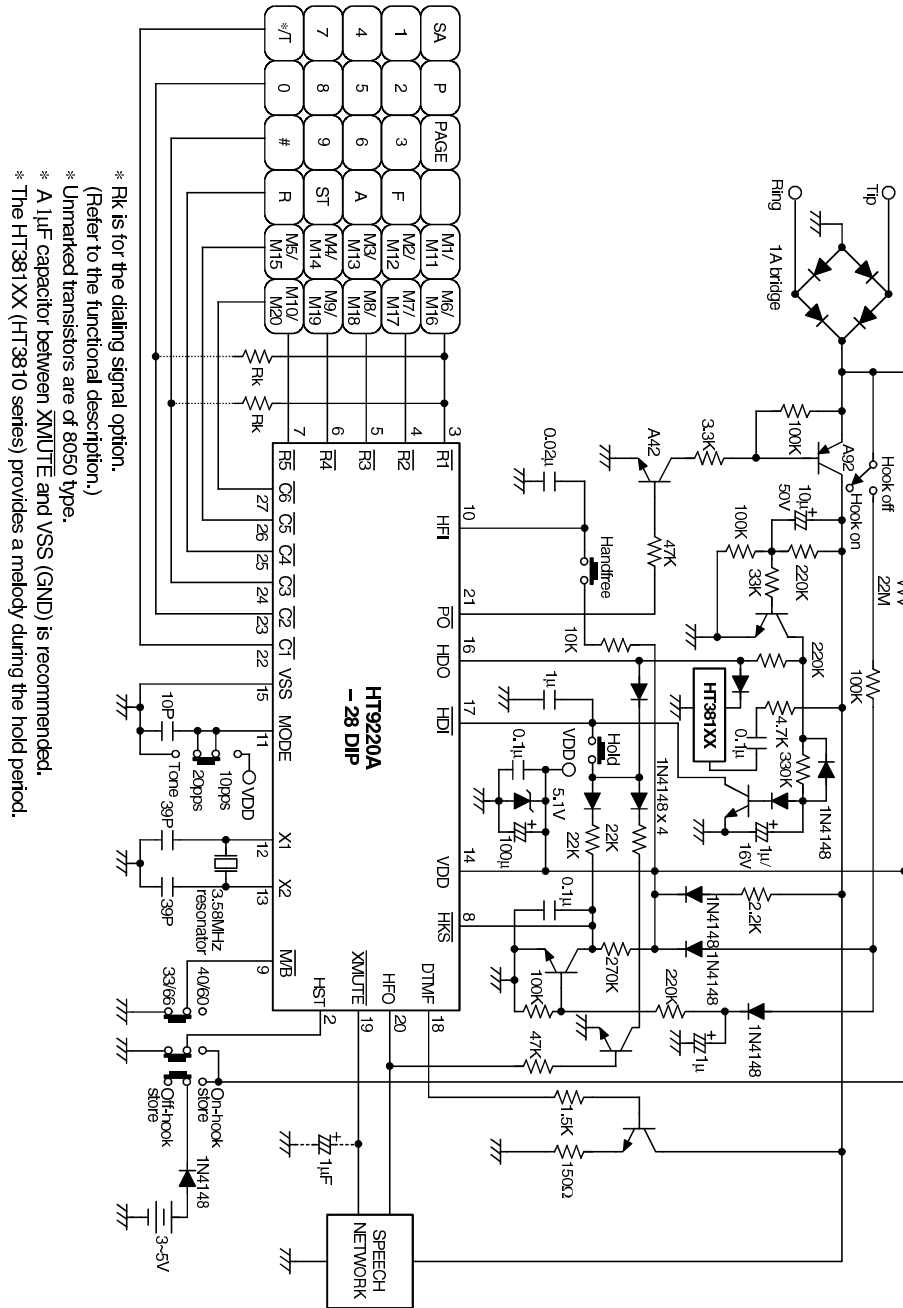
CLOCK & DOUT operating



Note: D1=D3=3
D2=2

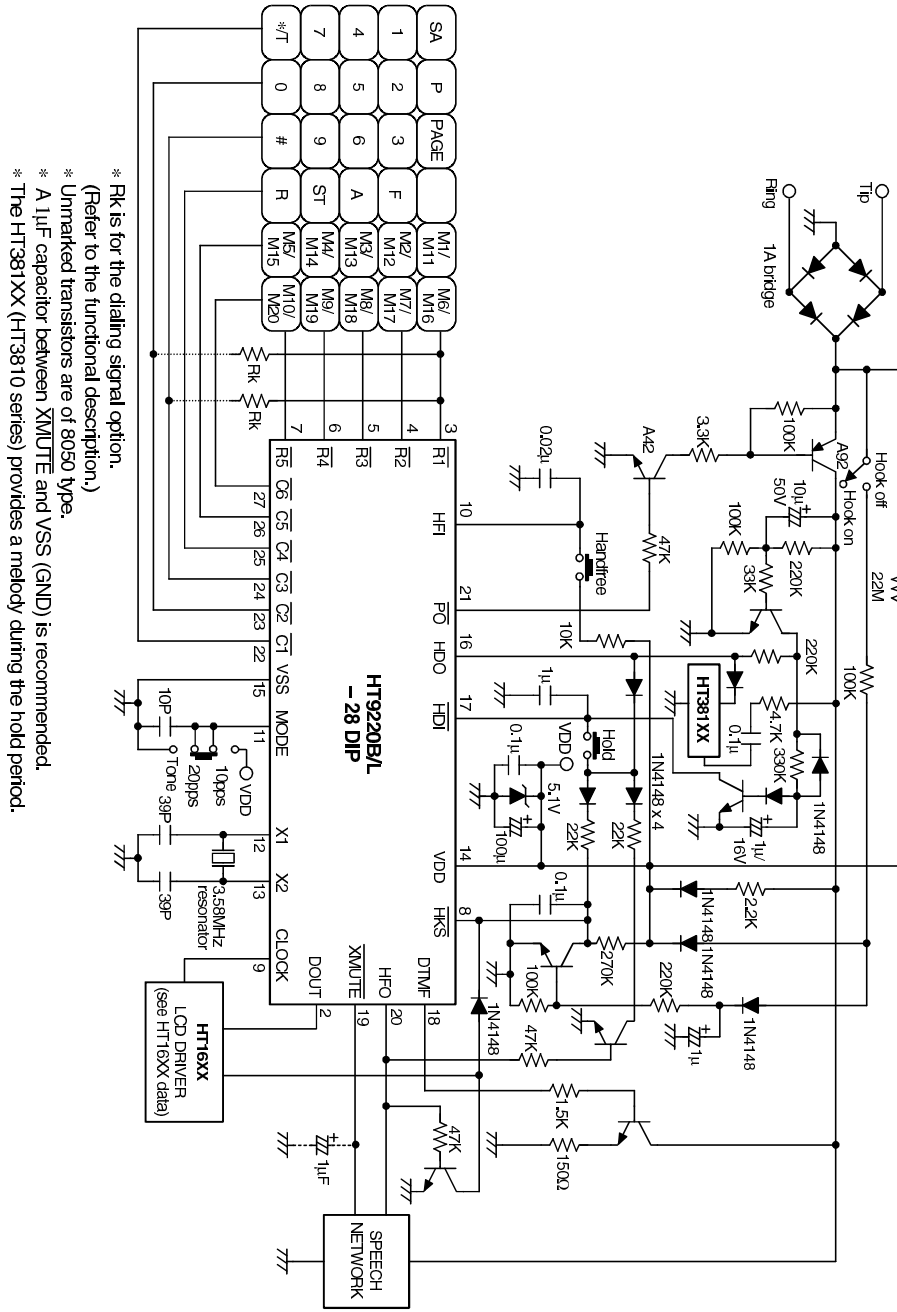
Application Circuits

Application circuit 1

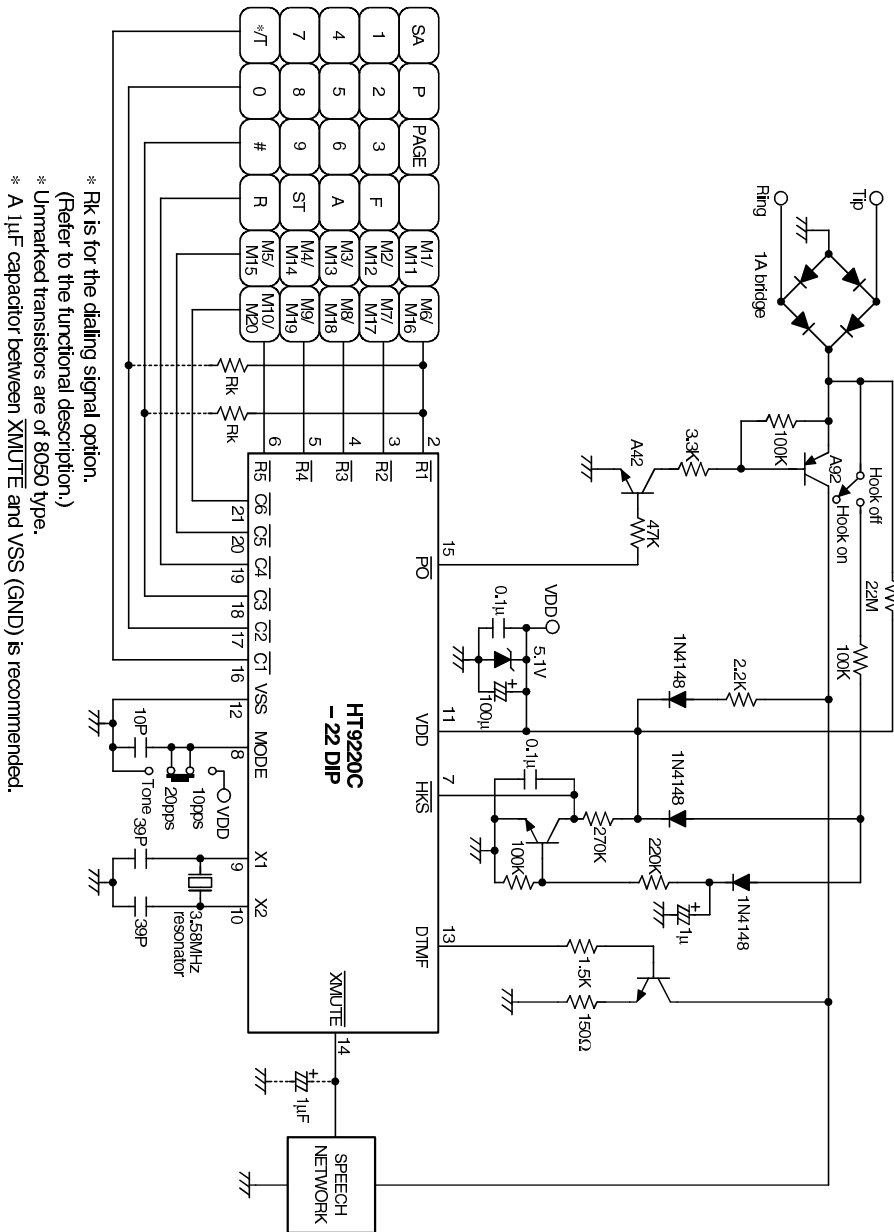


- * Rk is for the dialling signal option. (Refer to the functional description.)
- * Unmarked transistors are of 8050 type.
- * A 1μF capacitor between XMUTE and VSS (GND) is recommended.
- * The HT381XX (HT3810 series) provides a melody during the hold period.

Application circuit 2

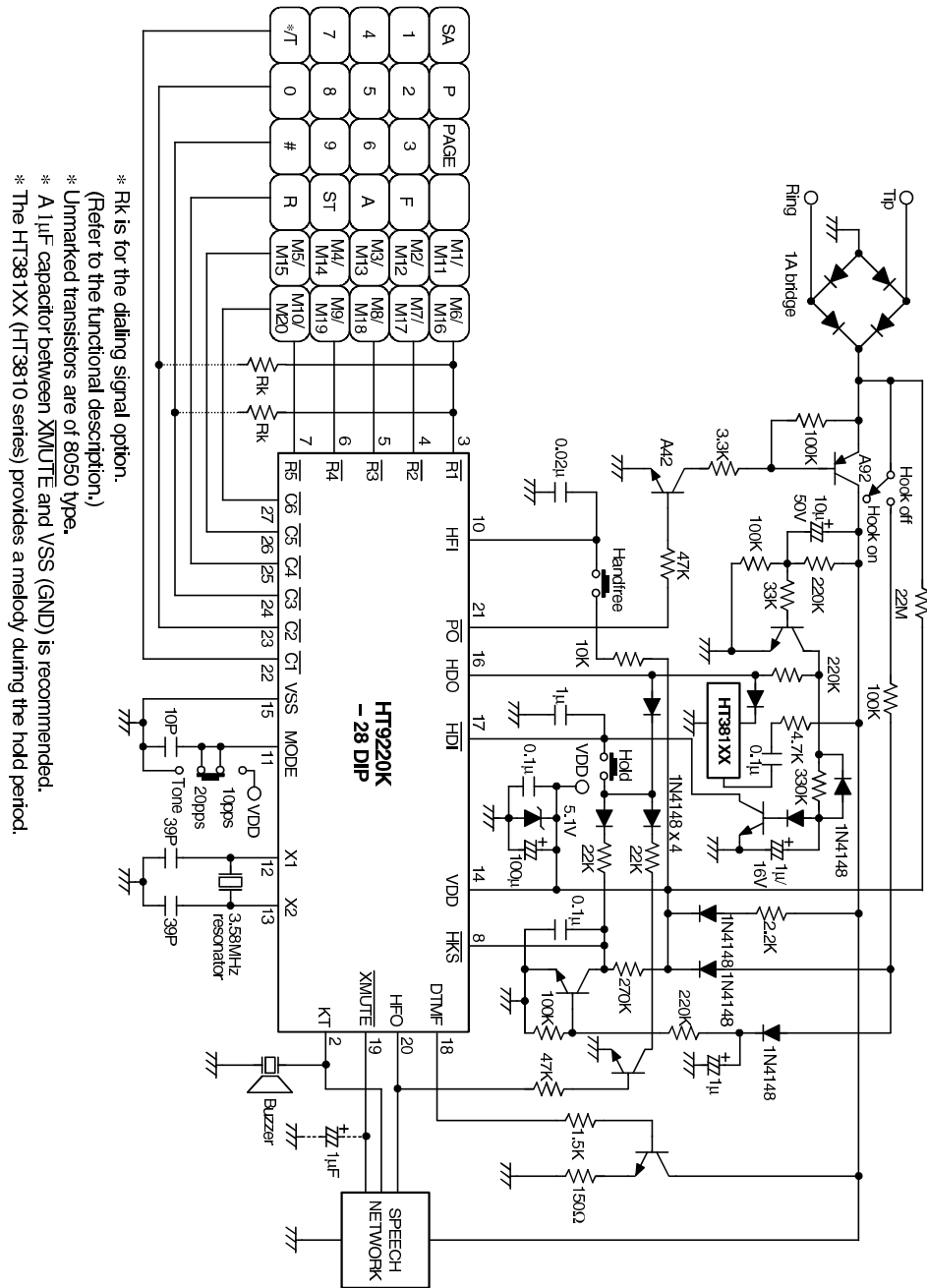


Application circuit 3



* Rk is for the dialing signal option.
 (Refer to the functional description.)
 * Unmarked transistors are of 8050 type.
 * A 1µF capacitor between XMUTE and VSS (GND) is recommended.

Application circuit 5



- * Fk is for the dialling signal option. (Refer to the functional description.)
- * Unmarked 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.