

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

Features

- Universal specification
- Operating voltage: 2.0V~5.5V
- Low standby current
- Low memory retention current: 0.1 μ A (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
- HT9320A/B/H/K/L-X: 28-pin DIP package
- HT9320C: 22-pin SKDIP package

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.

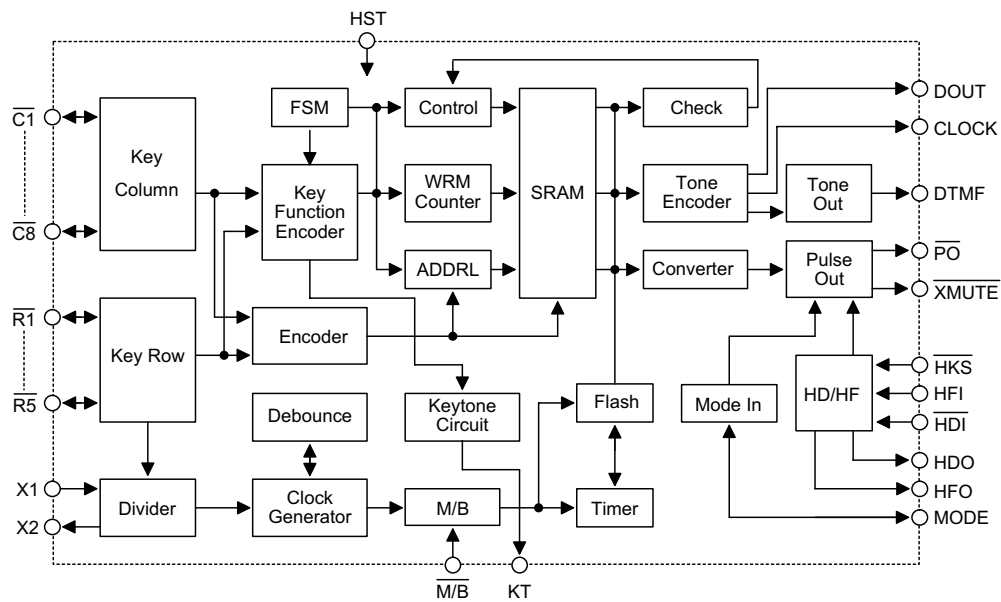
The HT9320 series are offered in six different versions. The different functions of the six versions are listed in the selection table. The HT9320A, HT9320H versions provide the on-hook store function; the HT9320B version provides the LCD interface function; the HT9320K version provides the keytone function; 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.

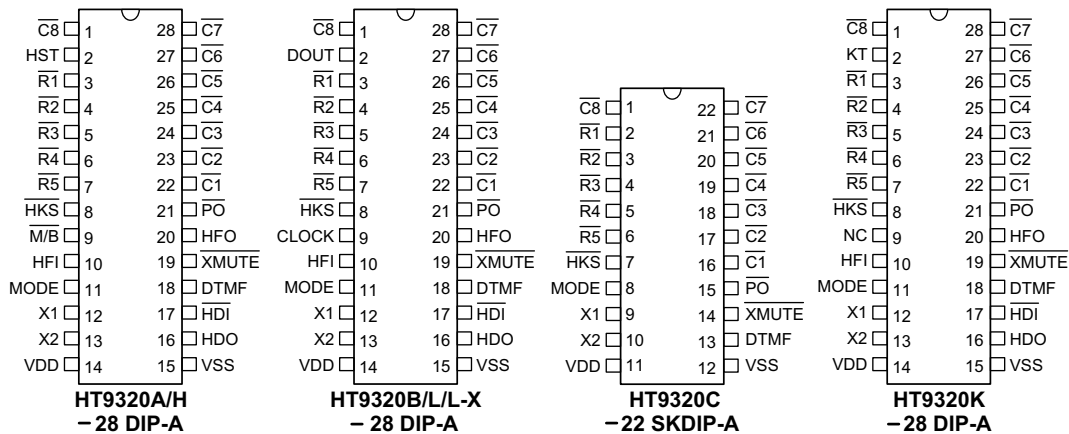
HT9320 series provide SA, Redial and 20 one-touch/two-touch memory dialing. If the keyboard includes M1~M20 keys it can be used as one-touch memory dialing. Otherwise, it works as two-touch (PAGE→M1~M10) or three-touch (A→PAGE→0~9) memory dialing for speed dialing in either pulse or tone mode.

Selection Table

Function Part No.	Memory Dialing	Hold- Line	Hand- Free	LCD Interface	Flash Function	Flash Time (ms)	Pulse No.	Tone Dura- tion (ms)	Inter- Tone- Pause (ms)	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	85.5	√	—	—	√	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.													

Block Diagram


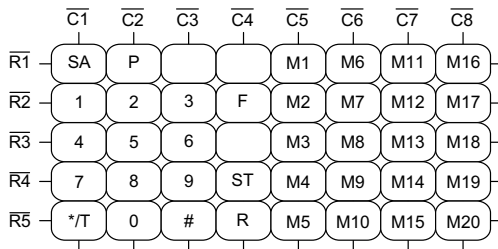
Pin Assignment



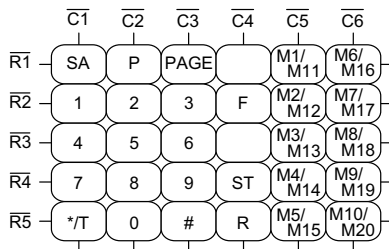
Keyboard Information

HT9320A/B/C/K/L

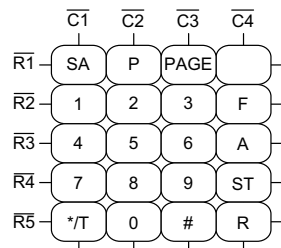
• One-touch memory keyboard



• Two-touch memory keyboard

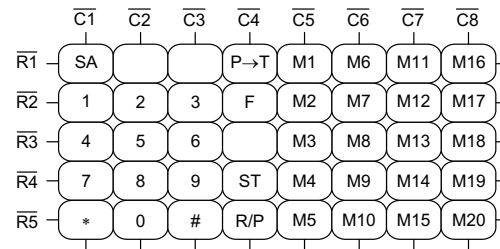


• Three-touch memory keyboard

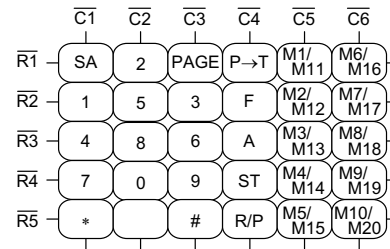


HT9320H

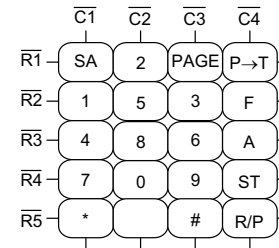
• One-touch memory keyboard



• Two-touch memory keyboard



• Three-touch memory keyboard



Memory dialing vs. keyboard form table

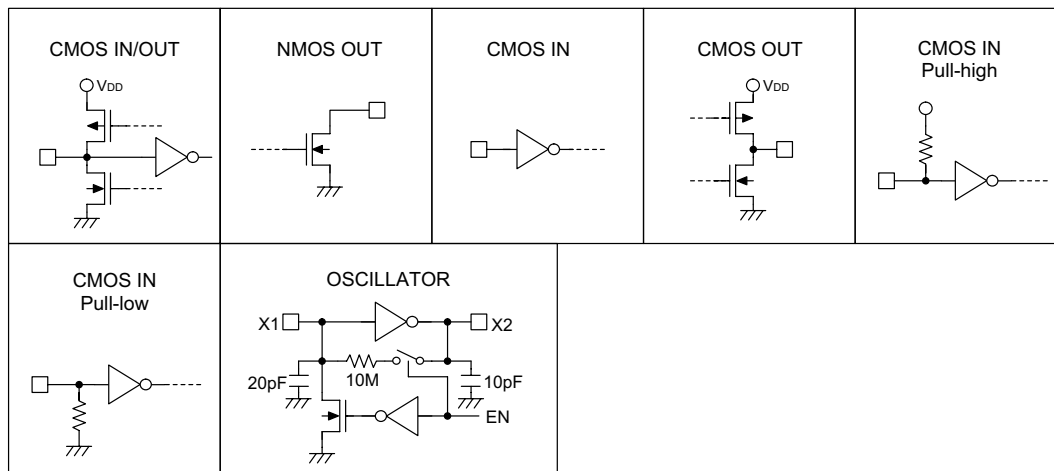
Dialing Output	One-Touch Memory Keyboard	Two-Touch Memory Keyboard	Three-Touch Memory Keyboard
M1~M10	M1 ~ M10	A a (a=1~9, 0)	
M11~M20	M11 ~ M20	PAGE Ma (Ma=M1~M10)	A PAGE a (a=1~9, 0)

Pin Description

Pin Name	I/O	Internal Connection	Description
$\overline{C1}\sim\overline{C8}$ $\overline{R1}\sim\overline{R5}$	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 ($\overline{C1}\sim\overline{C8}$) remains low and the row group ($\overline{R1}\sim\overline{R5}$) 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/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/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 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.
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.

Pin Name	I/O	Internal Connection	Description
$\overline{\text{HDI}}$	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 200k Ω typ.
HDO	O	CMOS OUT	The HDO is a CMOS output structure. Its output is toggle- controlled by a negative transition on HDI. When HDO is toggled high, 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 HDI input. 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 200k Ω 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 MCU for dialing number display. Refer to the functional description for the detailed timing.
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	—	—	Positive power supply, 2.0V~5.5V for normal operation
VSS	—	—	Negative power supply, ground
HST	I	CMOS IN Pull-low (HT9320A)	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 200k Ω typ.
		CMOS IN (HT9320H)	
$\overline{\text{M/B}}$	I	CMOS IN Pull-high (HT9320A)	Make/Break ratio selection $\overline{\text{M/B}}$ =VSS: 33.3/66.6 (HT9320A) $\overline{\text{M/B}}$ =Floating: 40/60 (HT9320A) $\overline{\text{M/B}}$ =VDD: 33.3/66.6 (HT9320H) $\overline{\text{M/B}}$ =VSS: 40/60 (HT9320H) The pull-high resistance is 200k Ω typ.
		CMOS IN (HT9320H)	
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	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

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

$f_{osc}=3.5795MHz$, $T_a=25^{\circ}C$

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	—	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	—	5.5	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_{HKS}	HKS Pin Input Current	2.5V	$V_{HKS}=2.5V$	—	—	0.1	μA
R_{HFI}	HFI Pull-low Resistance	2.5V	$V_{HFI}=2.5V$	—	200	—	$k\Omega$
R_{HDI}	HDI Pull-high Resistance	2.5V	$V_{HDI}=0V$	—	200	—	$k\Omega$
$R_{M/B}$	$\overline{M/B}$ Pull-high Resistance	2.5V	$V_{\overline{M/B}}=0V$	—	200	—	$k\Omega$

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V _{DD}	Conditions				
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
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, T_a=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 R2 and C1 (HT9320B/C/K/L)	—	33:66	—	%	
			$\overline{M/B}$ =VSS (HT9320A)					
			$\overline{M/B}$ =VDD (HT9320H)					
			No resistor is linked between R2 and 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 R1 and C5 (HT9320A/B/C/K)	—	400	—	
			Pulse rate=20pps				
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	V _{rms}
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

$\overline{C1}\sim\overline{C8}$ and $\overline{R1}\sim\overline{R5}$ 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**.

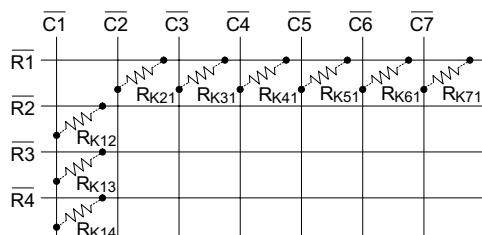
Tone frequency

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→T} = 3.6s
R _{K31}	Pulse Number Selection	N
R _{K41}		
R _{K51} (HT9320A /B/C/K)	Inter-digit- Pause Time for 10pps	800ms
R _{K51} R _{K61} R _{K71} (HT9320L)	International Direct Dialing Lock Selection	Normal dialing (unlock)

M/B ratio selection table

• HT9320A

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

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→T} (sec)
No	3.6	3.6
Yes	2	1

- HT9320H

T _P (sec)	T _{P→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		
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 HDI, enabling the Hold-line function (HDO becomes high). The 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 HDI
 - ♦ Changing the HFO pin from low to high

Hold-line function table

Current State			Input		Next State		
HKS	HDO	HFO	HFI	HDI	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

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→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_{FF} (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 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 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 TP→T Dn+1 ... Dm
Pulse 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 TP→T Dn+1 ... Dm
Pulse 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 TBRK TRP

Pulse
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 TP→T Dn+1 ... Dm
Pulse Tone
TBRK TRP D1 D2 ... Dn TP T
Pulse

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

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]** 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

- 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

- 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 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 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

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 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 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, *, #

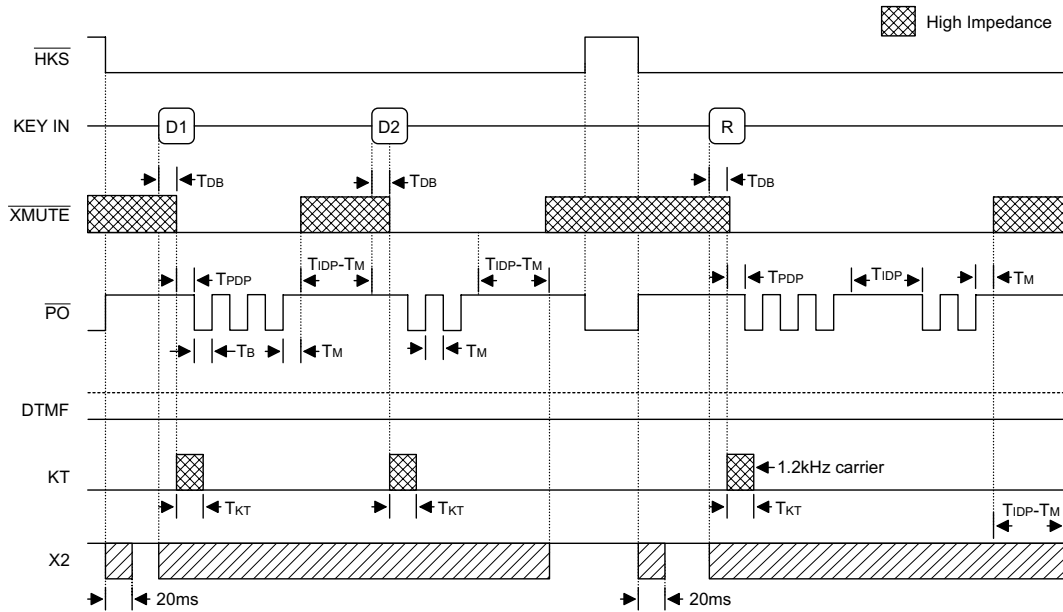
Dm+1 ... DI: 0~9, *, #

DI+1 ... DK: 0~9, *, #

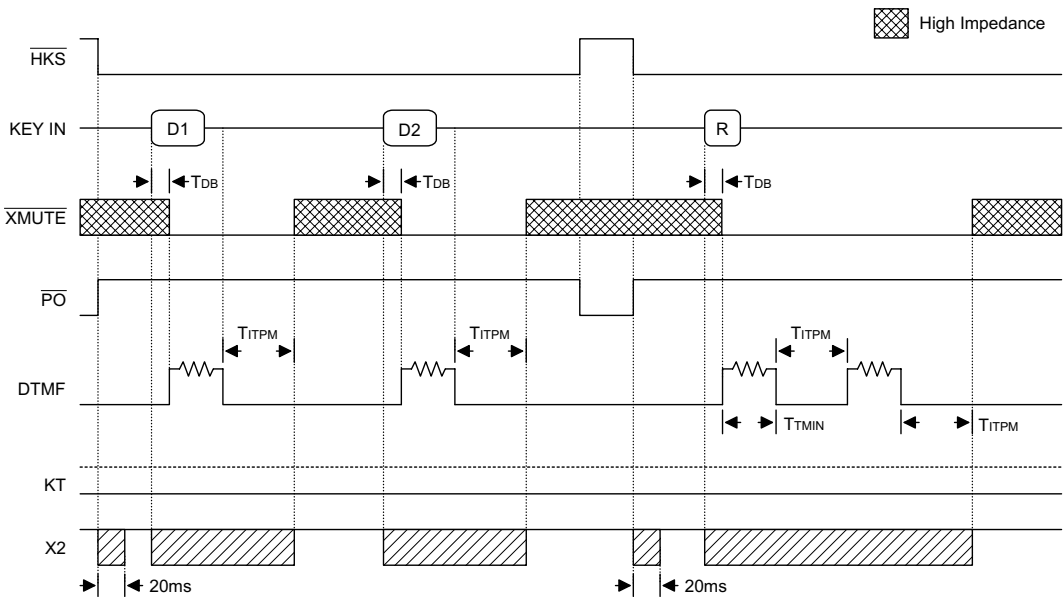
Timing Diagrams

Normal dialing

- Pulse mode

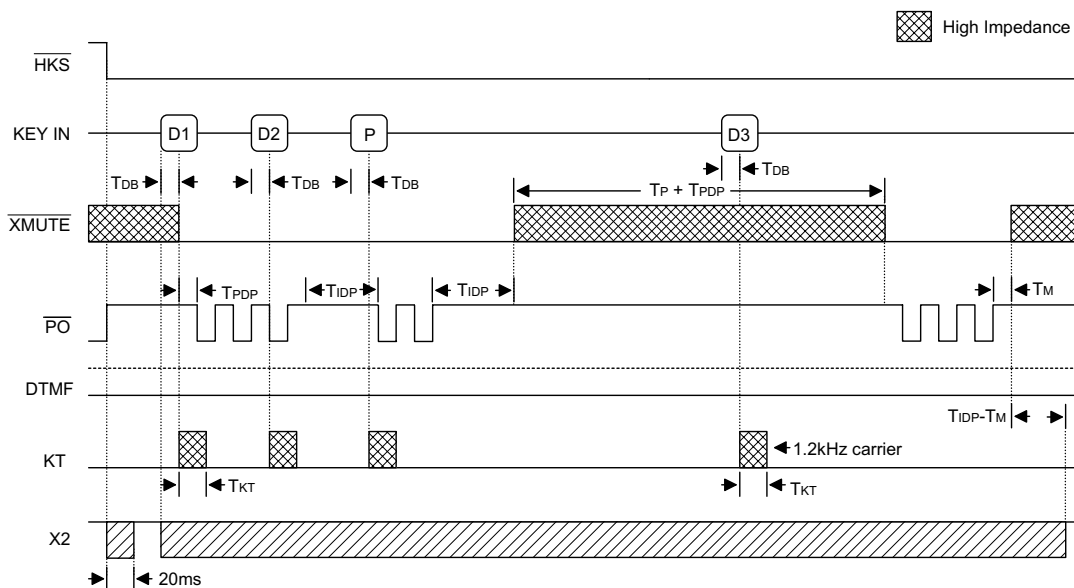


- Tone mode

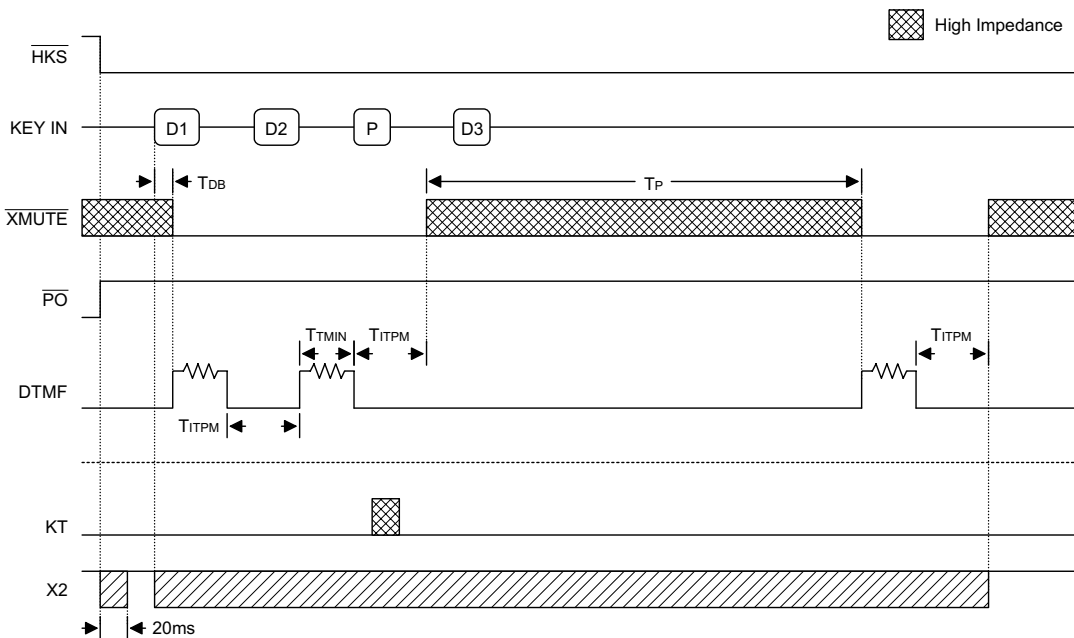


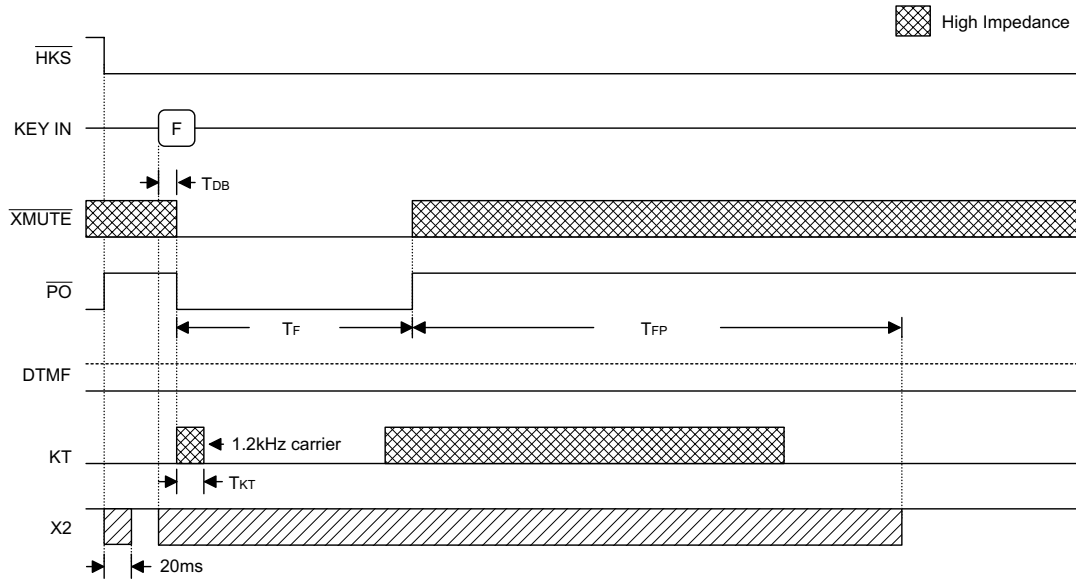
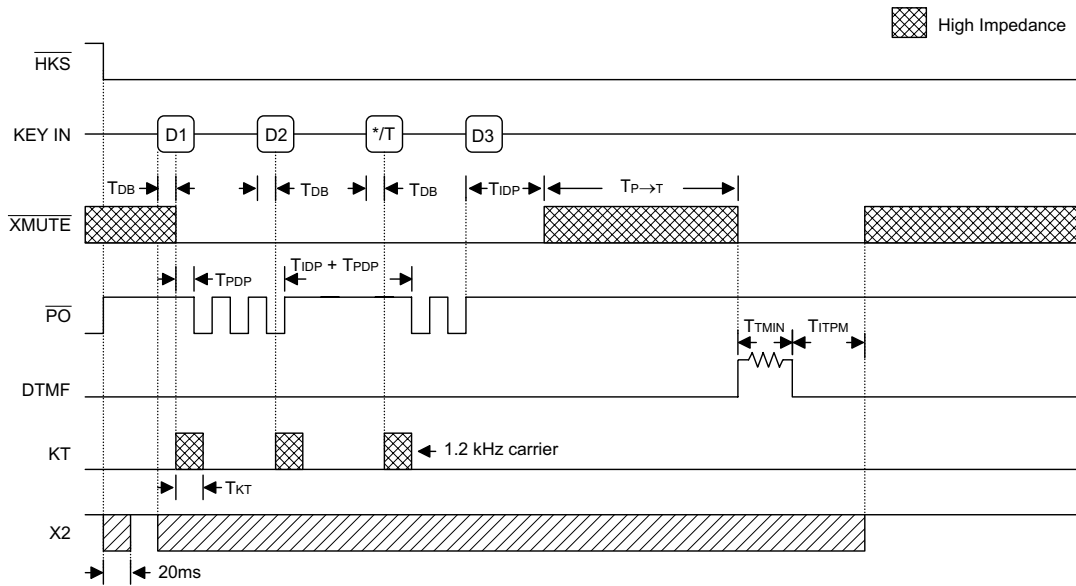
Dialing with Pause key

- Pulse mode



- Tone mode



Flash key operation

Pulse → Tone operation


The diagram shows the following signal behavior:

- HKS:** A high-level signal that transitions to a low state during key presses.
- KEY IN:** A signal that pulses for each key press (D1, D2, R).
- XMUTE:** A signal that transitions to a high impedance state (indicated by a cross-hatched pattern) during key presses.
- PO:** A signal that transitions to a low state during key presses.
- DTMF:** A signal that transitions to a low state during key presses.
- KT:** A signal that transitions to a low state during key presses.
- X2:** A signal that transitions to a low state during key presses.

Timing parameters and transitions are labeled as follows:

- TDB:** Debounce Time, the time between key presses.
- TITPM:** Inter-Trip Minimum Time, the time between key releases.
- TRP (1 sec):** Trip Time, the time from key release to the start of the trip.
- TBRK (1.2 secs):** Break Time, the time from the start of the trip to the end of the trip.
- 20ms:** Scale bar for the time axis.

The diagram illustrates the timing sequence for a D1 data transfer. The signals and their states are as follows:

- HKS**: High Impedance (indicated by a cross-hatched pattern).
- KEY IN**: Active low signal, transitioning from high to low at the start of the D1 transfer and returning to high at the end.
- XMUTE**: Active low signal, transitioning from high to low at the start of the D1 transfer and returning to high at the end.
- PO**: Active low signal, transitioning from high to low at the start of the D1 transfer and returning to high at the end.
- KT**: Active low signal, transitioning from high to low at the start of the D1 transfer and returning to high at the end.
- CLOCK**: A square wave signal with a frequency of $F_{CLOCK} = 2.4\text{kHz}$.
- DOUT**: Data output signal, showing a sequence of data bytes (indicated by a cross-hatched pattern) during the D1 transfer.
- X2**: Active low signal, transitioning from high to low at the start of the D1 transfer and returning to high at the end.

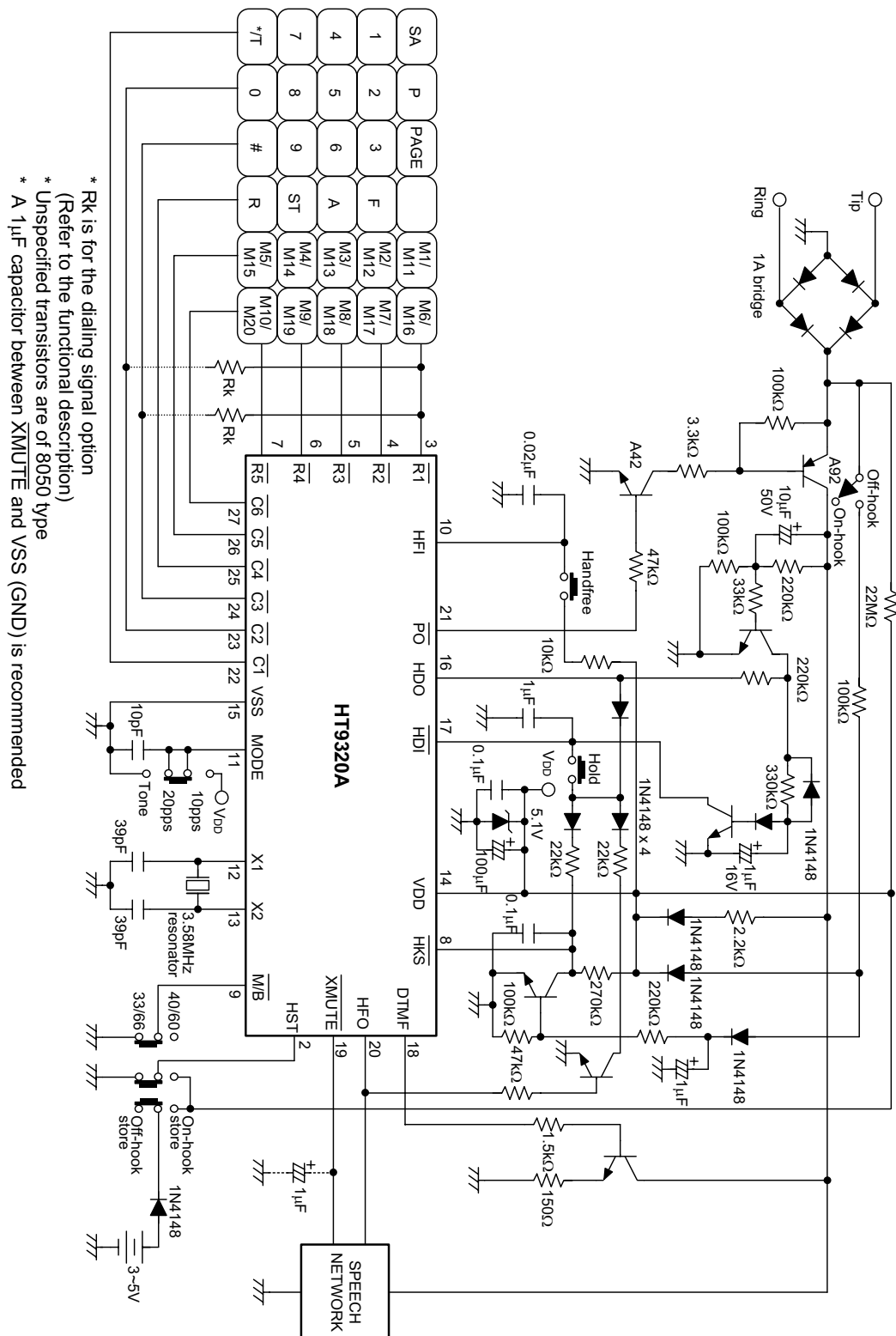
Key timing parameters are labeled:

- T_{DB} : Data Bus Delay
- T_{PDP} : Data Path Delay
- T_B : Bus Delay
- T_M : Memory Delay
- $T_{KT} (34\text{ms})$: Key Transfer Time
- $F_{CLOCK} = 2.4\text{kHz}$: Clock Frequency
- 20ms : Delay time for the X2 pin

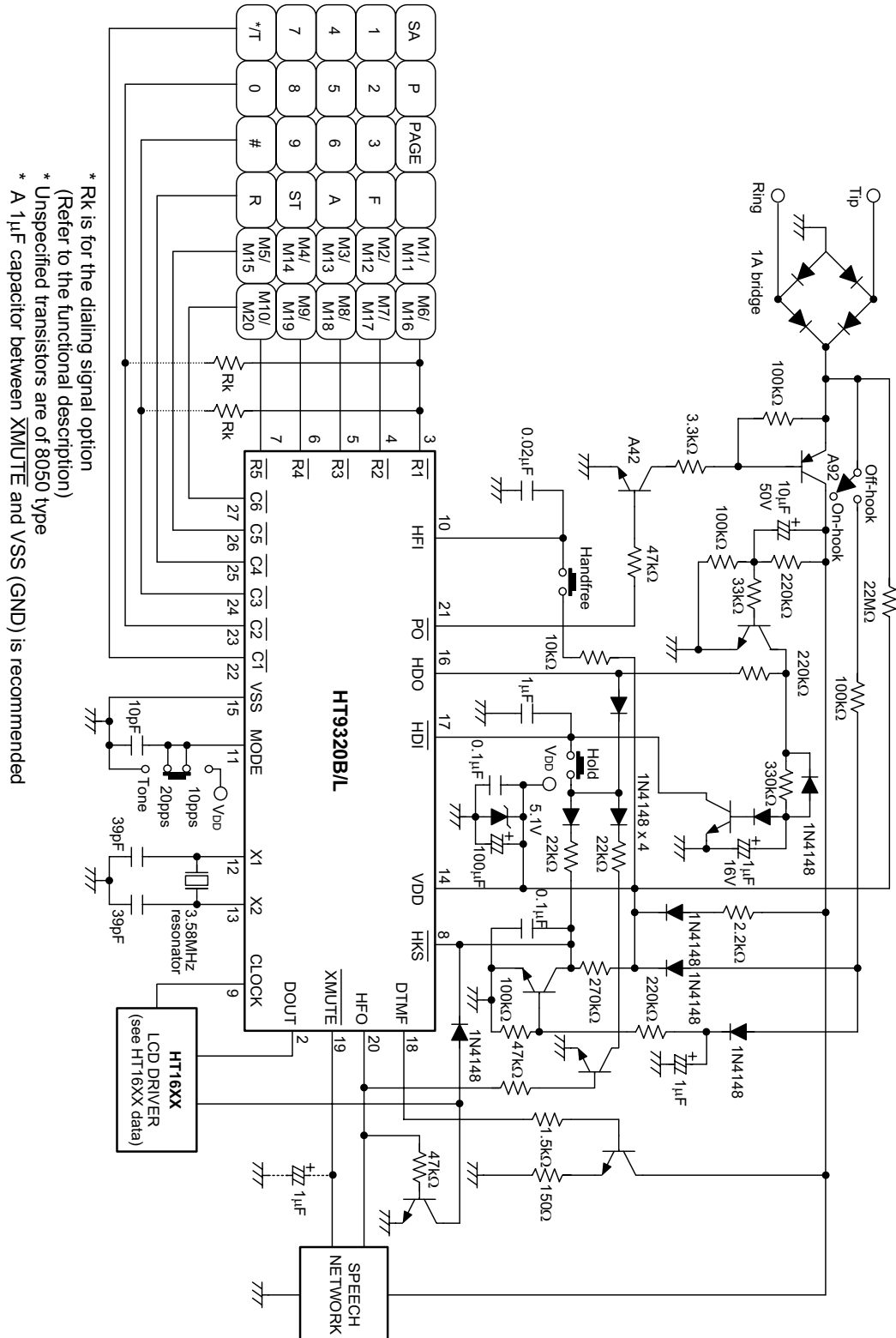
October 1, 2002

Application Circuits

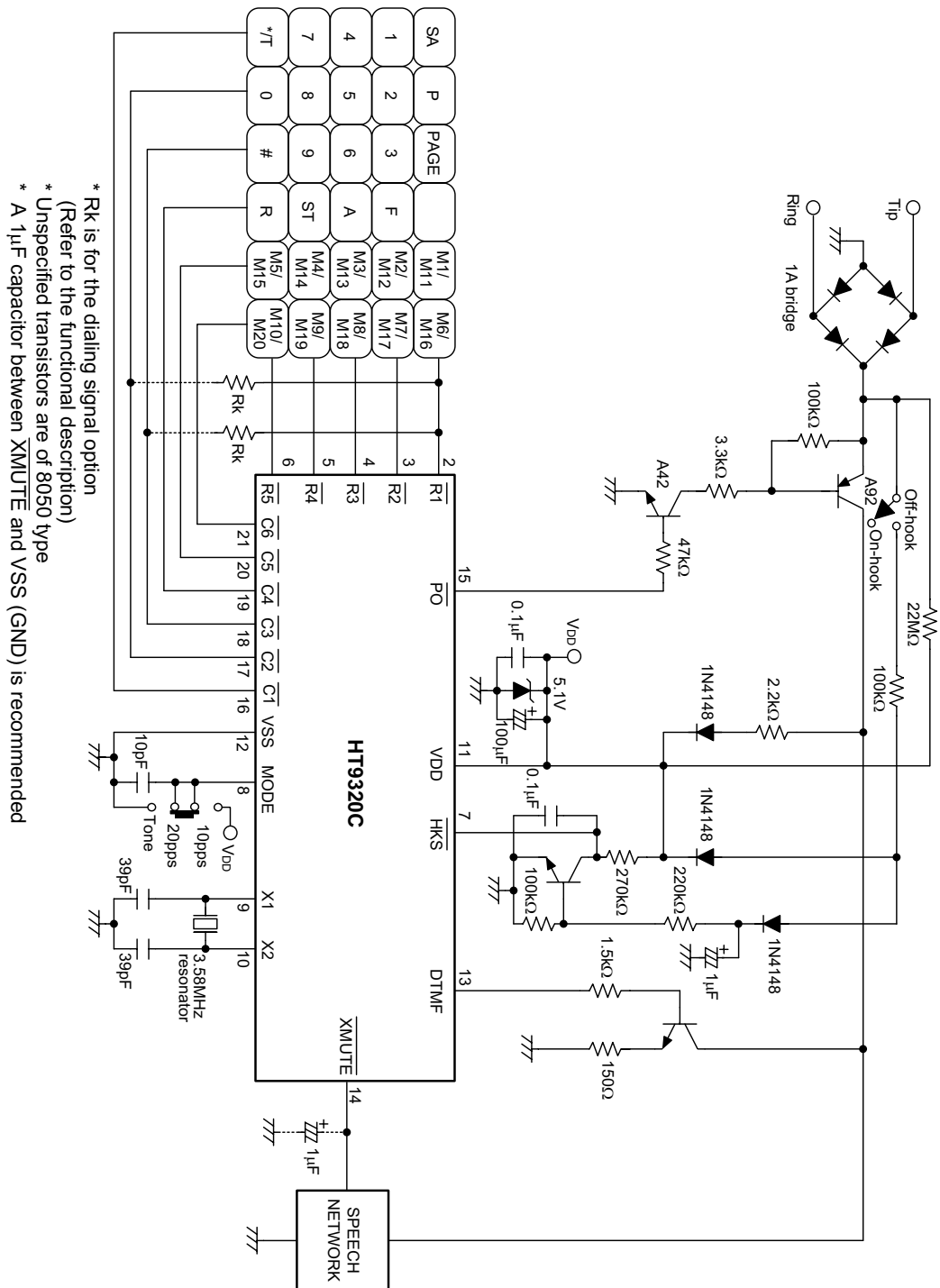
Application circuit 1



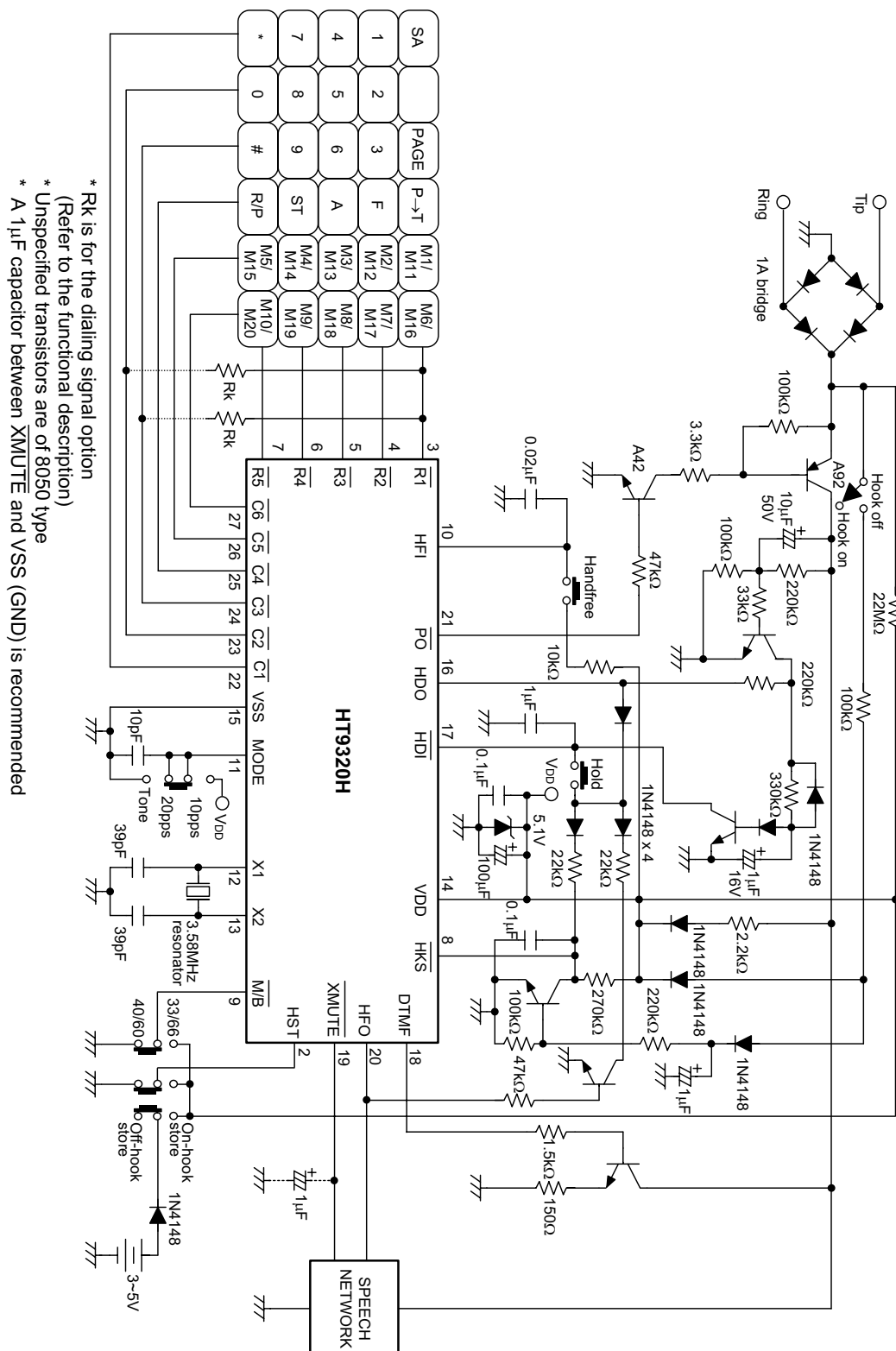
Application circuit 2



Application circuit 3

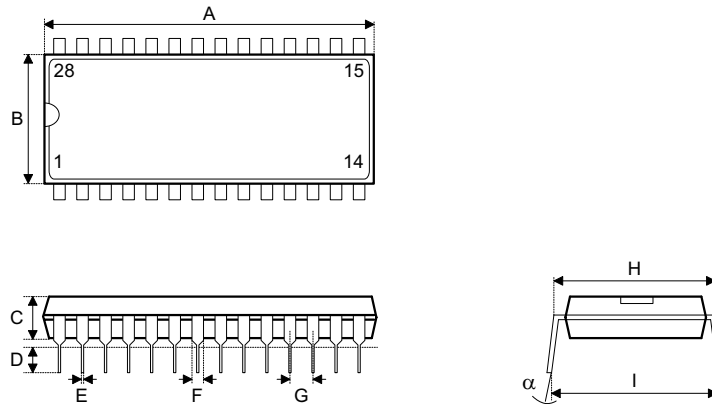


Application circuit 4

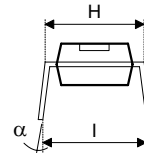
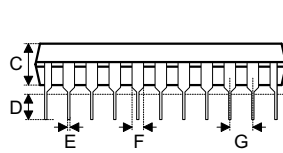
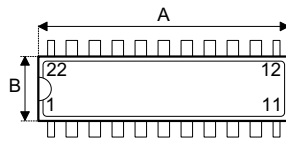


Rev. 1.10



Package Information
28-pin DIP (600mil) outline dimensions


Symbol	Dimensions in mil		
	Min.	Nom.	Max.
A	1445	—	1465
B	535	—	555
C	145	—	155
D	125	—	145
E	16	—	20
F	50	—	70
G	—	100	—
H	595	—	615
I	635	—	670
α	0°	—	15°

22-pin SKDIP (300mil) outline dimensions


Symbol	Dimensions in mil		
	Min.	Nom.	Max.
A	1085	—	1105
B	253	—	263
C	125	—	135
D	125	—	145
E	16	—	20
F	50	—	70
G	—	100	—
H	295	—	315
I	330	—	375
α	0°	—	15°

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