HT9302 Series

1-Memory/2-Memory Tone/Pulse Dialer

Patent Number: 64097, 86474, 64529, 113235 (R.O.C.)
5424740 (U.S.A.)

Features

- Universal specification
- Operating voltage: 2.0V~5.5V
- Low standby current
- Low memory retention current: 0.1μA (typ.)
- Tone/pulse switchable
- Interface with LCD driver
- 32 digits for redialing
- 32 digits for SA memory dialing
- One-key redialing
- Pause and P→T key for PBX
- 4×4 keyboard matrix
- 3.58MHz crystal or ceramic resonator
- Hand-free control
- Hold-line control
- Pause, P→T can be saved for redialing
- Lock function
- Resistor options
  - M/B ratio
  - Flash function and flash time
  - Pause and P→T duration
  - Pulse number
- HT9302A: 18-pin DIP package
  HT9302B: 22-pin SKDIP package
  HT9302C: 20-pin DIP package
  HT9302D: 24-pin SKDIP package
  HT9302G: 16-pin DIP/NSOP packages

General Description

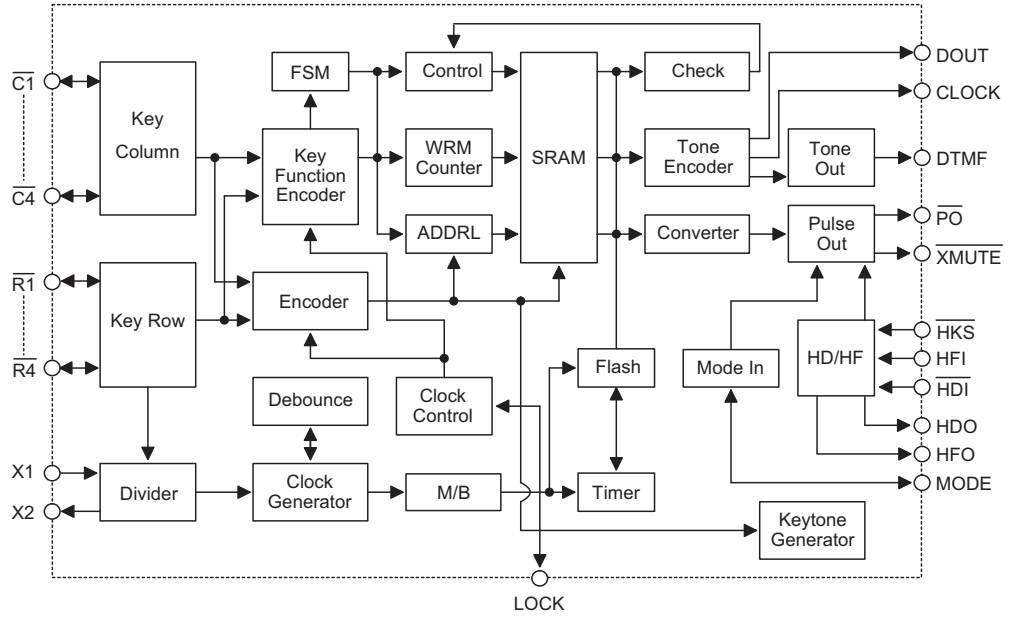
The HT9302 series tone/pulse dialers are CMOS LSIs for telecommunication systems. They are designed to meet various dialing specifications through resistor option matrix.

The HT9302 series provide the pin-selected lock function, Hold-line, Hand-free and LCD dialing number display interface, all of which are suitable for feature phone applications. HT9302G is simpler than HT9302X version. It provides only a redialing memory for simple low-cost system applications.

Selection Table

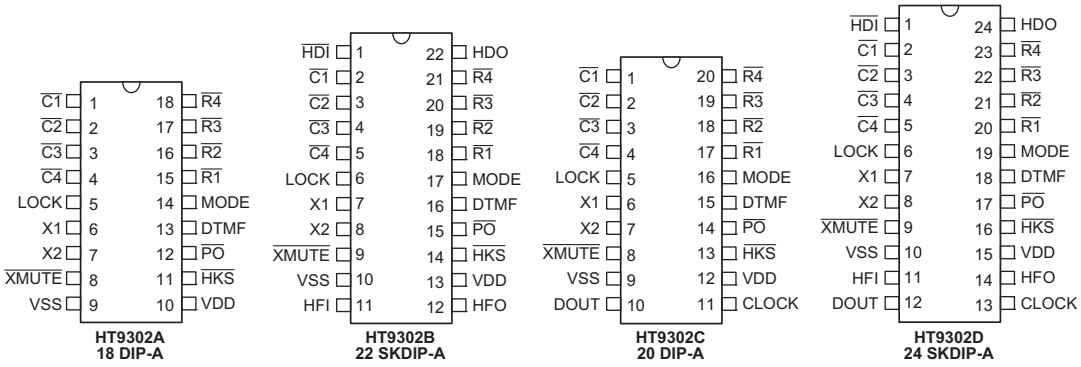
Function / Part No.	Lock Function (Pin Selection)	Hold Line	Hand Free	LCD Interface	Package
HT9302x	(Normal version)				
HT9302A	√	—	—	—	18 DIP
HT9302B	√	√	√	—	22 SKDIP
HT9302C	√	—	—	√	20 DIP
HT9302D	√	√	√	√	24 SKDIP
HT9302G	(Simple version)				
HT9302G	—	—	—	—	16 DIP/NSOP

Block Diagram

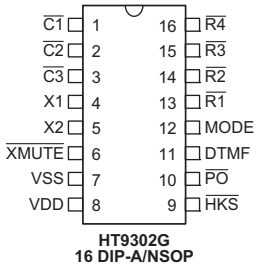


Pin Assignment

HT9302x normal version

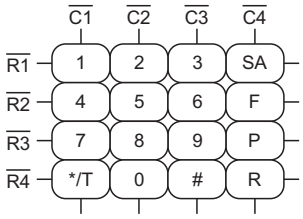


HT9302G simple version

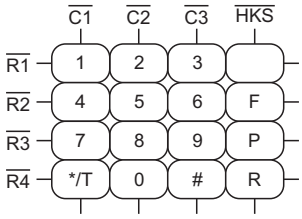


Keyboard Information

HT9302A/B/C/D



HT9302G

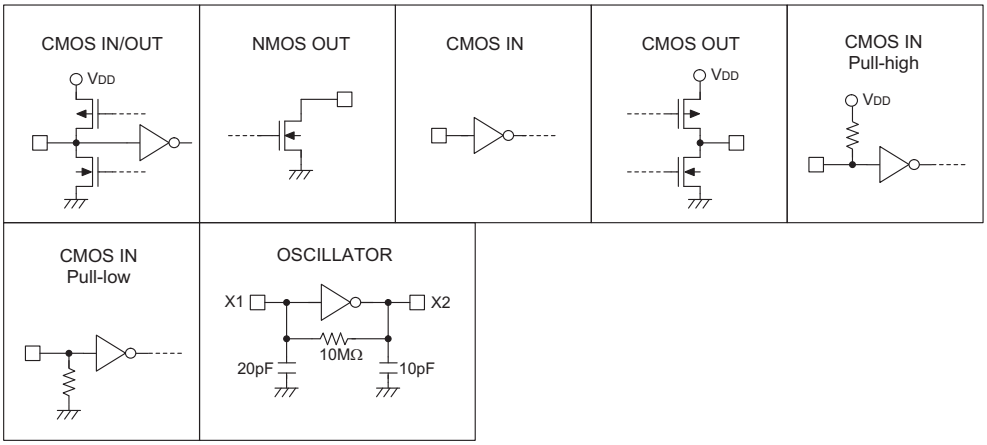


Pin Description

Pin Name	I/O	Internal Connection	Description
$\overline{C1}$~$\overline{C4}$ $\overline{R1}$~$\overline{R4}$	I/O	CMOS IN/OUT	These pins form a 4×4 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 ($\overline{C1}$~$\overline{C4}$) remains low and the row group ($\overline{R1}$~$\overline{R4}$) is set high for key input detection. An inexpensive single contact 4×4 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. 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/$\overline{HDI}$ 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. $\overline{HKS}$=VSS: Off-hook state ($\overline{PO}$=high). The chip is in the standby mode and ready to receive the key input.
$\overline{PO}$	O	CMOS OUT	This pin is a CMOS output structure, which by receiving $\overline{HKS}$ and HFO/HDO signals, control the dialer to connect or disconnect the telephone line. $\overline{PO}$ outputs a low to break the line when $\overline{HKS}$ is high (on-hook) and HFO/HDO is low. $\overline{PO}$ outputs a high to make the 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.
MODE	I/O	CMOS IN/OUT	This is a three-state input/output pin, used for dialing mode selection whether Tone mode or Pulse mode; 10pps/20pps. MODE=VDD: Pulse mode, 10pps MODE=OPEN: Pulse mode, 20pps MODE=VSS: Tone mode During pulse mode dialing, switching this pin to the tone mode changes the subsequent digit entry to tone mode. When the chips are in tone mode, switching to the pulse mode will also be recognized.

Pin Name	I/O	Internal Connection	Description
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.
$\overline{HDI}$	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 $\overline{HDI}$. When HDO is toggled high, $\overline{PO}$ 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 $\overline{HDI}$ 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. The Pull-low resistance of HFI is 200kΩ typ. An external RC network is recommended for input debouncing.
HFO	O	CMOS OUT	The HFO is a CMOS output structure. Its output is toggle- controlled by a positive transition on HFI pin. When HFO is high, the hand-free function is enabled and $\overline{PO}$ outputs a high to connect the line. The hand-free function can be released by setting HDO high or by an on-off-hook operation or by another HFI input. Refer to the functional description for the hand-free functional operation.
LOCK	I/O	CMOS IN/OUT	This is a three-state input/output pin, used for controlling long distance call function with a lock-switch. LOCK=OPEN: Normal dialing (no lock) LOCK=VDD: ″0, 9″ is inhibited for use as the first key input LOCK=VSS: ″0″ is inhibited for use as the first key input
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

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 Keypad entry No load	—	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
$I_{\overline{HKS}}$	$\overline{HKS}$ 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
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
t_{FP}	Pause Time After Flash	—	Control key		—	0.2	—	s
			Digit key		—	1	—	
t_{RP}	One-key Redialing Pause Time	—	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 $\overline{C1}$	—	33:66	—	%
			No resistor is linked between $\overline{R2}$ and $\overline{C1}$	—	40:60	—	
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	—	800	—	ms
			Pulse rate=20pps	—	500	—	
t_M	Pulse Make Duration	—	A resistor is linked between $\overline{R2}$ and $\overline{C1}$	—	33 (10pps) 17 (20pps)	—	ms
			No resistor is linked between $\overline{R2}$ and $\overline{C1}$	—	40 (10pps) 20 (20pps)	—	
t_B	Pulse Break Duration	—	A resistor is linked between $\overline{R2}$ and $\overline{C1}$	—	66 (10pps) 33 (20pps)	—	ms
			No resistor is linked between $\overline{R2}$ and $\overline{C1}$	—	60 (10pps) 30 (20pps)	—	

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
THD	Tone Signal Distortion	2.5V	R_L=5kΩ		—	–30	–23	dB
t_{TMIN}	Minimum Tone Duration	—	Auto-redial	Others	—	82.5	—	ms
				9302G	—	100	—	
t_{ITPM}	Minimum Inter-tone Pause	—	Auto-redial	Others	—	85.5	—	ms
				9302G	—	106	—	

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

Vi, Vh: Row group and column group signals

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

Functional Description

Keyboard matrix

$\overline{C1}$~$\overline{C4}$ and $\overline{R1}$~$\overline{R4}$ form a keyboard matrix. Together with a standard 4×4 keyboard, the keyboard matrix is used for dialing entries. In addition, the keyboard matrix provides resistor option for different dialing specification selections. The keyboard arrangement for each of the HT9302 series are shown in the **Keyboard Information**.

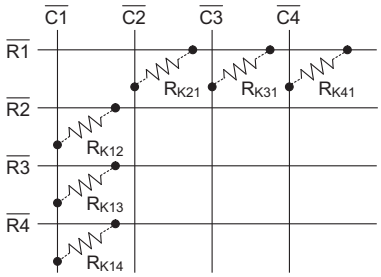
Tone frequency

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

Note: % Error does not contain the crystal frequency drift

Dialing specification selection

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



All the resistors are 330kΩ. The resistor option functions and the default specifications (without option resistors) are listed below.

Option Resistor	Option Function	Default (No Resistor)
R_{K12}	Make/Break Ratio Selection	40:60
R_{K13}	Flash Function and Flash 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}		

M/B ratio selection table

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

Flash function/time (duration) selection table

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

Pause and P→T duration selection table

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

Pulse number selection table

- This table shows pulse number selections for HT9302x.

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

- HT9302G has different selection method listed in the table below.

R_{K31}	Pulse Number
No	N
Yes	10-N

Pulse number table

Keypad	Output Pulse Number		
Digit Key	Normal N	New Zealand (10−N)	Sweden/ Denmark (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

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 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
- 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

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

LOCK function

The function aims to detect locked dialing number to prevent a long distance call. The dialing output of the chip is disabled if the first input key after on-off-hook is the locked number when the lock function is enabled. The lock function selection is listed below.

- HT9302x version

LOCK Pin	Function
OPEN	Normal dialing (no lock)
VDD	″0, 9″ is inhibited
VSS	″0″ is inhibited

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 waits a $t_{P\rightarrow T}$ duration in the pulse mode. On the other hand, the ∗/T key executes the ∗ function in the tone mode.
- #
  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 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 the pause key pauses 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.
- ST
  This key can store lock number with personal code in IDD lock operation.
- 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.

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 $t_{P\rightarrow T}$ 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
    RM content: D1 D2 ... Dn
    Keyboard input: [R] or [R/P]
    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 $t_{P\rightarrow T}$ Dn+1 ... Dm (Pulse / Tone)
    RM: Unchanged
    SAM: Unchanged
  - Tone mode
    (a) without */T
    RM content: D1 D2 ... Dn
    Keyboard input: [R] or [R/P]
    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

- One-key redial

  – Pulse mode

  (a) without */T

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

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

  RM: D1 D2 ... Dn

  SAM: Unchanged

  (b) with */T

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

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

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

  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

- 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 $t_{P\rightarrow T}$ Dn+1 ... Dm
  (D1 D2 ... Dn: Pulse; 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 $t_{P\rightarrow T}$ Dn+1 ... Dm (Pulse / 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

- 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

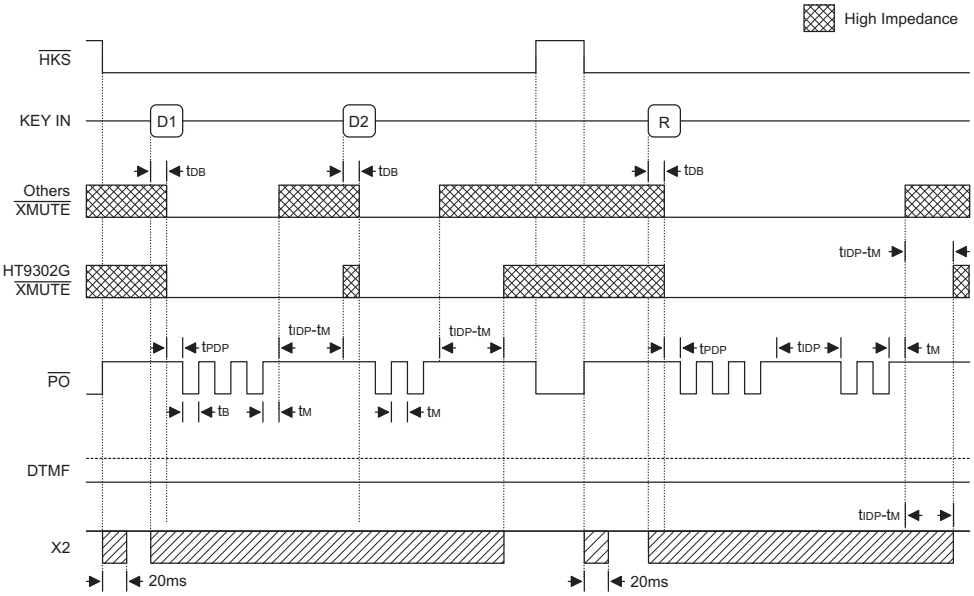
- Pause
  Keyboard input: D1 D2 ... Dn P Dn+1 ... Dm
  Dialing output: D1 D2 ... Dn t_P Dn+1 ... Dm
  RM: D1 D2 ... Dn P Dn+1 ... Dm
  SAM: Unchanged

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

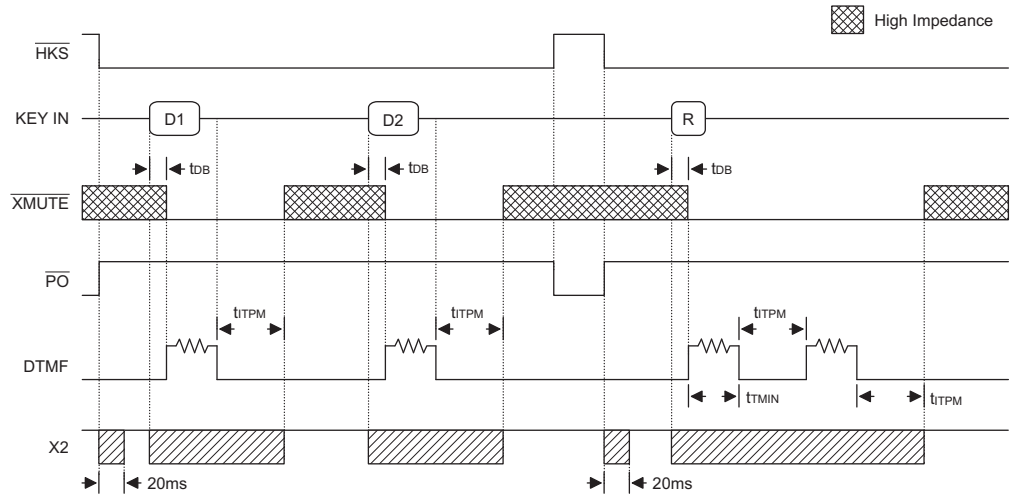
Timing Diagrams

Normal dialing

- Pulse mode

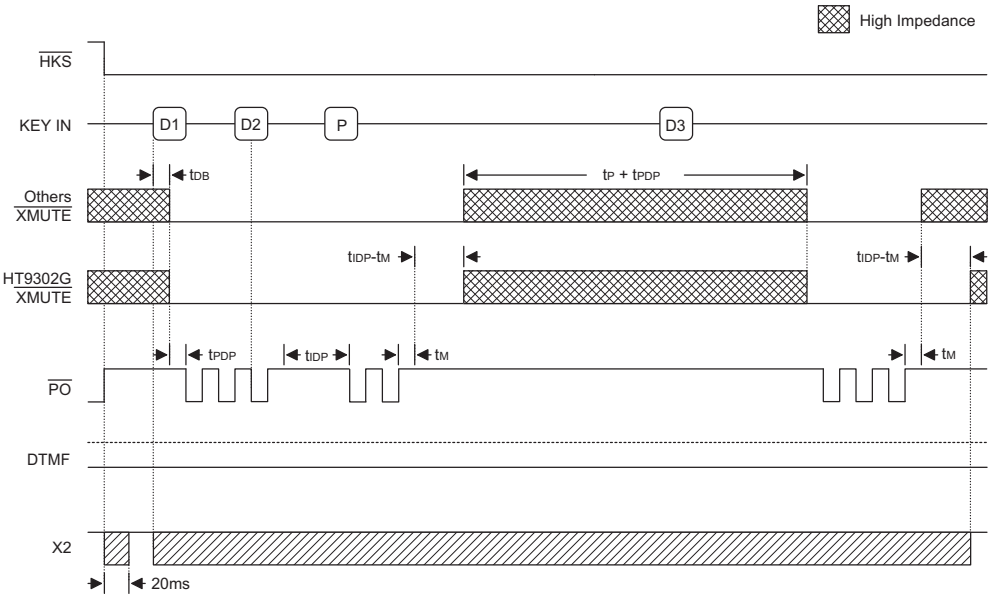


- Tone mode

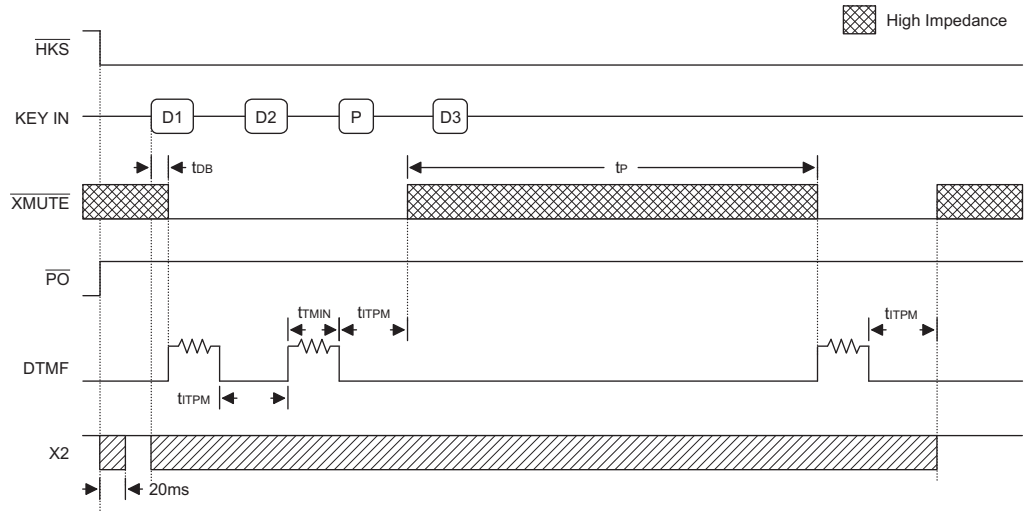


Dialing with pause key

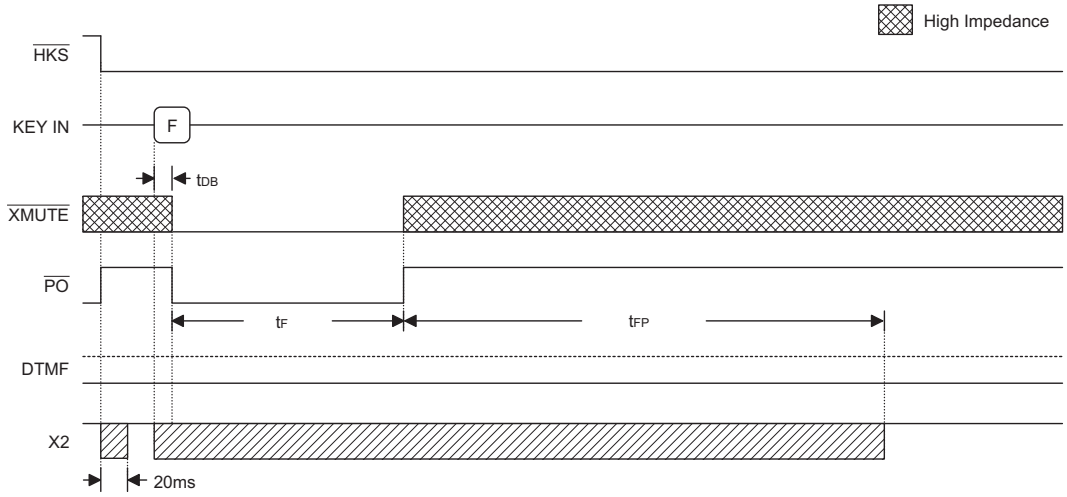
- Pulse mode



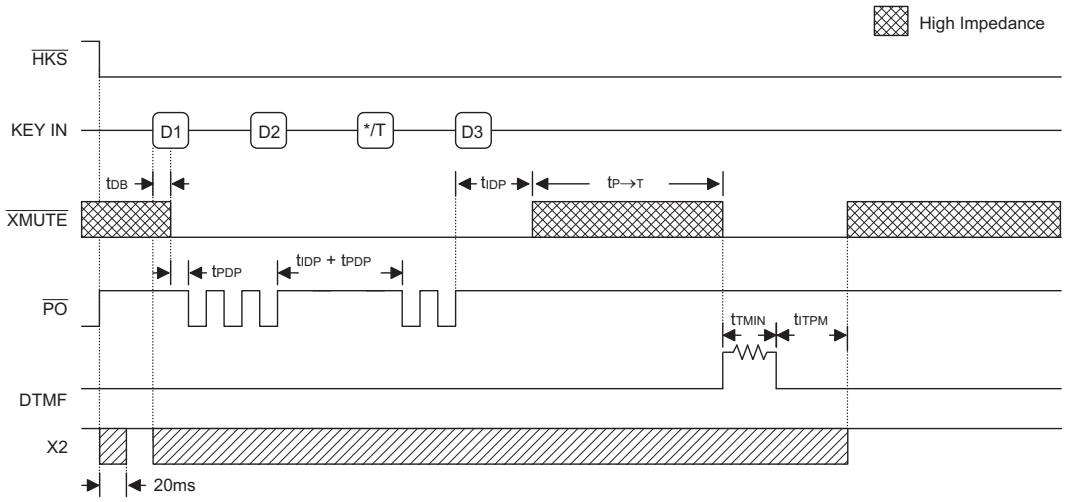
- Tone mode



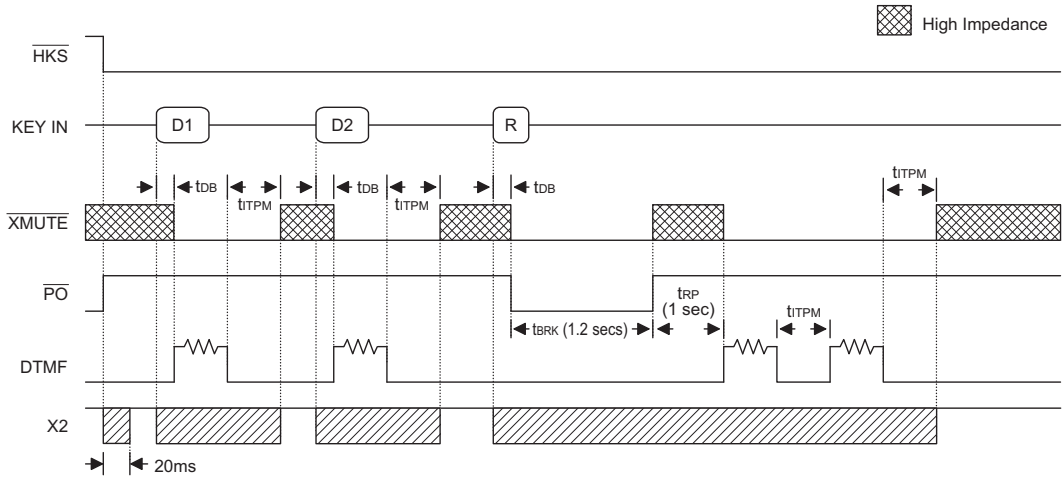
Flash key operation



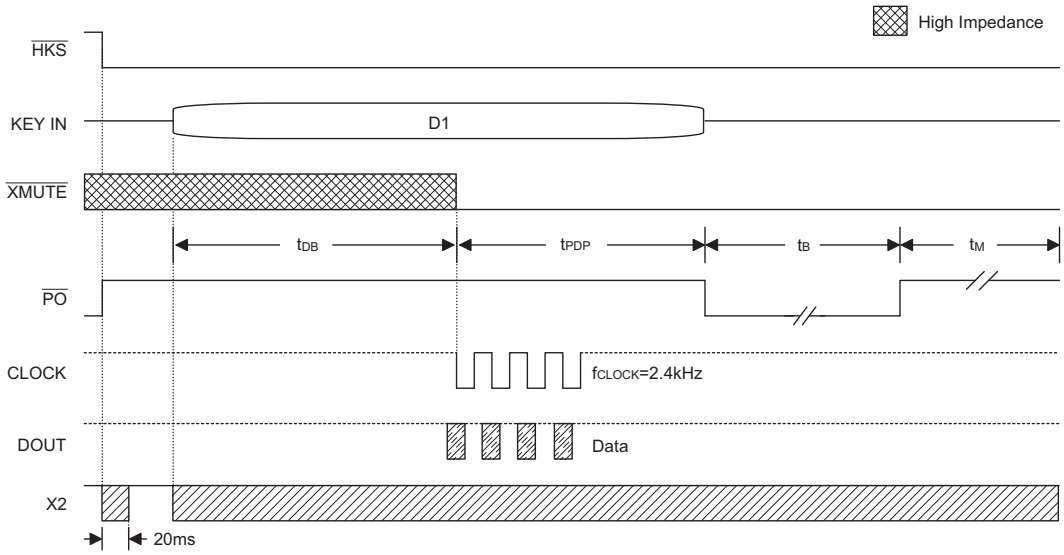
Pulse→Tone operation



One key redial operation



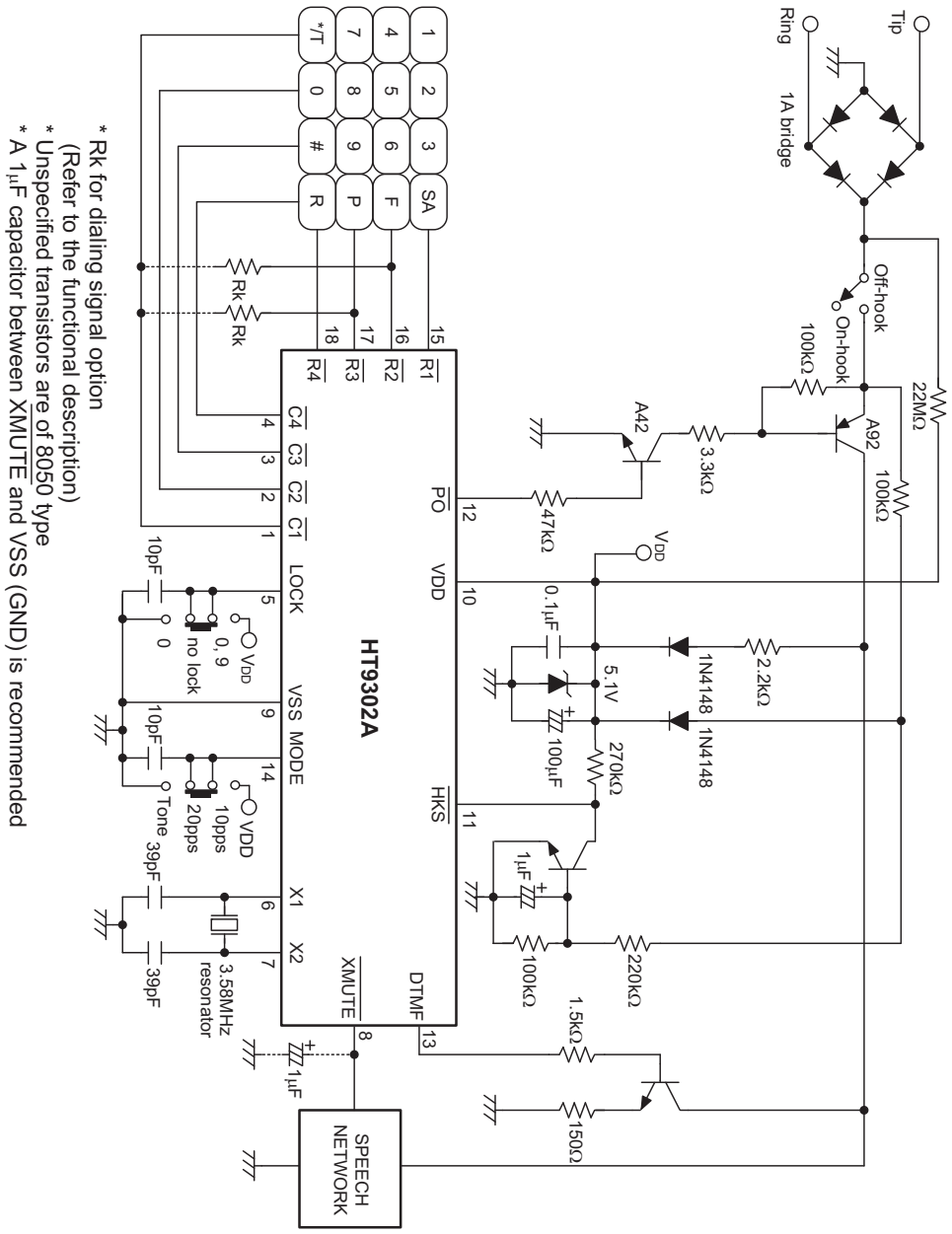
CLOCK & DOUT operation



Note: D1=D3=3
D2=2

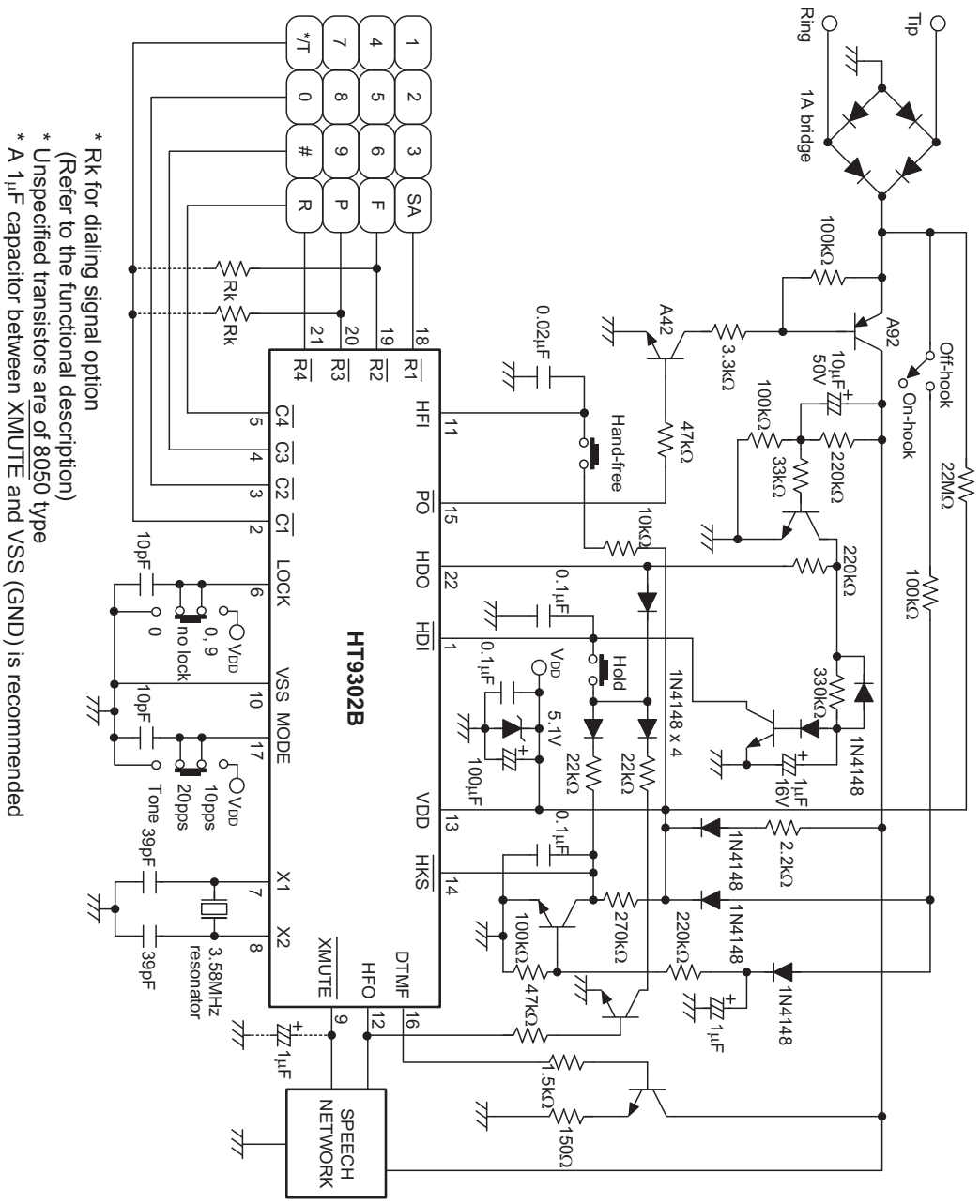
Application Circuits

Application circuit 1



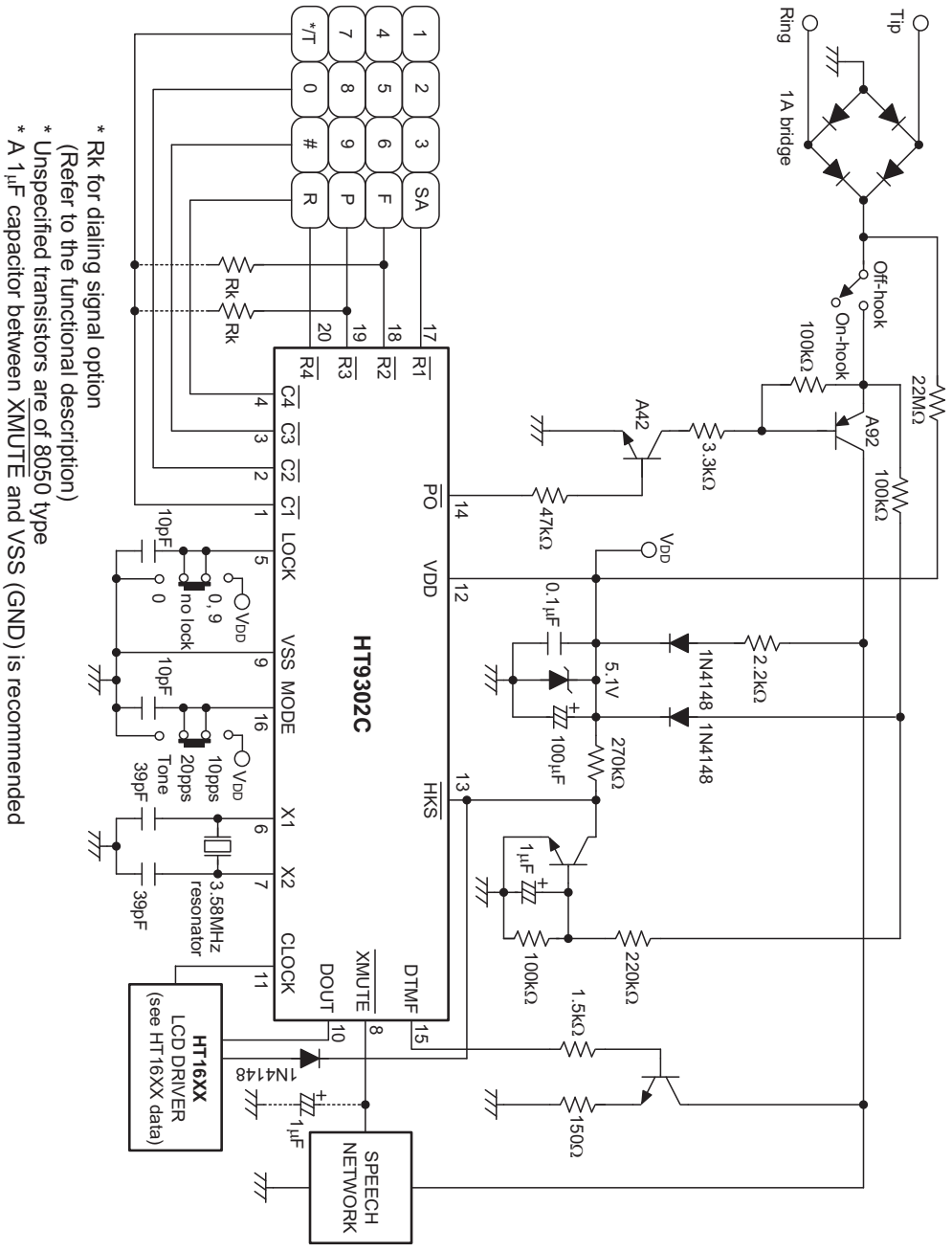
* Rk for dialing signal option
(Refer to the functional description)
* Unspecified transistors are of 8050 type
* A 1μF capacitor between XMUTE and VSS (GND) is recommended

Application circuit 2



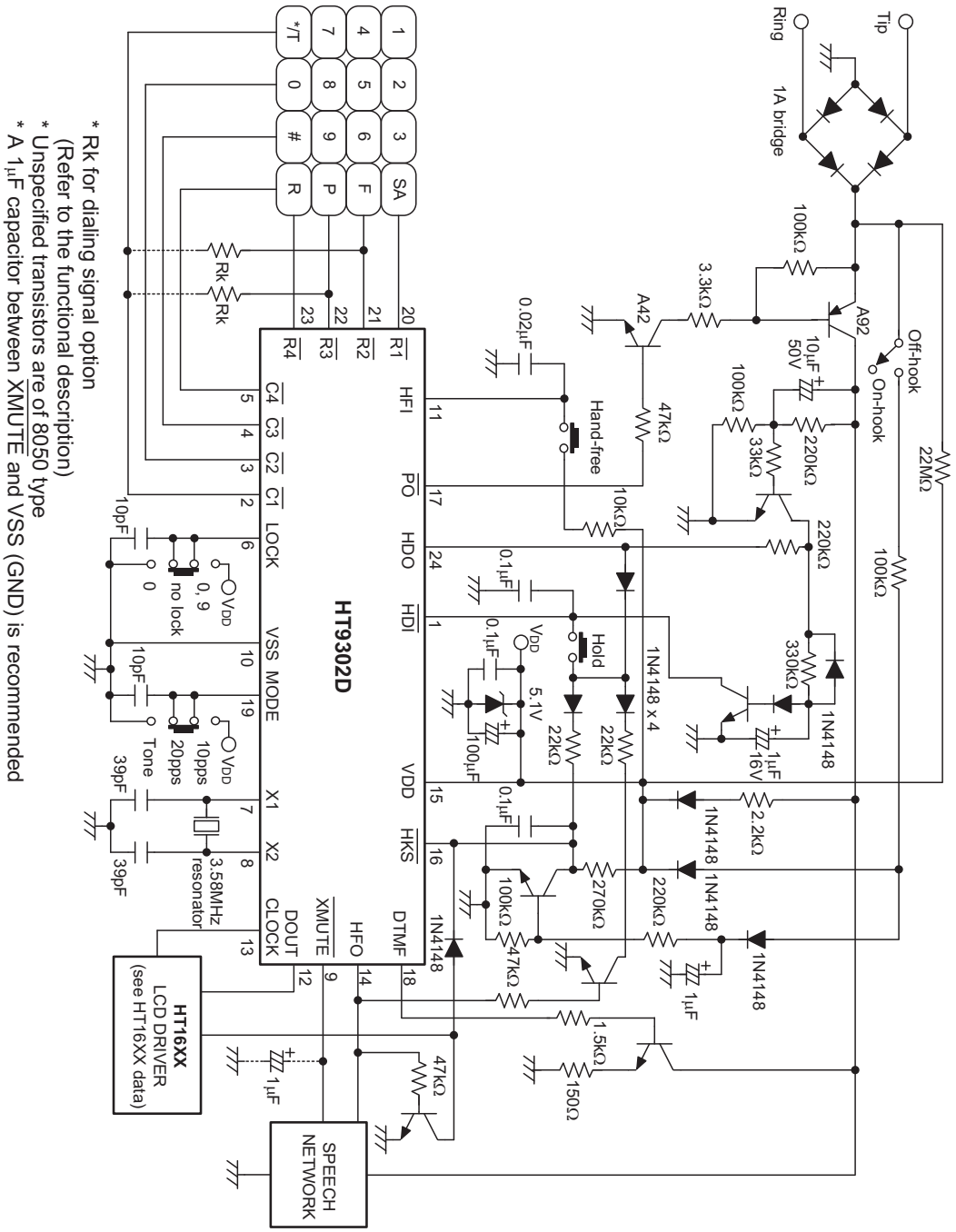
* Rk for dialing signal option
(Refer to the functional description)
* Unspecified transistors are of 8050 type
* A 1μF capacitor between XMUTE and VSS (GND) is recommended

Application circuit 3

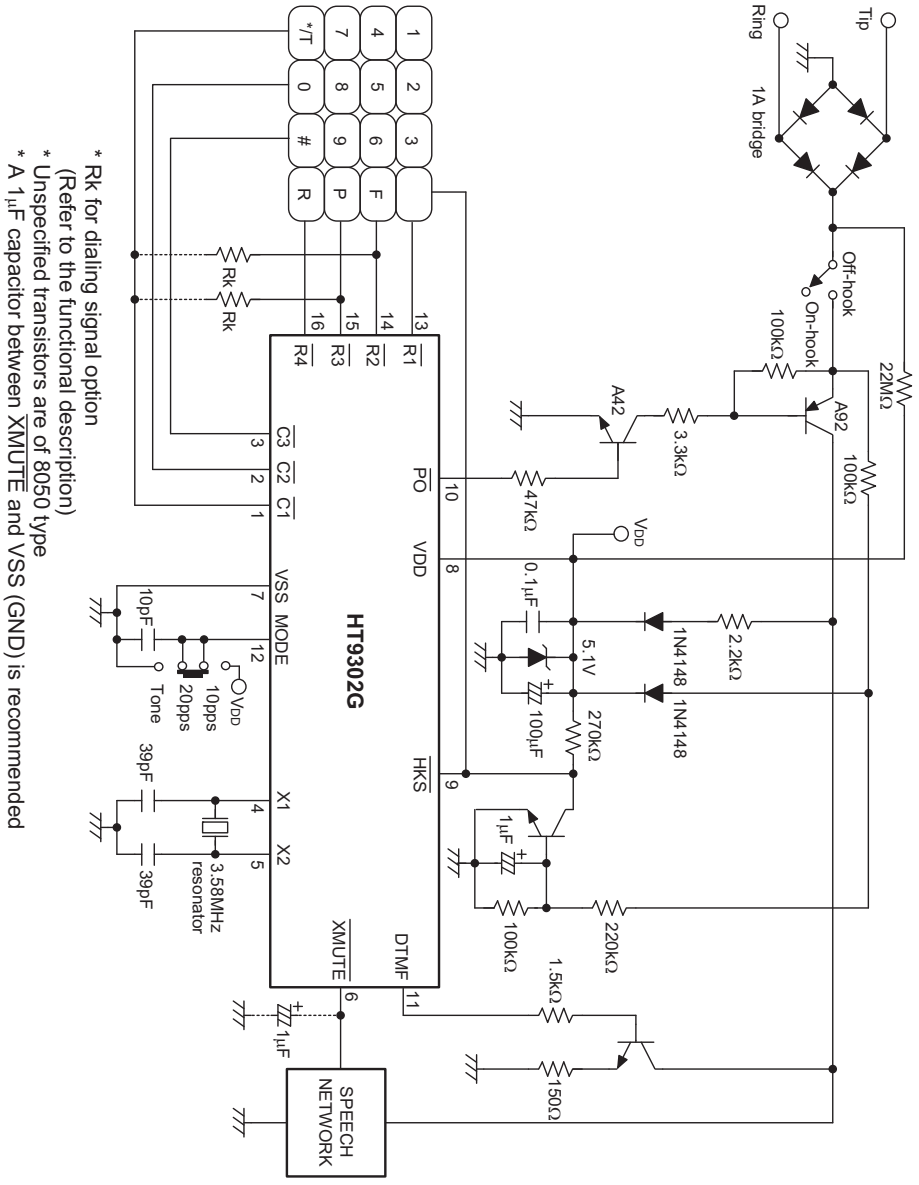


* Rk for dialing signal option
(Refer to the functional description)
* Unspecified transistors are of 8050 type
* A 1μF capacitor between XMUTE and VSS (GND) is recommended

Application circuit 4



Application circuit 5



Package Information

16-pin DIP (300mil) Outline Dimensions

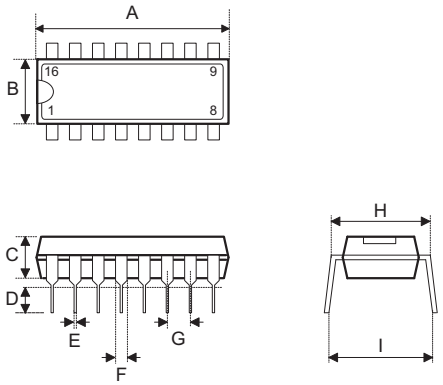


Fig1. Full Lead Packages

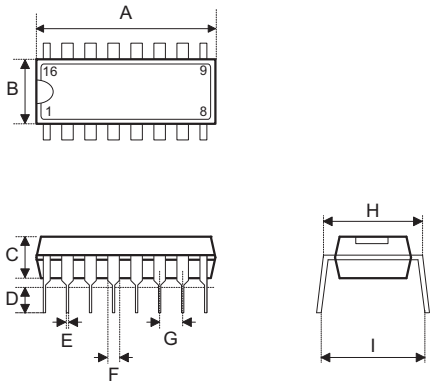


Fig2. 1/2 Lead Packages

• MS-001d (see fig1)

Symbol	Dimensions in mil		
	Min.	Nom.	Max.
A	780	—	880
B	240	—	280
C	115	—	195
D	115	—	150
E	14	—	22
F	45	—	70
G	—	100	—
H	300	—	325
I	—	—	430

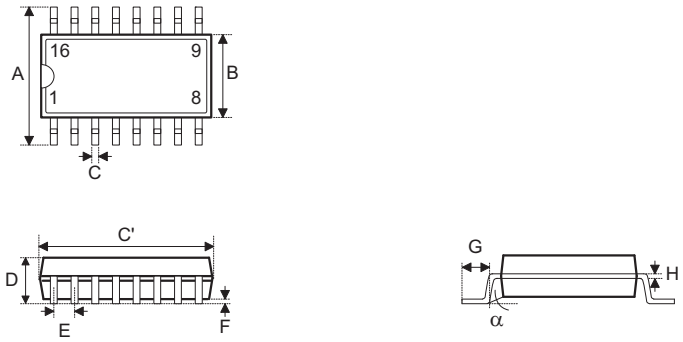
• MS-001d (see fig2)

Symbol	Dimensions in mil		
	Min.	Nom.	Max.
A	735	—	775
B	240	—	280
C	115	—	195
D	115	—	150
E	14	—	22
F	45	—	70
G	—	100	—
H	300	—	325
I	—	—	430

• MO-095a (see fig2)

Symbol	Dimensions in mil		
	Min.	Nom.	Max.
A	745	—	785
B	275	—	295
C	120	—	150
D	110	—	150
E	14	—	22
F	45	—	60
G	—	100	—
H	300	—	325
I	—	—	430

16-pin NSOP (150mil) Outline Dimensions



• MS-012

Symbol	Dimensions in mil		
	Min.	Nom.	Max.
A	228	—	244
B	150	—	157
C	12	—	20
C′	386	—	394
D	—	—	69
E	—	50	—
F	4	—	10
G	16	—	50
H	7	—	10
α	0°	—	8°

18-pin DIP (300mil) Outline Dimensions

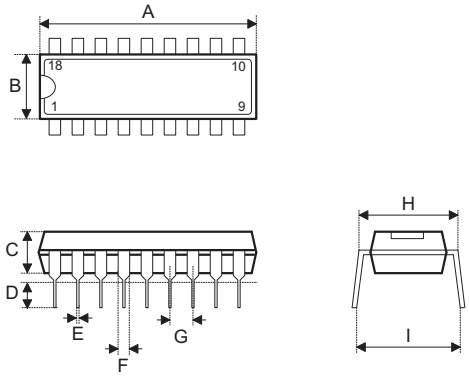


Fig1. Full Lead Packages

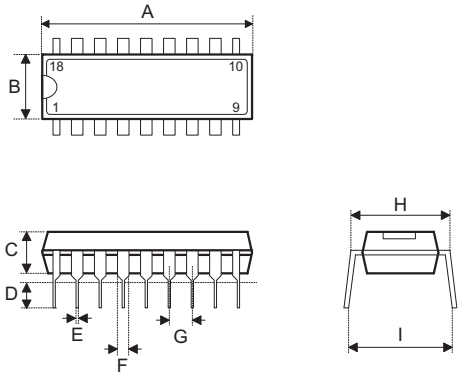


Fig2. 1/2 Lead Packages

• MS-001d (see fig1)

Symbol	Dimensions in mil		
	Min.	Nom.	Max.
A	880	—	920
B	240	—	280
C	115	—	195
D	115	—	150
E	14	—	22
F	45	—	70
G	—	100	—
H	300	—	325
I	—	—	430

• MS-001d (see fig1)

Symbol	Dimensions in mil		
	Min.	Nom.	Max.
A	845	—	880
B	240	—	280
C	115	—	195
D	115	—	150
E	14	—	22
F	45	—	70
G	—	100	—
H	300	—	325
I	—	—	430

• MO-095a (see fig2)

Symbol	Dimensions in mil		
	Min.	Nom.	Max.
A	845	—	885
B	275	—	295
C	120	—	150
D	110	—	150
E	14	—	22
F	45	—	60
G	—	100	—
H	300	—	325
I	—	—	430

20-pin DIP (300mil) Outline Dimensions

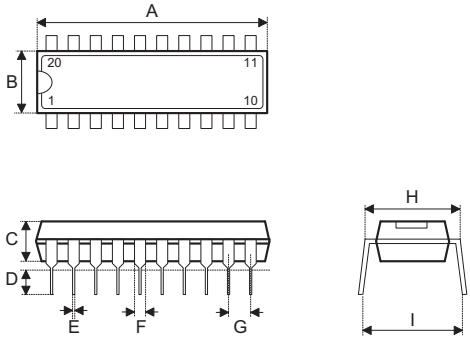


Fig1. Full Lead Packages

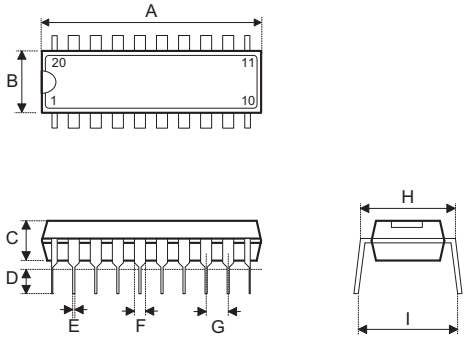


Fig2. 1/2 Lead Packages

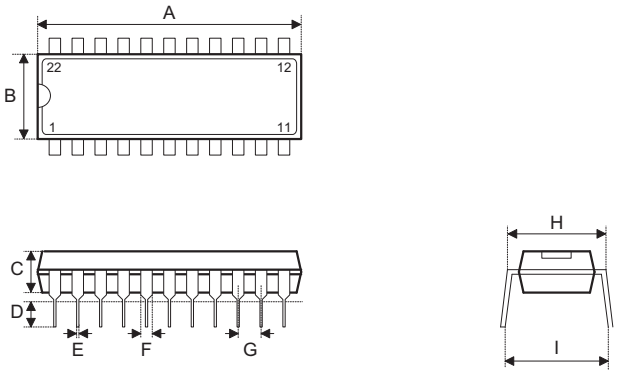
• MS-001d (see fig1)

Symbol	Dimensions in mil		
	Min.	Nom.	Max.
A	980	—	1060
B	240	—	280
C	115	—	195
D	115	—	150
E	14	—	22
F	45	—	70
G	—	100	—
H	300	—	325
I	—	—	430

• MO-095a (see fig2)

Symbol	Dimensions in mil		
	Min.	Nom.	Max.
A	945	—	985
B	275	—	295
C	120	—	150
D	110	—	150
E	14	—	22
F	45	—	60
G	—	100	—
H	300	—	325
I	—	—	430

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	—	—	375

24-pin SKDIP (300mil) Outline Dimensions

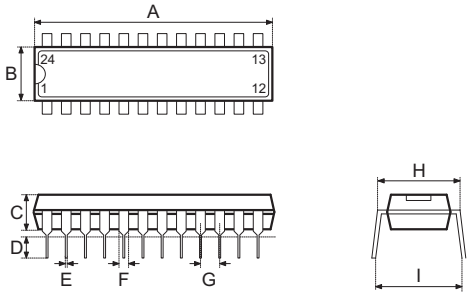


Fig1. Full Lead Packages

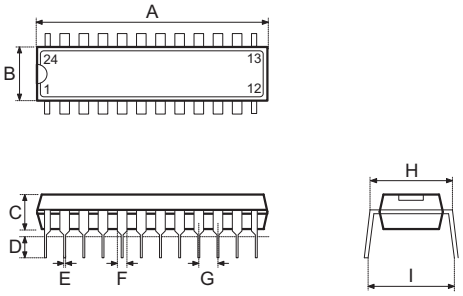


Fig2. 1/2 Lead Packages

• MS-001d (see fig1)

Symbol	Dimensions in mil		
	Min.	Nom.	Max.
A	1230	—	1280
B	240	—	280
C	115	—	195
D	115	—	150
E	14	—	22
F	45	—	70
G	—	100	—
H	300	—	325
I	—	—	430

• MS-001d (see fig2)

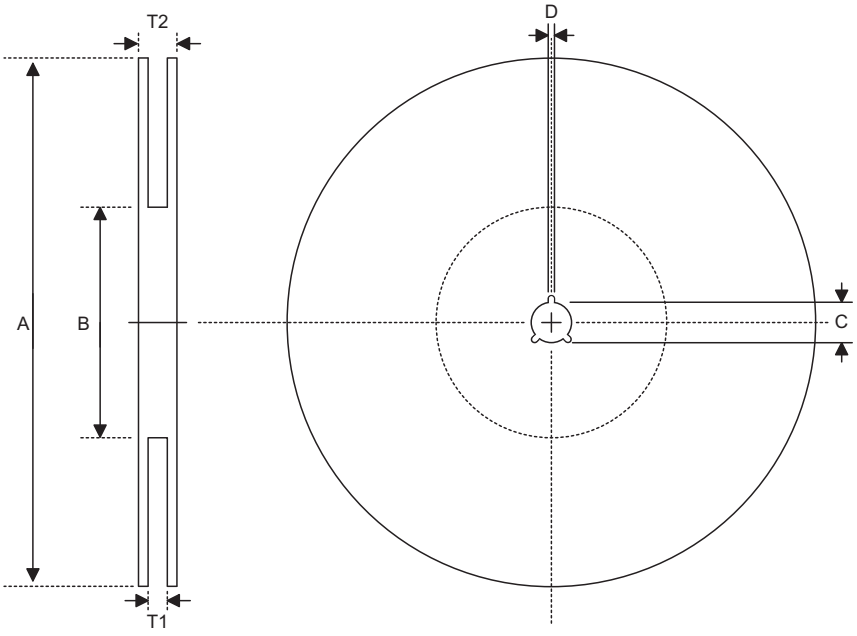
Symbol	Dimensions in mil		
	Min.	Nom.	Max.
A	1160	—	1195
B	240	—	280
C	115	—	195
D	115	—	150
E	14	—	22
F	45	—	70
G	—	100	—
H	300	—	325
I	—	—	430

• MO-095a (see fig2)

Symbol	Dimensions in mil		
	Min.	Nom.	Max.
A	1145	—	1185
B	275	—	295
C	120	—	150
D	110	—	150
E	14	—	22
F	45	—	60
G	—	100	—
H	300	—	325
I	—	—	430

Product Tape and Reel Specifications

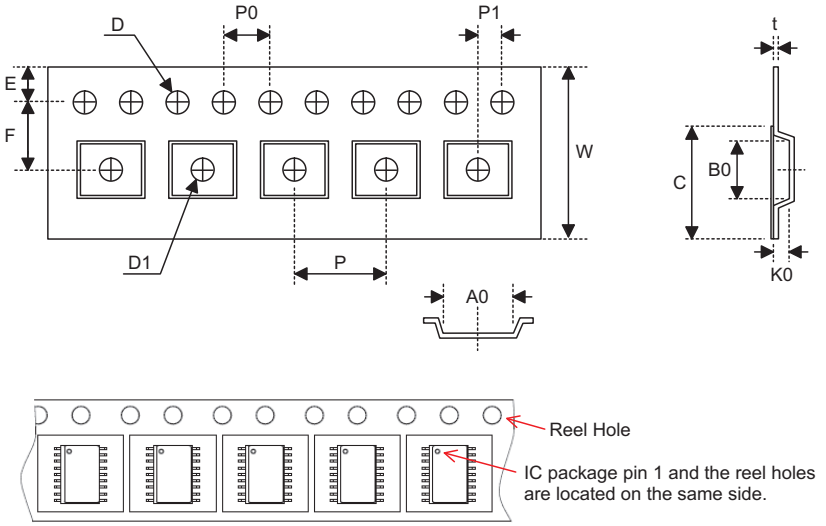
Reel Dimensions



SOP 16N (150mil)

Symbol	Description	Dimensions in mm
A	Reel Outer Diameter	330.0±1.0
B	Reel Inner Diameter	100.0±1.5
C	Spindle Hole Diameter	$13.0^{+0.5/-0.2}$
D	Key Slit Width	2.0±0.5
T1	Space Between Flange	$16.8^{+0.3/-0.2}$
T2	Reel Thickness	22.2±0.2

Carrier Tape Dimensions



SOP 16N (150mil)

Symbol	Description	Dimensions in mm
W	Carrier Tape Width	16.0±0.3
P	Cavity Pitch	8.0±0.1
E	Perforation Position	1.75±0.1
F	Cavity to Perforation (Width Direction)	7.5±0.1
D	Perforation Diameter	1.55 +0.10/-0.00
D1	Cavity Hole Diameter	1.50 +0.25/-0.00
P0	Perforation Pitch	4.0±0.1
P1	Cavity to Perforation (Length Direction)	2.0±0.1
A0	Cavity Length	6.5±0.1
B0	Cavity Width	10.3±0.1
K0	Cavity Depth	2.1±0.1
t	Carrier Tape Thickness	0.30±0.05
C	Cover Tape Width	13.3±0.1

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