



## NT91315XL Series

PRELIMINARY

### Microcontroller for Monitor

#### Features

- Tone/Pulse switchable
- 32-digit redial memory
- 32-digit save memory (DL version)
- 3 emergency memory banks (16 digits each)
- 10 indirect memory banks (16 digits each)
- Flash, Pause, P→T can be saved as a digit in memory
- Chain dialing allowed
- None or (0) or (0, 9) or (0, 168) or all digits dialing inhibition (diode option) for PABX system or long distance dialing lock out
- Pause time 2.2/3.6 sec selectable (diode option)
- 3 pulse dialing number systems N/N+1/10-N (diode option)
- Dialing rate 10pps, M/B ratio 2/3 & 1/2 selectable/dialing rate 10pps & 20pps selectable, M/B ratio 1/2 (diode option)
- Hands-Free control function with debouncing (BL, CL & DL version)
- Hold function with debouncing (CL & DL version)
- Key-tone output for dialing access (DL version)
- One-key redial (DL version)
- Flash time 600ms, 300ms, 100ms (DL version)
- Power-up reset circuit provided
- Key release debouncing
- 32-step synthetic tone output for low DTMF output harmonic distortion
- 16/18/20/22-pin packages

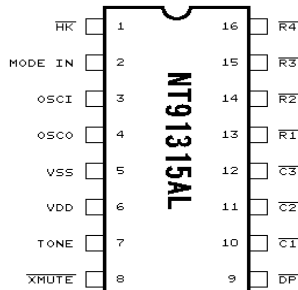
#### General Description

The NT91315XL series are single-chip silicon gate CMOS integrated circuits with on-chip oscillators to be used with a 3.58 MHz crystal or ceramic resonator. They provide dialing pulse (DP) or dual tone multi-frequency (DTMF) dialing. A 24-key (5x5-1) matrix keyboard is used for either DP or DTMF mode. In on-chip RAM, up to

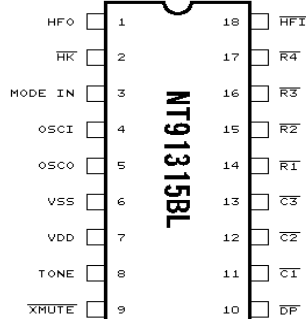
32 digits can be saved for both redial and save functions, and up to 16 digits can be saved for 3 direct emergency and 10 indirect dialing memory banks. In DTMF mode, a small minimum tone duration and minimum inter-tone pause allows for rapid dialing. Maximum tone duration depends on the key depression time in manual dialing.

#### Pin Configurations

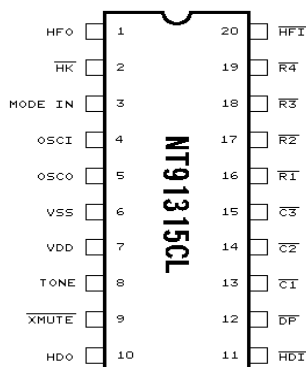
a. NT91315AL



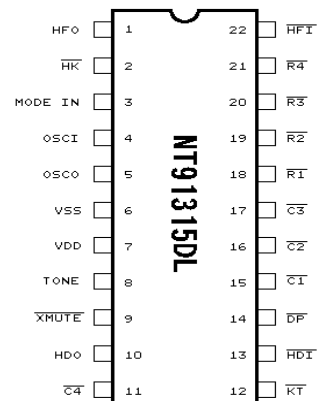
b. NT91315BL



c. NT91315CL

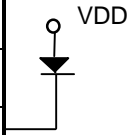


d. NT91315DL



**Keyboard Assignments**

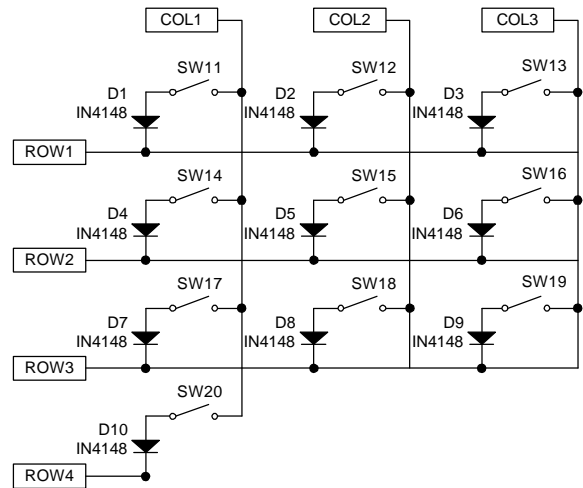
	$\overline{C1}$	$\overline{C2}$	$\overline{C3}$	GND	$\overline{C4}$
$\overline{R1}$	1	2	3	ST	RD
$\overline{R2}$	4	5	6	A/L	P
$\overline{R3}$	7	8	9	F1	F2
$\overline{R4}$	*/T	0	#	RD/P	F3
	M1	M2	M3		SAVE

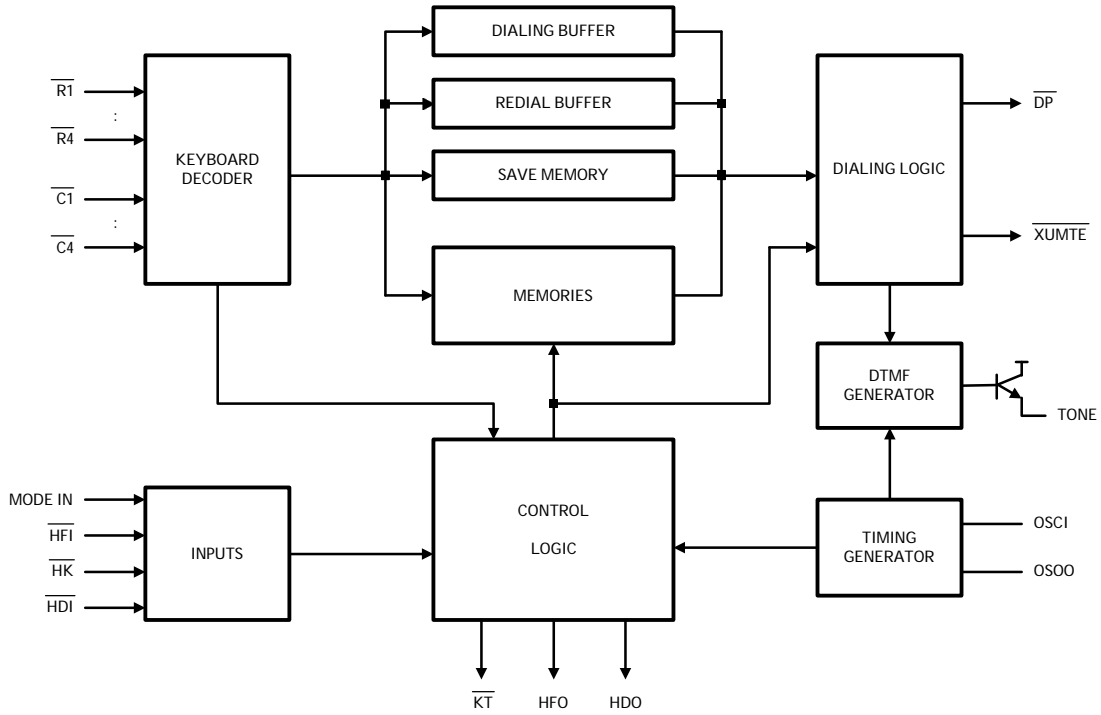


Flash time, F1: 600ms( default ), F2: 300ms, F3: 100ms

Diode options (switch closed):

- D1. Lock 0
- D2. Pause time 2.2sec
- D3. Flash time 300ms for F1
- D4. Lock 0, 9
- D5. Pulse dialing 10-N
- D6. Pulse dialing N+1
- D7. Lock 0, 168
- D8. Flash time 100ms for F1
- D9. Dialing rate 10pps & 20pps selectable, M/B ratio 1/2
- D10. Lock all digits



**Block Diagram**


**Absolute Maximum Ratings\***

Supply Voltage (V<sub>DD</sub>) . . . . . -0.3V to +6.0V  
 Input Voltage (V<sub>IN</sub>) . . . . . V<sub>SS</sub> - 0.3V to V<sub>DD</sub> + 0.3V  
 Output Voltage (V<sub>OUT</sub>) . . . . . V<sub>SS</sub> - 0.3V to V<sub>DD</sub> + 0.3V  
 Output Voltage (V<sub>OUT</sub>)( $\overline{DP}$ ,  $\overline{XMUTE}$ ) . . . . . <1.2V  
 Tone Output Current (I<sub>TONE</sub>) . . . . . <50 mA  
 Power Dissipation (P<sub>d</sub>) . . . . . <500 mW  
 Operating Temperature (T<sub>OP</sub>) . . . . . -20°C to +70°C  
 Storage Temperature (T<sub>stg</sub>) . . . . . -40°C to +125°C

**\* Comments**

Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only. Functional operation of this device at these or any other conditions above those indicated in the operational sections of this specification is not implied and exposure to absolute maximum rating conditions for extended periods may affect device reliability.

**DC Electrical Characteristics (V<sub>DD</sub> = 2.5V, V<sub>SS</sub> = 0V, Fosc = 3.579MHz, T<sub>OP</sub> = 25°C, unless otherwise specified.)**

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Test CKT.	
Operating Voltage	V <sub>DD</sub>	2.0		5.5	V	PULSE mode	A	
		2.0		5.5		TONE mode		
Memory Retention Voltage	V <sub>MR</sub>	0.8			V		-	
Memory Retention Current	I <sub>MR</sub>			0.5	μA	V <sub>DD</sub> = 1.0V, $\overline{HK}$ = V <sub>DD</sub> All outputs unloaded	-	
Operating Current	I <sub>DDP</sub>			1.0	mA	PULSE mode	All outputs unloaded	A
	I <sub>DDT</sub>			2.0		TONE mode		
Standby Current	I <sub>SC</sub>		0.3	0.5	μA	$\overline{HK}$ = V <sub>DD</sub> = 1.5V	All outputs unloaded No key selected	
				20		$\overline{HK}$ = V <sub>SS</sub>		
Input Voltage	V <sub>IH</sub>	0.8		1	V <sub>DD</sub>	---		
	V <sub>IL</sub>	0		0.2				
$\overline{R1}$ - $\overline{R4}$ Input Current	I <sub>R</sub>		16		μA		C	
Tone Out Voltage	V <sub>OC</sub>		720		mVp.p	Column	V <sub>DD</sub> = 2.5V RL = 5K	D
	V <sub>OR</sub>		560			Row		
$\overline{HFI}$ Pull Low Current	I <sub>HFI</sub>		2.4		μA	V <sub>DD</sub> = 2.5V (Note 1) $\overline{HFI}$ pin connected to 0V	C	

**DC Electrical Characteristics (continued)**

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Test CKT.
HFO, HDO Source Current	I <sub>OH1</sub>	0.25	0.85		mA	V <sub>DD</sub> = 2.5V V <sub>OH</sub> = V <sub>DD</sub> - 0.4V	B
HFO, HDO, $\overline{KT}$ , $\overline{XMUTE}$ Sink Current	I <sub>OL1</sub>	0.8	2.5		mA	V <sub>DD</sub> = 2.5V V <sub>OL</sub> = 0.4V	B
$\overline{DP}$ Sink Current	I <sub>OL2</sub>	0.8	2.2		mA	V <sub>OL</sub> = 0.4V	B
Distortion	DIS%		1	5	%	*(See note below)	

\*Note:

$$DIS\% = \frac{100 * (V_1^2 + V_2^2 + \dots + V_n^2)^{1/2}}{(V_{IL}^2 + V_{IH}^2)^{1/2}}$$

- V<sub>1</sub> . . . . V<sub>n</sub> are the intermodulation or the harmonic frequencies in the 500 Hz to 3400 Hz band.
- V<sub>IL</sub> and V<sub>IH</sub> are the individual frequency components of the DTMF signal.

**AC Characteristics** (V<sub>DD</sub> = 2.5V, V<sub>SS</sub> = 0V, F<sub>osc</sub> = 3.579MHz, T<sub>op</sub> = 25°C, unless otherwise specified.)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Make Time	T <sub>M</sub>		33.3		ms	10 pps
			40.0			M/B = 1/2
			16.7			M/B = 2/3
			20.0			20 pps
Break Time	T <sub>B</sub>		66.6		ms	10 pps
			60.0			M/B = 1/2
			33.3			M/B = 2/3
			30.0			20 pps
Inter-digit Pause Time	T <sub>IDP</sub>		824		ms	10 pps
			458			20 pps
Pause Time	T <sub>PAU</sub>		2.2		sec	
			3.6			
Auto-redial Break Time	T <sub>AOBK</sub>		2.2		sec	
Delay time key valid to signal out	T <sub>d</sub>		2		ms	
Pick-Up Pause	T <sub>HK</sub>		824		ms	
Key-in Debounce	T <sub>kd</sub>		22		ms	
Key-release Debounce	T <sub>rd</sub>		24		ms	

**AC Characteristics (continued)**

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Key-in Tone Duration	$T_{KTD}$		27		ms	
Key-in Tone Frequency	$F_{KT}$		437		Hz	
Minimum Tone Duration Time	$T_{MFD}$		94		ms	
Min. Tone inter-digit Pause	$T_{IDP}$		96		ms	
Redial Tone Duration	$T_{RFDR}$		94		ms	
Redial Tone inter-digit Duration	$T_{TIDPR}$		96		ms	
Memory Tone Duration	$T_{RFDM}$		94		ms	
Memory Tone inter-digit Duration	$T_{TIDPM}$		96		ms	
Hold-in Debounce	$T_{HD}$		23		ms	
Hold-release Debounce	$T_{HRD}$		295		ms	
Hands-Free in Debounce	$T_{HFID}$		22		ms	
Hands-Free release Debounce	$T_{HFRD}$		24		ms	

**Comparisons of Specified vs. Actual Tone Frequencies**

R/C	Spec.	Actual	Error(%)	Unit	Conditions
R1	697	699.2	+0.32	Hz	Fosc = 3.579MHz
R2	770	766.3	-0.48	Hz	
R3	852	847.5	-0.53	Hz	
R4	941	948.1	+0.74	Hz	
C1	1,209	1,216.0	+0.58	Hz	
C2	1,336	1,331.8	-0.31	Hz	
C3	1,477	1,472.0	-0.34	Hz	

**Pin Descriptions**

Pin No.				Designation	I/O	Description																																
NT91315AL	NT91315BL	NT91315CL	NT91315DL																																			
1	2	2	2	$\overline{\text{HK}}$	I	<p>Hook switch input</p> <p>This inverter input pin detects the state of the hook switch contact. "Off Hook" is represented by a <math>V_{SS}</math> condition. "On Hook" is represented by a <math>V_{DD}</math> condition</p>																																
2	3	3	3	MODE IN	I, Z	<p>TRI-STATE mode select pin</p> <p>The two types the NT91315XL are listed as follows (diode options)</p> <p>a. Without diode added</p> <table border="1"> <thead> <tr> <th>MODE IN</th> <th>Tone/Pulse</th> <th>Dial Rate</th> <th>M/B Ratio</th> </tr> </thead> <tbody> <tr> <td><math>V_{DD}</math></td> <td>Pulse</td> <td>10pps</td> <td>2/3</td> </tr> <tr> <td><math>V_{SS}</math></td> <td>Tone</td> <td>-</td> <td>-</td> </tr> <tr> <td>Floating</td> <td>Pulse</td> <td>10pps</td> <td>1/2</td> </tr> </tbody> </table> <p>b. With diode added</p> <table border="1"> <thead> <tr> <th>MODE IN</th> <th>Tone/Pulse</th> <th>Dial Rate</th> <th>M/B Ratio</th> </tr> </thead> <tbody> <tr> <td><math>V_{DD}</math></td> <td>Pulse</td> <td>10pps</td> <td>1/2</td> </tr> <tr> <td><math>V_{SS}</math></td> <td>Tone</td> <td>-</td> <td>-</td> </tr> <tr> <td>Floating</td> <td>Pulse</td> <td>20pps</td> <td>1/2</td> </tr> </tbody> </table> <p>The mode selection pin checks for tone/pulse dialing as each digit is entered. In the PULSE mode, the dialing rate is checked, along with the make/break ratio, at the entry of the first key</p>	MODE IN	Tone/Pulse	Dial Rate	M/B Ratio	$V_{DD}$	Pulse	10pps	2/3	$V_{SS}$	Tone	-	-	Floating	Pulse	10pps	1/2	MODE IN	Tone/Pulse	Dial Rate	M/B Ratio	$V_{DD}$	Pulse	10pps	1/2	$V_{SS}$	Tone	-	-	Floating	Pulse	20pps	1/2
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**Pin Descriptions (continued)**

Pin No.				Designation	I/O	Description
NT91315AL	NT91315BL	NT91315CL	NT91315DL			
3 4	4 5	4 5	4 5	OSCI OSCO	I	Oscillator Input and Output pins The time base for the NT91315XL is a crystal controlled on-chip oscillator. It is completed by connecting a 3.58 MHz crystal or ceramic resonator between the OSCI and OSKO pins
5	6	6	6	V <sub>SS</sub>		Power supply pins These devices are designed to operate from 2.0V to 5.5V
6	7	7	7	V <sub>DD</sub>		
7	8	8	8	TONE	O	Tone dialing output When a valid keystroke is detected in DTMF mode, appropriate low group and high group frequencies are generated, which hybridize the dual tone output. Tone output is in the OFF state when in PULSE mode
8	9	9	9	$\overline{\text{XMUTE}}$	O	Dialing transmission mute output This is an N-channel open drain output. The $\overline{\text{XMUTE}}$ is normally OFF. During pulse or DTMF dialing, this output is ON
9	10	12	14	$\overline{\text{DP}}$	O	Dialing pulse output This is an N-channel open drain output. The normal output will be ON during break and OFF during make in the PULSE DIALING mode
10	11	13	15	$\overline{\text{C1}}$		
11	12	14	16	$\overline{\text{C2}}$		
12	13	15	17	$\overline{\text{C3}}$		
13	14	16	18	$\overline{\text{R1}}$		
14	15	17	19	$\overline{\text{R2}}$		
15	16	18	20	$\overline{\text{R3}}$		
16	17	19	21	$\overline{\text{R4}}$		
(N.A.)	(N.A.)	(N.A.)	11	$\overline{\text{C4}}$		



**Pin Descriptions (continued)**

Pin No.				Designation	I/O	Description																																								
NT91315AL	NT91315BL	NT91315CL	NT91315DL																																											
(N.A.)	(N.A.)	10	10	HDO	O	HOLD output pin This inverter output pin will stay high when HOLD function is active																																								
(N.A.)	(N.A.)	11	13	$\overline{\text{HDI}}$	I	The HOLD function will be toggled when this pin goes from high to low in the OFF HOOK state																																								
(N.A.)	(N.A.)	(N.A.)	12	$\overline{\text{KT}}$	O	Key-in tone output This N-channel open drain pin sends out a "beep" tone for each PULSE mode and each store state key entry, as well as for entries of accepted function keys (ST, F, A/L, R/P, SAVE and memory keys). Tone output frequency is 437 Hz and tone duration is 27 ms																																								
(N.A.)	1	1	1	HFO	O	Hands-Free Control I/O pins These pins enable and disable the Hands-Free Control function. When input pin $\overline{\text{HFI}}$ goes low, the Hands-Free Control state is toggled on. The status of the Hands-Free Control state is listed in the following table:																																								
						<table border="1"> <thead> <tr> <th colspan="2">Current State</th> <th colspan="3">Next States</th> </tr> <tr> <th>Hook sw.</th> <th>HFO</th> <th>Input</th> <th>HFO</th> <th>Dialing?</th> </tr> </thead> <tbody> <tr> <td>-</td> <td>Low</td> <td><math>\overline{\text{HFI}} \downarrow</math></td> <td>High</td> <td>Yes</td> </tr> <tr> <td>On Hook</td> <td>High</td> <td><math>\overline{\text{HFI}} \downarrow</math></td> <td>Low</td> <td>No</td> </tr> <tr> <td>Off Hook</td> <td>High</td> <td><math>\overline{\text{HFI}} \downarrow</math></td> <td>Low</td> <td>Yes</td> </tr> <tr> <td>On Hook</td> <td>-</td> <td>Off Hook</td> <td>Low</td> <td>Yes</td> </tr> <tr> <td>Off Hook</td> <td>Low</td> <td>On Hook</td> <td>Low</td> <td>No</td> </tr> <tr> <td>Off Hook</td> <td>High</td> <td>On Hook</td> <td>High</td> <td>Yes</td> </tr> </tbody> </table>	Current State		Next States			Hook sw.	HFO	Input	HFO	Dialing?	-	Low	$\overline{\text{HFI}} \downarrow$	High	Yes	On Hook	High	$\overline{\text{HFI}} \downarrow$	Low	No	Off Hook	High	$\overline{\text{HFI}} \downarrow$	Low	Yes	On Hook	-	Off Hook	Low	Yes	Off Hook	Low	On Hook	Low	No	Off Hook	High	On Hook	High	Yes
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	18	20	22	$\overline{\text{HFI}}$	I																																									

## Operating Procedures

### Symbol Definitions:

In the description below, signals are defined in terms of the key or switch which is activated.

**Off Hook** means the phone is off the hook.

**On Hook** means the phone is on the hook.

**D1** represents the first digit dialed in a string of digits.

**Dn** (**Dk**) represents the last digit dialed in a string of digits.

**Dn+1** (**Dk+1**) represents the beginning of a new string of digits.

**ST** is the Store key.

**A/L** is the Auto/Location key.

**F** is the Flash key.

**RD/P** is the Redial/Pause key.

**RD** is the Redial key.

**P** is the Pause key.

**Mi** is the Emergency key.

**SAVE** is the Save key.

### Functional Descriptions:

#### 1. Normal Dialing

**Off Hook** **D1** ... **Dn**

Dial out **D1** ... **Dn** in either PULSE or TONE mode according to the state of input pin "MODE IN". The redial memory will be **D1** ... **Dn**. (The number of dialing digits is unlimited, but redial memory is limited to 32 digits.)

#### 2. Flash Dialing

**Off Hook** **F** **D1** ... **Dn**

**DP** will break for 96/297/640ms and pause for an additional 824ms. It will then dial out **D1** ... **Dn**, which will be stored in redial memory.

**Off Hook** **D1** ... **Dk** **F** **Dk+1** ... **Dn**

The **F** key is unavailable until **D1** ... **Dk** is dialed out. Dialing **F** **Dk+1** ... **Dn** uses the same process as the previous case. The redial memory will be **Dk+1** ... **Dn**.

**Off Hook** **F**

**DP** will break for 96/297/640ms.

Redial memory remains unchanged.

#### 3. Memory Dialing

**Off Hook** (**A/L**) **Mn** (n = 1, 2, 3) or **Off Hook** **A/L** **Dn** (**Dn** = 0 - 9)

Dials out digits in direct memory **Mn** or indirect memory **Dn** (up to 16 digits). Redial memory remains unchanged.

#### Notes:

- In both PULSE and TONE modes, there can be up to 16 digits in a memory location. The tone/pulse attribute is also recorded. In memory dialing, the "MODE IN" pin state does not affect the tone/pulse attribute in memory.
- The **F** key can be stored only as the first key in memory, not in any other position.

#### 4. Chain Dialing

- a. **Off Hook** **D1** ... **Dk** **Mi** ( $i = 1, 2, 3$ )  
**A/L** **Dm** ( $Dm = 0 - 9$ ) **Dk+1** ... **Dn**.

It first dials out **D1** ... **Dk**, then the digits of **Mi**, then the digits of indirect memory **Dm**, and finally **Dk+1** ... **Dn**.

- b. **Off Hook** **R/P** **R/P** **D1** ... **Dn** **Mi**  
( $i = 1, 2, 3$ )

Dials out the digits in redial memory, pauses for 2.2/3.6 sec, then dials **D1** ... **Dn**, and finally the digits in **Mi**. The redial memory is unchanged.

Note:

Memory keys can be accepted at any time during chain dialing, whether or not the dialing process is completed.

#### 5. Mix Dialing

Only PULSE mode to TONE mode is switchable. This is achieved by either changing the MODE IN state, or by depressing the **\*T** key in PULSE mode. TONE mode to PULSE mode switching is not allowed.

#### 6. Memory Storage

##### a. Direct memory storage

**ST** **D1** ... **Dn** **Mi** or **ST** **D1** ...  
**Dn** **ST** **Mi** or **ST** **D1** ... **Dn**  
**A/L** **Mi** or **ST** **D1** ... **Dn** **ST** **A/L**  
**Mi** ( $i = 1, 2, 3$ ).

##### b. Indirect memory storage

**ST** **D1** ... **Dn** **ST** **Dj** or **ST** **D1** ...  
... **Dn** **A/L** **Dj** or **ST** **D1** ... **Dn**  
**ST** **A/L** **Dj** ( $Dj = 0 - 9$ ).

##### c. Quick storage

**ST** **D1** ... **Dk** (**ST** **A/L**) **Mi** **ST**  
**Dk+1** ... **Dm** **ST** **Dj** **ST** **Dm+1** ...  
**Dn** **A/L** **D1**

##### d. Redial memory storage

**ST** (**RD**) **ST** **Mi** ( $i = 1, 2, 3$ ) or **ST**  
(**RD**) **ST** (**A/L**) **Dj** ( $Dj = 0 - 9$ )

Note: **ST** **RD/P** **ST** **Mi** will take **RD/P** as a pause key.

##### e. Store after dialing

**D1** ... **Dn** **ST** **ST** **Mi** ( $i = 1, 2, 3$ )  
**D1** ... **Dn** will be dialed out and will be stored in **Mi**.

**D1** ... **Dk** **ST** **Dk+1** ... **Dn** **ST**  
**A/L** **Dj** ( $Dj = 0 - 9$ )  
**D1** ... **Dk** will be dialed out, and **Dk+1** ...  
**Dn** will be stored in **A/L** **Dj**.

Notes:

a. Storage is processed in Off-Hook state only.

b. In PULSE mode, the key tone is active as valid key input. In TONE mode, **D1** ... **Dn** **ST** **ST** **Mi**, only the last three keys can produce key tones, but **ST** **D1** ... **Dn** **ST** **A/L** **Dj** has key tones with every key entry whether in PULSE or TONE mode.

c. ("MODE IN" = VDD or floated) **ST** **D1** ... **Dk**  
("MODE IN" = 0) **Dk+1** ... **Dn** **ST** **Dj**  
Store pulse digits **D1** ... **Dk**, **P→T**, and tone digits **Dk+1** ... **Dn** in indirect memory **Dj**.

d. In memory storage, the chip will retain the tone/pulse attribute automatically. In memory dialing, the "MODE IN" state is ignored.

e. Memory storage can proceed either before dialing out a number, or after a dialing sequence is completed.

f. During memory storage,  $\overline{XMUTE}$ ,  $\overline{DP}$  remains in the OFF state, and all outputs remain unchanged except the key tone.

g. Memory storage will not alter the digits in redial memory.

#### 7. Save Operation

##### a. Save dialing

**Off Hook** **SAVE**

Dials out the digits in **SAVE**. (up to 32 digits)

##### b. Save storage

**Off Hook** **D1** ... **Dn** **SAVE**

**D1** ... **Dn** will be dialed out and stored in **SAVE**.

**ST** **D1** ... **Dn** **SAVE**

**D1** ... **Dn** will be stored in **SAVE**.

**ST** **RD** **SAVE** or **ST** (**RD**) **ST** **SAVE**

The digits in redial will be stored in **SAVE**.

##### c. Save to memory

**ST** **SAVE** (**ST**) **Mi**

Stores the digits in **SAVE** to **Mi**.

**ST** **SAVE** (**ST**) **Dj**

Stores the digits in **SAVE** to **A/L** **Dj**.

#### 9. One-key Redial

**Off Hook** **D1** ... **Dn** **RD**

The **RD** key is unavailable until **D1** ... **Dn** is dialed out. **RD** will break 2.2 sec and pause for 824 ms, then redial **D1** ... **Dn**.

#### 10. Hold Operation

a. When in OFF HOOK state, pressing HOLD key will toggle hold function.

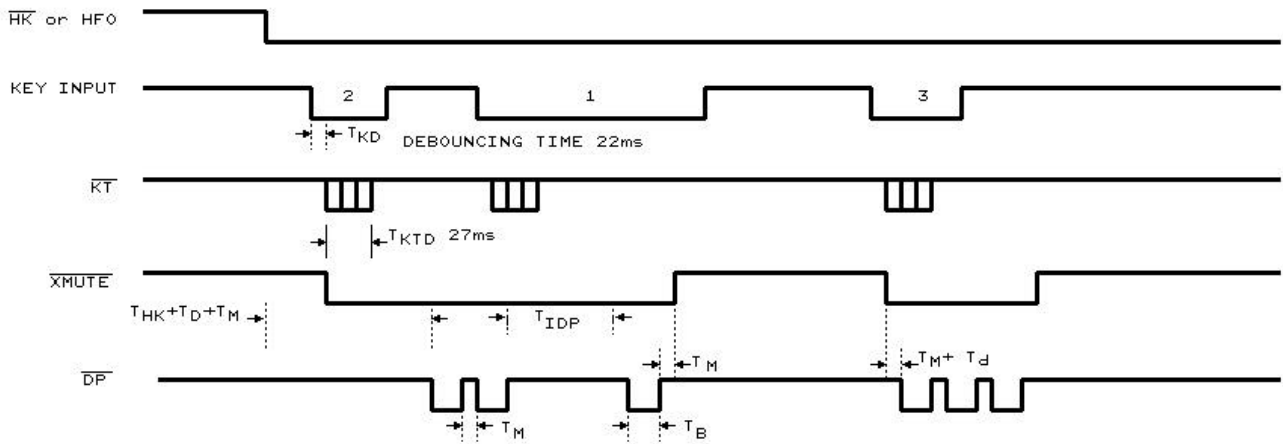
b. When hands-free function is active, pressing HOLD key will activate hold function and release hands-free function.

c. When hold function is active, pressing  $\overline{HF1}$  key will hands-free function activate and release hold function.

d. Picking up receiver will release hold function.

## Timing Waveforms

### 1. Timing Waveforms in PULSE Mode:



$T_{HK}$ : Pick-Up Pause, 824ms

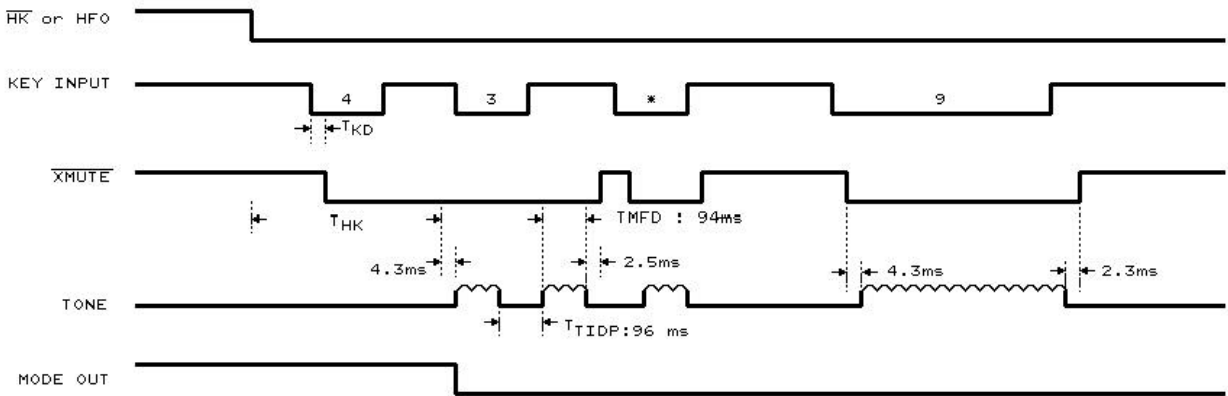
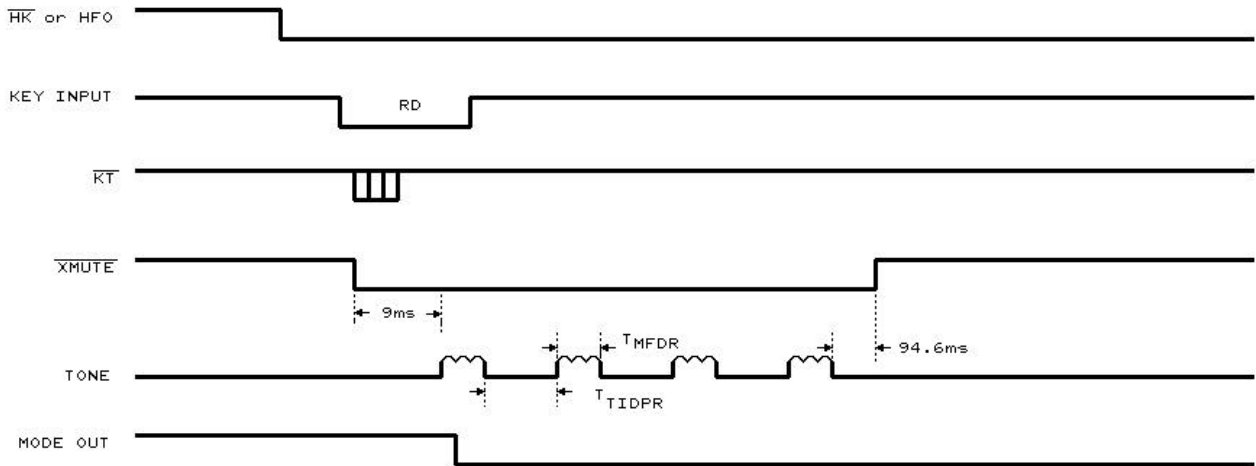
$T_D$ : Delay time or Key valid to dialing signal out, typically 2ms

$T_{IDP}$ : Inter-digit pause time

$T_{KTO}$ : Key-in tone duration

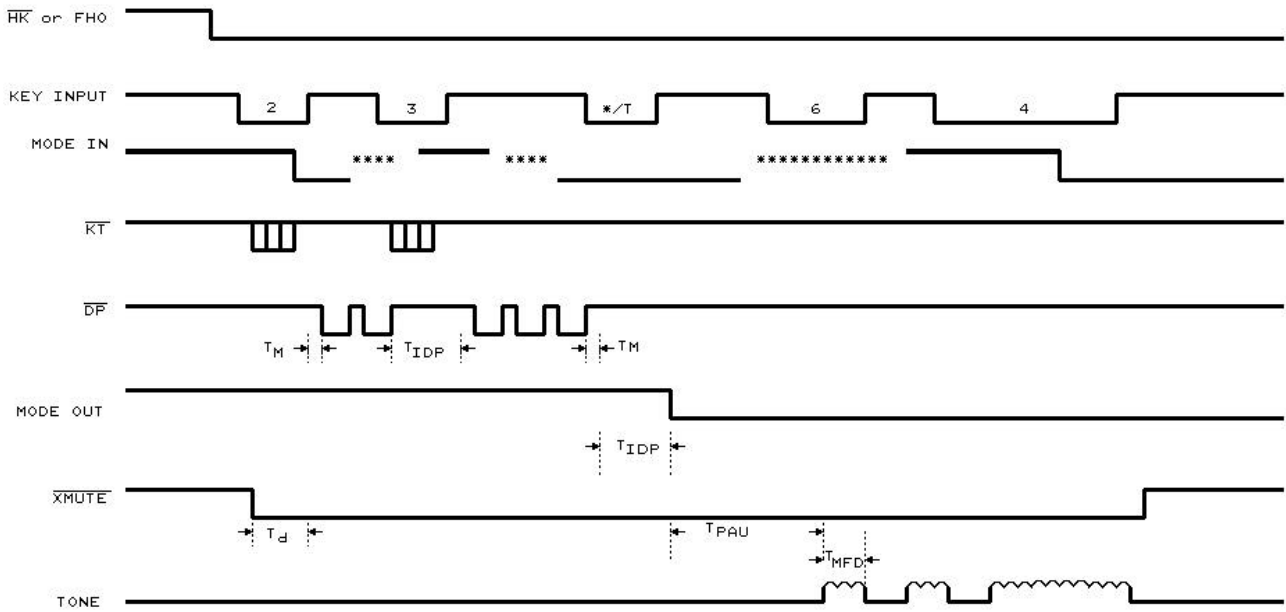
$T_{KD}$ : Debouncing time

Note: "HK" or "HFO" indicates that the chip is active when hook switch  $\overline{HK}$  goes low or Hands-Free control output HFO goes high.

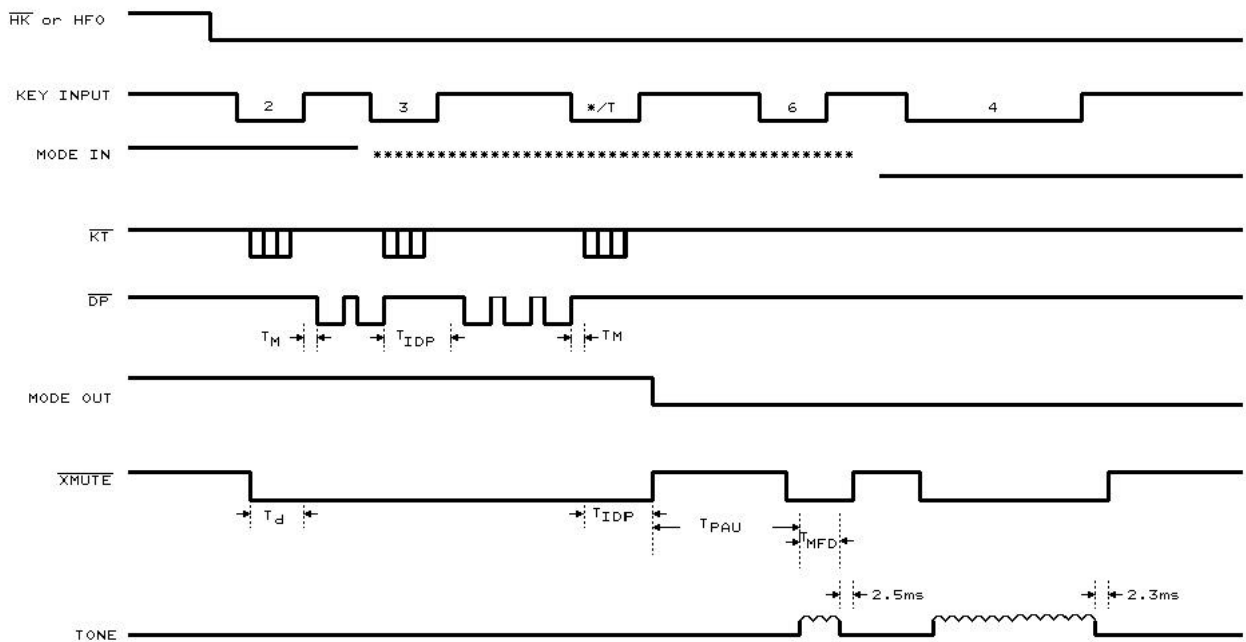
**Timing Waveforms (continued)**
**2. Timing Waveforms in TONE Mode:**
**(i) Normal Dialing**

**(ii) After (i), Redialing**


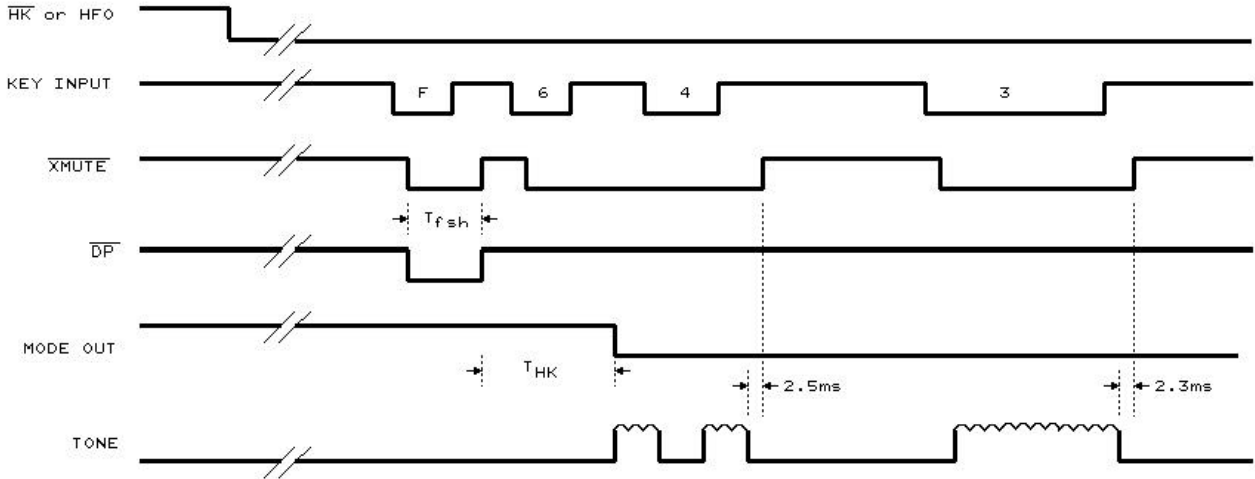
**Timing Waveforms (continued)**
**3. Timing Waveforms for Switching Mode Operation:**

(i) By mode selection pin switches

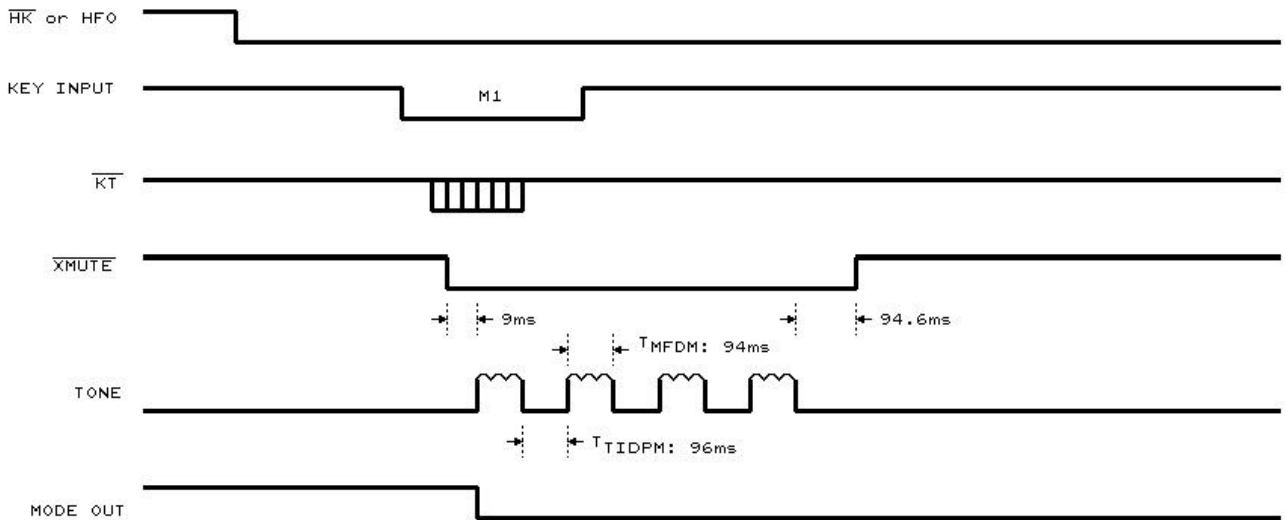


(ii) By \*/T key entry



**Timing Waveforms (continued)**
**4. Timing Dialing (DTMF mode used as example):**

**5. Memory Dial (DTMF mode used as example):**

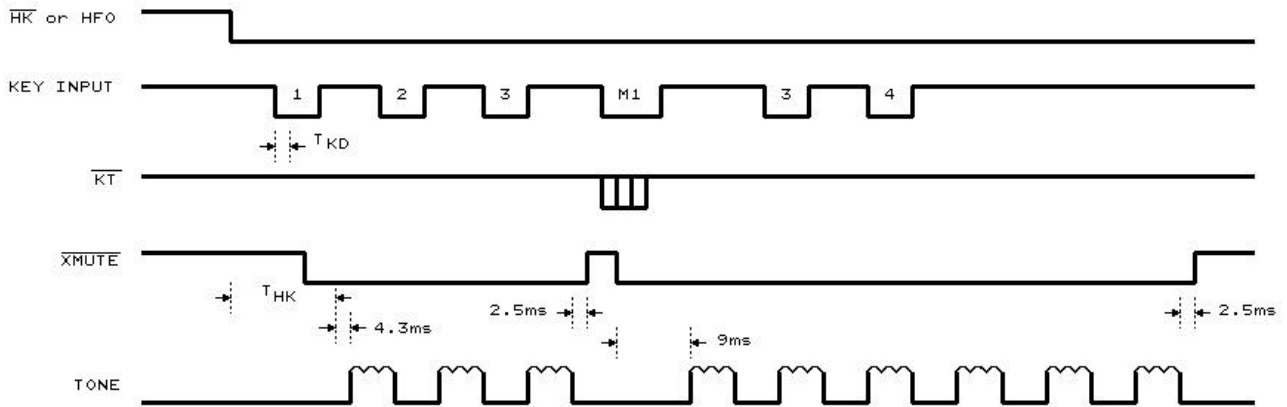
(1, 2, 3, 4 stored in M1)





**Timing Waveforms (continued)**
**6. Chain Dialing (DTMF mode used as example):**

(1, 2, 3, 4 stored in M1)



**Ordering Information**

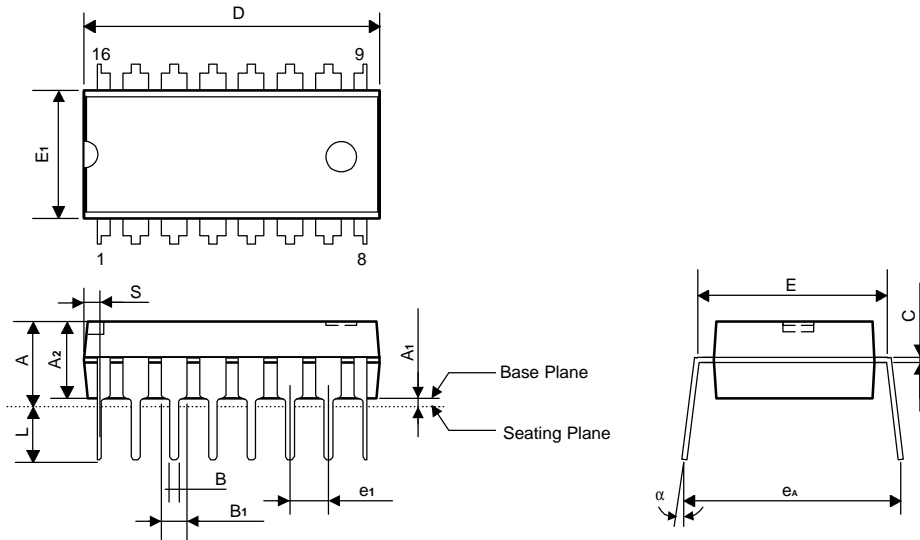
<b>Pin No.</b>	<b>Key Tone</b>	<b>Holds-Free Control</b>	<b>Hold Function</b>	<b>Package</b>
NT91315AL	N.A	N.A	N.A	16L DIP
NT91315BL	N.A	A	N.A	18L DIP
NT91315CL	N.A	A	A	20L DIP
NT91315DL	A	A	A	22L DIP

N.A: Not Available

A: Available

**Package Information**
**DIP 16L Outline Dimensions**

unit: inches/mm



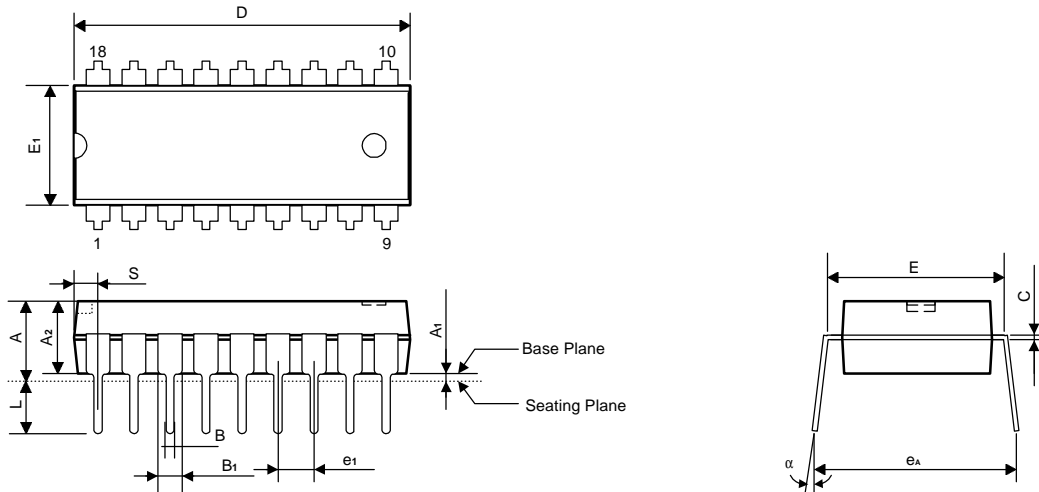
Symbol	Dimensions in inches	Dimensions in mm
A	0.175 Max.	4.45 Max.
A1	0.010 Min.	0.25 Min.
A2	0.130±0.010	3.30±0.25
B	0.018 +0.004 -0.002	0.46 +0.10 -0.05
B1	0.060 +0.004 -0.002	1.52 +0.10 -0.05
C	0.010 +0.004 -0.002	0.25 +0.10 -0.05
D	0.750 Typ. (0.770 Max.)	19.05 Typ. (19.56 Max.)
E	0.300±0.010	7.62±0.25
E1	0.250 Typ. (0.262 Max.)	6.35 Typ. (6.65 Max.)
e1	0.100±0.010	2.54±0.25
L	0.130±0.010	3.30±0.25
α	0° ~ 15°	0° ~ 15°
eA	0.345±0.035	8.76±0.89
S	0.040 Max.	1.02 Max.

**Notes:**

1. The maximum value of dimension D includes end flash.
2. Dimension E1 does not include resin fins.
3. Dimension S includes end flash.

**Package Information**
**DIP 18L Outline Dimensions**

unit: inches/mm



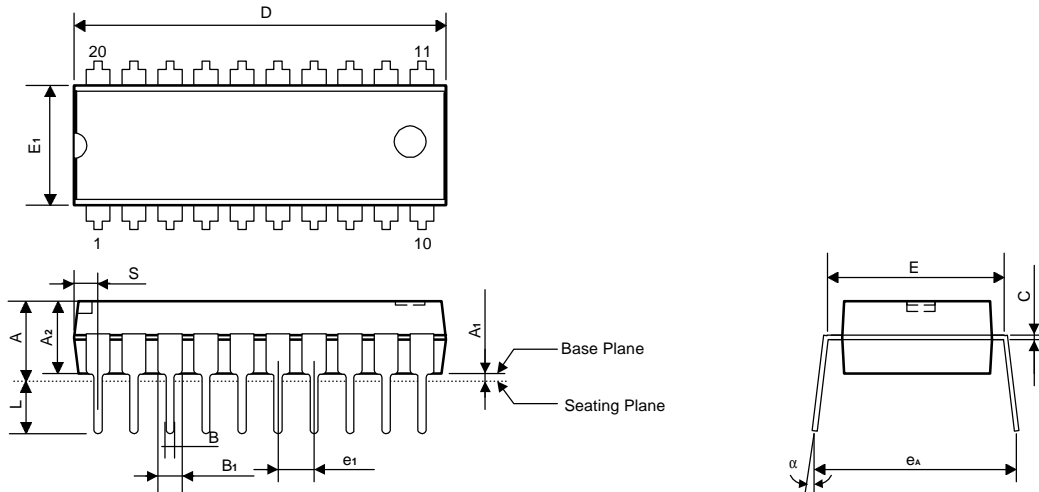
Symbol	Dimensions in inches	Dimension in mm
A	0.175 Max.	4.45 Max.
A1	0.010 Min.	0.25 Min.
A2	0.130±0.010	3.30±0.25
B	0.018 +0.004 -0.002	0.46 +0.10 -0.05
B1	0.060 +0.004 -0.002	1.52 +0.10 -0.05
C	0.010 +0.004 -0.002	0.25 +0.10 -0.05
D	0.900 Typ. (0.920 Max.)	22.86 Typ. (23.37 Max.)
E	0.300±0.010	7.62±0.25
E1	0.250 Typ. (0.262 Max.)	6.35 Typ. (6.65 Max.)
e1	0.100±0.010	2.54±0.25
L	0.130±0.010	3.30±0.25
α	0° ~ 15°	0° ~ 15°
eA	0.345±0.035	8.76±0.89
S	0.055 Max.	1.40 Max.

**Notes:**

1. The maximum value of dimension D includes end flash.
2. Dimension E1 does not include resin fins.
3. Dimension S includes end flash.

**Package Information**
**DIP 20L Outline Dimensions**

unit: inches/mm



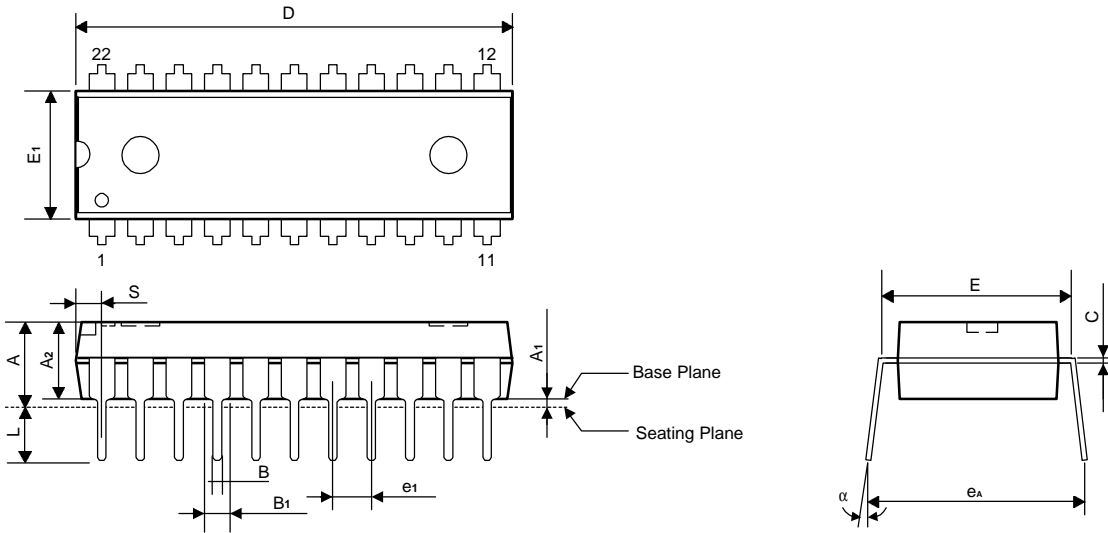
Symbol	Dimensions in inches	Dimensions in mm
A	0.175 Max.	4.45 Max.
A1	0.010 Min.	0.25 Min.
A2	0.130±0.010	3.30±0.25
B	0.018 +0.004 -0.002	0.46 +0.10 -0.05
B1	0.060 +0.004 -0.002	1.52 +0.10 -0.05
C	0.010 +0.004 -0.002	0.25 +0.10 -0.05
D	1.026 Typ. (1.046 Max.)	26.06 Typ. (26.57 Max.)
E	0.300±0.010	7.62±0.25
E1	0.250 Typ. (0.262 Max.)	6.35 Typ. (6.65 Max.)
e1	0.100±0.010	2.54±0.25
L	0.130±0.010	3.30±0.25
α	0° ~ 15°	0° ~ 15°
eA	0.345±0.035	8.76±0.89
S	0.078 Max.	1.98 Max.

**Notes:**

1. The maximum value of dimension D includes end flash.
2. Dimension E1 does not include resin fins.
3. Dimension S includes end flash.

**Package Information**
**DIP 22L Outline Dimensions**

unit: inches/mm



Symbol	Dimensions in inches	Dimensions in mm
A	0.190 Max.	4.83 Max.
A1	0.010 Min.	0.25 Min.
A2	0.130±0.010	3.30±0.25
B	0.018 +0.004 -0.002	0.46 +0.10 -0.05
B1	0.060 +0.004 -0.002	1.52 +0.10 -0.05
C	0.010 +0.004 -0.002	0.25 +0.10 -0.05
D	1.090 Typ. (1.110 Max.)	27.69 Typ. (28.19 Max.)
E	0.400±0.010	10.16±0.25
E1	0.350 Typ. (0.362 Max.)	8.89 Typ. (9.19 Max.)
e1	0.100±0.010	2.54±0.25
L	0.130±0.010	3.30±0.25
α	0° ~ 15°	0° ~ 15°
eA	0.445±0.035	11.30±0.89
S	0.060 Max.	1.52 Max.

**Notes:**

1. The maximum value of dimension D includes end flash.
2. Dimension E1 does not include resin fins.
3. Dimension S includes end flash.