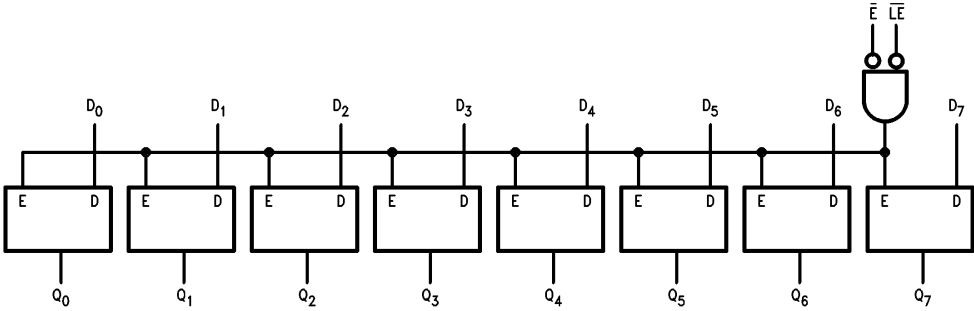




### Logic Diagram



TL/F/10250-5

### Truth Table

Inputs			Outputs
D <sub>n</sub>	$\bar{E}$	$\bar{LE}$	Q <sub>n</sub>
L	L	L	L
H	L	L	H
X	H	X	Latched*
X	X	H	Latched*

\*Retains data present before either  $\bar{LE}$  or  $\bar{E}$  went HIGH

H = HIGH voltage level

L = LOW voltage level

X = Don't care

## Absolute Maximum Ratings

Above which the useful life may be impaired (Note 1)

**If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.**

Storage Temperature (T <sub>STG</sub> )	–65°C to +150°C
Maximum Junction Temperature (T <sub>J</sub> )	
Ceramic	+175°C
Plastic	+150°C
V <sub>EE</sub> Pin Potential to Ground Pin	–7.0V to +0.5V
Input Voltage (DC)	V <sub>EE</sub> to +0.5V
Output Current (DC Output HIGH)	–50 mA
ESD (Note 2)	≥2000V

**Note 1:** Absolute maximum ratings are those values beyond which the device may be damaged or have its useful life impaired. Functional operation under these conditions is not implied.

**Note 2:** ESD testing conforms to MIL-STD-883, Method 3015.

## Recommended Operating Conditions

Case Temperature (T <sub>C</sub> )	
Commercial	0°C to +85°C
Industrial	–40°C to +85°C
Military	–55°C to +125°C
Supply Voltage (V <sub>EE</sub> )	–5.7V to –4.2V

## Commercial Version

### DC Electrical Characteristics

V<sub>EE</sub> = –4.2V to –5.7V, V<sub>CC</sub> = V<sub>CCA</sub> = GND, T<sub>C</sub> = 0°C to +85°C (Note 3)

Symbol	Parameter	Min	Typ	Max	Units	Conditions	
V <sub>OH</sub>	Output HIGH Voltage	–1025	–955	–870	mV	V <sub>IN</sub> = V <sub>IH</sub> (Max) or V <sub>IL</sub> (Min)	Loading with 50Ω to –2.0V
V <sub>OL</sub>	Output LOW Voltage	–1830	–1705	–1620	mV		
V <sub>OHc</sub>	Output HIGH Voltage	–1035			mV	V <sub>IN</sub> = V <sub>IH</sub> (Min) or V <sub>IL</sub> (Max)	Loading with 50Ω to –2.0V
V <sub>OLc</sub>	Output LOW Voltage			–1610	mV		
V <sub>IH</sub>	Input HIGH Voltage	–1165		–870	mV	Guaranteed HIGH Signal for All Inputs	
V <sub>IL</sub>	Input LOW Voltage	–1830		–1475	mV	Guaranteed LOW Signal for All Inputs	
I <sub>IL</sub>	Input LOW Current	0.50			μA	V <sub>IN</sub> = V <sub>IL</sub> (Min)	
I <sub>IH</sub>	Input HIGH Current			240	μA	V <sub>IN</sub> = V <sub>IH</sub> (Max)	
I <sub>EE</sub>	Power Supply Current	–95 –97		–55 –55	mA	Inputs Open V <sub>EE</sub> = –4.2V to –4.8V V <sub>EE</sub> = –4.2V to –5.7V	

**Note 3:** The specified limits represent the “worst case” value for the parameter. Since these values normally occur at the temperature extremes, additional noise immunity and guardbanding can be achieved by decreasing the allowable system operating ranges. Conditions for testing shown in the tables are chosen to guarantee operation under “worst case” conditions.

### DIP AC Electrical Characteristics

V<sub>EE</sub> = –4.2V to –5.7V, V<sub>CC</sub> = V<sub>CCA</sub> = GND

Symbol	Parameter	T <sub>C</sub> = 0°C		T <sub>C</sub> = +25°C		T <sub>C</sub> = +85°C		Units	Conditions
		Min	Max	Min	Max	Min	Max		
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay D <sub>n</sub> to Output	0.80	2.00	0.80	2.00	0.80	2.20	ns	Figures 1, 2, 3 (Note 1)
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay $\overline{LE}$ , $\overline{E}$ to Output	1.40	2.90	1.40	2.90	1.60	3.10	ns	Figures 1, 2, 3 (Note 1)
t <sub>TLH</sub> t <sub>THL</sub>	Transition Time 20% to 80%, 80% to 20%	0.45	2.00	0.45	2.00	0.45	2.00	ns	Figures 1, 3
t <sub>s</sub>	Setup Time D <sub>0</sub> –D <sub>7</sub>	1.0		1.0		1.1		ns	Figures 1, 4
t <sub>h</sub>	Hold Time D <sub>0</sub> –D <sub>7</sub>	0.1		0.1		0.1		ns	Figures 1, 4
t <sub>pw(H)</sub>	Pulse Width HIGH $\overline{LE}$ , $\overline{E}$	2.00		2.00		2.00		ns	Figures 1, 4

**Note 1:** The propagation delay specified is for single output switching. Delays may vary up to 300 ps with multiple outputs switching.

**Commercial Version** (Continued)

**PCC and Cerpack AC Electrical Characteristics**

$V_{EE} = -4.2V$  to  $-5.7V$ ,  $V_{CC} = V_{CCA} = GND$

Symbol	Parameter	$T_C = 0^\circ C$		$T_C = +25^\circ C$		$T_C = +85^\circ C$		Units	Conditions
		Min	Max	Min	Max	Min	Max		
$t_{PLH}$ $t_{PHL}$	Propagation Delay $D_n$ to Output	0.80	1.80	0.80	1.80	0.80	2.00	ns	Figures 1, 2, 3 (Note 2)
$t_{PLH}$ $t_{PHL}$	Propagation Delay $\overline{LE}, \overline{E}$ to Output	1.40	2.70	1.40	2.70	1.60	2.90	ns	Figures 1, 2, 3 (Note 2)
$t_{TLH}$ $t_{THL}$	Transition Time 20% to 80%, 80% to 20%	0.45	1.90	0.45	1.90	0.45	1.90	ns	Figures 1, 3
$t_s$	Setup Time $D_0-D_7$	0.90		0.90		1.00		ns	Figures 1, 4
$t_h$	Hold Time $D_0-D_7$	0.0		0.0		0.0		ns	Figures 1, 4
$t_{pw(H)}$	Pulse Width HIGH $\overline{LE}, \overline{E}$	2.00		2.00		2.00		ns	Figures 1, 4
$t_{OSHL}$	Maximum Skew Common Edge Output-to-Output Variation Data to Output Path		340		340		340	ps	PCC Only (Note 1)
$t_{OSLH}$	Maximum Skew Common Edge Output-to-Output Variation Data to Output Path		440		440		440	ps	PCC Only (Note 1)
$t_{OST}$	Maximum Skew Opposite Edge Output-to-Output Variation Data to Output Path		480		480		480	ps	PCC Only (Note 1)
$t_{PS}$	Maximum Skew Pin (Signal) Transition Variation Data to Output Path		300		300		300	ps	PCC Only (Note 1)

**Note 1:** Output-to-Output Skew is defined as the absolute value of the difference between the actual propagation delay for any outputs within the same packaged device. The specifications apply to any outputs switching in the same direction either HIGH to LOW ( $t_{OSHL}$ ), or LOW to HIGH ( $t_{OSLH}$ ), or in opposite directions both HL and LH ( $t_{OST}$ ). Parameters  $t_{OST}$  and  $t_{PS}$  guaranteed by design.

**Note 2:** The propagation delay specified is for single output switching. Delays may vary up to 300 ps with multiple outputs switching.

## Industrial Version

### PCC DC Electrical Characteristics

$V_{EE} = -4.2V$  to  $-5.7V$ ,  $V_{CC} = V_{CCA} = GND$ ,  $T_C = -40^{\circ}C$  to  $+85^{\circ}C$  (Note 3)

Symbol	Parameter	$T_C = -40^{\circ}C$		$T_C = 0^{\circ}C$ to $+85^{\circ}C$		Units	Conditions	
		Min	Max	Min	Max			
$V_{OH}$	Output HIGH Voltage	-1085	-870	-1025	-870	mV	$V_{IN} = V_{IH} (Max)$ or $V_{IL} (Min)$	Loading with 50Ω to $-2.0V$
$V_{OL}$	Output LOW Voltage	-1830	-1575	-1830	-1620	mV		
$V_{OHC}$	Output HIGH Voltage	-1095		-1035		mV	$V_{IN} = V_{IH} (Min)$ or $V_{IL} (Max)$	Loading with 50Ω to $-2.0V$
$V_{OLC}$	Output LOW Voltage		-1565		-1610	mV		
$V_{IH}$	Input HIGH Voltage	-1170	-870	-1165	-870	mV	Guaranteed HIGH Signal for All Inputs	
$V_{IL}$	Input LOW Voltage	-1830	-1480	-1830	-1475	mV	Guaranteed LOW Signal for All Inputs	
$I_{IL}$	Input LOW Current	0.50		0.50		μA	$V_{IN} = V_{IL} (Min)$	
$I_{IH}$	Input HIGH Current		240		240	μA	$V_{IN} = V_{IH} (Max)$	
$I_{EE}$	Power Supply Current	-95 -97	-50 -50	-95 -97	-55 -55	mA	Inputs Open $V_{EE} = -4.2V$ to $-4.8V$ $V_{EE} = -4.2V$ to $-5.7V$	

**Note 3:** The specified limits represent the "worst case" value for the parameter. Since these values normally occur at the temperature extremes, additional noise immunity and guardbanding can be achieved by decreasing the allowable system operating ranges. Conditions for testing shown in the tables are chosen to guarantee operation under "worst case" conditions.

### PCC AC Electrical Characteristics

$V_{EE} = -4.2V$  to  $-5.7V$ ,  $V_{CC} = V_{CCA} = GND$

Symbol	Parameter	$T_C = -40^{\circ}C$		$T_C = +25^{\circ}C$		$T_C = +85^{\circ}C$		Units	
		Min	Max	Min	Max	Min	Max		
$t_{PLH}$ $t_{PHL}$	Propagation Delay $D_n$ to Output	0.80	1.80	0.80	1.80	0.80	2.00	ns	Figures 1, 2, 3 (Note 1)
$t_{PLH}$ $t_{PHL}$	Propagation Delay $\overline{LE}$ , $\overline{E}$ to Output	1.40	2.70	1.40	2.70	1.60	2.90	ns	Figures 1, 2, 3 (Note 1)
$t_{TLH}$ $t_{THL}$	Transition Time 20% to 80%, 80% to 20%	0.40	2.50	0.45	1.90	0.45	1.90	ns	Figures 1, 3
$t_s$	Setup Time $D_0-D_7$	0.60		0.90		1.00		ns	Figures 1, 4
$t_h$	Hold Time $D_0-D_7$	0.8		0.0		0.0		ns	Figures 1, 4
$t_{pw(H)}$	Pulse Width HIGH $\overline{LE}$ , $\overline{E}$	2.40		2.00		2.00		ns	Figures 1, 4

**Note 1:** The propagation delay specified is for single output switching. Delays may vary up to 300 ps with multiple outputs switching.

## Military Version

### DC Electrical Characteristics

$V_{EE} = -4.2V$  to  $-5.7V$ ,  $V_{CC} = V_{CCA} = GND$ ,  $T_C = -55^{\circ}C$  to  $+125^{\circ}C$

Symbol	Parameter	Min	Max	Units	$T_C$	Conditions	Notes	
V <sub>OH</sub>	Output HIGH Voltage	-1025	-870	mV	0°C to +125°C	V <sub>IN</sub> = V <sub>IH</sub> (Max) or V <sub>IL</sub> (Min)	Loading with 50Ω to -2.0V	1, 2, 3
		-1085	-870	mV	-55°C			
V <sub>OL</sub>	Output LOW Voltage	-1830	-1620	mV	0°C to +125°C	V <sub>IN</sub> = V <sub>IH</sub> (Max) or V <sub>IL</sub> (Min)	Loading with 50Ω to -2.0V	1, 2, 3
		-1830	-1555	mV	-55°C			
V <sub>OHc</sub>	Output HIGH Voltage	-1035		mV	0°C to +125°C	V <sub>IN</sub> = V <sub>IH</sub> (Max) or V <sub>IL</sub> (Min)	Loading with 50Ω to -2.0V	1, 2, 3
		-1085		mV	-55°C			
V <sub>OLc</sub>	Output LOW Voltage		-1610	mV	0°C to +125°C	V <sub>IN</sub> = V <sub>IH</sub> (Max) or V <sub>IL</sub> (Min)	Loading with 50Ω to -2.0V	1, 2, 3
			-1555	mV	-55°C			
V <sub>IH</sub>	Input HIGH Voltage	-1165	-870	mV	-55°C to +125°C	Guaranteed HIGH Signal for All Inputs		1, 2, 3, 4
V <sub>IL</sub>	Input LOW Voltage	-1830	-1475	mV	-55°C to +125°C	Guaranteed LOW Signal for All Inputs		1, 2, 3, 4
I <sub>IL</sub>	Input LOW Current	0.50		μA	-55°C to +125°C	V <sub>EE</sub> = -4.2V V <sub>IN</sub> = V <sub>IL</sub> (Min)		1, 2, 3
I <sub>EE</sub>	Power Supply Current	-100 -105	-35 -35	mA	-55 to +125°C	V <sub>EE</sub> = -4.2V to -4.8V V <sub>EE</sub> = -4.2V to -5.7V		1, 2, 3
I <sub>IH</sub>	Input HIGH Current		240	μA	0°C to +125°C	V <sub>EE</sub> = -5.7V V <sub>IN</sub> = V <sub>IH</sub> (Max)		1, 2, 3
			340	μA	-55°C			
I <sub>EE</sub>	Power Supply Current	-100 -105	-35 -35	mA	-55°C to +125°C	Inputs Open V <sub>EE</sub> = -4.2V to -4.8V V <sub>EE</sub> = -4.2V to -5.7V		1, 2, 3

**Note 1:** F100K 300 Series cold temperature testing is performed by temperature soaking (to guarantee junction temperature equals -55°C), then testing immediately without allowing for the junction temperature to stabilize due to heat dissipation after power-up. This provides "cold start" specs which can be considered a worst case condition at cold temperatures.

**Note 2:** Screen tested 100% on each device at -55°C, +25°C, and +125°C, Subgroups 1, 2, 3, 7, and 8.

**Note 3:** Sample tested (Method 5005, Table I) on each manufactured lot at -55°C, +25°C, and +125°C, Subgroups A1, 2, 3, 7, and 8.

**Note 4:** Guaranteed by applying specified input condition and testing V<sub>OH</sub>/V<sub>OL</sub>.

## Military Version (Continued)

### AC Electrical Characteristics

$V_{EE} = -4.2V$  to  $-5.7V$ ,  $V_{CC} = V_{CCA} = GND$

Symbol	Parameter	$T_C = -55^\circ C$		$T_C = +25^\circ C$		$T_C = +125^\circ C$		Units	Conditions	Notes
		Min	Max	Min	Max	Min	Max			
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay D <sub>n</sub> to Output	0.50	2.70	0.50	2.30	0.50	2.80	ns	Figures 1, 2, 3	1, 2, 3, 5
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay $\overline{LE}$ , $\overline{E}$ to Output	0.90	3.40	1.0	3.10	1.10	3.90	ns	Figures 1, 2, 3	1, 2, 3, 5
t <sub>TLH</sub> t <sub>THL</sub>	Transition Time 20% to 80%, 80% to 20%	0.40	2.50	0.40	2.40	0.40	2.70	ns	Figures 1, 3	4
t <sub>s</sub>	Setup Time D <sub>0</sub> -D <sub>7</sub>	0.60		0.60		0.60		ns	Figures 1, 4	4
t <sub>h</sub>	Hold Time D <sub>0</sub> -D <sub>7</sub>	1.50		1.50		1.70		ns	Figures 1, 4	4
t <sub>pw(H)</sub>	Pulse Width HIGH $\overline{LE}$ , $\overline{E}$	2.40		2.40		2.40		ns	Figures 1, 4	4

**Note 1:** F100K 300 Series cold temperature testing is performed by temperature soaking (to guarantee junction temperature equals  $-55^\circ C$ ), then testing immediately after power-up. This provides "cold start" specs which can be considered a worst case condition at cold temperatures.

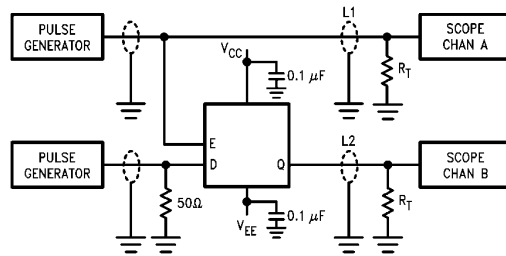
**Note 2:** Screen tested 100% on each device at  $+25^\circ C$  temperature only, Subgroup A9.

**Note 3:** Sample tested (Method 5005, Table I) on each manufactured lot at  $+25^\circ C$ , Subgroup A9, and at  $+125^\circ C$  and  $-55^\circ C$  temperatures, Subgroups A10 and A11.

**Note 4:** Not tested at  $+25^\circ C$ ,  $+125^\circ C$ , and  $-55^\circ C$  temperature (design characterization data).

**Note 5:** The propagation delay specified is for single output switching. Delays may vary up to 300 ps with multiple outputs switching.

## Test Circuitry



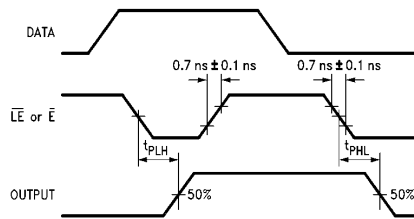
TL/F/10250-6

**FIGURE 1. AC Test Circuit**

### Notes:

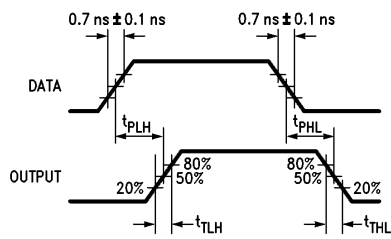
$V_{CC}, V_{CCA} = +2V, V_{EE} = -2.5V$   
 $L1$  and  $L2 =$  equal length  $50\Omega$  impedance lines  
 $R_T = 50\Omega$  terminator internal to scope  
 Decoupling  $0.1 \mu F$  from GND to  $V_{CC}$  and  $V_{EE}$   
 All unused outputs are loaded with  $50\Omega$  to GND  
 $C_L =$  Fixture and stray capacitance  $\leq 3 pF$

## Switching Waveforms



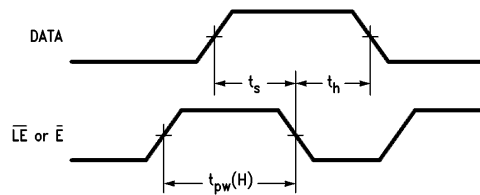
TL/F/10250-7

**FIGURE 2. Propagation Delays**



TL/F/10250-8

**FIGURE 3. Propagation and Transition Times**

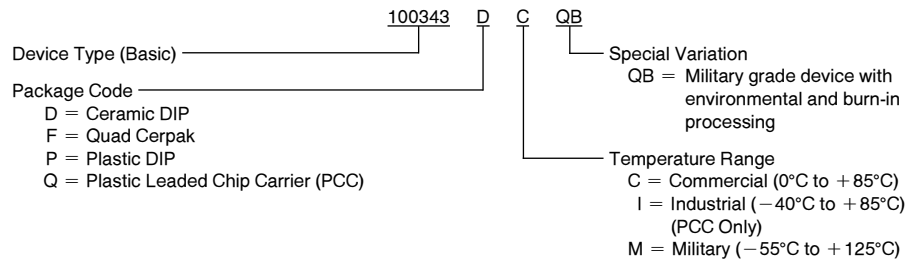


TL/F/10250-9

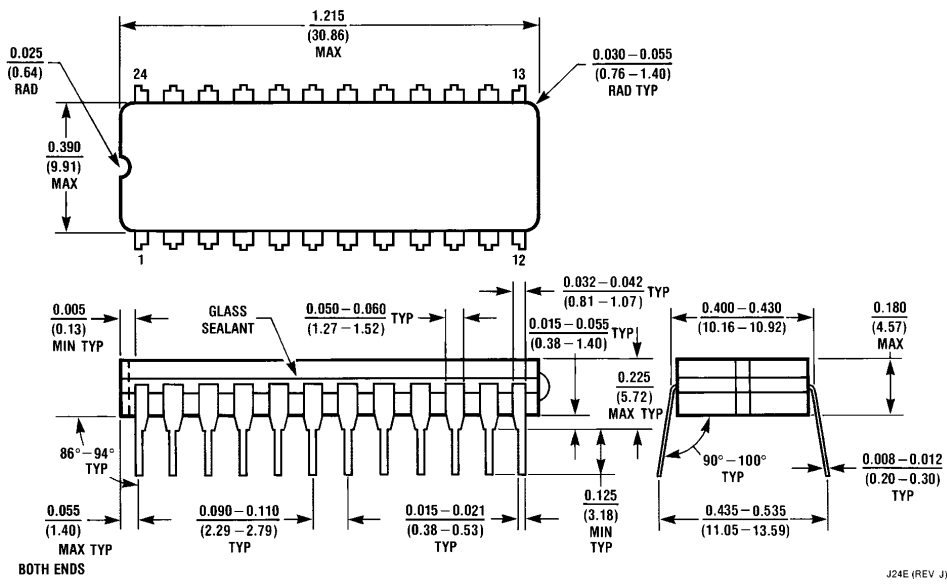
**FIGURE 4. Setup, Hold and Pulse Width Times**

## Ordering Information

The device number is used to form part of a simplified purchasing code where a package type and temperature range are defined as follows:



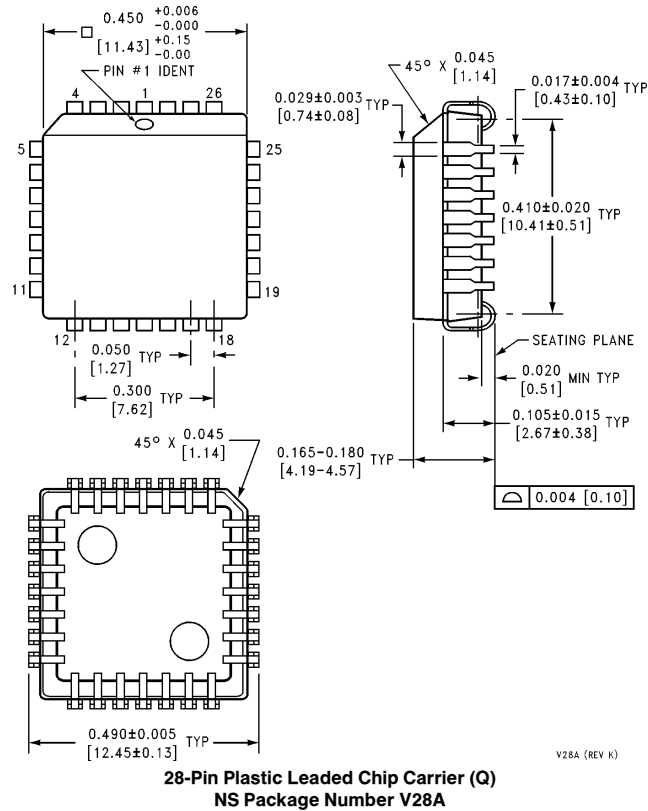
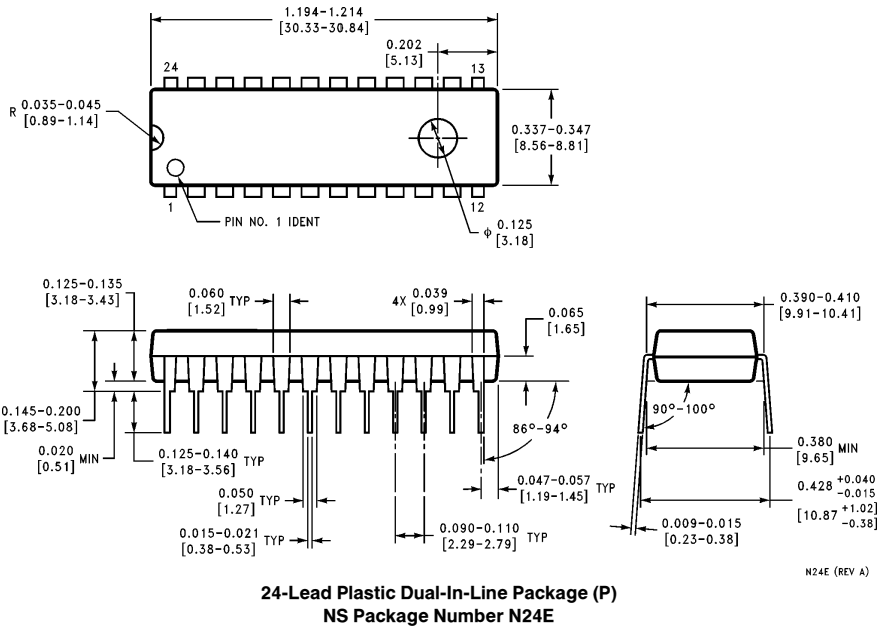
**Physical Dimensions** inches (millimeters)



**24-Pin Ceramic Dual-In-Line Package (D)**  
**NS Package Number J24E**

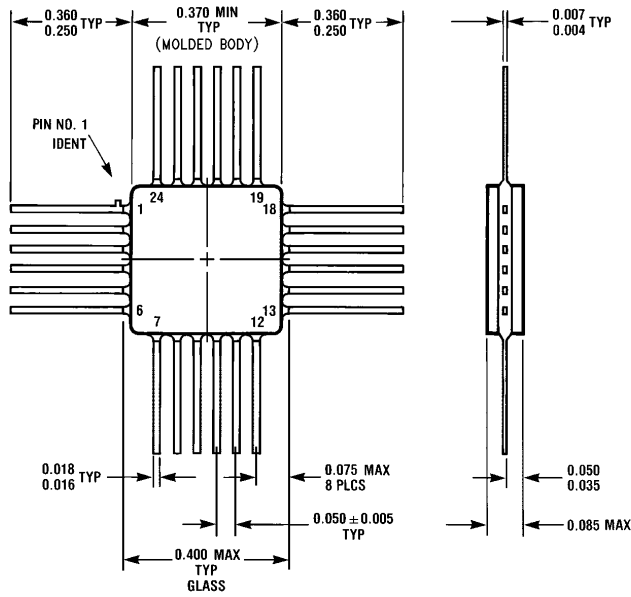
J24E (REV. J)

**Physical Dimensions** inches (millimeters) (Continued)



**Physical Dimensions** inches (millimeters) (Continued)

Lit. # 114916



**24-Lead Quad Cerpak (F)  
NS Package Number W24B**

W24B (REV D)

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