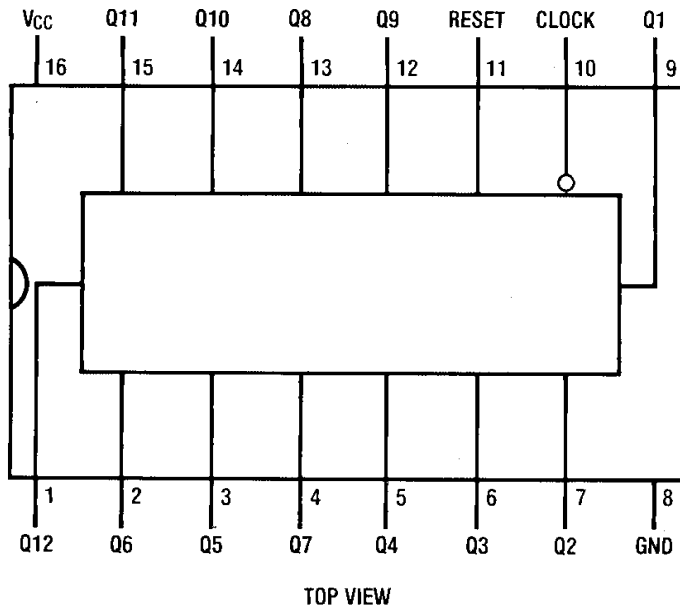
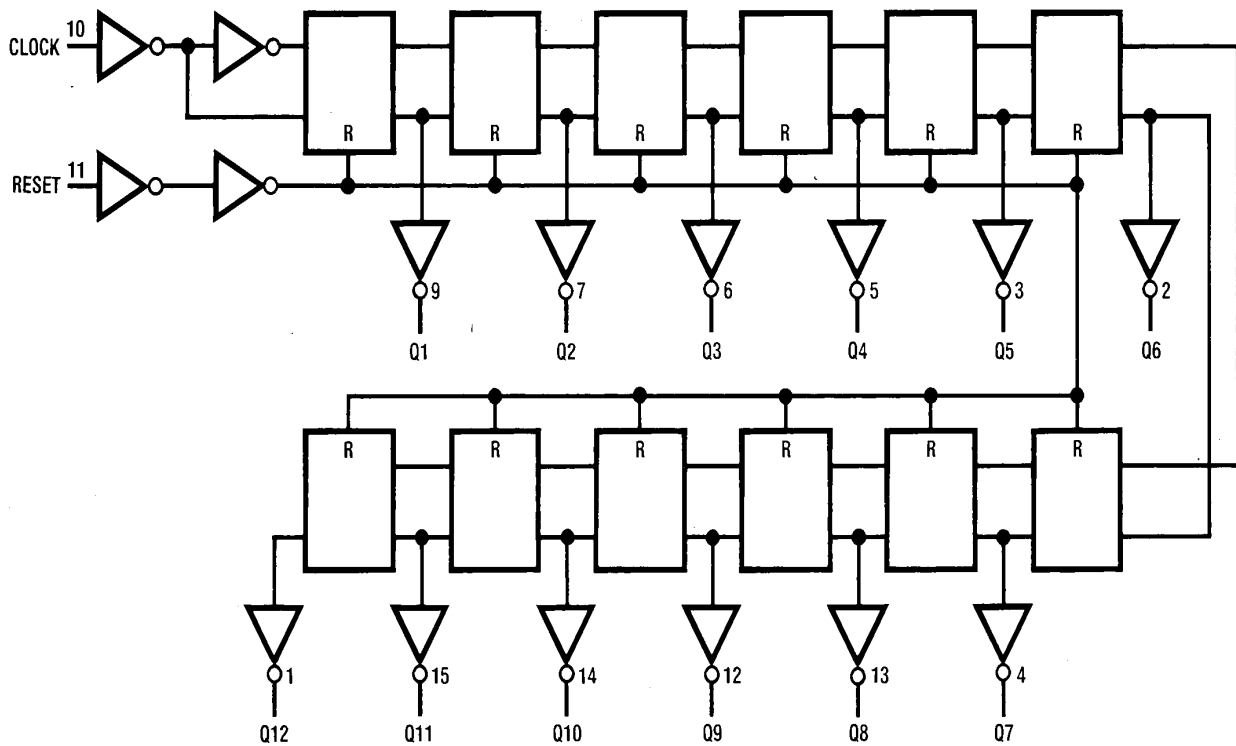


Connection Diagram



Logic Diagram



## Absolute Maximum Ratings<sup>(2)</sup>

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter	Rating
$V_{CC}$	Supply Voltage	-0.5 to +7.0V
$V_{IN}$	DC Input Voltage	-1.5 to $V_{CC} + 1.5V$
$V_{OUT}$	DC Output Voltage	-0.5 to $V_{CC} + 0.5V$
$I_{CD}$	Clamp Diode Current	$\pm 20mA$
$I_{OUT}$	DC Output Current, per pin	$\pm 25mA$
$I_{CC}$	DC $V_{CC}$ or GND Current, per pin	$\pm 50mA$
$T_{STG}$	Storage Temperature Range	-65°C to +150°C
$P_D$	Power Dissipation	
	Note 3 S.O. Package only	600mW 500mW
$T_L$	Lead Temperature (Soldering 10 seconds)	260°C

### Note:

- Unless otherwise specified all voltages are referenced to ground.
- Power Dissipation temperature derating — plastic "N" package: -12mW/°C from 65°C to 85°C.

## Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to absolute maximum ratings.

Symbol	Parameter	Min.	Max.	Units	
$V_{CC}$	Supply Voltage	2	6	V	
$V_{IN}, V_{OUT}$	DC Input or Output Voltage	0	$V_{CC}$	V	
$T_A$	Operating Temperature Range	-40	+85	°C	
$t_r, t_f$	Input Rise and Fall Times				
		$V_{CC} = 2.0V$		1000	ns
		$V_{CC} = 4.5V$		500	
		$V_{CC} = 6.0V$		400	

DC Electrical Characteristics<sup>(4)</sup>

Symbol	Parameter	Conditions	V <sub>CC</sub>	T <sub>A</sub> = 25°C			T <sub>A</sub> = -40 to 85°C	T <sub>A</sub> = -55 to 125°C	Units
				Typ.	Guaranteed Limits				
V <sub>IH</sub>	Minimum HIGH Level Input Voltage		2.0V		1.5	1.5	1.5	V	
			4.5V		3.15	3.15	3.15		
			6.0V		4.2	4.2	4.2		
V <sub>IL</sub>	Maximum LOW Level Input Voltage		2.0V		0.5	0.5	0.5	V	
			4.5V		1.35	1.35	1.35		
			6.0V		1.8	1.8	1.8		
V <sub>OH</sub>	Minimum HIGH Level Output Voltage	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> :  I <sub>OUT</sub>   ≤ 20 μA	2.0V	2.0	1.9	1.9	1.9	V	
			4.5V	4.5	4.4	4.4	4.4		
			6.0V	6.0	5.9	5.9	5.9		
		V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> :  I <sub>OUT</sub>   ≤ 4.0 mA	4.5V	4.2	3.98	3.84	3.7		
			6.0V	5.7	5.48	5.34	5.2		
V <sub>OL</sub>	Maximum LOW Level Output Voltage	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> :  I <sub>OUT</sub>   ≤ 20 μA	2.0V	0	0.1	0.1	0.1	V	
			4.5V	0	0.1	0.1	0.1		
			6.0V	0	0.1	0.1	0.1		
		V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> :  I <sub>OUT</sub>   ≤ 4.0 mA	4.5V	0.2	.26	0.33	0.4		
			6.0V	0.2	.26	0.33	0.4		
I <sub>IN</sub>	Maximum Input Current	V <sub>IN</sub> = V <sub>CC</sub> or GND	6.0V		±0.1	±1.0	±1.0	μA	
I <sub>CC</sub>	Maximum Quiescent Supply Current	V <sub>IN</sub> = V <sub>CC</sub> or GND, I <sub>OUT</sub> = 0 μA	6.0V		8.0	80	160	μA	

**Note:**

4. For a power supply of 5V ±10% the worst case output voltages (V<sub>OH</sub>, and V<sub>OL</sub>) occur for HC at 4.5V. Thus the 4.5V values should be used when designing with this supply. Worst case V<sub>IH</sub> and V<sub>IL</sub> occur at V<sub>CC</sub> = 5.5V and 4.5V respectively. (The V<sub>IH</sub> value at 5.5V is 3.85V.) The worst case leakage current (I<sub>IN</sub>, I<sub>CC</sub>, and I<sub>OZ</sub>) occur for CMOS at the higher voltage and so the 6.0V values should be used.

## AC Electrical Characteristics

V<sub>CC</sub> = 5V, T<sub>A</sub> = 25°C, C<sub>L</sub> = 15pF, t<sub>r</sub> = t<sub>f</sub> = 6ns

Symbol	Parameter	Conditions	Typ.	Guaranteed Limit	Units
f <sub>MAX</sub>	Maximum Operating Frequency		50	30	MHz
t <sub>PHL</sub> , t <sub>PLH</sub>	Maximum Propagation Delay Clock to Q	<sup>(5)</sup>	17	35	ns
t <sub>PHL</sub>	Maximum Propagation Delay Reset to any Q		16	40	ns
t <sub>REM</sub>	Minimum Reset Removal Time		10	20	ns
t <sub>W</sub>	Minimum Pulse Width		10	16	ns

**Note:**

5. Typical Propagation delay time to any output can be calculated using: t<sub>p</sub> = 17 + 12(N-1) ns; where N is the number of the output, Q<sub>W</sub>, at V<sub>CC</sub> = 5V.

**AC Electrical Characteristics**

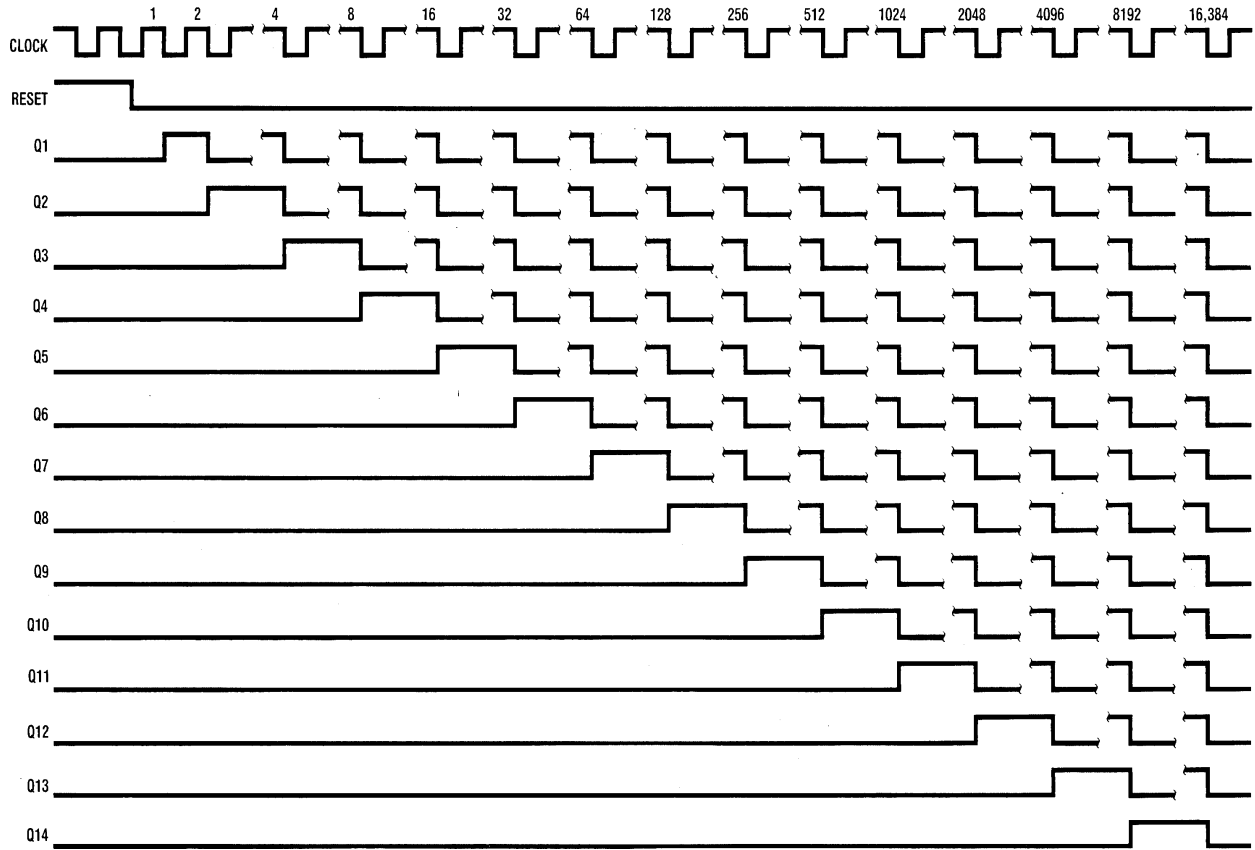
$V_{CC} = 2.0V$  to  $6.0V$ ,  $C_L = 50pF$ ,  $t_r = t_f = 6ns$  (unless otherwise specified).

Symbol	Parameter	Conditions	$V_{CC}$	$T_A = 25^\circ C$				Units
				Typ	Guaranteed Limits			
$f_{MAX}$	Maximum Operating Frequency		2.0V	10	6	5	4	MHz
			4.5V	40	30	24	20	
			6.0V	50	35	28	24	
$t_{PHL}, t_{PLH}$	Maximum Propagation Delay Clock to $Q_1$		2.0V	80	210	265	313	ns
			4.5V	21	42	53	63	
			6.0V	18	36	45	53	
$t_{PHL}, t_{PLH}$	Maximum Propagation Delay Between Stages from $Q_n$ to $Q_{n+1}$		2.0V	80	125	156	188	ns
			4.5V	18	25	31	38	
			6.0V	15	21	26	31	
$t_{PHL}$	Maximum Propagation Delay Reset to any Q (4020 and 4040)		2.0V	72	240	302	358	ns
			4.5V	24	48	60	72	
			6.0V	20	41	51	61	
$t_{REM}$	Minimum Reset Removal Time		2.0V		100	126	149	ns
			4.5V		20	25	50	
			6.0V		16	21	25	
$t_W$	Minimum Pulse Width		2.0V		90	100	120	ns
			4.5V		16	20	24	
			6.0V		14	18	20	
$t_{TLH}, t_{THL}$	Maximum Output Rise and Fall Time		2.0V	30	75	95	110	ns
			4.5V	10	15	19	22	
			6.0V	9	13	16	19	
$t_r, t_f$	Maximum Input Rise and Fall Time				1000	1000	1000	ns
					500	500	500	
					400	400	400	
$C_{PD}$	Power Dissipation Capacitance <sup>(6)</sup>	(per package)		55				pF
$C_{IN}$	Maximum Input Capacitance			5	10	10	10	pF

**Note:**

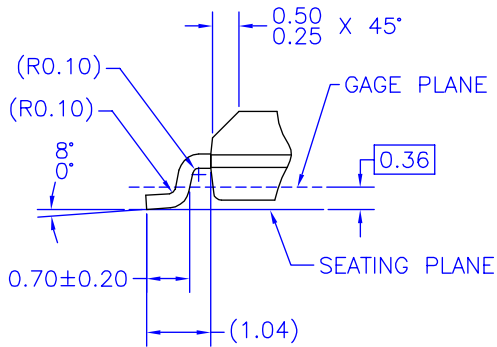
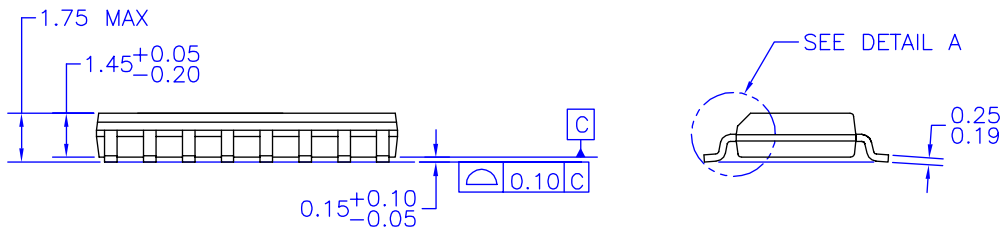
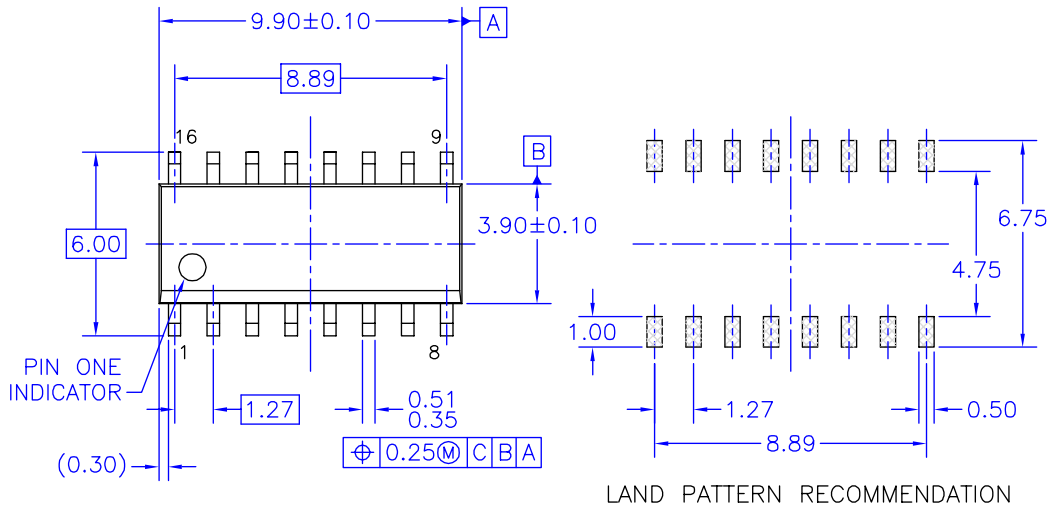
6.  $C_{PD}$  determines the no load dynamic power consumption,  $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$ , and the no load dynamic current consumption,  $I_S = C_{PD} V_{CC} f + I_{CC}$ .

### Timing Diagram



### Physical Dimensions

Dimensions are in millimeters unless otherwise noted.



NOTES: UNLESS OTHERWISE SPECIFIED

- A) THIS PACKAGE CONFORMS TO JEDEC MS-012, VARIATION AC, ISSUE C, DATED MAY 1990.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS DO NOT INCLUDE MOLD FLASH OR BURRS.
- D) STANDARD LEAD FINISH: 200 MICRONS / 5.08 MICRONS MIN. LEAD/TIN (SOLDER) ON COPPER.

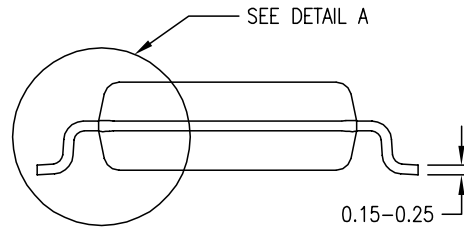
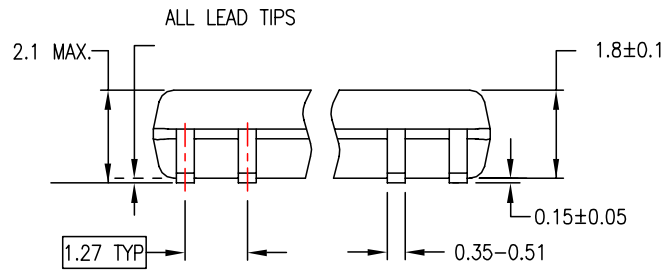
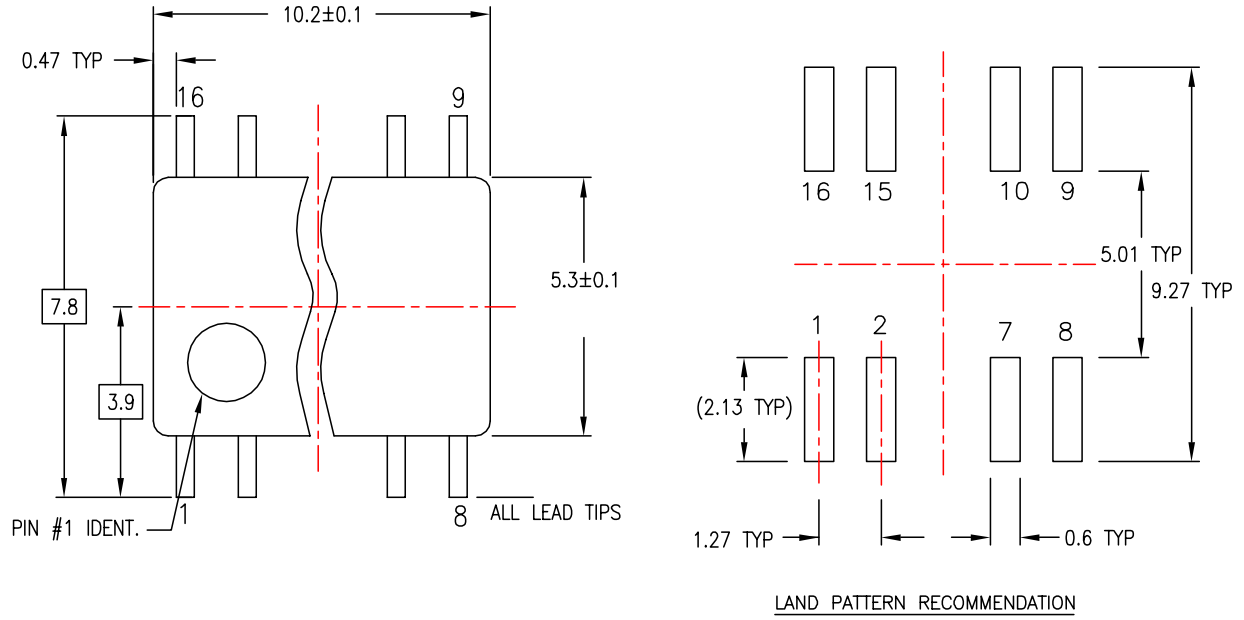
DETAIL A  
SCALE: 2:1

M16AREVK

Figure 1. 16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow Package Number M16A

**Physical Dimensions** (Continued)

Dimensions are in millimeters unless otherwise noted.



DIMENSIONS ARE IN MILLIMETERS

NOTES:

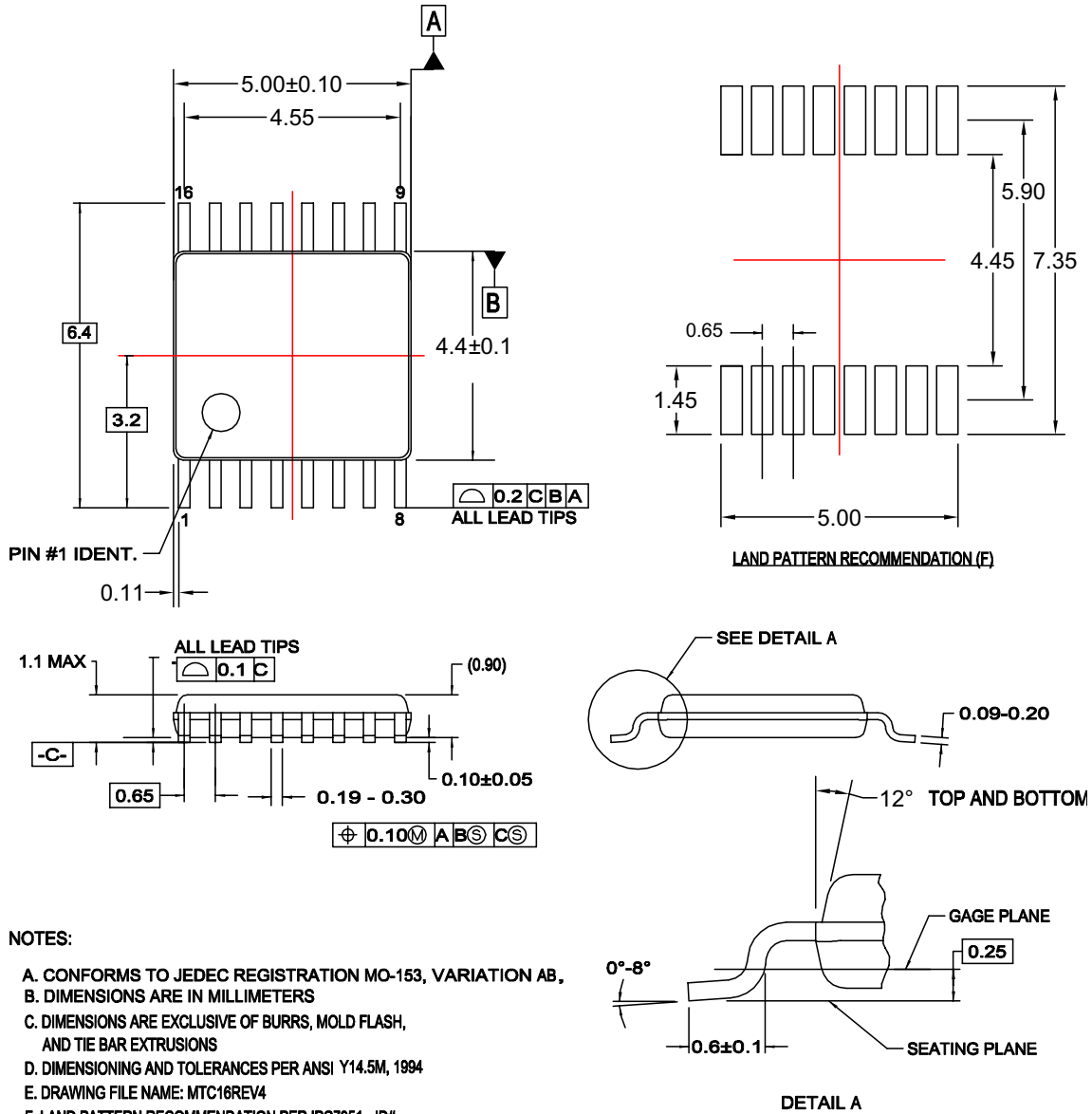
- A. CONFORMS TO EIAJ EDR-7320 REGISTRATION, ESTABLISHED IN DECEMBER, 1998.
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

M16DREVC

**Figure 2. 16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide Package Number M16D**

**Physical Dimensions** (Continued)

Dimensions are in millimeters unless otherwise noted.



**NOTES:**

- A. CONFORMS TO JEDEC REGISTRATION MO-153, VARIATION AB,
- B. DIMENSIONS ARE IN MILLIMETERS
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS
- D. DIMENSIONING AND TOLERANCES PER ANSI Y14.5M, 1994
- E. DRAWING FILE NAME: MTC16REV4
- F. LAND PATTERN RECOMMENDATION PER IPC7351 - ID# TSOP65P640X110-16N

MTC16rev4

**Figure 3. 16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide Package Number MTC16**



**Physical Dimensions** (Continued)

Dimensions are in inches (millimeters) unless otherwise noted.

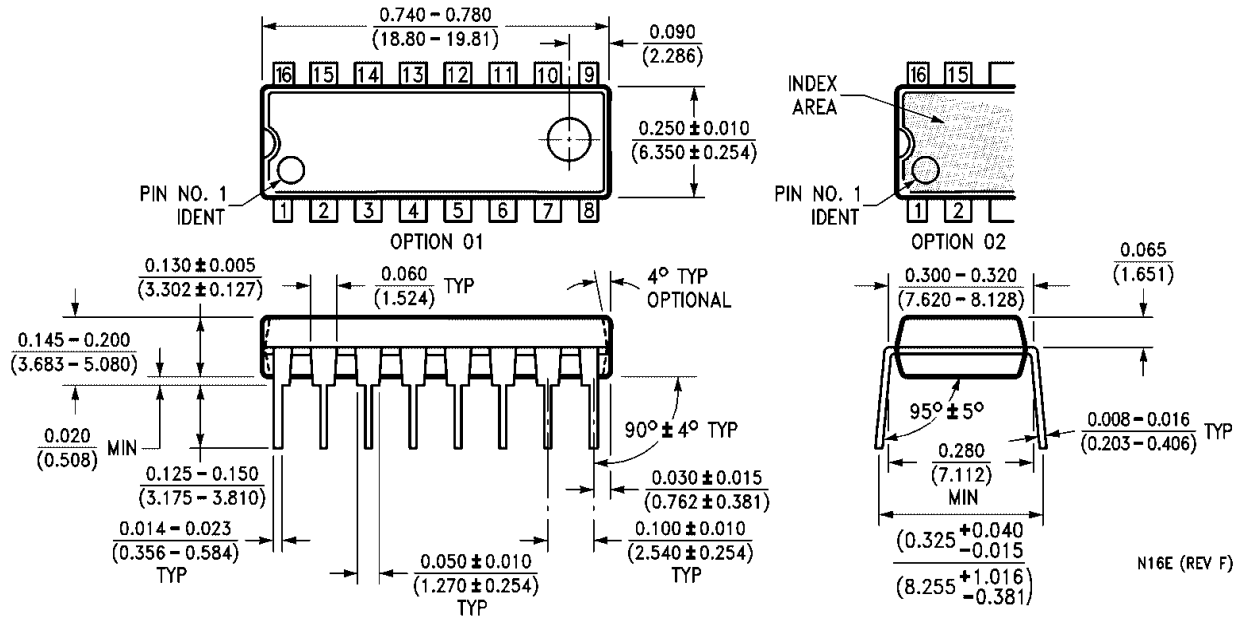



Figure 4. 16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide Package Number N16E

N16E (REV F)



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