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FAIRCHILD SEMICONDUCTOR®

May 2007

74VHC112
Dual J-K Flip-Flops with Preset and Clear

Features

- High speed: f_{MAX} = 200MHz (Typ.) at V_{CC} = 5.0V
- Low power dissipation: I_{CC} = 2µA (Max.) at T_A = 25°C
- High noise immunity: $V_{NIH} = V_{NIL}$ = 28% V_{CC} (Min.)
- Power down protection is provided on all inputs
- Pin and function compatible with 74HC112

General Description

The VHC112 is an advanced high speed CMOS device fabricated with silicon gate CMOS technology. It achieves the high-speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

The VHC112 contains two independent, high-speed JK flip-flops with Direct Set and Clear inputs. Synchronous state changes are initiated by the falling edge of the clock. Triggering occurs at a voltage level of the clock and is not directly related to transition time. The J and K inputs can change when the clock is in either state without affecting the flip-flop, provided that they are in the desired state during the recommended setup and hold times relative to the falling edge of the clock. The LOW signal on PR or CLR prevents clocking and forces Q and $\overline{Q}$ HIGH, respectively. Simultaneous LOW signals on PR and CLR force both Q and $\overline{Q}$ HIGH.

An input protection circuit ensures that 0V to 7V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5V to 3V systems and two supply systems such as battery backup. This circuit prevents device destruction due to mismatched supply and input voltages.

Ordering Information

Order Number	Package Number	Package Description
74VHC112M	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
74VHC112SJ	M16D	16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74VHC112MTC	MTC16	16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

Surface mount packages are also available on Tape and Reel. Specify by appending the suffix letter “X” to the ordering number.

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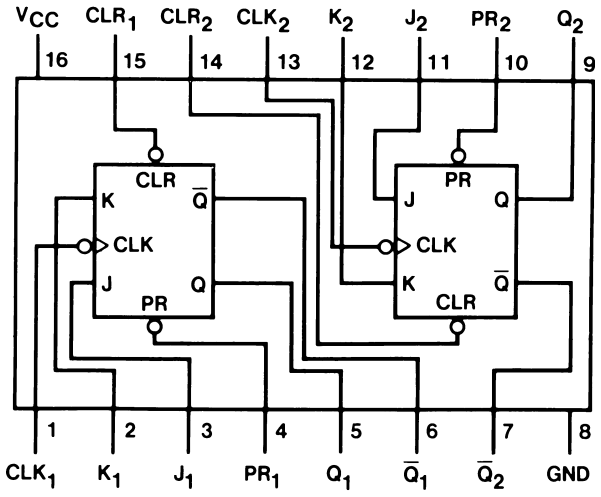
Connection Diagram



Truth Table

Inputs					Outputs	
PR	CLR	$\overline{CP}$	J	K	Q	$\overline{Q}$
L	H	X	X	X	H	L
H	L	X	X	X	L	H
L	L	X	X	X	H	H
H	H	↘	h	h	$\overline{Q}_0$	Q_0
H	H	↘	l	h	L	H
H	H	↘	h	l	H	L
H	H	↘	l	l	Q_0	$\overline{Q}_0$

H (h) = HIGH Voltage Level

L (l) = LOW Voltage Level

X = Immaterial

↘ = HIGH-to-LOW Clock Transition

Q_0 ($\overline{Q}_0$) = Before HIGH-to-LOW Transition of Clock

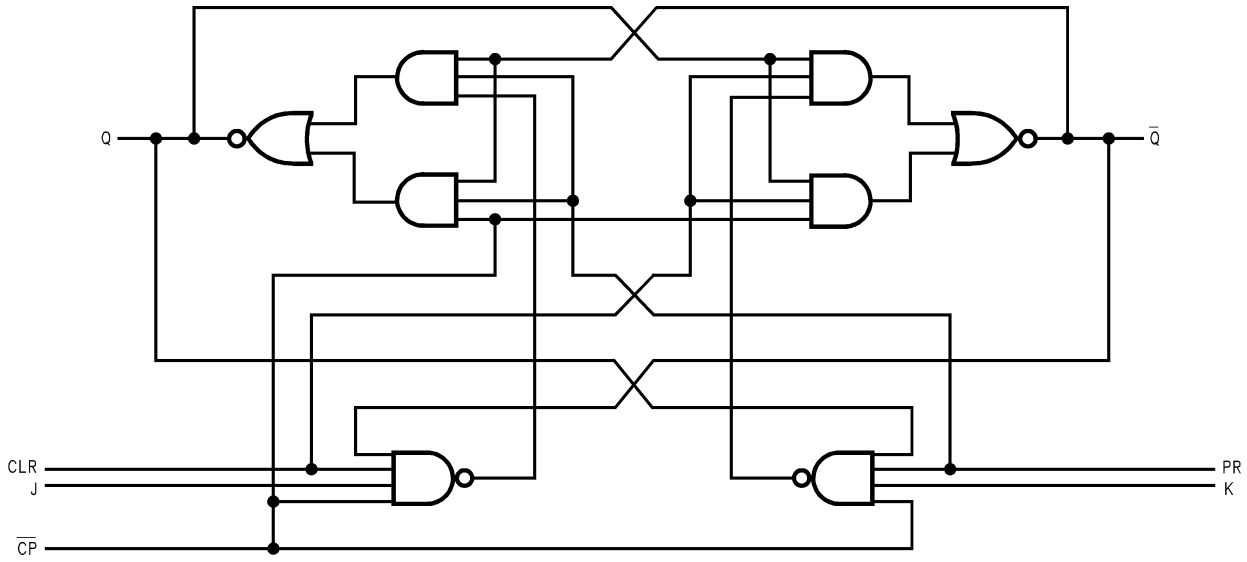
Lower case letters indicate the state of the referenced input or output one setup time prior to the HIGH-to-LOW clock transition.

Pin Description

Pin Names	Description
J_1, J_2, K_1, K_2	Data Inputs
CLK_1, CLK_2	Clock Pulse Inputs (Active Falling Edge)
CLR_1, CLR_2	Direct Clear Inputs (Active LOW)
PR_1, PR_2	Direct Preset Inputs (Active LOW)
Q_1, Q_2, $\overline{Q}_1$, $\overline{Q}_2$	Outputs

Logic Diagram

(One Half Shown)



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Absolute Maximum Ratings

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	–0.5V to +7.0V
V_{IN}	DC Input Voltage	–0.5V to +7.0V
V_{OUT}	DC Output Voltage	–0.5V to V_{CC} + 0.5V
I_{IK}	Input Diode Current	–20mA
I_{OK}	Output Diode Current	±20mA
I_{OUT}	DC Output Current	±25mA
I_{CC}	DC V_{CC} / GND Current	±50mA
T_{STG}	Storage Temperature	–65°C to +150°C
T_L	Lead Temperature (Soldering, 10 seconds)	260°C

Recommended Operating Conditions(1)

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	Rating
V_{CC}	Supply Voltage	2.0V to +5.5V
V_{IN}	Input Voltage	0V to +5.5V
V_{OUT}	Output Voltage	0V to V_{CC}
T_{OPR}	Operating Temperature	–40°C to +85°C
t_r, t_f	Input Rise and Fall Time,	
	V_{CC} = 3.3V ± 0.3V	0ns/V ~ 100ns/V
	V_{CC} = 5.0V ± 0.5V	0ns/V ~ 20ns/V

Note:

1. Unused inputs must be held HIGH or LOW. They may not float.

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DC Electrical Characteristics

Symbol	Parameter	V_{CC} (V)	Conditions		T_A = 25°C			T_A = –40°C to +85°C		Units
					Min.	Typ.	Max.	Min.	Max.	
V_{IH}	HIGH Level Input Voltage	2.0			1.50			1.50		V
		3.0–5.5			0.7 x V_{CC}			0.7 x V_{CC}		
V_{IL}	LOW Level Input Voltage	2.0					0.50		0.50	V
		3.0–5.5					0.3 x V_{CC}		0.3 x V_{CC}	
V_{OH}	HIGH Level Output Voltage	2.0	V_{IN} = V_{IH} or V_{IL}	I_{OH} = –50µA	1.9	2.0		1.9		V
		3.0			2.9	3.0		2.9		
		4.5			4.4	4.5		4.4		
		3.0		I_{OH} = –4mA	2.58			2.48		
		4.5		I_{OH} = –8mA	3.94			3.80		
V_{OL}	LOW Level Output Voltage	2.0	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 50µA		0.0	0.1		0.1	V
		3.0				0.0	0.1		0.1	
		4.5				0.0	0.1		0.1	
		3.0		I_{OL} = 4mA			0.36		0.44	
		4.5		I_{OL} = 8mA			0.36		0.44	
I_{IN}	Input Leakage Current	0–5.5	V_{IN} = 5.5V or GND				±0.1		±1.0	µA
I_{CC}	Quiescent Supply Current	5.5	V_{IN} = V_{CC} or GND				2.0		20.0	µA

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AC Electrical Characteristics

Symbol	Parameter	V_{CC} (V)	Conditions	T_A = 25°C			T_A = –40°C to +85°C		Units
				Min.	Typ.	Max.	Min.	Max.	
f_{MAX}	Maximum Clock Frequency	3.3 ± 0.3	C_L = 15pF	110	150		100		MHz
			C_L = 50pF	90	120		80		
		5.0 ± 0.5	C_L = 15pF	150	200		135		MHz
			C_L = 50pF	120	185		110		
t_{PLH}, t_{PHL}	Propagation Delay Time (CP to Q_n or $\overline{Q}_n$)	3.3 ± 0.3	C_L = 15pF		8.5	11.0	1.0	13.4	ns
			C_L = 50pF		10.0	15.0	1.0	16.5	
		5.0 ± 0.5	C_L = 15pF		5.1	7.3	1.0	8.8	ns
			C_L = 50pF		6.3	10.5	1.0	12.0	
t_{PLH}, t_{PHL}	Propagation Delay Time (PR or CLR to Q_n or $\overline{Q}_n$)	3.3 ± 0.3	C_L = 15pF		6.7	10.2	1.0	11.7	ns
			C_L = 50pF		9.7	13.5	1.0	15.0	
		5.0 ± 0.5	C_L = 15pF		4.6	6.7	1.0	8.0	ns
			C_L = 50pF		6.4	9.5	1.0	11.0	
C_{IN}	Input Capacitance		V_{CC} = Open		4	10		10	pF
C_{PD}	Power Dissipation Capacitance		(2)		18				pF

Note:

2. C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained from the equation: I_{CC} (opr.) = C_{PD} • V_{CC} • f_{IN} + I_{CC} / 4 (per F/F), and the total C_{PD} when n pcs of the Flip-Flop operate can be calculated by the following equation: C_{PD} (total) = 30 + 14 • n

AC Operating Requirements

Symbol	Parameter	V_{CC} (V)(3)	T_A = 25°C	T_A = –40°C to +85°C		Units
			Typ.	Guaranteed Minimum		
t_W	Minimum Pulse Width (CP or CLR or PR)	3.3		5.0	5.0	ns
		5.0		5.0	5.0	
t_S	Minimum Setup Time (J_n or K_n to CP_n)	3.3		5.0	5.0	ns
		5.0		4.0	4.0	
t_H	Minimum Hold Time (J_n or K_n to CP_n)	3.3		1.0	1.0	ns
		5.0		1.0	1.0	
t_{REC}	Minimum Recovery Time (CLR or PR to CP)	3.3		6.0	6.0	ns
		5.0		5.0	5.0	

Note:

3. V_{CC} is 3.3 ± 0.3V or 5.0 ± 0.5V.

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Physical Dimensions

Dimensions are in millimeters unless otherwise noted.

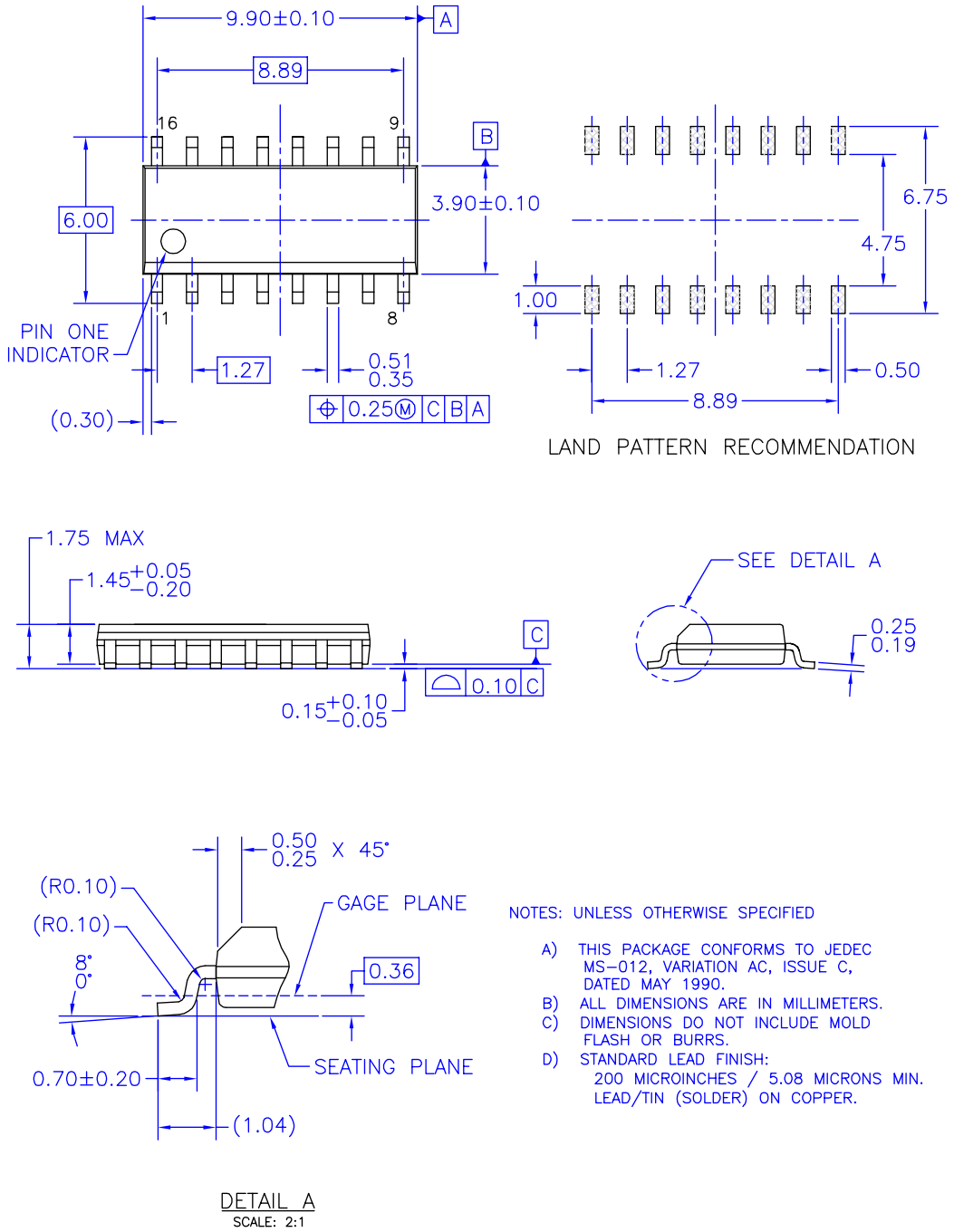
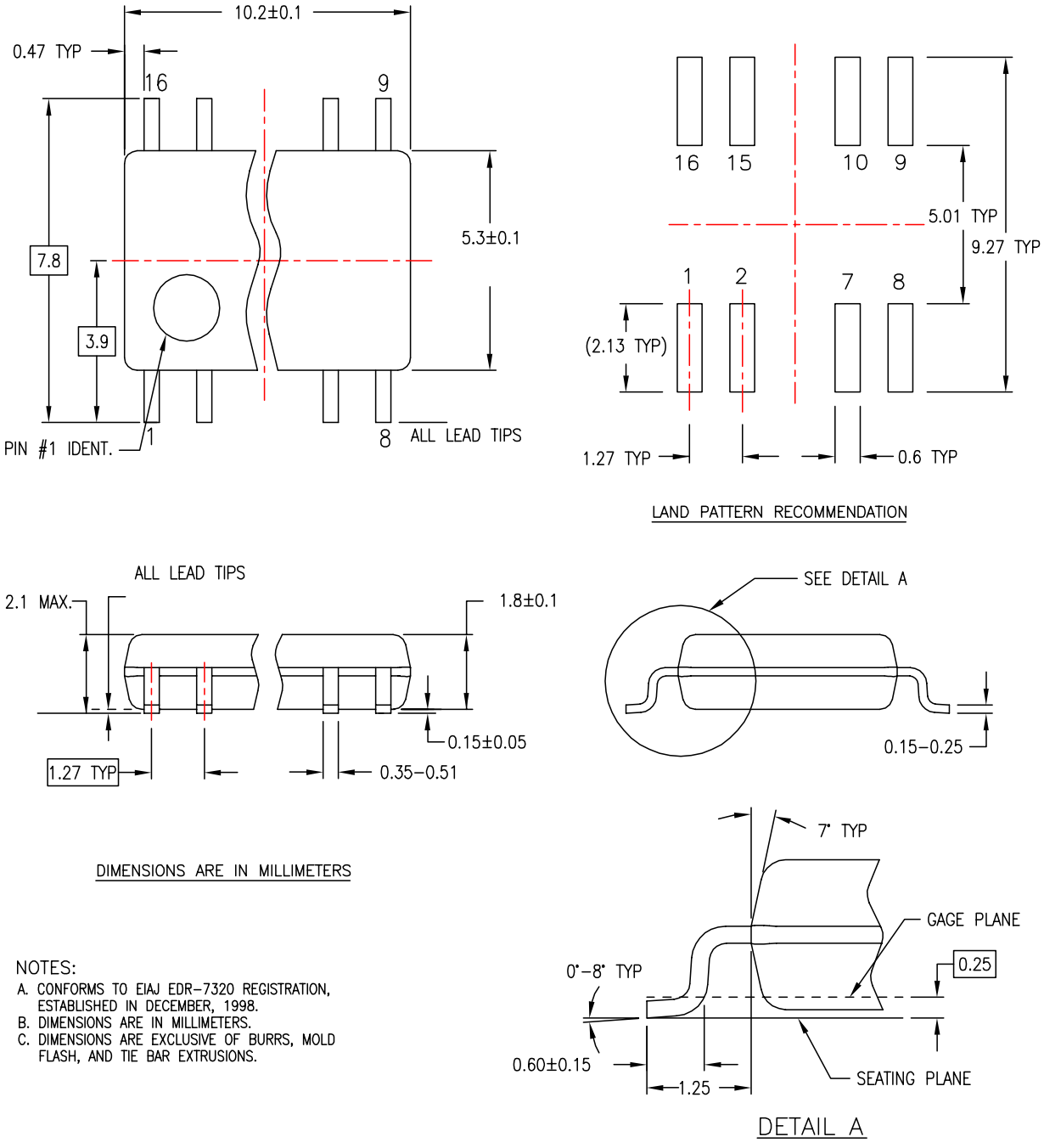


Figure 1. 16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
Package Number M16A

Physical Dimensions (Continued)

Dimensions are in millimeters unless otherwise noted.



NOTES:

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M16DREVC

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

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Physical Dimensions (Continued)

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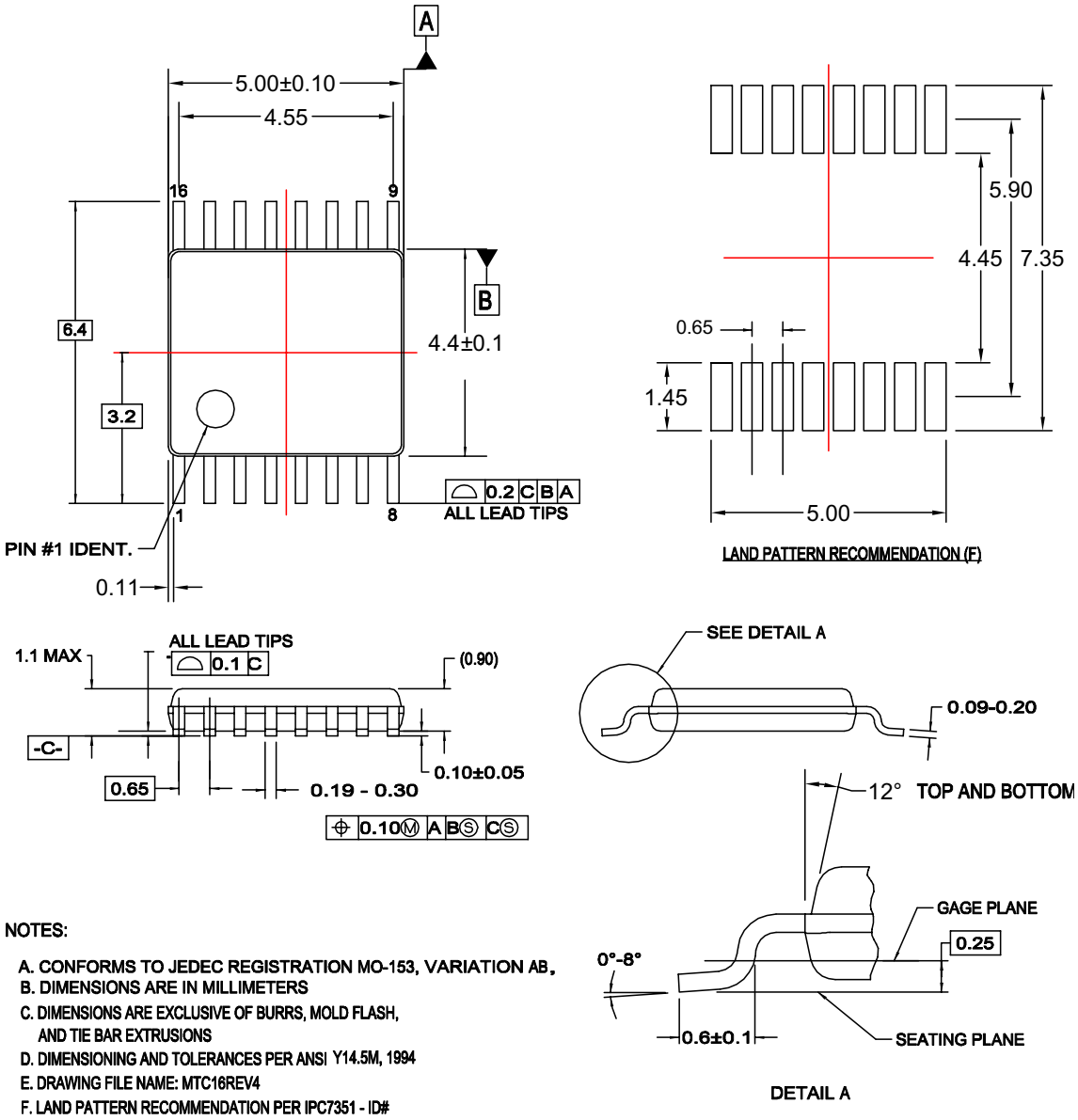

NOTES:

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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

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