December 2007

74VHC393
Dual 4-Bit Binary Counter

Features

- High Speed: f_{MAX} = 170MHz (Typ.) at T_A = 25°C
- Low power dissipation: I_{CC} = 4μA (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 74HC393

General Description

The VHC393 is an advanced high speed CMOS 4-bit Binary Counter 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. It contains two independent counter circuits in one package, so that counting or frequency division of 8 binary bits can be achieved with one IC. This device changes state on the negative going transition of the $\overline{\text{CLOCK}}$ pulse. The counter can be reset to "0" (Q_0–Q_3 = "L") by a HIGH at the CLEAR input regardless of other inputs.

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 back up. This circuit prevents device destruction due to mismatched supply and input voltages.

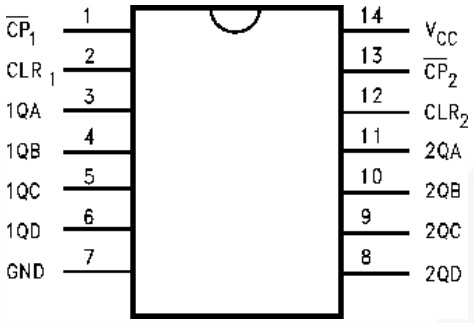
Ordering Information

Order Number	Package Number	Package Description
74VHC393M	M14A	14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
74VHC393SJ	M14D	14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74VHC393MTC	MTC14	14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

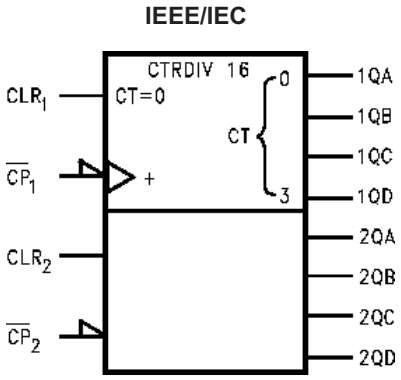
Device also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering number.

All packages are lead free per JEDEC: J-STD-020B standard.

Connection Diagram



Logic Symbol/s



Pin Descriptions

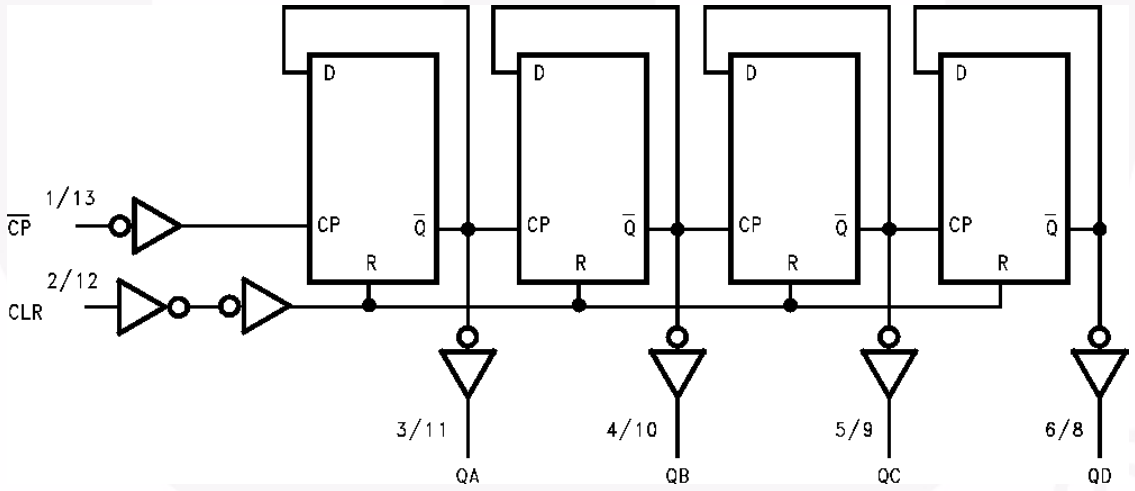
Pin Names	Description
CLR1, CLR2	Clear Inputs
$\overline{CP}_1$, $\overline{CP}_2$	Clock Pulse Inputs
QA, QB, QC, QD	Outputs

Truth Table

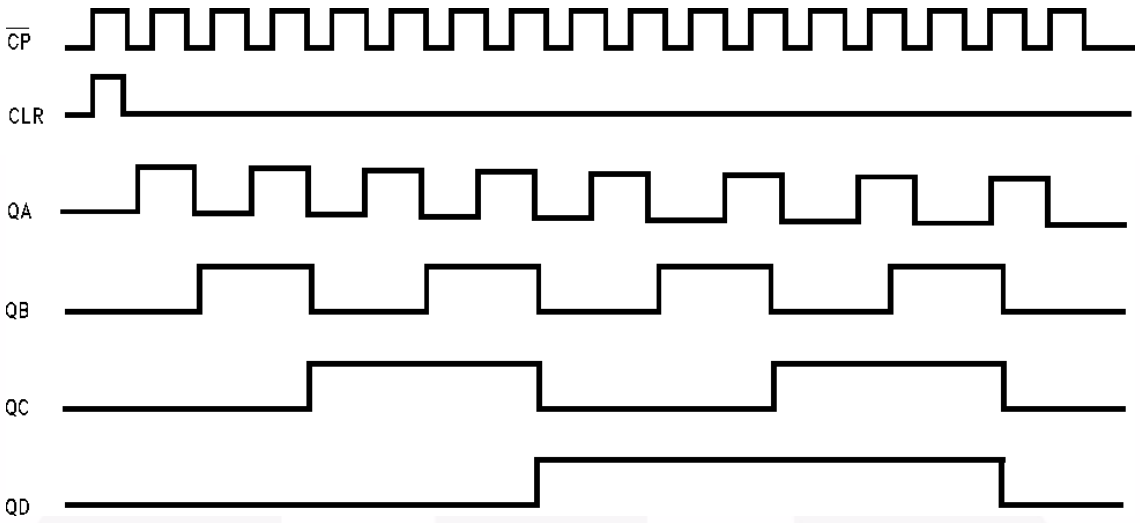
Inputs		Outputs			
$\overline{CP}$	CLR	QA	QB	QC	QD
X	H	L	L	L	L
↓	L	Count Up			
↑	L	No Change			

X: Don't Care

System Diagram



Timing Chart



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[4]	±20mA
I_{OUT}	DC Output Current	±25mA
I_{CC}	DC V_{CC} / GND Current	±75mA
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	0 ~ 100ns/V
	V_{CC} = 5.0V ±0.5V	0 ~ 20ns/V

Note:

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

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}	$I_{OH} = -50\mu A$	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		V
		4.5		$I_{OH} = -8mA$	3.94			3.80		
V_{OL}	LOW Level Output Voltage	2.0	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 50\mu A$		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	V
		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				4.0		40.0	µA

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.	
t_{PLH}, t_{PHL}	Propagation Delay Time ($\overline{CP}$–QA)	3.3 ± 0.3	C_L = 15pF		8.6	13.2	1.0	15.5	ns
			C_L = 50pF		11.1	16.7	1.0	19.0	
		5.0 ± 0.5	C_L = 15pF		5.8	8.5	1.0	10.0	
			C_L = 50pF		7.3	10.5	1.0	12.0	
t_{PLH}, t_{PHL}	Propagation Delay Time ($\overline{CP}$–QB)	3.3 ± 0.3	C_L = 15pF		10.2	15.8	1.0	18.5	ns
			C_L = 50pF		12.7	19.3	1.0	22.0	
		5.0 ± 0.5	C_L = 15pF		6.8	9.8	1.0	11.5	
			C_L = 50pF		8.3	11.8	1.0	13.5	
t_{PLH}, t_{PHL}	Propagation Delay Time ($\overline{CP}$–QC)	3.3 ± 0.3	C_L = 15pF		11.7	18.0	1.0	21.0	ns
			C_L = 50pF		14.2	21.5	1.0	24.5	
		5.0 ± 0.5	C_L = 15pF		7.7	11.2	1.0	13.0	
			C_L = 50pF		9.2	13.2	1.0	15.0	
t_{PLH}, t_{PHL}	Propagation Delay Time ($\overline{CP}$–QD)	3.3 ± 0.3	C_L = 15pF		13.0	19.7	1.0	23.0	ns
			C_L = 50pF		15.5	23.2	1.0	26.5	
		5.0 ± 0.5	C_L = 15pF		8.5	12.5	1.0	14.5	
			C_L = 50pF		10.0	14.5	1.0	16.5	
t_{PLH}, t_{PHL}	Propagation Delay Time (CLR–Q_n)	3.3 ± 0.3	C_L = 15pF		7.9	12.3	1.0	14.5	ns
			C_L = 50pF		10.4	15.8	1.0	18.0	
		5.0 ± 0.5	C_L = 15pF		5.4	8.1	1.0	9.5	
			C_L = 50pF		6.9	10.1	1.0	11.5	
f_{MAX}	Maximum Clock	3.3 ± 0.3	C_L = 15pF	75	120		65		MHz
			C_L = 50pF	45	65		35		
		5.0 ± 0.5	C_L = 15pF	125	170		105		
			C_L = 50pF	85	115		75		
C_{IN}	Input Capacitance		V_{CC} = Open		4	10		10	pF
C_{PD}	Power Dissipation Capacitance		(2)		23				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 by the equation: $I_{CC}(Opr.) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC} / 2$ (per Counter)

AC Operating Requirements

Symbol	Parameter	V_{CC} (V)	T_A = 25°C	T_A = – 40°C to +85°C		Units
			Typ.	Guaranteed Minimum		
$t_W(L)$, $t_W(H)$	Minimum Pulse Width ($\overline{CP}$)	3.3 ± 0.3		5.0	5.0	ns
		5.0 ± 0.5		5.0	5.0	
$t_W(H)$	Minimum Pulse Width (CLR)	3.3 ± 0.3		5.0	5.0	ns
		5.0 ± 0.5		5.0	5.0	
t_{REM}	Minimum Removal Time	3.3 ± 0.3		5.0	5.0	ns
		5.0 ± 0.5		4.0	4.0	

Physical Dimensions

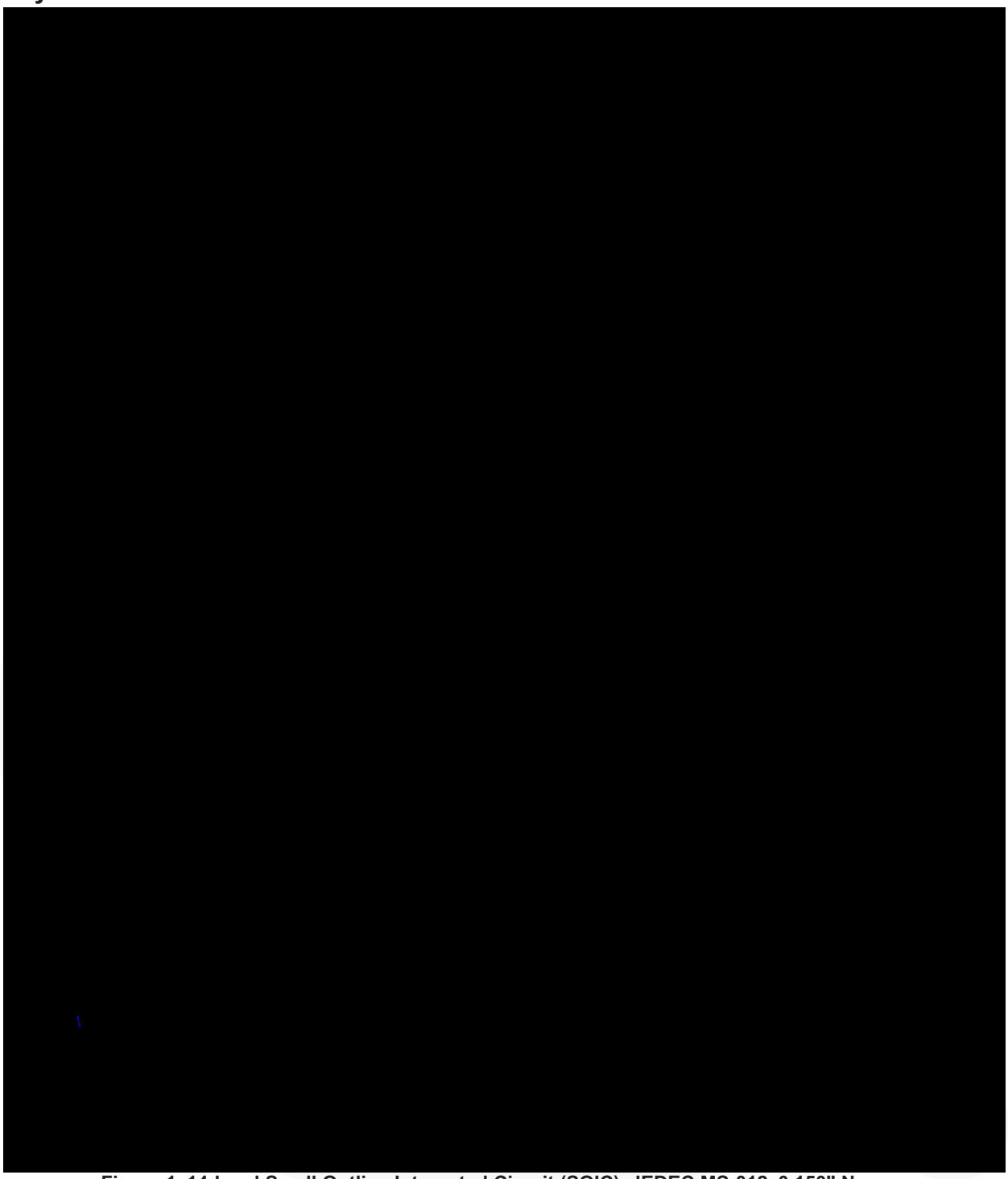


Figure 1. 14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow

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Physical Dimensions (Continued)

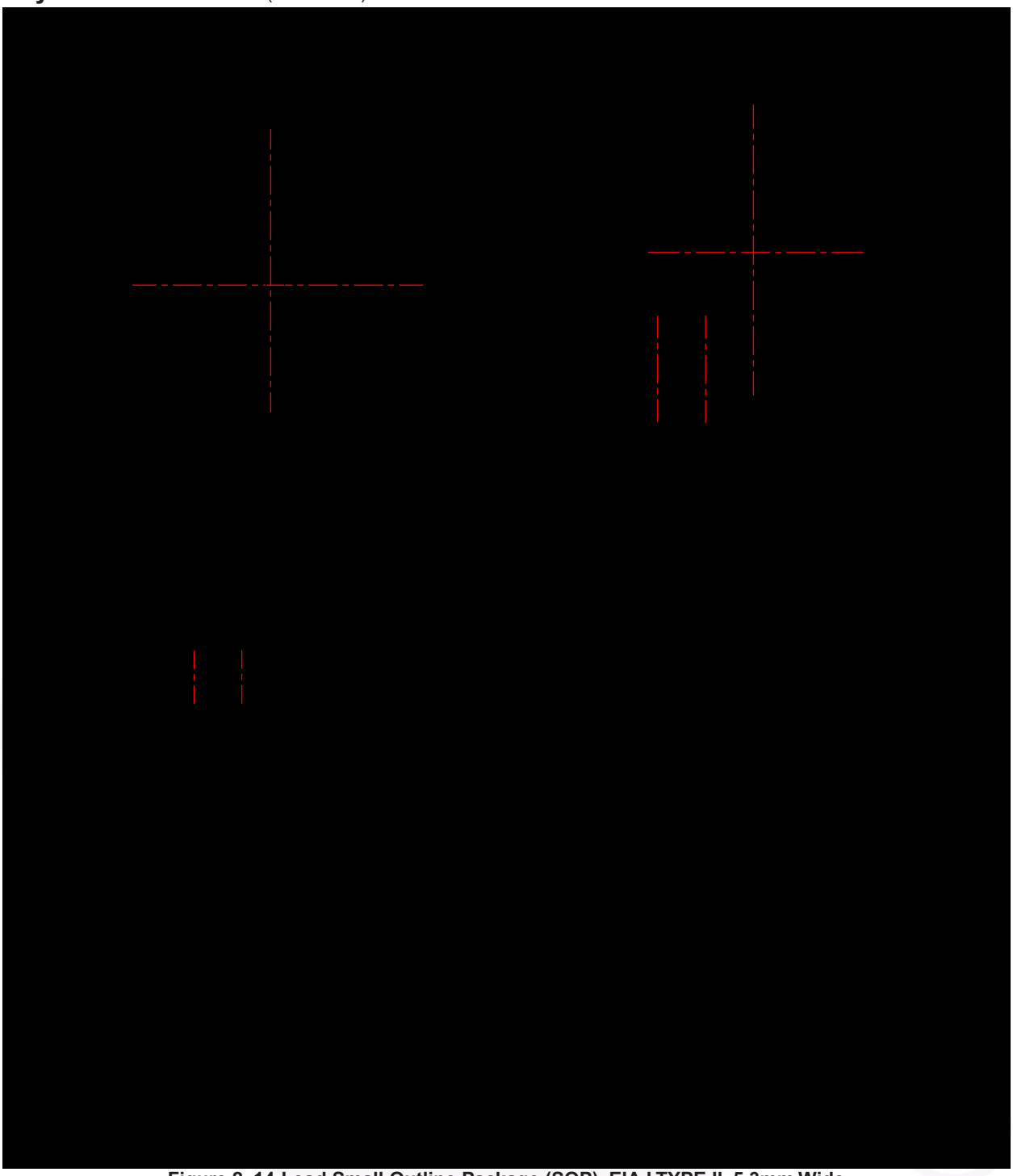

Figure 2. 14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide

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Physical Dimensions (Continued)

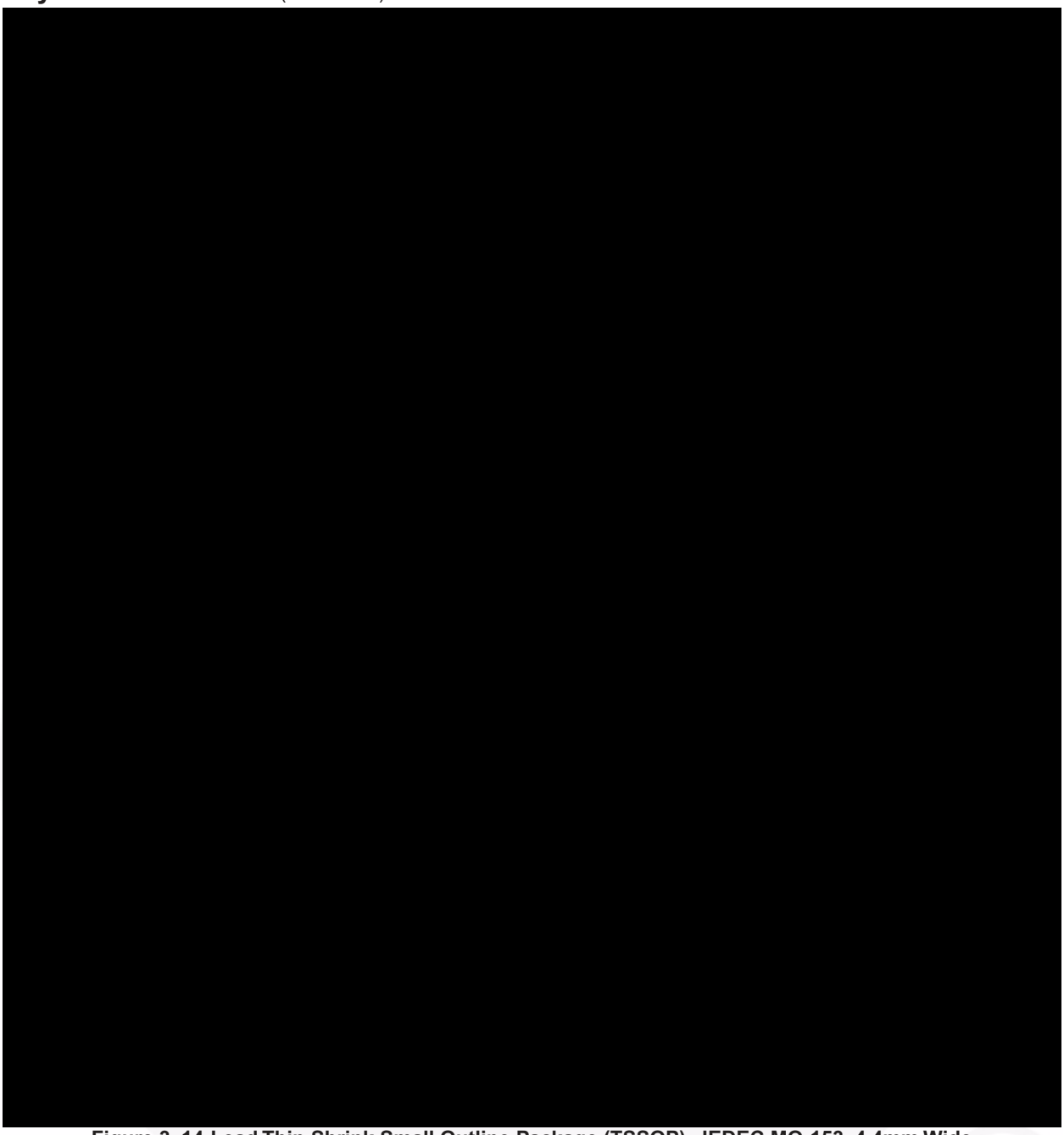

Figure 3. 14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

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