



Is Now Part of



**ON Semiconductor®**

To learn more about ON Semiconductor, please visit our website at  
[www.onsemi.com](http://www.onsemi.com)

Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor's system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (\_), the underscore (\_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (\_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at [www.onsemi.com](http://www.onsemi.com). Please email any questions regarding the system integration to [Fairchild\\_questions@onsemi.com](mailto:Fairchild_questions@onsemi.com).

ON Semiconductor and the ON Semiconductor logo are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.



# 74VHC595 8-Bit Shift Register with Output Latches

## Features

- High Speed:  $t_{PD} = 5.4ns$  (Typ.) at  $V_{CC} = 5V$
- Low power dissipation:  $I_{CC} = 4\mu A$  (Max.) at  $T_A = 25^\circ C$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (Min.)
- Power down protection is provided on all inputs
- Low noise:  $V_{OLP} = 0.9V$  (Typ.)
- Pin and function compatible with 74HC595

## General Description

The VHC595 is an advanced high-speed CMOS Shift Register 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.

This device contains an 8-bit serial-in, parallel-out shift register that feeds an 8-bit D-type storage register. The storage register has eight 3-STATE outputs. Separate clocks are provided for both the shift register and the storage register. The shift register has a direct-overriding clear, serial input, and serial output (standard) pins for cascading. Both the shift register and storage register use positive-edge triggered clocks. If both clocks are connected together, the shift register state will always be one clock pulse ahead of the storage register.

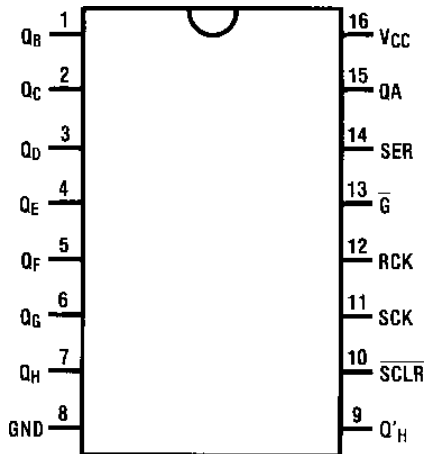
An input protection circuit insures that 0V to 7V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5V to 3V systems and two supply systems such as battery backup. This circuit prevents device destruction due to mismatched supply and input voltages.

## Ordering Information

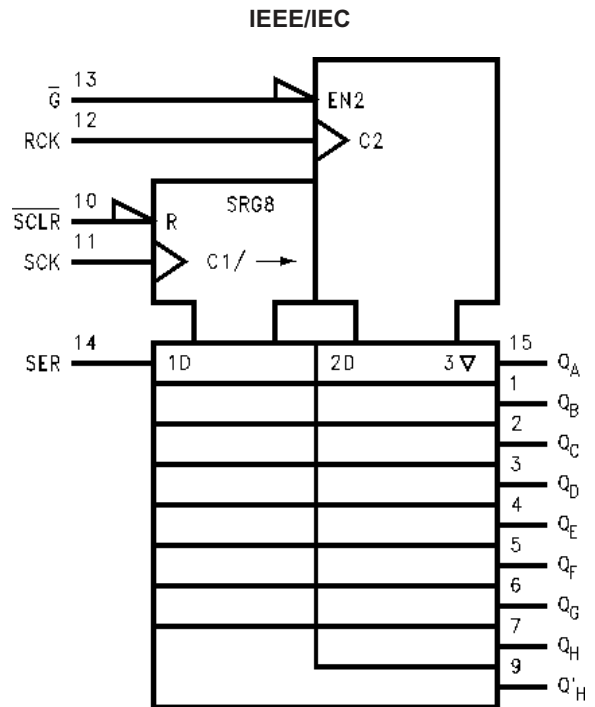
Order Number	Package Number	Package Description
74VHC595M	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
74VHC595SJ	M16D	16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74VHC595MTC	MTC16	16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

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

### Connection Diagram



### Logic Symbol



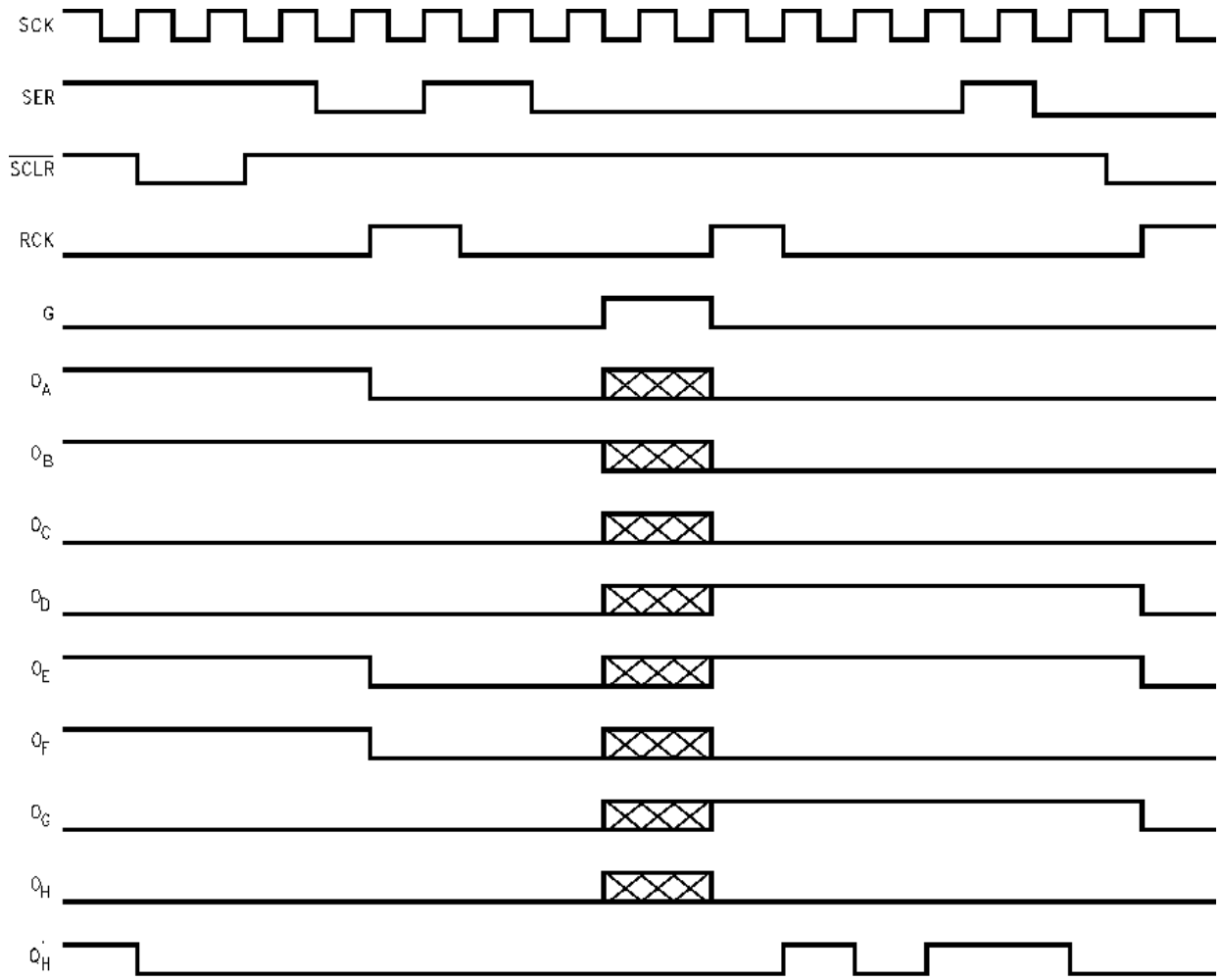
### Pin Description


Pin Names	Description
SER	Serial Data Input
SCK	Shift Register Clock Input (Active rising edge)
RCK	Storage Register Clock Input (Active rising edge)
$\overline{\text{SCLR}}$	Reset Input
$\overline{\text{G}}$	3-STATE Output Enable Input (Active LOW)
$Q_A - Q_H$	Parallel Data Outputs
$Q'_H$	Serial Data Output

### Truth Table

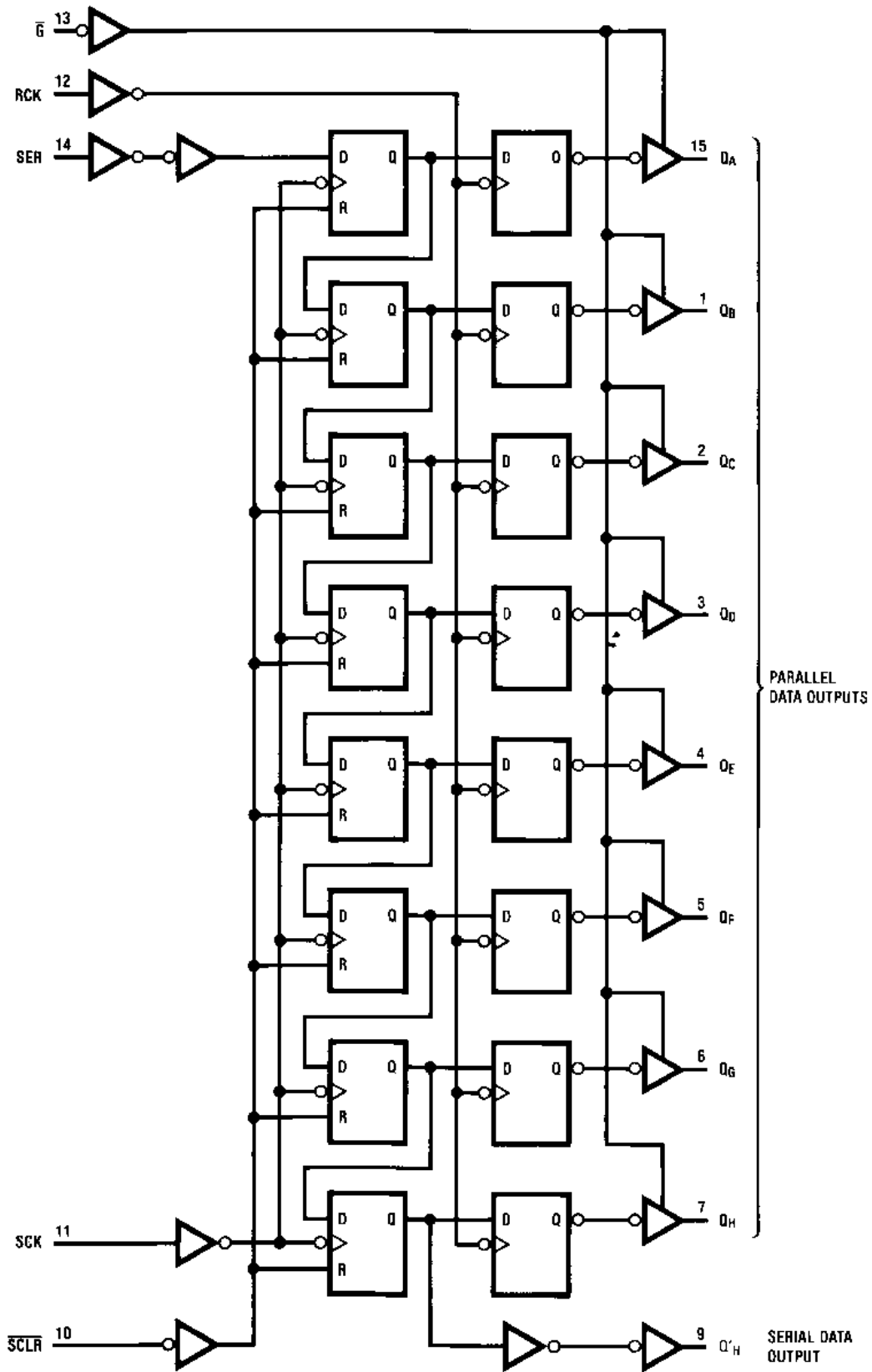
Inputs					Function
SER	RCK	SCK	$\overline{\text{SCLR}}$	$\overline{\text{G}}$	
X	X	X	X	H	$Q_A$ thru $Q_H$ 3-STATE
X	X	X	X	L	$Q_A$ thru $Q_H$ outputs enabled
X	X	X	L	L	Shift Register cleared: $Q'_H = 0$
L	X	$\uparrow$	H	L	Shift Register clocked: $Q_N = Q_{n-1}$ , $Q_0 = \text{SER} = \text{L}$
H	X	$\uparrow$	H	L	Shift Register clocked: $Q_N = Q_{n-1}$ , $Q_0 = \text{SER} = \text{H}$
X	$\uparrow$	X	H	L	Contents of Shift Register transferred to output latches

### Timing Diagram



NOTE:  Implies that the output is in 3-STATE mode.

Logic Diagram (positive logic)



## 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	$\pm 20mA$
$I_{OUT}$	DC Output Current	$\pm 25mA$
$I_{CC}$	DC $V_{CC}$ /GND Current	$\pm 75mA$
$T_{STG}$	Storage Temperature	-65°C to +150°C
$T_L$	Lead Temperature (Soldering, 10 seconds)	260°C

## Recommended Operating Conditions<sup>(1)</sup>

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 $V_{CC} = 3.3V \pm 0.3V$ $V_{CC} = 5.0V \pm 0.5V$	0 ~ 100ns/V 0 ~ 20ns/V

### Note:

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

## DC Electrical Characteristics

Symbol	Parameter	V <sub>CC</sub> (V)	Conditions	T <sub>A</sub> = 25°C			T <sub>A</sub> = -40°C to +85°C		Units			
				Min.	Typ.	Max.	Min.	Max.				
V <sub>IH</sub>	HIGH Level Input Voltage	2.0		1.50			1.50		V			
		3.0 – 5.5		0.7 x V <sub>CC</sub>			0.7 x V <sub>CC</sub>					
V <sub>IL</sub>	LOW Level Input Voltage	2.0				0.50		0.50	V			
		3.0 – 5.5				0.3 x V <sub>CC</sub>		0.3 x V <sub>CC</sub>				
V <sub>OH</sub>	HIGH Level Output Voltage	2.0	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -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 <sub>OH</sub> = -4mA	2.58				2.48	
		4.5				I <sub>OH</sub> = -8mA	3.94				3.80	
V <sub>OL</sub>	LOW Level Output Voltage	2.0	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 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 <sub>OL</sub> = 4mA		0.36			0.44	
		4.5				I <sub>OL</sub> = 8mA		0.36			0.44	
I <sub>OZ</sub>	3-STATE Output Off-State Current	5.5	V <sub>IN</sub> = V <sub>CC</sub> or GND, V <sub>OUT</sub> = V <sub>CC</sub> or GND, V <sub>IN</sub> $\bar{G}$ = V <sub>IH</sub> or V <sub>IL</sub>				±0.25		±2.5	μA		
I <sub>IN</sub>	Input Leakage Current	0 – 5.5	V <sub>IN</sub> = 5.5V or GND				±0.1		±1.0	μA		
I <sub>CC</sub>	Quiescent Supply Current	5.5	V <sub>IN</sub> = V <sub>CC</sub> or GND			4.0			40.0	μA		

## Noise Characteristics

Symbol	Parameter	V <sub>CC</sub> (V)	Conditions	T <sub>A</sub> = 25°C		Units
				Typ.	Limits	
V <sub>OLP</sub> <sup>(2)</sup>	Quiet Output Maximum Dynamic V <sub>OL</sub>	5.0	C <sub>L</sub> = 50pF	0.9	1.2	V
V <sub>OLV</sub> <sup>(2)</sup>	Quiet Output Minimum Dynamic V <sub>OL</sub>	5.0	C <sub>L</sub> = 50pF	-0.9	-1.2	V
V <sub>IHD</sub> <sup>(2)</sup>	Minimum HIGH Level Dynamic Input Voltage	5.0	C <sub>L</sub> = 50pF		3.5	V
V <sub>ILD</sub> <sup>(2)</sup>	Maximum LOW Level Dynamic Input Voltage	5.0	C <sub>L</sub> = 50pF		1.5	V

**Note:**

- Parameter guaranteed by design.

## AC Electrical Characteristics

Symbol	Parameter	V <sub>CC</sub> (V)	Conditions	T <sub>A</sub> = +25°C			T <sub>A</sub> = -40°C to +85°C		Units
				Min.	Typ.	Max.	Min.	Max.	
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation Delay Time, RCK to Q <sub>A</sub> -Q <sub>H</sub>	3.3 ± 0.3		C <sub>L</sub> = 15pF	7.7	11.9	1.0	13.5	ns
				C <sub>L</sub> = 50pF	10.2	15.4	1.0	17.0	
		5.0 ± 0.5		C <sub>L</sub> = 15pF	5.4	7.4	1.0	8.5	ns
				C <sub>L</sub> = 50pF	6.9	9.4	1.0	10.5	
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation Delay Time, SCK-Q'H	3.3 ± 0.3		C <sub>L</sub> = 15pF	8.8	13.0	1.0	15.0	ns
				C <sub>L</sub> = 50pF	11.3	16.5	1.0	18.5	
		5.0 ± 0.5		C <sub>L</sub> = 15pF	6.2	8.2	1.0	9.4	ns
				C <sub>L</sub> = 50pF	7.7	10.2	1.0	11.4	
t <sub>PHL</sub>	Propagation Delay Time, SCLR-Q'H	3.3 ± 0.3		C <sub>L</sub> = 15pF	8.4	12.8	1.0	13.7	ns
				C <sub>L</sub> = 50pF	10.9	16.3	1.0	17.2	
		5.0 ± 0.5		C <sub>L</sub> = 15pF	5.9	8.0	1.0	9.1	ns
				C <sub>L</sub> = 50pF	7.4	10.0	1.0	11.1	
t <sub>PZL</sub> , t <sub>PZH</sub>	Output Enable Time, $\bar{G}$ to Q <sub>A</sub> -Q <sub>H</sub>	3.3 ± 0.3	R <sub>L</sub> = 1kΩ	C <sub>L</sub> = 15pF	7.5	11.5	1.0	13.5	ns
				C <sub>L</sub> = 50pF	9.0	15.0	1.0	17.0	
		5.0 ± 0.5		C <sub>L</sub> = 15pF	4.8	8.6	1.0	10.0	ns
				C <sub>L</sub> = 50pF	8.3	10.6	1.0	12.0	
t <sub>PLZ</sub> , t <sub>PHZ</sub>	Output Disable Time, $\bar{G}$ to Q <sub>A</sub> -Q <sub>H</sub>	3.3 ± 0.3	R <sub>L</sub> = 1kΩ	C <sub>L</sub> = 50pF	12.1	15.7	1.0	16.2	ns
		5.0 ± 0.5		C <sub>L</sub> = 50pF	7.6	10.3	1.0	11.0	
f <sub>MAX</sub>	Maximum Clock Frequency	3.3 ± 0.3		C <sub>L</sub> = 15pF	80	150	70		MHz
				C <sub>L</sub> = 50pF	55	130	50		
		5.0 ± 0.5		C <sub>L</sub> = 15pF	135	185	115		MHz
				C <sub>L</sub> = 50pF	95	155	85		
t <sub>OSLH</sub> , t <sub>OSSL</sub>	Output to Output Skew	3.3 ± 0.3	<sup>(3)</sup>	C <sub>L</sub> = 50pF		1.5		1.5	ns
		5.0 ± 0.5		C <sub>L</sub> = 50pF		1.0		1.0	
C <sub>IN</sub>	Input Capacitance		V <sub>CC</sub> = Open		5.0	10		10	pF
C <sub>OUT</sub>	Output Capacitance		V <sub>CC</sub> = 5.0V		6.0				pF
C <sub>PD</sub>	Power Dissipation Capacitance		<sup>(4)</sup>		87				pF

**Notes:**

- Parameter guaranteed by design. t<sub>OSLH</sub> = | t<sub>PLH</sub> max - t<sub>PLH</sub> min |; t<sub>OSSL</sub> = | t<sub>PHL</sub> max - t<sub>PHL</sub> min |
- C<sub>PD</sub> 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<sub>CC</sub> (Opr.) = C<sub>PD</sub> • V<sub>CC</sub> • f<sub>IN</sub> + I<sub>CC</sub>



## AC Operating Requirements

Symbol	Parameter	V <sub>CC</sub> (V)	T <sub>A</sub> = 25°C		T <sub>A</sub> = -40°C to +85°C	Units
			Typ.	Guaranteed Minimum		
t <sub>S</sub>	Minimum Setup Time (SER–SCK)	3.3 ± 0.3		3.5	3.5	ns
		5.0 ± 0.5		3.0	3.0	
t <sub>S</sub>	Minimum Setup Time (SCK–RCK)	3.3 ± 0.3		8.0	8.5	ns
		5.0 ± 0.5		5.0	5.0	
t <sub>S</sub>	Minimum Setup Time ( $\overline{\text{SCLR}}$ –RCK)	3.3 ± 0.3		8.0	9.0	ns
		5.0 ± 0.5		5.0	5.0	
t <sub>H</sub>	Minimum Hold Time (SER–SCK)	3.3 ± 0.3		1.5	1.5	ns
		5.0 ± 0.5		2.0	2.0	
t <sub>H</sub>	Minimum Hold Time (SCK–RCK)	3.3 ± 0.3		0.0	0.0	ns
		5.0 ± 0.5		0.0	0.0	
t <sub>H</sub>	Minimum Hold Time ( $\overline{\text{SCLR}}$ –RCK)	3.3 ± 0.3		0.0	0.0	ns
		5.0 ± 0.5		0.0	0.0	
t <sub>W(L)</sub>	Minimum Pulse Width ( $\overline{\text{SCLR}}$ )	3.3 ± 0.3		5.0	5.0	ns
		5.0 ± 0.5		5.0	5.0	
t <sub>W(L)</sub> , t <sub>W(H)</sub>	Minimum Pulse Width (SCK)	3.3 ± 0.3		5.0	5.0	ns
		5.0 ± 0.5		5.0	5.0	
t <sub>W(L)</sub> , t <sub>W(H)</sub>	Minimum Pulse Width (RCK)	3.3 ± 0.3		5.0	5.0	ns
		5.0 ± 0.5		5.0	5.0	
t <sub>rem</sub>	Minimum Removal Time ( $\overline{\text{SCLR}}$ –SCK)	3.3 ± 0.3		3.0	3.0	ns
		5.0 ± 0.5		2.5	2.5	

### Physical Dimensions

Dimensions are in millimeters unless otherwise noted.

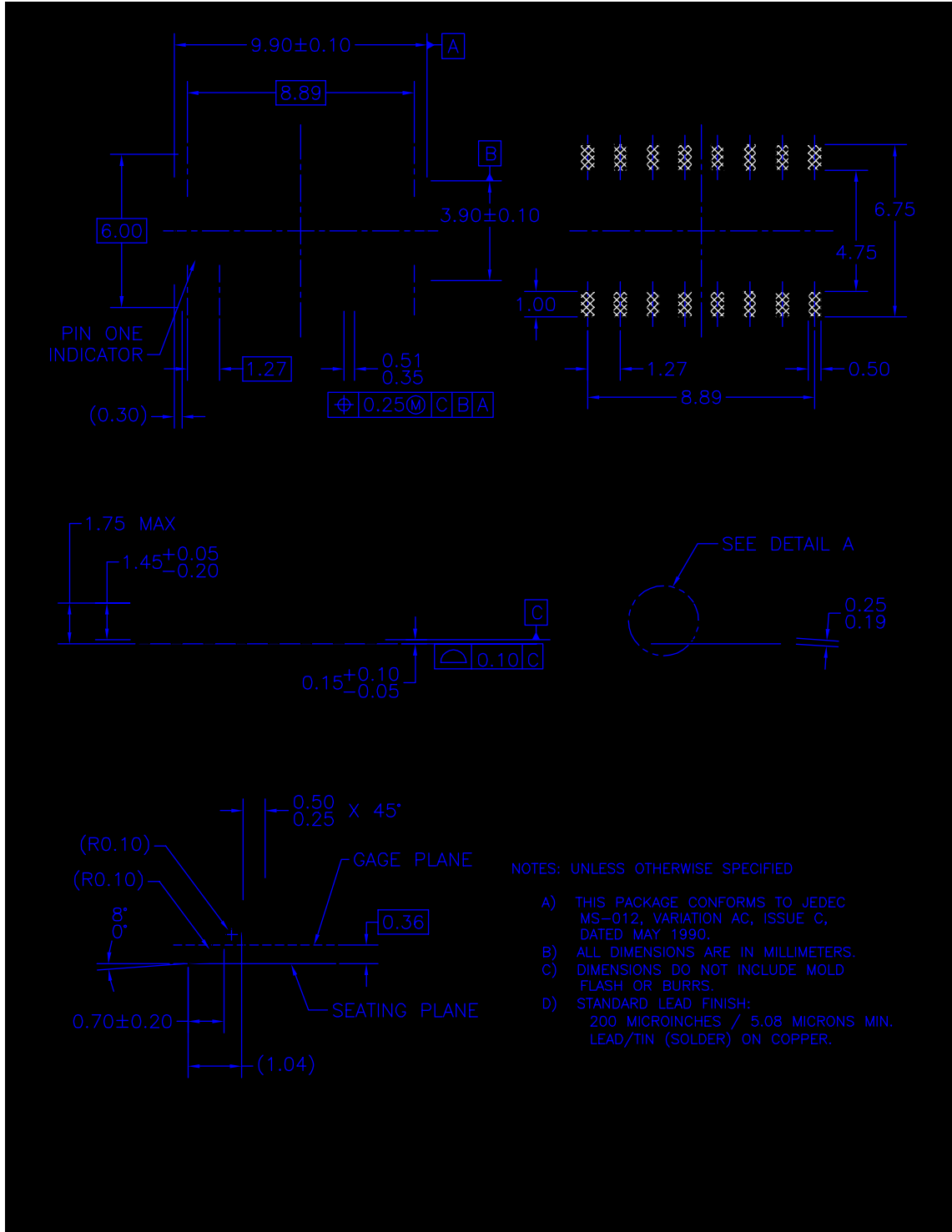
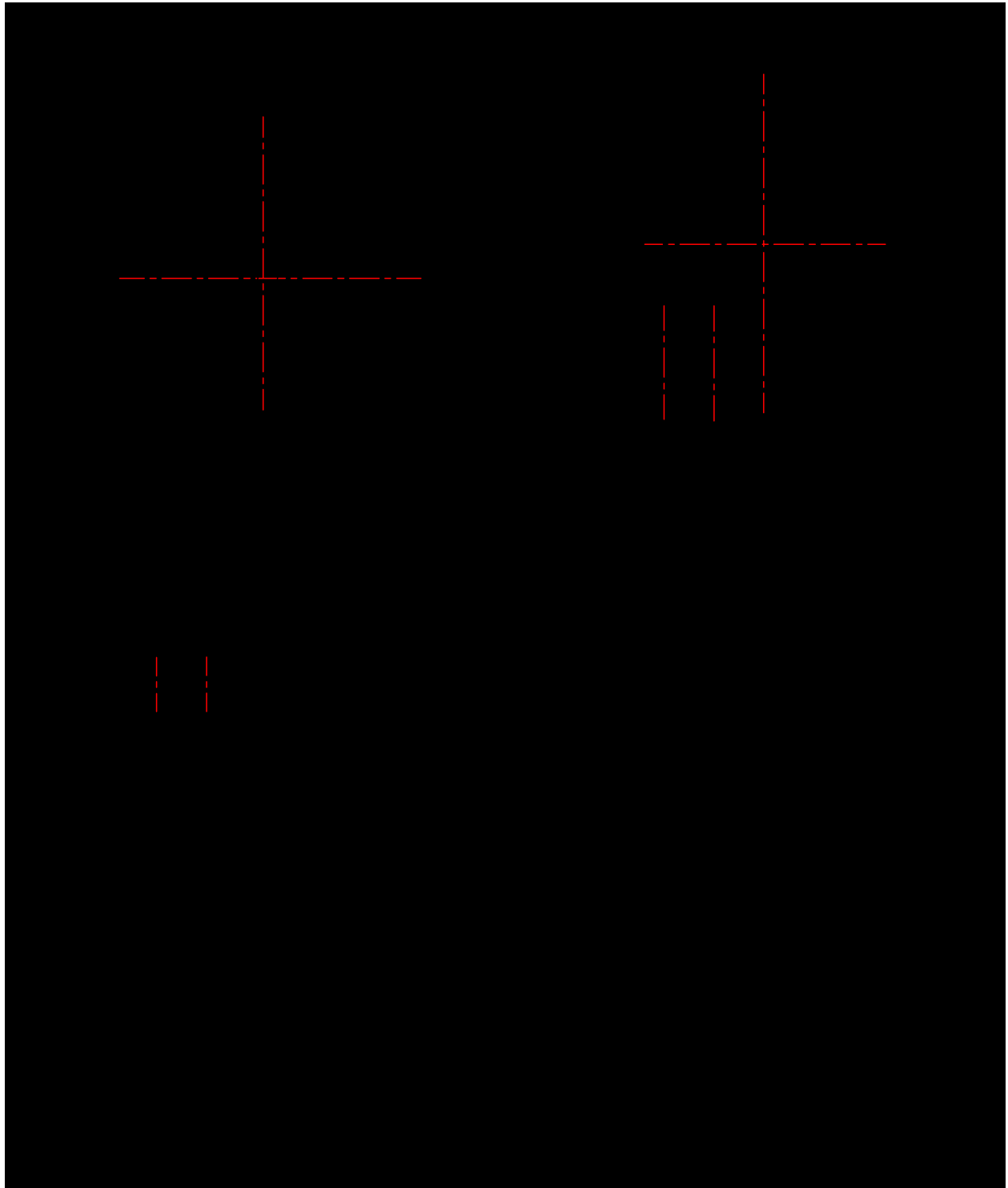


Figure 1. 16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow Package Number M16A

**Physical Dimensions** (Continued)

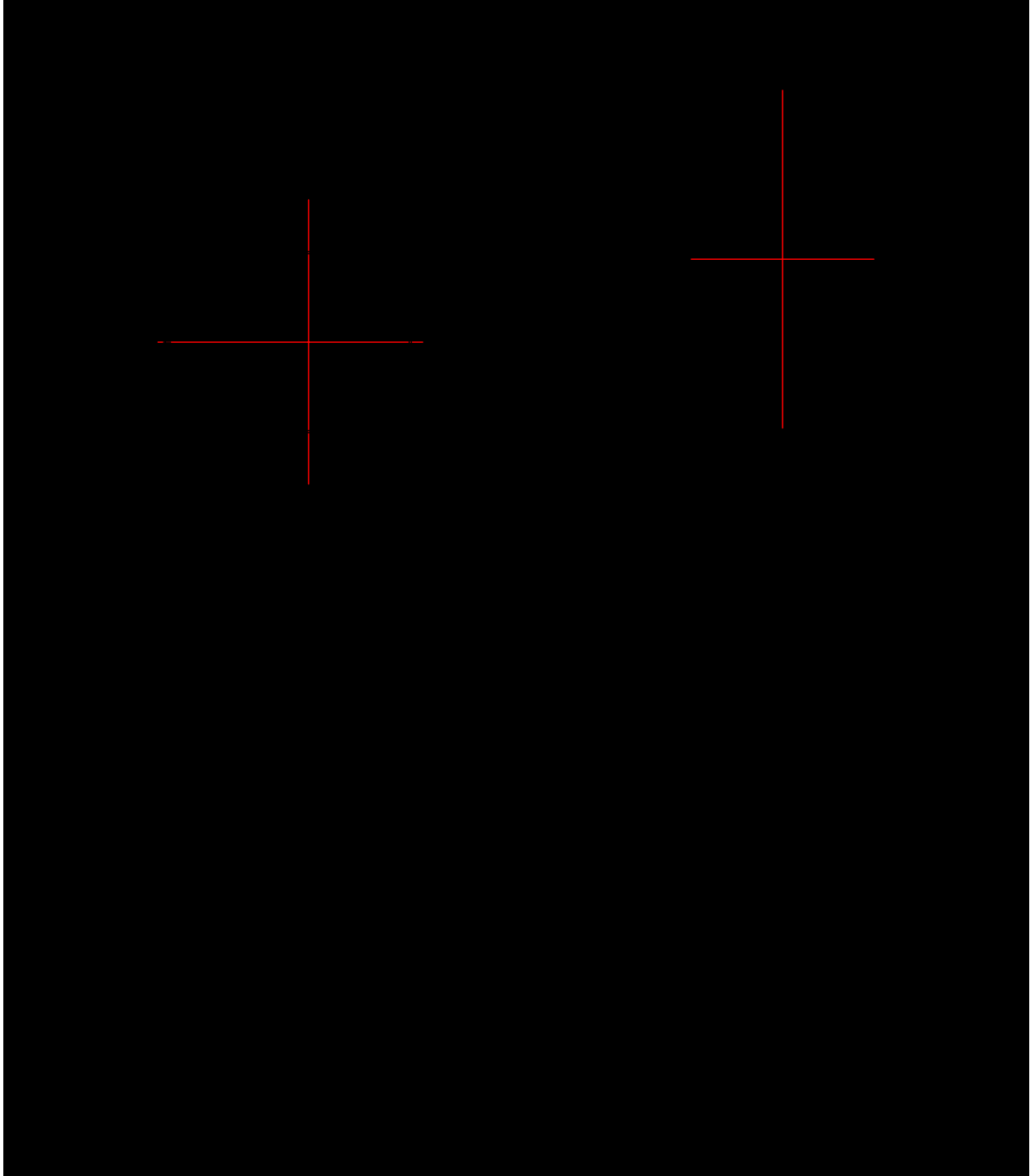
Dimensions are in millimeters unless otherwise noted.



**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.



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



ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## PUBLICATION ORDERING INFORMATION

### LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor  
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA  
**Phone:** 303-675-2175 or 800-344-3860 Toll Free USA/Canada  
**Fax:** 303-675-2176 or 800-344-3867 Toll Free USA/Canada  
**Email:** [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

**N. American Technical Support:** 800-282-9855 Toll Free  
USA/Canada  
**Europe, Middle East and Africa Technical Support:**  
Phone: 421 33 790 2910  
**Japan Customer Focus Center**  
Phone: 81-3-5817-1050

**ON Semiconductor Website:** [www.onsemi.com](http://www.onsemi.com)  
**Order Literature:** <http://www.onsemi.com/orderlit>  
For additional information, please contact your local  
Sales Representative