

# 8-Bit Shift Register with Output Latches

## MM74HC595

### General Description

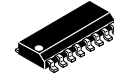
The MM74HC595 high-speed shift register utilizes advanced silicon-gate CMOS technology. This device possesses the high noise immunity and low power consumption of standard CMOS integrated circuits, as well as the ability to drive 15 LS-TTL loads.

This device contains an eight-bit serial-in, parallel-out, shift register that feeds an eight-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 is one clock pulse ahead of the storage register.

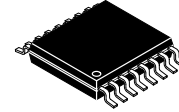
The 74HC logic family is speed, function, and pin-out compatible with the standard 74LS logic family. All inputs are protected from damage due to static discharge by internal diode clamps to  $V_{CC}$  and ground.

### Features

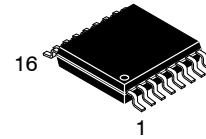
- Low Quiescent Current: 160  $\mu$ A Maximum (74HC Series)
- Low Input Current: 1  $\mu$ A Maximum
- 8-Bit Serial-In, Parallel-Out Shift Register with Storage
- Wide Operating Voltage Range: 2 V–6 V
- Cascadable
- Shift Register has Direct Clear
- Guaranteed Shift Frequency: DC to 30 MHz
- This Device is Pb-Free and is RoHS Compliant



SOIC-16  
CASE 751B-05

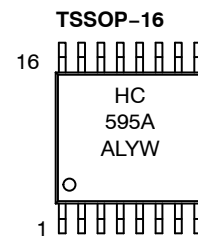
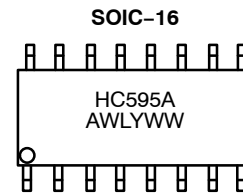


TSSOP 16  
CASE 948AH-01



TSSOP-16  
CASE 948F-01

### MARKING DIAGRAMS



HC595A = Specific Device Code  
 A = Assembly Location  
 WL, L = Wafer Lot Number  
 Y = Year  
 WW, YW = Work Week

### ORDERING INFORMATION

See detailed ordering and shipping information on page 8 of this data sheet.

# MM74HC595

## Block Diagram

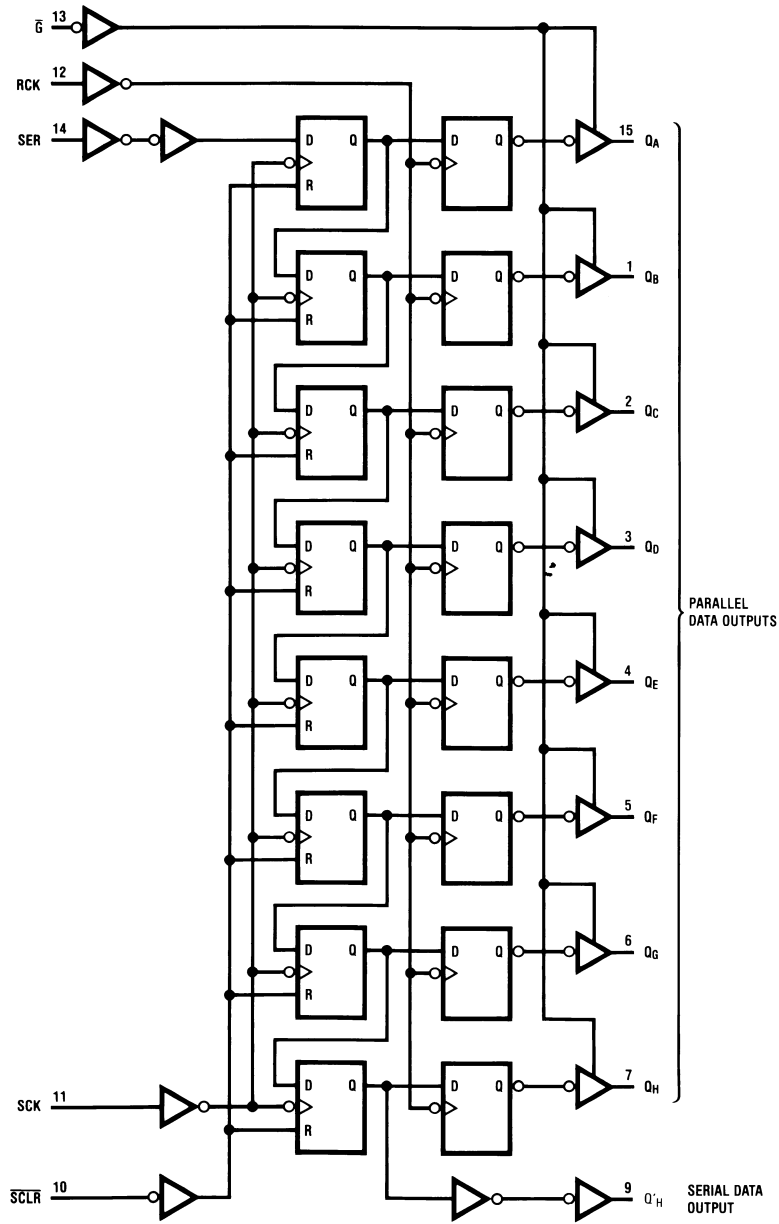


Figure 1. Logic Diagram (Positive Logic)

# MM74HC595

## Pin Configuration

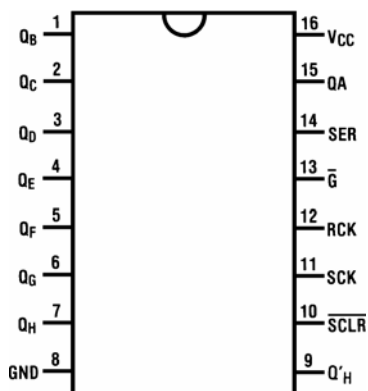


Figure 2. Pin Configuration

## PIN DEFINITIONS

Pin No.	Symbol	Description
1	Q <sub>B</sub>	Output Bit B
2	Q <sub>C</sub>	Output Bit C
3	Q <sub>D</sub>	Output Bit D
4	Q <sub>E</sub>	Output Bit E
5	Q <sub>F</sub>	Output Bit F
6	Q <sub>G</sub>	Output Bit G
7	Q <sub>H</sub>	Output Bit H
8	GND	Ground
9	Q' <sub>H</sub>	Serial Data Output
10	SCLR	Shift Register Clear
11	SCK	Shift Register Clock Input
12	RCK	Storage Register Clock Input
13	Ḡ	Output Enable
14	SER	Serial Data Input
15	QA	Output Bit A
16	V <sub>CC</sub>	Supply Voltage

## TRUTH TABLE

RCK	SCK	SCLR	G	Function
X	X	X	H	QA through Q <sub>H</sub> = 3-state
X	X	L	L	Shift register clocked; Q' <sub>H</sub> = 0
X	↑	H	L	Shift register clocked; Q <sub>N</sub> = Q <sub>n-1</sub> , Q <sub>0</sub> = SER
↑	X	H	L	Contents of shift; register transferred to output latches

NOTES: L = Logic Level LOW  
H = Logic Level HIGH  
X = Don't Care  
↑ = Transition from LOW to HIGH level

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## ABSOLUTE MAXIMUM RATINGS (Note 1)

Symbol	Rating	Min	Max	Unit	
$V_{CC}$	Supply Voltage	-0.5	7.0	V	
$V_{IN}$	DC Input Voltage	-0.5	$V_{CC} + 0.5$	V	
$V_{OUT}$	DC Output Voltage	-0.5	$V_{CC} + 0.5$	V	
$I_{IK}, I_{OK}$	Clamp Diode Current		$\pm 20$	mA	
$I_{OUT}$	DC Output Current, per pin		$\pm 35$	mA	
$I_{CC}$	DC VCC or GND Current, per pin		$\pm 70$	mA	
$T_{STG}$	Storage Temperature Range	-65	+150	°C	
$P_D$	Power Dissipation	SOIC Package only		500	mW
$T_L$	Lead Temperature		+260	°C	
ESD	Electrostatic Discharge Capability	Human Body Model, JESD22-A114		4000	V

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Unless otherwise specified all voltages are referenced to ground.

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit	
$V_{CC}$	Supply Voltage	2	6	V	
$V_{IN}, V_{OUT}$	DC Input or Output Voltage	0	$V_{CC}$	V	
$T_A$	Operating Temperature Range	-55	+125	°C	
$t_R, t_F$	Input Rise and Fall Times	$V_{CC} = 2.0\text{ V}$	-	1000	ns
		$V_{CC} = 4.5\text{ V}$	-	500	
		$V_{CC} = 6.0\text{ V}$	-	400	

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

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## ELECTRICAL CHARACTERISTICS (Note 2)

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	Unit	
				Typ	Guaranteed Limits				
V <sub>IH</sub>	Minimum HIGH Level Input Voltage		2.0 V		1.50	1.50	1.50	V	
			4.5 V		3.15	3.15	3.15	V	
			6.0 V		4.20	4.20	4.20	V	
V <sub>IL</sub>	Minimum LOW Level Input Voltage		2.0 V		0.50	0.50	0.50	V	
			4.5 V		1.35	1.35	1.35	V	
			6.0 V		1.80	1.80	1.80	V	
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	2.0 V	2.00	1.90	1.90	1.90	V
				4.5 V	4.50	4.40	4.40	4.40	V
				6.0 V	6.00	5.90	5.90	5.90	V
Q' <sub>H</sub>	Q' <sub>H</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OUT</sub>   ≤ 4.0 mA  I <sub>OUT</sub>   ≤ 5.2 mA	4.5 V	4.20	3.98	3.84	3.70	V
				6.0 V	5.20	5.48	5.34	5.20	V
				QA through Q <sub>H</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OUT</sub>   ≤ 6.0 mA  I <sub>OUT</sub>   ≤ 7.8 mA	4.5 V	4.20	3.98
6.0 V	5.70	5.48	5.34	5.20			V		
V <sub>OL</sub>	Minimum LOW Level Output Voltage	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OUT</sub>   ≤ 20 μA	2.0 V	0	0.10	0.10	0.10	V
				4.5 V	0	0.10	0.10	0.10	V
				6.0 V	0	0.10	0.10	0.10	V
Q' <sub>H</sub>	Q' <sub>H</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OUT</sub>   ≤ 4.0 mA  I <sub>OUT</sub>   ≤ 5.2 mA	4.5 V	0.20	0.26	0.33	0.40	V
				6.0 V	0.20	0.26	0.33	0.40	V
				QA through Q <sub>H</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OUT</sub>   ≤ 6.0 mA  I <sub>OUT</sub>   ≤ 7.8 mA	4.5 V	0.20	0.26
6.0 V	0.20	0.26	0.33	0.40			V		
I <sub>IN</sub>	Maximum Input Output Leakage	V <sub>IN</sub> = V <sub>CC</sub> or GND	6.0 V		±0.1	±1.0	±1.0	μA	
I <sub>OZ</sub>	Maximum 3-STATE Output Leakage	V <sub>OUT</sub> = V <sub>CC</sub> or GND $\bar{G} = V_{IH}$	6.0 V		±0.5	±5.0	±10	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	6.0 V		8.0	80	160	μA	

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

2. For a power supply of 5 V ±10% the worst-case output voltages (V<sub>OH</sub>, and V<sub>OL</sub>) occur for HC at 4.5 V. The 4.5 V 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> = 5.5 V and 4.5 V, respectively; V<sub>IH</sub> value at 5.5 V is 3.85 V. 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; so the 6.0 V values should be used.

## AC ELECTRICAL CHARACTERISTICS

(V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C, t<sub>r</sub> = t<sub>f</sub> = 6 ns)

Symbol	Parameter	Conditions	Typ	Guaranteed Limit	Unit
f <sub>MAX</sub>	Maximum Operating Frequency of SCK		50	30	MHz
t <sub>PHL</sub> , t <sub>PLH</sub>	Maximum Propagation Delay, SCK to Q' <sub>H</sub>	C <sub>L</sub> = 45 pF	12	20	ns
	Maximum Propagation Delay, RCK to Q <sub>A</sub> thru Q' <sub>H</sub>				
t <sub>PZH</sub> , t <sub>PZL</sub>	Maximum Output Enable Time from $\bar{G}$ to Q <sub>A</sub> thru Q' <sub>H</sub>	R <sub>L</sub> = 1 kΩ C <sub>L</sub> = 45 pF	17	28	ns
t <sub>PHZ</sub> , t <sub>PLZ</sub>	Maximum Output Disable Time from $\bar{G}$ to Q <sub>A</sub> thru Q' <sub>H</sub>	R <sub>L</sub> = 1 kΩ C <sub>L</sub> = 45 pF	15	25	ns
t <sub>S</sub>	Minimum Setup Time from SER to SCK			20	ns
	Minimum Setup Time from SCLR to SCK			20	ns
	Minimum Setup Time from SER to RCK (Note 3)			40	ns

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## AC ELECTRICAL CHARACTERISTICS (continued)

( $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$ ,  $t_r = t_f = 6\text{ ns}$ )

Symbol	Parameter	Conditions	Typ	Guaranteed Limit	Unit
$t_H$	Minimum Hold Time from SER to SCK			0	ns
$t_W$	Minimum Pulse Width of SCK or RCK			16	ns

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

3. This setup time ensures the register will see stable data from the shift-register outputs. The clocks may be connected together in which case the storage register state will be one clock pulse behind the shift register.

## ELECTRICAL CHARACTERISTICS

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

Symbol	Parameter	Conditions	$V_{CC}$	$T_A = 25^\circ\text{C}$		$T_A = -40\text{ to }85^\circ\text{C}$	$T_A = -55\text{ to }125^\circ\text{C}$	Unit	
				Typ	Guaranteed Limits				
$f_{MAX}$	Maximum Operating Frequency	$C_L = 50\text{ pF}$	2.0 V	10.0	6.0	4.8	4.0	ns	
			4.5 V	45.0	30.0	24.0	20.0	ns	
			6.0 V	50.0	35.0	28.0	24.0	ns	
$t_{PHL}$ , $t_{PLH}$	Maximum Propagation Delay, SCK to $Q'_H$	$C_L = 50\text{ pF}$	2.0 V	58.0	210.0	235.0	315.0	ns	
			2.0 V	83.0	294.0	367.0	441.0	ns	
		$C_L = 150\text{ pF}$	4.5 V	14.0	42.0	53.0	63.0	ns	
			4.5 V	17.0	58.0	74.0	88.0	ns	
		$C_L = 50\text{ pF}$	6.0 V	10.0	36.0	45.0	54.0	ns	
			6.0 V	14.0	50.0	63.0	76.0	ns	
	Maximum Propagation Delay, RCK to $Q_A$ thru $Q'_H$	$C_L = 50\text{ pF}$	2.0 V	70.0	175.0	220.0	265.0	ns	
			2.0 V	105.0	245.0	306.0	368.0	ns	
		$C_L = 150\text{ pF}$	4.5 V	21.0	35.0	44.0	53.0	ns	
			4.5 V	28.0	49.0	61.0	74.0	ns	
		$C_L = 50\text{ pF}$	6.0 V	18.0	30.0	37.0	45.0	ns	
			6.0 V	26.0	42.0	53.0	63.0	ns	
Maximum Propagation Delay, $\overline{SCLR}$ to $Q'_H$		2.0 V		175.0	221.0	261.0	ns		
		4.5 V		35.0	44.0	52.0	ns		
		6.0 V		30.0	37.0	44.0	ns		
$t_{PZH}$ , $t_{PZL}$	Maximum Output Enable Time from $\overline{G}$ to $Q_A$ thru $Q'_H$	$R_L = 1\text{ k}\Omega$	$C_L = 50\text{ pF}$	2.0 V	75.0	175.0	220.0	265.0	ns
			$C_L = 150\text{ pF}$	2.0 V	100.0	245.0	306.0	368.0	ns
		$C_L = 50\text{ pF}$	4.5 V	15.0	35.0	44.0	53.0	ns	
			4.5 V	20.0	49.0	61.0	74.0	ns	
		$C_L = 150\text{ pF}$	6.0 V	13.0	30.0	37.0	45.0	ns	
			6.0 V	17.0	42.0	53.0	63.0	ns	
$t_{PHZ}$ , $t_{PLZ}$	Maximum Output Disable Time from $\overline{G}$ to $Q_A$ thru $Q'_H$	$R_L = 1\text{ k}\Omega$	$C_L = 50\text{ pF}$	2.0 V	75.0	175.0	220.0	265.0	ns
			4.5 V	15.0	35.0	44.0	53.0	ns	
			6.0 V	13.0	30.0	37.0	45.0	ns	
$t_S$	Minimum Setup Time from SER to SCK	$R_L = 1\text{ k}\Omega$	$C_L = 50\text{ pF}$	2.0 V		100.0	125.0	150.0	ns
			4.5 V		20.0	25.0	30.0	ns	
			6.0 V		17.0	21.0	25.0	ns	
$t_R$	Minimum Removal Time from $\overline{SCLR}$ to SCK		2.0 V		50.0	63.0	75.0	ns	
			4.5 V		10.0	13.0	15.0	ns	
			6.0 V		9.0	11.0	13.0	ns	
$t_S$	Minimum Setup Time from SCK to RCK		2.0 V		100.0	125.0	150.0	ns	
			4.5 V		20.0	25.0	30.0	ns	
			6.0 V		17.0	21.0	26.0	ns	

# MM74HC595

## ELECTRICAL CHARACTERISTICS (continued)

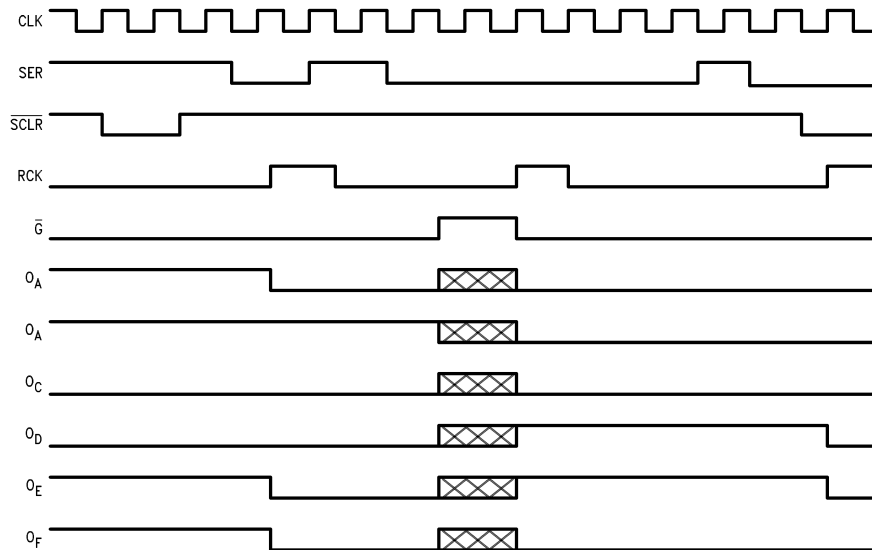
( $V_{CC} = 2.0\text{ V} - 6.0\text{ V}$ ,  $C_L = 50\text{ pF}$ ,  $t_r = t_f = 6\text{ ns}$ , unless otherwise specified)

Symbol	Parameter	Conditions	$V_{CC}$	$T_A = 25^\circ\text{C}$		$T_A = -40\text{ to }85^\circ\text{C}$	$T_A = -55\text{ to }125^\circ\text{C}$	Unit
				Typ	Guaranteed Limits			
$t_H$	Minimum Hold Time from SER to SCK		2.0 V		5.0	5.0	5.0	ns
			4.5 V		5.0	5.0	5.0	ns
			6.0 V		5.0	5.0	5.0	ns
$t_W$	Minimum Pulse Width of SCK or SCLR		2.0 V	30.0	80.0	100.0	120.0	ns
			4.5 V	9.0	16.0	20.0	24.0	ns
			6.0 V	8.0	14.0	18.0	22.0	ns
$t_R, t_F$	Maximum Input Rise and Fall Time, Clock		2.0 V		1000.0	1000.0	1000.0	ns
			4.5 V		500.0	500.0	500.0	ns
			6.0 V		400.0	400.0	400.0	ns
$t_{THL}, t_{TLH}$	Maximum Output Rise and Fall Time $Q_A - Q_H$		2.0 V	25.0	60.0	75.0	90.0	ns
			4.5 V	7.0	12.0	15.0	18.0	ns
			6.0 V	6.0	10.0	13.0	15.0	ns
	Maximum Output Rise and Fall Time $Q'_H$		2.0 V		75.0	95.0	110.0	ns
			4.5 V		15.0	19.0	22.0	ns
			6.0 V		13.0	16.0	19.0	ns
$C_{PD}$	Power Dissipation Capacitance, Outputs Enabled (Note 4)	$\bar{G} = V_{CC}$ $\bar{G} = \text{GND}$		90.0				pF
				150.0				pF
$C_{IN}$	Maximum Input Capacitance			5.0	10.0	10.0	10.0	pF
$C_{OUT}$	Maximum Output Capacitance			15.0	20.0	20.0	20.0	pF

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

4.  $C_{PD}$  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



NOTE:

5. Implies that the output is in 3-state mode.

Figure 3. Timing Diagram

# MM74HC595

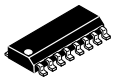
## ORDERING INFORMATION

Device	Package	Shipping†
MM74HC595M	SOIC-16 (Pb-Free)	48 Units / Tube
MM74HC595MX		2500 / Tape & Reel
MM74HC595MTC	TSSOP-16 (Pb-Free and Halide Free)	96 Units / Tube
MM74HC595MTCX	TSSOP 16 (Pb-Free and Halide Free)	2500 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, [BRD8011/D](#).



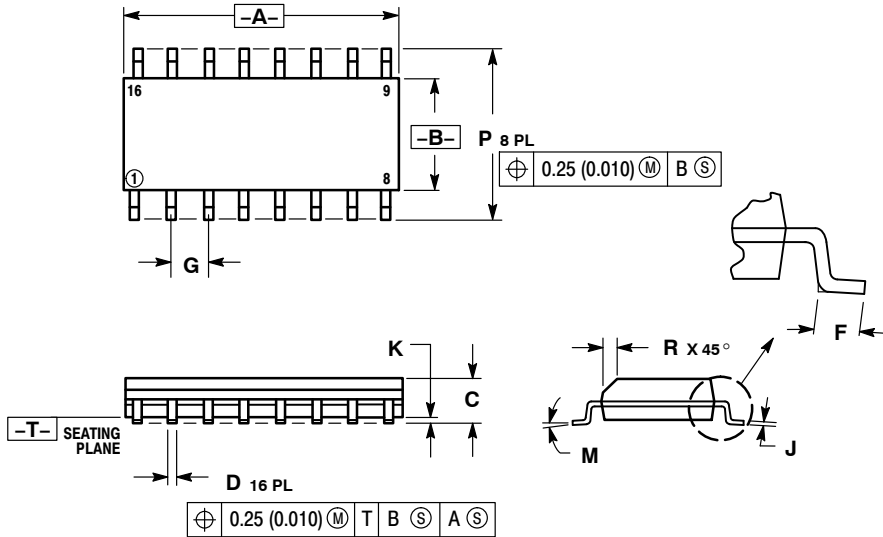
# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



SCALE 1:1

SOIC-16  
CASE 751B-05  
ISSUE K

DATE 29 DEC 2006



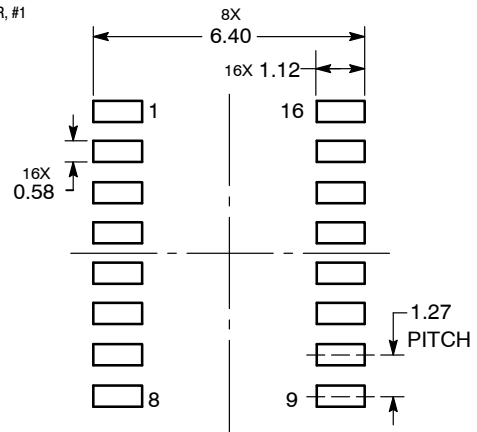
NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.80	10.00	0.386	0.393
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0° 7°		0° 7°	
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019

- |  |  |  |  |
|--|--|--|--|
| <p>STYLE 1:</p> <p>PIN 1. COLLECTOR</p> <p>2. BASE</p> <p>3. EMITTER</p> <p>4. NO CONNECTION</p> <p>5. EMITTER</p> <p>6. BASE</p> <p>7. COLLECTOR</p> <p>8. COLLECTOR</p> <p>9. BASE</p> <p>10. EMITTER</p> <p>11. NO CONNECTION</p> <p>12. EMITTER</p> <p>13. BASE</p> <p>14. COLLECTOR</p> <p>15. EMITTER</p> <p>16. COLLECTOR</p>                           | <p>STYLE 2:</p> <p>PIN 1. CATHODE</p> <p>2. ANODE</p> <p>3. NO CONNECTION</p> <p>4. CATHODE</p> <p>5. CATHODE</p> <p>6. NO CONNECTION</p> <p>7. ANODE</p> <p>8. CATHODE</p> <p>9. CATHODE</p> <p>10. ANODE</p> <p>11. NO CONNECTION</p> <p>12. CATHODE</p> <p>13. CATHODE</p> <p>14. NO CONNECTION</p> <p>15. ANODE</p> <p>16. CATHODE</p> | <p>STYLE 3:</p> <p>PIN 1. COLLECTOR, DYE #1</p> <p>2. BASE, #1</p> <p>3. EMITTER, #1</p> <p>4. COLLECTOR, #1</p> <p>5. COLLECTOR, #2</p> <p>6. BASE, #2</p> <p>7. EMITTER, #2</p> <p>8. COLLECTOR, #2</p> <p>9. COLLECTOR, #3</p> <p>10. BASE, #3</p> <p>11. EMITTER, #3</p> <p>12. COLLECTOR, #3</p> <p>13. COLLECTOR, #4</p> <p>14. BASE, #4</p> <p>15. EMITTER, #4</p> <p>16. COLLECTOR, #4</p>   | <p>STYLE 4:</p> <p>PIN 1. COLLECTOR, DYE #1</p> <p>2. COLLECTOR, #1</p> <p>3. COLLECTOR, #2</p> <p>4. COLLECTOR, #2</p> <p>5. COLLECTOR, #3</p> <p>6. COLLECTOR, #3</p> <p>7. COLLECTOR, #4</p> <p>8. COLLECTOR, #4</p> <p>9. BASE, #4</p> <p>10. EMITTER, #4</p> <p>11. BASE, #3</p> <p>12. EMITTER, #3</p> <p>13. BASE, #2</p> <p>14. EMITTER, #2</p> <p>15. BASE, #1</p> <p>16. EMITTER, #1</p> |
| <p>STYLE 5:</p> <p>PIN 1. DRAIN, DYE #1</p> <p>2. DRAIN, #1</p> <p>3. DRAIN, #2</p> <p>4. DRAIN, #2</p> <p>5. DRAIN, #3</p> <p>6. DRAIN, #3</p> <p>7. DRAIN, #4</p> <p>8. DRAIN, #4</p> <p>9. GATE, #4</p> <p>10. SOURCE, #4</p> <p>11. GATE, #3</p> <p>12. SOURCE, #3</p> <p>13. GATE, #2</p> <p>14. SOURCE, #2</p> <p>15. GATE, #1</p> <p>16. SOURCE, #1</p> | <p>STYLE 6:</p> <p>PIN 1. CATHODE</p> <p>2. CATHODE</p> <p>3. CATHODE</p> <p>4. CATHODE</p> <p>5. CATHODE</p> <p>6. CATHODE</p> <p>7. CATHODE</p> <p>8. CATHODE</p> <p>9. ANODE</p> <p>10. ANODE</p> <p>11. ANODE</p> <p>12. ANODE</p> <p>13. ANODE</p> <p>14. ANODE</p> <p>15. ANODE</p> <p>16. ANODE</p>                                 | <p>STYLE 7:</p> <p>PIN 1. SOURCE N-CH</p> <p>2. COMMON DRAIN (OUTPUT)</p> <p>3. COMMON DRAIN (OUTPUT)</p> <p>4. GATE P-CH</p> <p>5. COMMON DRAIN (OUTPUT)</p> <p>6. COMMON DRAIN (OUTPUT)</p> <p>7. COMMON DRAIN (OUTPUT)</p> <p>8. SOURCE P-CH</p> <p>9. SOURCE P-CH</p> <p>10. COMMON DRAIN (OUTPUT)</p> <p>11. COMMON DRAIN (OUTPUT)</p> <p>12. COMMON DRAIN (OUTPUT)</p> <p>13. GATE N-CH</p> <p>14. COMMON DRAIN (OUTPUT)</p> <p>15. COMMON DRAIN (OUTPUT)</p> <p>16. SOURCE N-CH</p> |  |

RECOMMENDED  
SOLDERING FOOTPRINT\*



DIMENSIONS: MILLIMETERS

\*For additional information on our Pb-Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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DESCRIPTION:	SOIC-16	PAGE 1 OF 1

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# MECHANICAL CASE OUTLINE

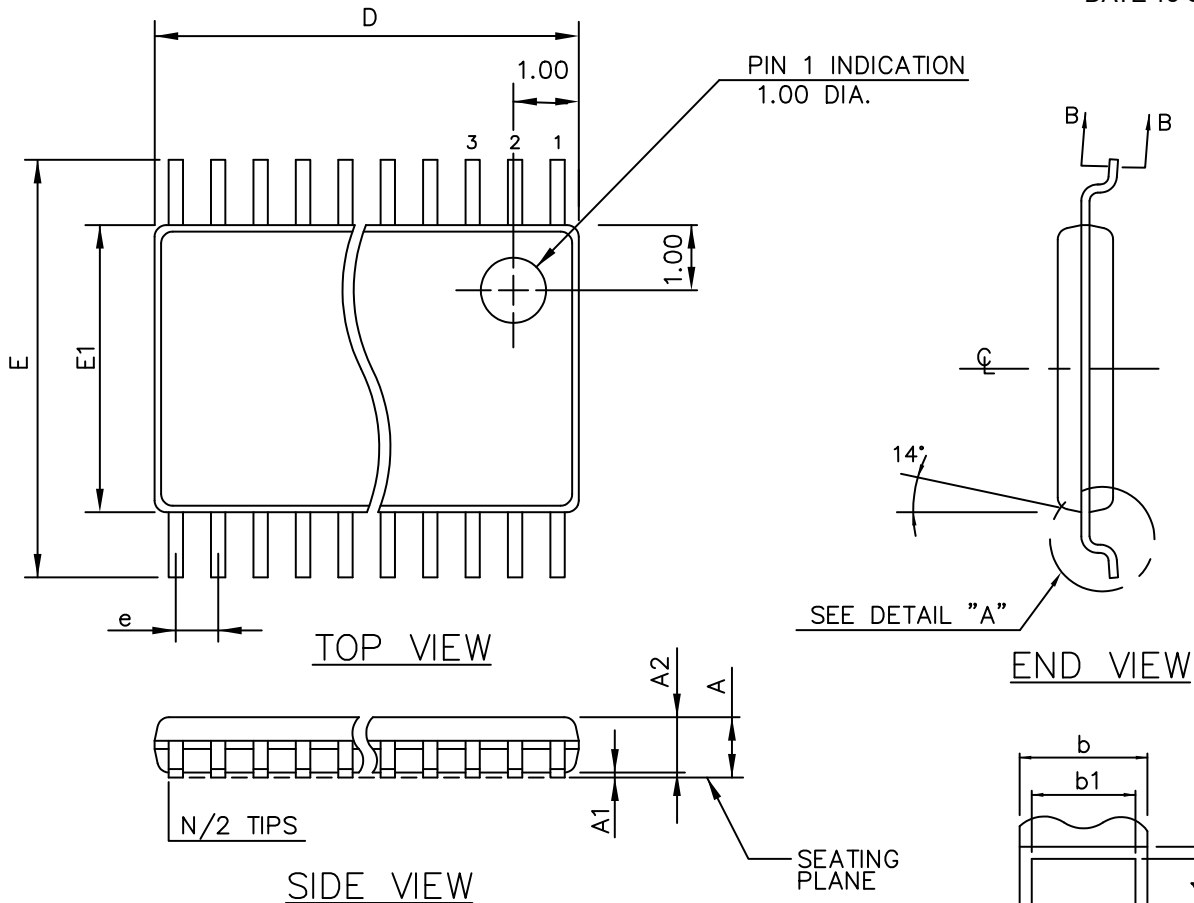
## PACKAGE DIMENSIONS

ON Semiconductor®



TSSOP 16  
CASE 948AH-01  
ISSUE O

DATE 19 SEP 2008

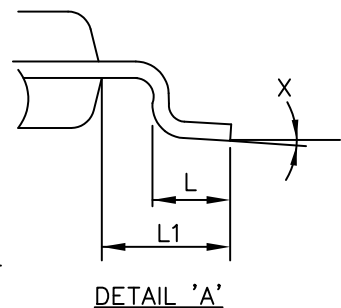


THIS TABLE FOR 0.65mm PITCH

SYMBOL	COMMON DIMENSIONS			NOTE VARIATIONS	D	N
	MIN.	NOM.	MAX.			
A	—	—	1.10	AA/AAT	3.00 BSC	8
A <sub>1</sub>	0.05	—	0.15	AB-1/ABT	5.00 BSC	14
A <sub>2</sub>	0.85	0.90	0.95	AB/ABT	5.00 BSC	16
b	0.19	—	0.30	AD/ADT	7.80 BSC	24
b <sub>1</sub>	0.19	0.22	0.25			
c	0.09	—	0.20			
c <sub>1</sub>	0.09	0.127	0.16			
D	SEE VARIATIONS					
E <sub>1</sub>	4.30	4.40	4.50			
e	0.65 BSC					
E	6.40 BSC					
L	0.50	0.60	0.70			
L <sub>1</sub>	1.00 REF					
N	SEE VARIATIONS					
X	0°	—	8°			

ALL DIMENSIONS IN MILLIMETERS

SECTION "B-B"

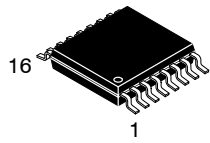


MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15mm ON D PER SIDE

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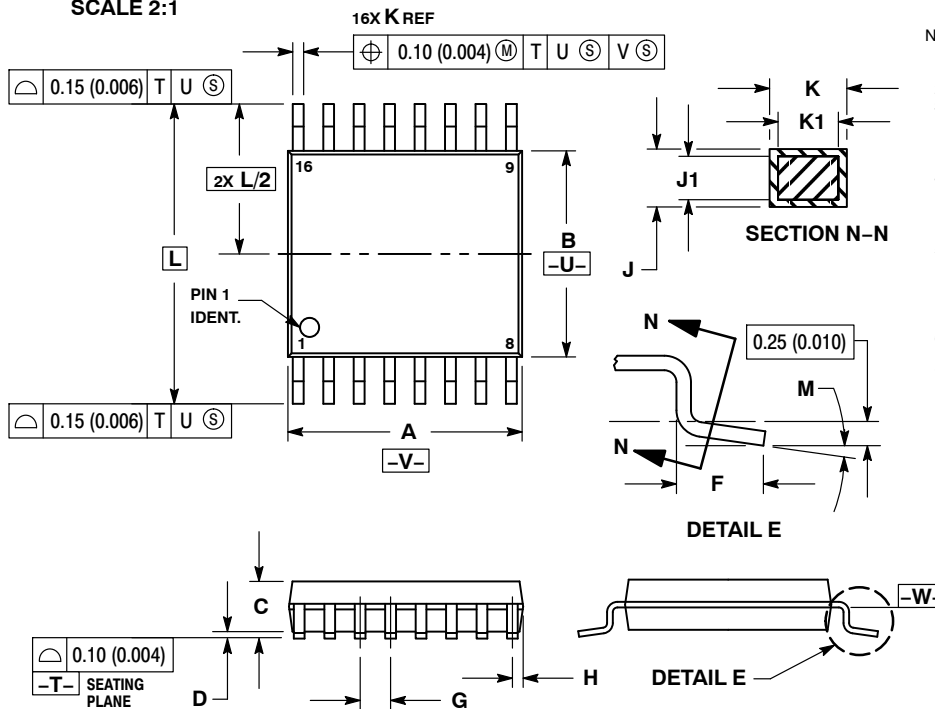
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# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



**TSSOP-16 WB**  
CASE 948F  
ISSUE B

DATE 19 OCT 2006

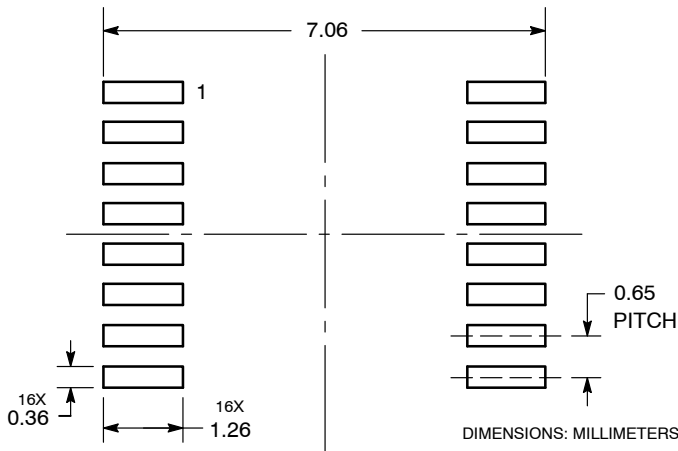


**NOTES:**

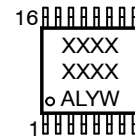
- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: MILLIMETER.
- DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
- DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
- DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
- TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
- DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.90	5.10	0.193	0.200
B	4.30	4.50	0.169	0.177
C	---	1.20	---	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.18	0.28	0.007	0.011
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0°	8°	0°	8°

**RECOMMENDED  
SOLDERING FOOTPRINT\***



**GENERIC  
MARKING DIAGRAM\***



- XXXX = Specific Device Code
- A = Assembly Location
- L = Wafer Lot
- Y = Year
- W = Work Week
- G or ■ = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "■", may or may not be present. Some products may not follow the Generic Marking.

\*For additional information on our Pb-Free strategy and soldering details, please download the **onsemi** Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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