

# MC74HC174A

## Hex D Flip-Flop with Common Clock and Reset

### High-Performance Silicon-Gate CMOS

The MC74HC174A is identical in pinout to the LS174. The device inputs are compatible with standard CMOS outputs; with pullup resistors, they are compatible with LSTTL outputs.

This device consists of six D flip-flops with common Clock and Reset inputs. Each flip-flop is loaded with a low-to-high transition of the Clock input. Reset is asynchronous and active-low.

#### Features

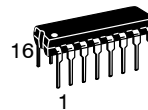
- Output Drive Capability: 10 LSTTL Loads
- Outputs Directly Interface to CMOS, NMOS, and TTL
- Operating Voltage Range: 2.0 to 6.0 V
- Low Input Current: 1.0  $\mu$ A
- In Compliance with the Requirements Defined by JEDEC Standard No. 7 A
- Chip Complexity: 162 FETs or 40.5 Equivalent Gates
- NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant



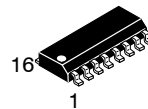
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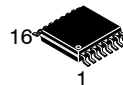
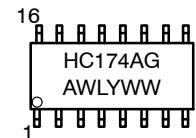
#### MARKING DIAGRAMS



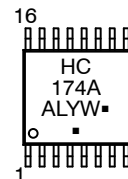
PDIIP-16  
N SUFFIX  
CASE 648



SOIC-16  
D SUFFIX  
CASE 751B



TSSOP-16  
DT SUFFIX  
CASE 948F



A = Assembly Location  
L, WL = Wafer Lot  
Y, YY = Year  
W, WW = Work Week  
G or ■ = Pb-Free Package

(Note: Microdot may be in either location)

#### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

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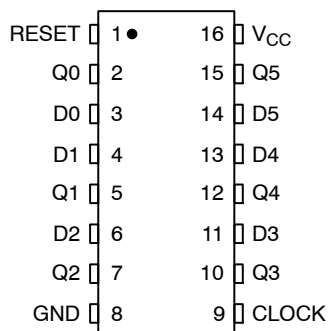


Figure 1. Pin Assignment

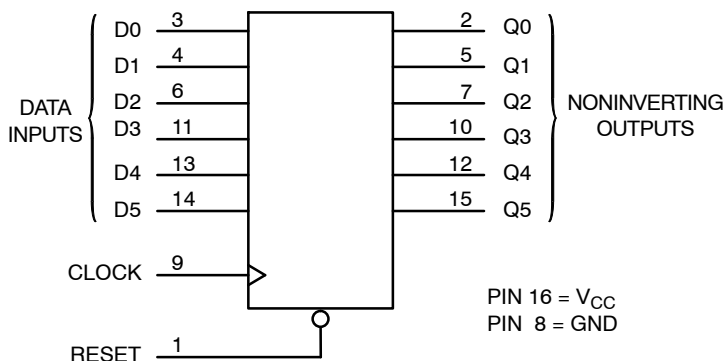


Figure 2. Logic Diagram

## FUNCTION TABLE

Inputs			Output
Reset	Clock	D	Q
L	X	X	L
H	↗	H	H
H	↘	L	L
H	L	X	No Change
H	↖	X	No Change

## DESIGN/VALUE TABLE

Design Criteria	Value	Units
Internal Gate Count*	40.5	ea.
Internal Gate Propagation Delay	1.5	ns
Internal Gate Power Dissipation	5.0	μW
Speed Power Product	0.0075	μJ

\*Equivalent to a two-input NAND gate.

## ORDERING INFORMATION

Device	Package	Shipping <sup>†</sup>
MC74HC174ANG	PDIP-16 (Pb-Free)	500 Units / Rail
MC74HC174ADG	SOIC-16 (Pb-Free)	48 Units / Rail
MC74HC174ADR2G	SOIC-16 (Pb-Free)	2500 / Tape & Reel
MC74HC174ADTR2G	TSSOP-16 (Pb-Free)	2500 / Tape & Reel
NLV74HC174ADG*	SOIC-16 (Pb-Free)	55 Units / Rail
NLV74HC174ADR2G*	SOIC-16 (Pb-Free)	2500 / Tape & Reel
NLV74HC174ADTR2G*	TSSOP-16 (Pb-Free)	2500 / Tape & Reel
NLV74HC174ANG*	PDIP-16 (Pb-Free)	25 Units / Rail

<sup>†</sup>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.

\*NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable

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## MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
$V_{CC}$	DC Supply Voltage (Referenced to GND)	- 0.5 to +7.0	V
$V_{IN}$	DC Input Voltage (Referenced to GND)	- 1.5 to $V_{CC} + 1.5$	V
$V_{OUT}$	DC Output Voltage (Referenced to GND) (Note 1)	- 0.5 to $V_{CC} + 0.5$	V
$I_{IN}$	DC Input Current, per Pin	$\pm 20$	mA
$I_{OUT}$	DC Output Current, per Pin	$\pm 25$	mA
$I_{CC}$	DC Supply Current, $V_{CC}$ and GND Pins	$\pm 50$	mA
$T_{STG}$	Storage Temperature Range	- 65 to + 150	$^{\circ}C$
$T_L$	Lead Temperature, 1 mm from Case for 10 Seconds	PDIP, SOIC, TSSOP	260
$T_J$	Junction Temperature Under Bias		+ 150
$\theta_{JA}$	Thermal Resistance	PDIP SOIC TSSOP	78 112 148
$P_D$	Power Dissipation in Still Air at 85 $^{\circ}C$	PDIP SOIC TSSOP	750 500 450
MSL	Moisture Sensitivity		Level 1
$F_R$	Flammability Rating	Oxygen Index: 30% - 35%	UL 94 V-0 @ 0.125 in.
$V_{ESD}$	ESD Withstand Voltage	Human Body Model (Note 2) Machine Model (Note 3) Charged Device Model (Note 4)	> 2000 > 100 > 500
$I_{LATCHUP}$	Latchup Performance	Above $V_{CC}$ and Below GND at 85 $^{\circ}C$ (Note 5)	$\pm 300$

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1.  $I_O$  absolute maximum rating must be observed.
2. Tested to EIA/JESD22-A114-A.
3. Tested to EIA/JESD22-A115-A.
4. Tested to JESD22-C101-A.
5. Tested to EIA/JESD78.

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
$V_{CC}$	DC Supply Voltage (Referenced to GND)	2.0	6.0	V
$V_{IN}, V_{OUT}$	DC Input Voltage, Output Voltage (Referenced to GND) (Note 6)	0	$V_{CC}$	V
$T_A$	Operating Temperature, All Package Types	- 55	+ 125	$^{\circ}C$
$t_r, t_f$	CLOCK Input Rise and Fall Time (Figure 4)	$V_{CC} = 2.0 V$ $V_{CC} = 3.3 V$ $V_{CC} = 4.5 V$ $V_{CC} = 6.0 V$	0 1000 700 500 400	ns

6. Unused inputs may not be left open. All inputs must be tied to a high- or low-logic input voltage level.

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## DC ELECTRICAL CHARACTERISTICS (Voltages Referenced to GND)

Symbol	Parameter	Test Conditions	V <sub>CC</sub> V	Guaranteed Limit			Unit
				−55°C to 25°C	≤ 85°C	≤ 125°C	
V <sub>IH</sub>	Minimum High-Level Input Voltage	V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> − 0.1 V  I <sub>OUT</sub>   ≤ 20 μA	2.0	1.5	1.5	1.5	V
			4.5	3.15	3.15	3.15	
			6.0	4.2	4.2	4.2	
V <sub>IL</sub>	Maximum Low-Level Input Voltage	V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> − 0.1 V  I <sub>OUT</sub>   ≤ 20 μA	2.0	0.5	0.5	0.5	V
			4.5	1.35	1.35	1.35	
			6.0	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	2.0	1.9	1.9	1.9	V
			4.5	4.4	4.4	4.4	
		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  I <sub>OUT</sub>   ≤ 5.2 mA	4.5	3.98	3.84	3.7	
6.0	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	2.0	0.1	0.1	0.1	V
			4.5	0.1	0.1	0.1	
		6.0	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  I <sub>OUT</sub>   ≤ 5.2 mA	4.5	0.26	0.33	0.4	
6.0	0.26	0.33	0.4				
I <sub>IN</sub>	Maximum Input Leakage Current	V <sub>IN</sub> = V <sub>CC</sub> or GND	6.0	±0.1	±1.0	±1.0	μA
I <sub>CC</sub>	Maximum Quiescent Supply Current (per Package)	V <sub>IN</sub> = V <sub>CC</sub> or GND I <sub>OUT</sub> = 0 μA	6.0	4.0	40	160	μA

## AC ELECTRICAL CHARACTERISTICS (C<sub>L</sub> = 50 pF, Input t<sub>r</sub> = t<sub>f</sub> = 6.0 ns)

Symbol	Parameter	V <sub>CC</sub> V	Guaranteed Limit			Unit
			−55°C to 25°C	≤ 85°C	≤ 125°C	
f <sub>max</sub>	Maximum Clock Frequency (50% Duty Cycle) (Figures 4 and 7)	2.0	6.0	4.8	4.0	MHz
		4.5	30	24	20	
		6.0	35	28	24	
t <sub>PLH</sub> t <sub>PHL</sub>	Maximum Propagation Delay, Clock to Q (Figures 5 and 7)	2.0	110	140	165	ns
		4.5	22	28	33	
		6.0	19	24	28	
t <sub>PLH</sub> t <sub>PHL</sub>	Maximum Propagation Delay, Reset to Q (Figures 2 and 7)	2.0	110	140	160	ns
		4.5	21	28	32	
		6.0	19	24	27	
t <sub>TLH</sub> t <sub>THL</sub>	Maximum Output Transition Time, Any Output (Figures 4 and 7)	2.0	75	95	110	ns
		4.5	15	19	22	
		6.0	13	16	19	
C <sub>in</sub>	Maximum Input Capacitance		10	10	10	pF

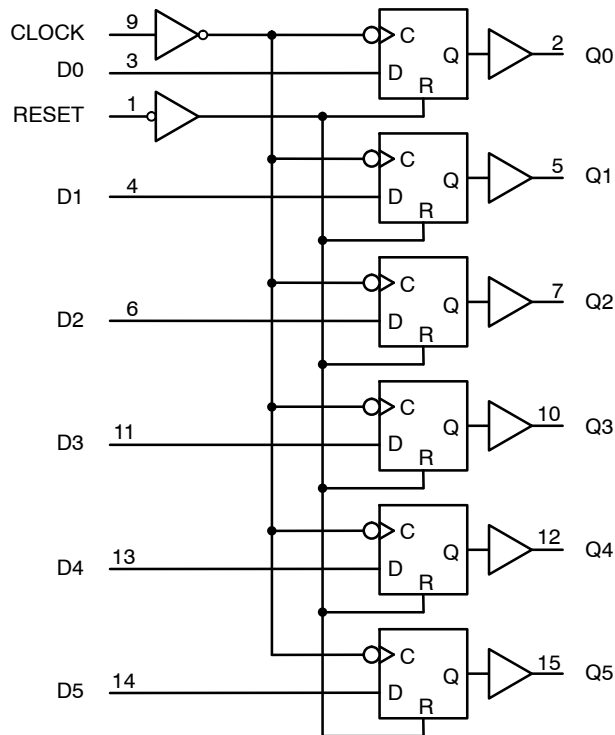
C <sub>PD</sub>	Power Dissipation Capacitance, per Enabled Output (Note 7)	Typical @ 25°C, V <sub>CC</sub> = 5.0 V		pF
		62		

7. Used to determine the no-load dynamic power consumption:  $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$ .

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**TIMING REQUIREMENTS** ( $C_L = 50$  pF, Input  $t_r = t_f = 6.0$  ns)

Symbol	Parameter	Figure	V <sub>CC</sub> V	Guaranteed Limit						Unit
				-55°C to 25°C		≤ 85°C		≤ 125°C		
				Min	Max	Min	Max	Min	Max	
$t_{su}$	Minimum Setup Time, Data to Clock	6	2.0 4.5 6.0	50 10 9.0		65 13 11		75 15 13		ns
$t_h$	Minimum Hold Time, Clock to Data	6	2.0 4.5 6.0	5.0 5.0 5.0		5.0 5.0 5.0		5.0 5.0 5.0		ns
$t_{rec}$	Minimum Recovery Time, Reset Inactive to Clock	5	2.0 4.5 6.0	5.0 5.0 5.0		5.0 5.0 5.0		5.0 5.0 5.0		ns
$t_w$	Minimum Pulse Width, Clock	4	2.0 4.5 6.0	75 15 13		95 19 16		110 22 19		ns
$t_w$	Minimum Pulse Width, Reset	5	2.0 4.5 6.0	75 15 13		95 19 16		110 22 19		ns
$t_r, t_f$	Maximum Input Rise and Fall Times	4	2.0 4.5 6.0		1000 500 400		1000 500 400		1000 500 400	ns



**Figure 3. Expanded Logic Diagram**

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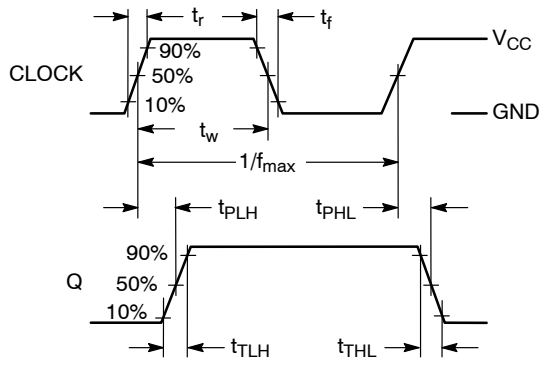


Figure 4. Switching Waveform

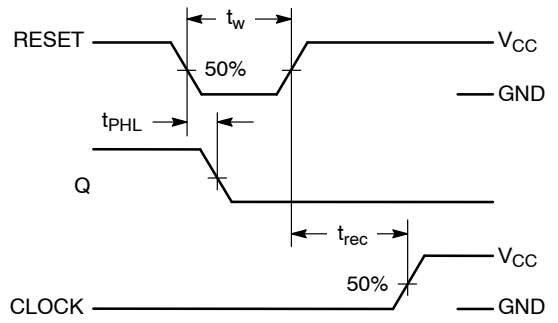


Figure 5. Switching Waveform

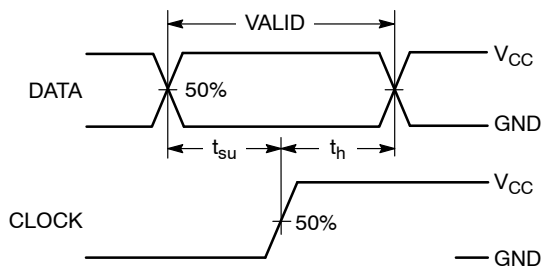
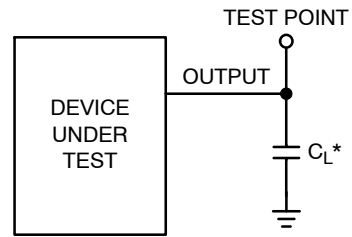


Figure 6. Switching Waveform



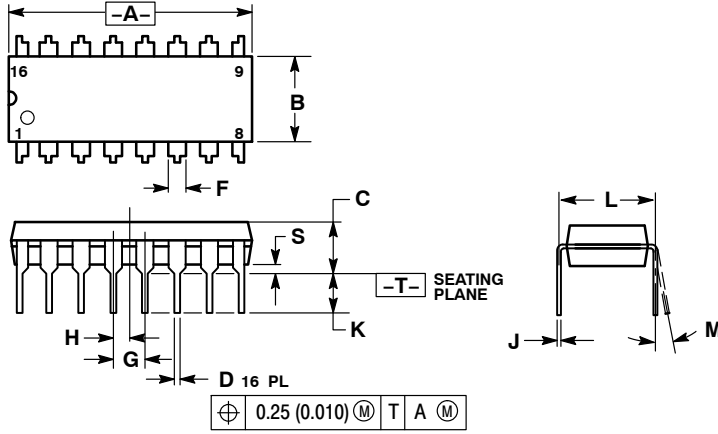
\*Includes all probe and jig capacitance

Figure 7. Test Circuit

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## PACKAGE DIMENSIONS

PDIP-16  
CASE 648-08  
ISSUE T



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.740	0.770	18.80	19.55
B	0.250	0.270	6.35	6.85
C	0.145	0.175	3.69	4.44
D	0.015	0.021	0.39	0.53
F	0.040	0.70	1.02	1.77
G	0.100 BSC		2.54 BSC	
H	0.050 BSC		1.27 BSC	
J	0.008	0.015	0.21	0.38
K	0.110	0.130	2.80	3.30
L	0.295	0.305	7.50	7.74
M	0°	10°	0°	10°
S	0.020	0.040	0.51	1.01

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## PACKAGE DIMENSIONS

SOIC-16  
CASE 751B-05  
ISSUE K

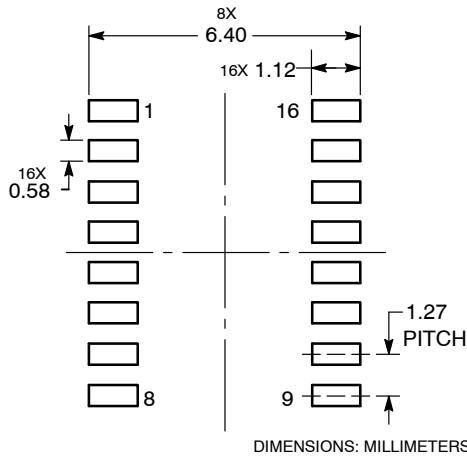


**NOTES:**

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

### SOLDERING FOOTPRINT\*



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



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## PACKAGE DIMENSIONS

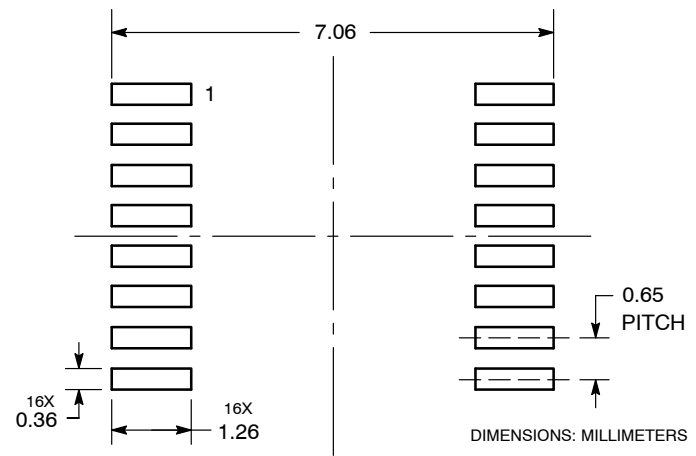
TSSOP-16  
CASE 948F-01  
ISSUE B



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. 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.
  4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
  5. 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.
  6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
  7. 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°

### SOLDERING FOOTPRINT\*



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**Адрес:** 198099, Санкт-Петербург,  
Промышленная ул, дом № 19, литера Н,  
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