

MC74VHC1G66, NLVHC1G66

SPST (NO) Normally Open Analog Switch

The MC74VHC1G66, NLVHC1G66 is a single pole single throw (SPST) analog switch. It achieves high speed propagation delays and low ON resistances while maintaining low power dissipation. This bilateral switch controls analog and digital voltages that may vary across the full power-supply range (from V_{CC} to GND).

The MC74VHC1G66, NLVHC1G66 is compatible in function to a single gate of the High Speed CMOS MC74VHC4066 and the metal-gate CMOS MC14066. The device has been designed so that the ON resistances (R_{ON}) are much lower and more linear over input voltage than R_{ON} of the metal-gate CMOS or High Speed CMOS analog switches.

The newer NLVHC offers the same functionality in a 1.2x1.0x0.55mm UDFN6 package.

The ON/OFF control inputs are compatible with standard CMOS outputs. The ON/OFF control input structure provides protection when voltages between 0 V and 5.5 V are applied, regardless of the supply voltage. This input structure helps prevent device destruction caused by supply voltage – input/output voltage mismatch, battery backup, hot insertion, etc.

Features

- High Speed: $t_{PD} = 20$ ns (Typ) at $V_{CC} = 5.0$ V
- Low Power Dissipation: $I_{CC} = 1.0$ μ A (Max) at $T_A = 25^\circ\text{C}$
- Diode Protection Provided on Inputs and Outputs
- Improved Linearity and Lower ON Resistance over Input Voltage
- Chip Complexity: 11 FETs or 3 Equivalent Gates
- ON/OFF Control Input has OVT
- Chip Complexity: FETs = 11
- Pb-Free Packages are Available

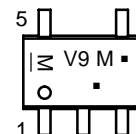


ON Semiconductor®

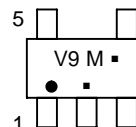
<http://onsemi.com>

MARKING DIAGRAMS


SC-88A
DF SUFFIX
CASE 419A




TSOP-5
DT SUFFIX
CASE 483




UDFN6
MU SUFFIX
CASE 517AA



V9, V = Device Code
M = Date Code*
W = Work Week
▪ = Pb-Free Package

(Note: Microdot may be in either location)

*Date Code orientation and/or position may vary depending upon manufacturing location.

PIN ASSIGNMENT

1	IN/OUT X_A
2	OUT/IN Y_A
3	GND
4	ON/OFF CONTROL
5	V_{CC}

FUNCTION TABLE

On/Off Control Input	State of Analog Switch
L	Off
H	On

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 7 of this data sheet.

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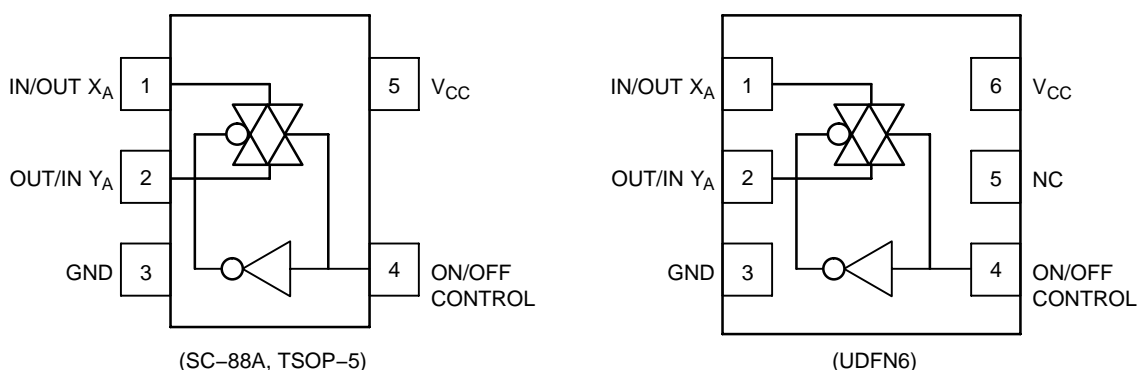


Figure 1. Pinout Diagrams

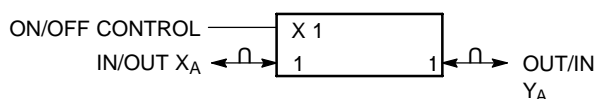


Figure 2. Logic Symbol

MAXIMUM RATINGS

Symbol	Characteristics	Value	Unit
V _{CC}	DC Supply Voltage	−0.5 to +7.0	V
V _{IN}	Digital Input Voltage	−0.5 to +7.0	V
V _{IS}	Analog Output Voltage	−0.5 to V _{CC} +0.5	V
I _{IK}	Digital Input Diode Current	−20	mA
I _{CC}	DC Supply Current, V _{CC} and GND	+25	mA
T _{STG}	Storage Temperature Range	− 65 to + 150	°C
T _L	Lead Temperature, 1 mm from Case for 10 Seconds	260	°C
T _J	Junction Temperature Under Bias	+ 150	°C
θ _{JA}	Thermal Resistance SC70−5 (Note 1) SOT23−5	350 230	°C/W
P _D	Power Dissipation in Still Air at 85°C SC70−5 SOT23−5	150 200	mW
MSL	Moisture Sensitivity	Level 1	
F _R	Flammability Rating Oxygen Index: 28 to 34	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 > 200 N/A	V
I _{LATCHUP}	Latchup Performance Above V _{CC} and Below GND at 125°C (Note 5)	± 500	mA

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. Measured with minimum pad spacing on an FR4 board, using 10 mm-by-1 inch, 2-ounce copper trace with no air flow.
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.

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RECOMMENDED OPERATING CONDITIONS

Symbol	Characteristics	Min	Max	Unit
V_{CC}	DC Supply Voltage	2.0	5.5	V
V_{IN}	DC Input Voltage	GND	5.5	V
V_{IS}	DC Output Voltage	GND	V_{CC}	V
T_A	Operating Temperature Range	-55	+125	°C
t_r, t_f	Input Rise and Fall Time ON/OFF Control Input	$V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$ 0 $V_{CC} = 5.0 \text{ V} \pm 0.5 \text{ V}$ 0	100 20	ns/V

Device Junction Temperature versus Time to 0.1% Bond Failures

Junction Temperature °C	Time, Hours	Time, Years
80	1,032,200	117.8
90	419,300	47.9
100	178,700	20.4
110	79,600	9.4
120	37,000	4.2
130	17,800	2.0
140	8,900	1.0

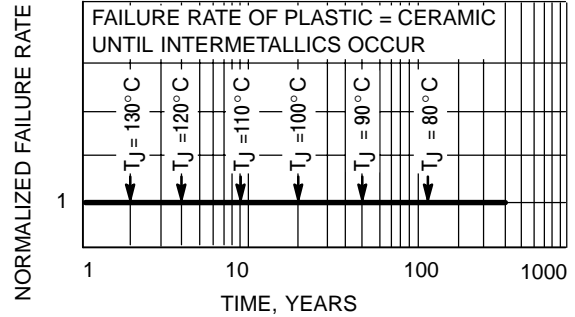


Figure 3. Failure Rate vs. Time Junction Temperature

DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Conditions	V_{CC} (V)	$T_A = 25^\circ\text{C}$		$T_A \leq 85^\circ\text{C}$		$-55 \leq T_A \leq 125^\circ\text{C}$		Unit
				Min	Max	Min	Max	Min	Max	
V_{IH}	Minimum High-Level Input Voltage ON/OFF Control Input	$R_{ON} = \text{Per Spec}$	2.0 3.0 4.5 5.5	1.5 2.1 3.15 3.85		1.5 2.1 3.15 3.85		1.5 2.1 3.15 3.85		V
V_{IL}	Maximum Low-Level Input Voltage ON/OFF Control Input	$R_{ON} = \text{Per Spec}$	2.0 3.0 4.5 5.5		0.5 0.9 1.35 1.65		0.5 0.9 1.35 1.65		0.5 0.9 1.35 1.65	V
I_{IN}	Maximum Input Leakage Current ON/OFF Control Input	$V_{IN} = V_{CC} \text{ or GND}$	0 to 5.5		± 0.1		± 1.0		± 1.0	μA
I_{CC}	Maximum Quiescent Supply Current	$V_{IN} = V_{CC} \text{ or GND}$ $V_{IO} = 0 \text{ V}$	5.5		1.0		20		40	μA
R_{ON}	Maximum "ON" Resistance	$V_{IN} = V_{IH}$ $V_{IS} = V_{CC} \text{ or GND}$ $ I_{IS} \leq 5 \text{ mA}$ (Figure 4)	3.0 4.5 5.5		60 45 40		70 50 45		100 60 55	Ω
I_{OFF}	Maximum Off-Channel Leakage Current	$V_{IN} = V_{IL}$ $V_{IS} = V_{CC} \text{ or GND}$ Switch Off (Figure 5)	5.5		0.1		0.5		1.0	μA

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AC ELECTRICAL CHARACTERISTICS $C_{load} = 50 \text{ pF}$, Input $t_r/t_f = 3.0 \text{ ns}$

Symbol	Parameter	Test Conditions	V_{CC} (V)	$T_A = 25^\circ\text{C}$			$T_A \leq 85^\circ\text{C}$		$-55 \leq T_A \leq 125^\circ\text{C}$		Unit
				Min	Typ	Max	Min	Max	Min	Max	
t_{PLH} , t_{PHL}	Maximum Propagation Delay, Input X to Y	$Y_A = \text{Open}$ (Figure 14)	2.0 3.0 4.5 5.5		1 0.6 0.6 0.6	5 2 1 1		6 3 1 1		7 4 2 1	ns
t_{PLZ} , t_{PHZ}	Maximum Propagation Delay, ON/OFF Control to Analog Output	$R_L = 1000 \Omega$ (Figure 15)	2.0 3.0 4.5 5.5		32 28 24 20	40 35 30 25		45 40 35 30		50 45 40 35	ns
t_{PZL} , t_{PZH}	Maximum Propagation Delay, ON/OFF Control to Analog Output	$R_L = 1000 \Omega$ (Figure 15)	2.0 3.0 4.5 5.5		32 28 24 20	40 35 30 25		45 40 35 30		50 45 40 35	ns
C_{IN}	Maximum Input Capacitance	ON/OFF Control Input	0.0		3	10		10		10	pF
		Control Input = GND Analog I/O Feedthrough	5.0		4 4	10 10		10 10		10 10	

C _{PD}	Power Dissipation Capacitance (Note 6)	Typical @ 25°C, V _{CC} = 5.0 V		pF
		18		

6. 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: $I_{CC(OPR)} = C_{PD} \cdot V_{CC} \cdot f_{in} + I_{CC}$. C_{PD} is used to determine the no-load dynamic power consumption; $P_D = C_{PD} \cdot V_{CC}^2 \cdot f_{in} + I_{CC} \cdot V_{CC}$.

ADDITIONAL APPLICATION CHARACTERISTICS (Voltages Referenced to GND Unless Noted)

Symbol	Parameter	Test Conditions	V_{CC}	Limit 25°C	Unit
BW	Maximum On-Channel Bandwidth or Minimum Frequency Response (Figure 10)	$f_{in} = 1 \text{ MHz}$ Sine Wave Adjust f_{in} voltage to obtain 0 dBm at V_{OS} Increase f_{in} = frequency until dB meter reads -3 dB $R_L = 50 \Omega$	3.0 4.5 5.5	150 175 180	MHz
ISO_{off}	Off-Channel Feedthrough Isolation (Figure 11)	$f_{in} = \text{Sine Wave}$ Adjust f_{in} voltage to obtain 0 dBm at V_{IS} $f_{in} = 10 \text{ kHz}$, $R_L = 600 \Omega$	3.0 4.5 5.5	-80 -80 -80	dB
$NOISE_{feed}$	Feedthrough Noise Control to Switch (Figure 12)	$V_{in} \leq 1 \text{ MHz}$ Square Wave ($t_r = t_f = 2 \text{ ns}$) $R_L = 600 \Omega$	3.0 4.5 5.5	45 60 130	mV _{PP}
THD	Total Harmonic Distortion (Figure 13)	$f_{in} = 1 \text{ kHz}$, $R_L = 10 \text{ k}\Omega$ $THD = THD_{Measured} - THD_{Source}$ $V_{IS} = 3.0 \text{ V}_{PP}$ sine wave $V_{IS} = 5.0 \text{ V}_{PP}$ sine wave	3.3 5.5	0.30 0.15	%

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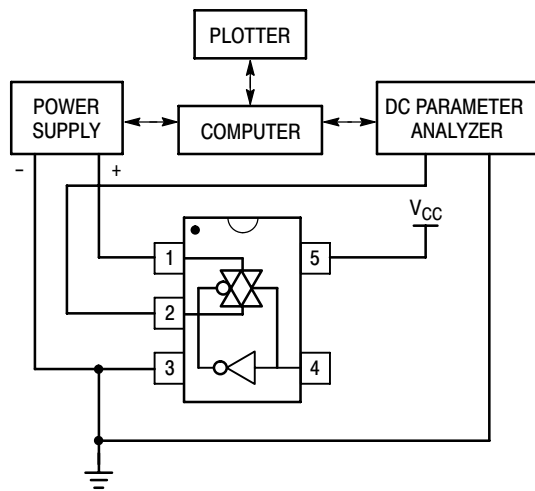


Figure 4. On Resistance Test Set-Up

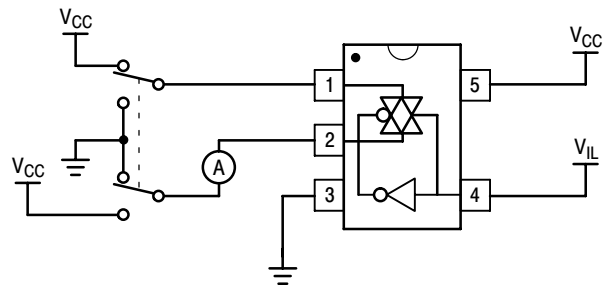


Figure 5. Maximum Off-Channel Leakage Current Test Set-Up

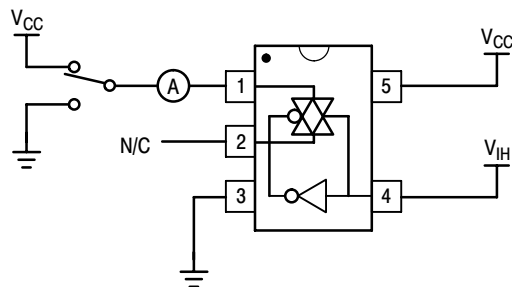


Figure 6. Maximum On-Channel Leakage Current Test Set-Up

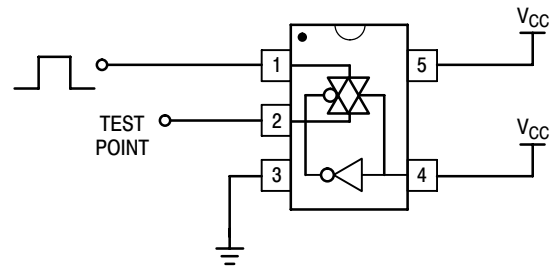


Figure 7. Propagation Delay Test Set-Up

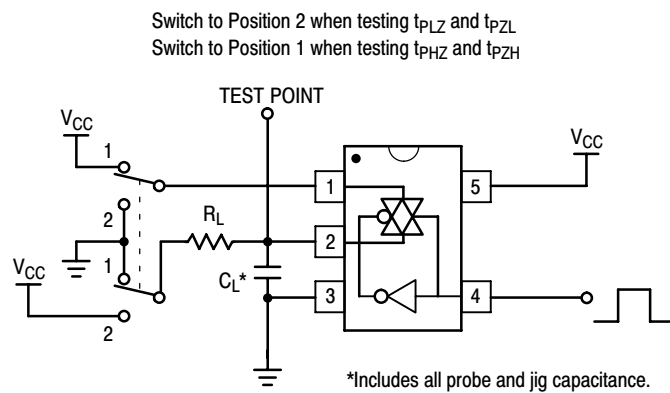


Figure 8. Propagation Delay Output Enable/Disable Test Set-Up

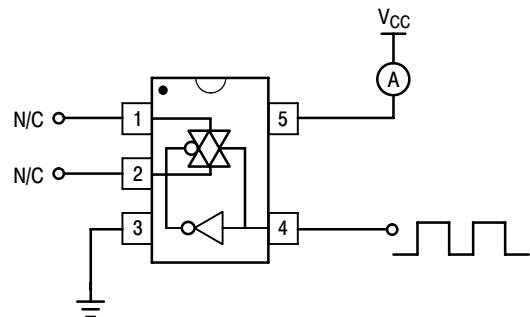


Figure 9. Power Dissipation Capacitance Test Set-Up

MC74VHC1G66, NLVHC1G66

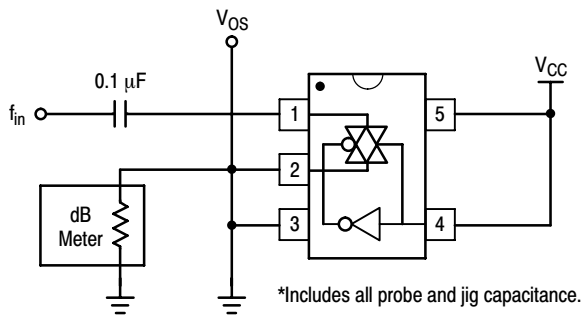


Figure 10. Maximum On-Channel Bandwidth Test Set-Up

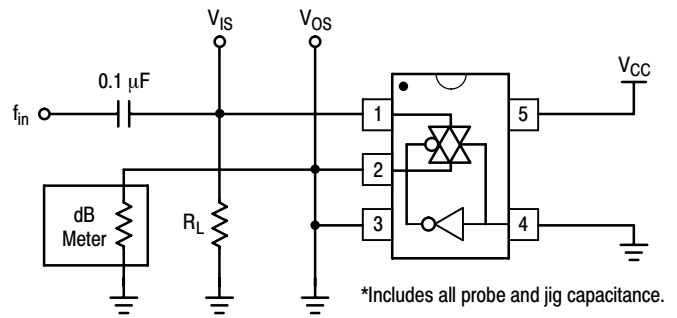


Figure 11. Off-Channel Feedthrough Isolation Test Set-Up

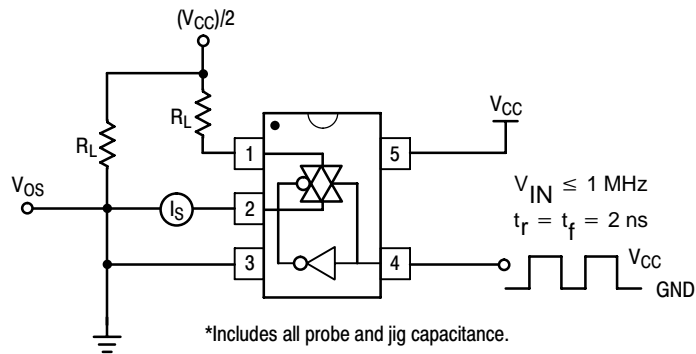


Figure 12. Feedthrough Noise, ON/OFF Control to Analog Out, Test Set-Up

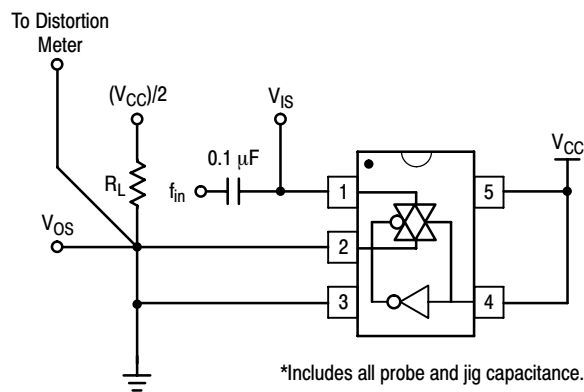


Figure 13. Total Harmonic Distortion Test Set-Up

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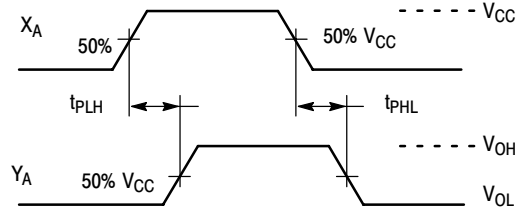


Figure 14. Propagation Delay, Analog In to Analog Out Waveforms

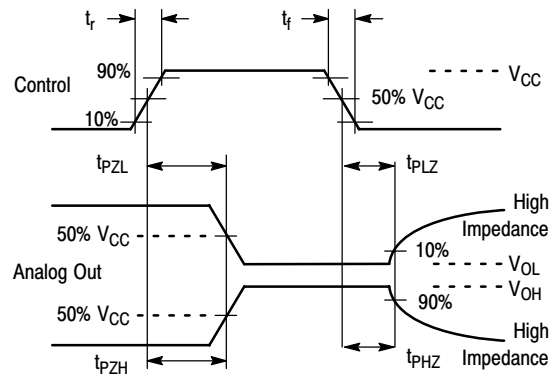


Figure 15. Propagation Delay, ON/OFF Control

ORDERING INFORMATION

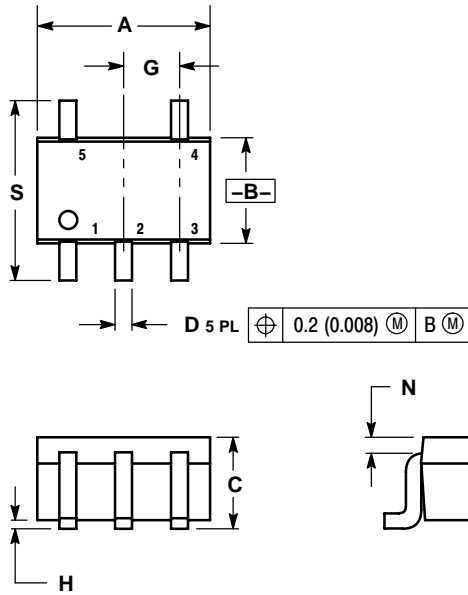
Device	Package	Shipping [†]
MC74VHC1G66DFT1	SC-88A	3000 / Tape & Reel
MC74VHC1G66DFT1G	SC-88A (Pb-Free)	
MC74VHC1G66DFT2	SC-88A	
MC74VHC1G66DFT2G	SC-88A (Pb-Free)	
MC74VHC1G66DTT1	TSOP-5	
MC74VHC1G66DTT1G	TSOP-5 (Pb-Free)	
NLVHC1G66MUR2G	UDFN6 (Pb-Free)	

[†]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.

MC74VHC1G66, NLVHC1G66

PACKAGE DIMENSIONS

SC-88A, SOT-353, SC-70
CASE 419A-02
ISSUE J

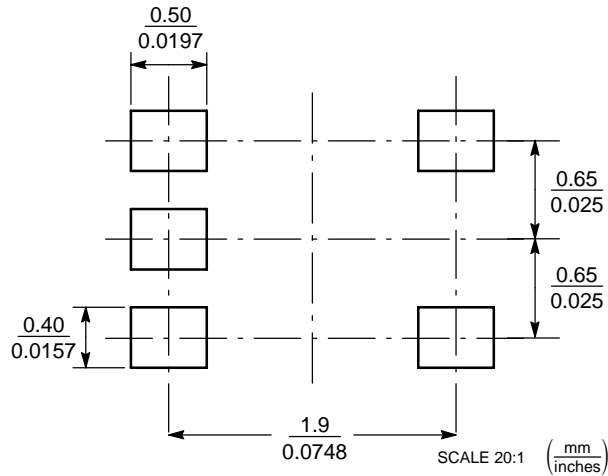


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. 419A-01 OBSOLETE. NEW STANDARD 419A-02.
4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.071	0.087	1.80	2.20
B	0.045	0.053	1.15	1.35
C	0.031	0.043	0.80	1.10
D	0.004	0.012	0.10	0.30
G	0.026 BSC		0.65 BSC	
H	---	0.004	---	0.10
J	0.004	0.010	0.10	0.25
K	0.004	0.012	0.10	0.30
N	0.008 REF		0.20 REF	
S	0.079	0.087	2.00	2.20

SOLDERING FOOTPRINT*

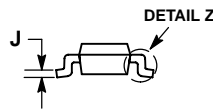
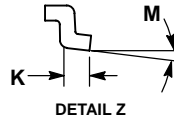
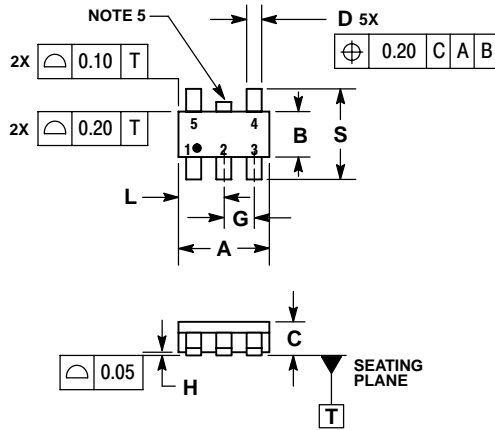


*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

MC74VHC1G66, NLVHC1G66

PACKAGE DIMENSIONS

TSOP-5, SOT23-5
CASE 483-02
ISSUE F

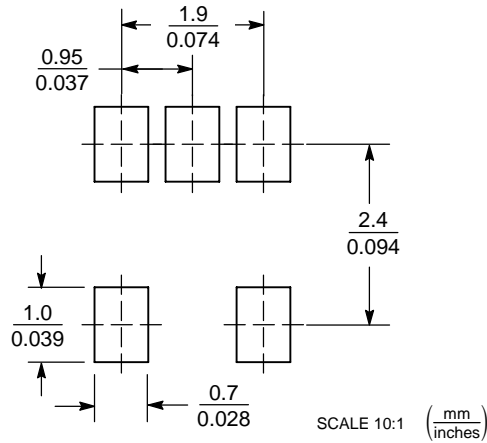


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.
5. OPTIONAL CONSTRUCTION: AN ADDITIONAL TRIMMED LEAD IS ALLOWED IN THIS LOCATION. TRIMMED LEAD NOT TO EXTEND MORE THAN 0.2 FROM BODY.

DIM	MILLIMETERS	
	MIN	MAX
A	3.00 BSC	
B	1.50 BSC	
C	0.90	1.10
D	0.25	0.50
G	0.95 BSC	
H	0.01	0.10
J	0.10	0.26
K	0.20	0.60
L	1.25	1.55
M	0°	10°
S	2.50	3.00

SOLDERING FOOTPRINT*

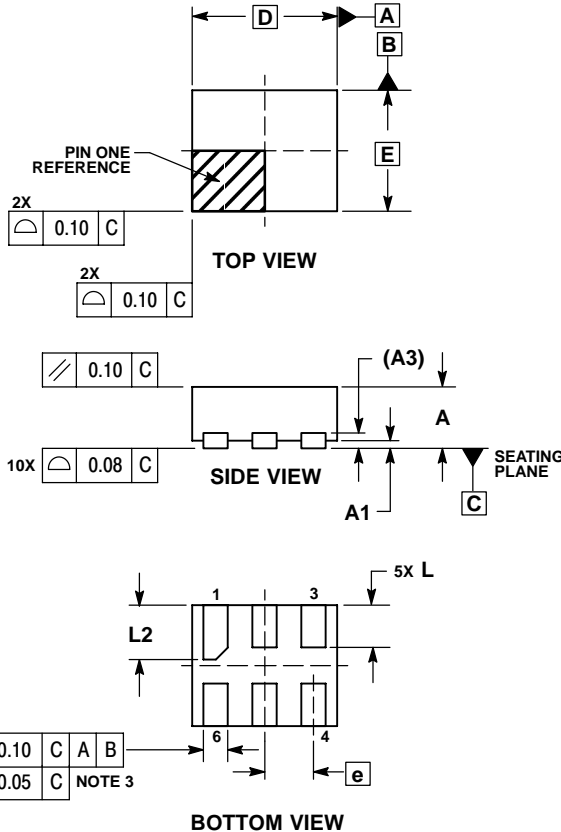


*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

MC74VHC1G66, NLVHC1G66

PACKAGE DIMENSIONS

UDFN6, 1.2x1.0, 0.4P
CASE 517AA-01
ISSUE A

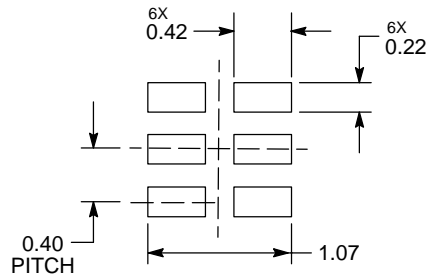


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.25 AND 0.30 mm FROM TERMINAL.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.


MILLIMETERS		
DIM	MIN	MAX
A	0.45	0.55
A1	0.00	0.05
A3	0.127 REF	
b	0.15	0.25
D	1.00 BSC	
E	1.20 BSC	
e	0.40 BSC	
L	0.30	0.40
L2	0.40	0.50

MOUNTING FOOTPRINT*



DIMENSIONS: MILLIMETERS

*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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