

Zero Voltage Switch

This series is designed for thyristor control in a variety of AC power switching applications for AC input voltages of 24 V, 120 V, 208/230 V, and 277 V @ 50/60 Hz.

Applications:

- Relay Control
- Valve Control
- Heater Control
- Lamp Control
- On-Off Motor Switching
- Differential Comparator with Self-Contained Power Supply for Industrial Applications
- Synchronous Switching of Flashing Lights

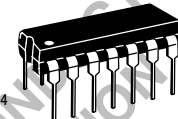


ON Semiconductor®

<http://onsemi.com>

ZERO VOLTAGE SWITCH

SEMICONDUCTOR TECHNICAL DATA



PLASTIC PACKAGE
CASE 646

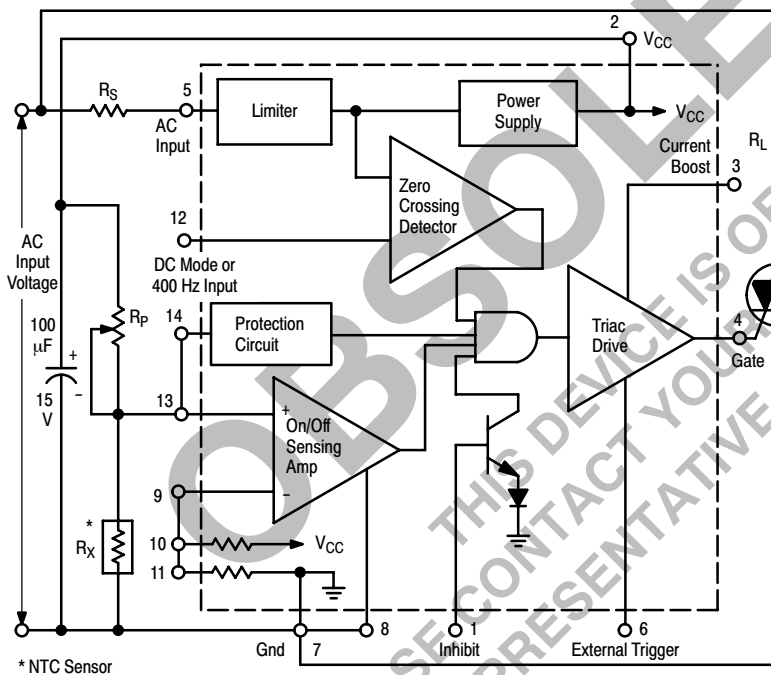


Figure 1. Representative Block Diagram

AC Input Voltage (50/60 Hz) Vac	Input Series Resistor (Rs) kΩ	Dissipation Rating for Rs W
24	2.0	0.5
120	10	2.0
208/230	20	4.0
277	25	5.0

ORDERING INFORMATION

Device	Operating Temperature Range	Package
CA3059	T _A = - 40° to +85°C	Plastic DIP

FUNCTIONAL BLOCK DESCRIPTION

- 1. Limiter-Power Supply** — Allows operation of the CA3059 directly from an AC line. Suggested dropping resistor (R_S) values are given in the table below.
- 2. Differential On/Off Sensing Amplifier** — Tests for condition of external sensors or input command signals. Proportional control capability or hysteresis may be implemented using this block.
- 3. Zero-Crossing Detector** — Synchronizes the output pulses to the zero voltage point of the AC cycle. This synchronization eliminates RFI when used with resistive loads.
- 4. Triac Drive** — Supplies high-current pulses to the external power controlling thyristor.
- 5. Protection Circuit** — A built-in circuit may be actuated, if the sensor opens or shorts, to remove the drive current from the external triac.
- 6. Inhibit Capability** — Thyristor firing may be inhibited by the action of an internal diode gate at Pin 1.
- 7. High Power DC Comparator Operation** — Operation in this mode is accomplished by connecting Pin 7 to Pin 12 (thus overriding the action of the zero-crossing detector). When Pin 13 is positive with respect to Pin 9, current to the thyristor is continuous.

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
DC Supply Voltage (Between Pins 2 and 7)	V_{CC}	12	Vdc
DC Supply Voltage (Between Pins 2 and 8)	V_{CC}	12	Vdc
Peak Supply Current (Pins 5 and 7)	$I_{5,7}$	± 50	mA
Fail-Safe Input Current (Pin 14)	I_{14}	2.0	mA
Output Pulse Current (Pin 4) (Note 1)	I_{out}	150	mA
Junction Temperature	T_J	150	°C
Operating Temperature Range	T_A	- 40 to + 85	°C
Storage Temperature Range	T_{stg}	- 65 to + 150	°C

ELECTRICAL CHARACTERISTICS (Operation @ 120 Vrms, 50–60 Hz, $T_A = 25^\circ\text{C}$ [Note 2])

Characteristic	Figure	Symbol	Min	Typ	Max	Unit
DC Supply Voltage Inhibit Mode $R_S = 10\text{ k}$, $I_L = 0$ $R_S = 5.0\text{ k}$, $I_L = 2.0\text{ mA}$ Pulse Mode $R_S = 10\text{ k}$, $I_L = 0$ $R_S = 5.0\text{ k}$, $R_L = 2.0\text{ mA}$	2	V_S	6.1 —	6.5 6.1	7.0 —	Vdc
Gate Trigger Current ($V_{GT} = 1.0\text{ V}$, Pins 3 and 2 connected)	3	I_{GT}	—	160	—	mA
Peak Output Current, Pulsed With Internal Power Supply, $V_{GT} = 0$ Pin 3 Open Pins 3 and 2 Connected With External Power Supply, $V_{CC} = 12\text{ V}$, $V_{GT} = 0$ Pin 3 Open Pins 3 and 2 Connected	3 4	I_{OM}	50 90 — —	125 190 230 300	— — — —	mA
Inhibit Input Ratio (Ratio of Voltage @ Pin 9 to Pin 2)	5	V_9/V_2	0.465	0.485	0.520	—
Total Gate Pulse Duration ($C_{Ext} = 0$) Positive dv/dt Negative dv/dt	6	t_p t_n	70 70	100 100	140 140	μs
Pulse Duration After Zero Crossing ($C_{Ext} = 0$, $R_{Ext} = \infty$) Positive dv/dt Negative dv/dt	6	t_{p1} t_{n1}	— —	50 60	— —	μs
Output Leakage Current Inhibit Mode (Note 3)	3	I_4	—	0.001	10	μA
Input Bias Current	7	I_{IB}	—	0.15	1.0	μA
Common Mode Input Voltage Range (Pins 9 and 13 Connected)	—	V_{CMR}	—	1.4 to 5.0	—	Vdc
Inhibit Input Voltage	8	V_1	—	1.4	1.6	Vdc
External Trigger Voltage	—	V_6-V_4	—	1.4	—	Vdc

NOTES: 1. Care must be taken, especially when using an external power supply, that total package dissipation is not exceeded.

2. The values given in the Electrical Characteristics Table at 120 V also apply for operation at input voltages of 24 V, 208/230 V, and 277 V, except for Pulse Duration test. However, the series resistor (R_S) must have the indicated value, shown in Table A for the specified input voltage.

3. I_4 out of Pin 4, 2.0 V on Pin 1, S_1 position 2.

TEST CIRCUITS

(All resistor values are in ohms)

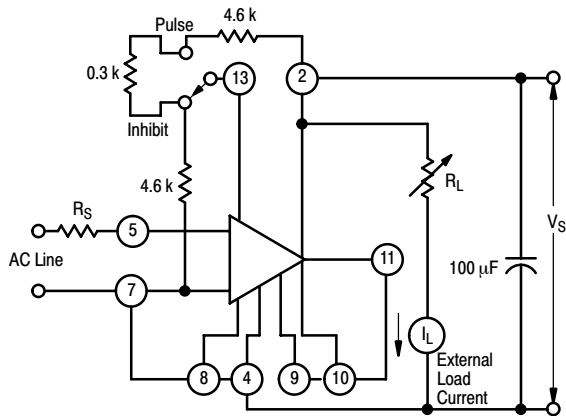


Figure 2. DC Supply Voltage

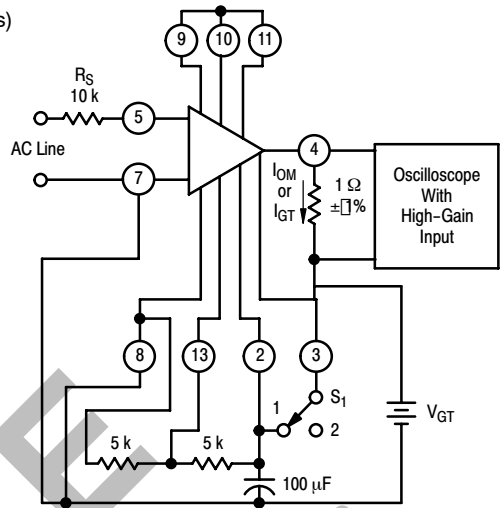


Figure 3. Peak Output (Pulsed) and Gate Trigger Current with Internal Power Supply

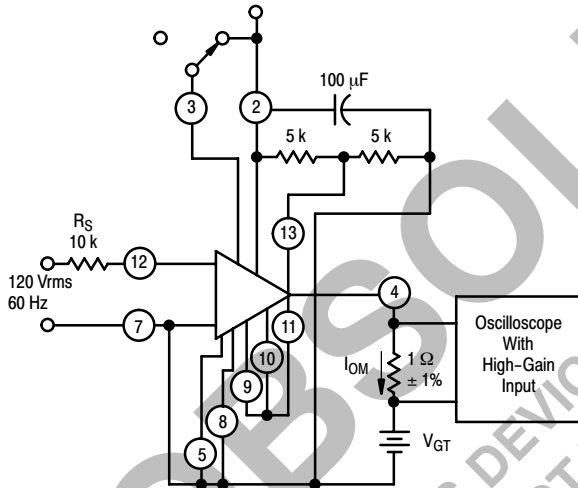


Figure 4. Peak Output Current (Pulsed) with External Power Supply

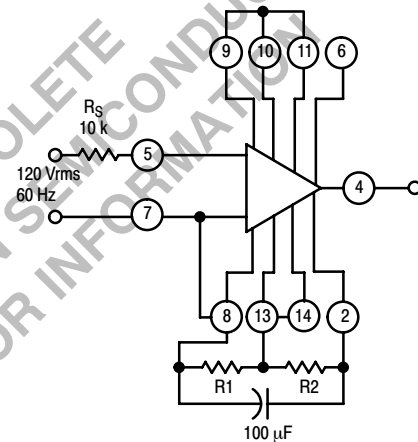


Figure 5. Input Inhibit Ratio

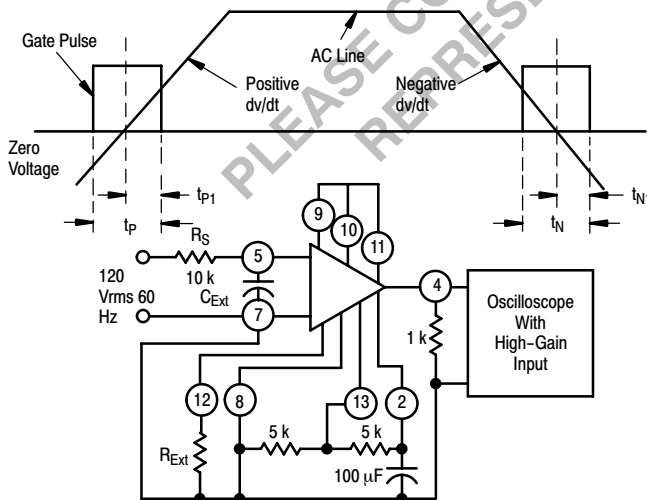


Figure 6. Gate Pulse Duration Test Circuit with Associated Waveform

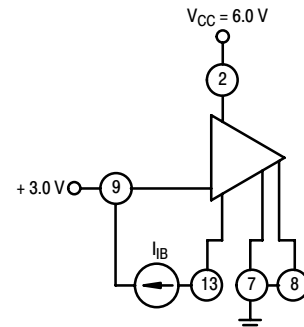


Figure 7. Input Bias Current Test Circuit

TYPICAL CHARACTERISTICS

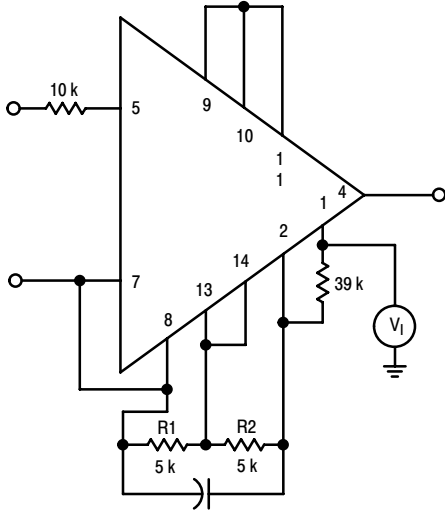


Figure 8. Inhibit Input Voltage Test

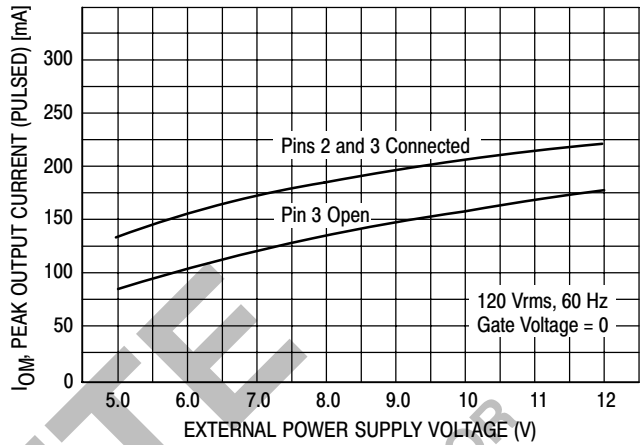


Figure 9. Peak Output Current (Pulsed) versus External Power Supply Voltage

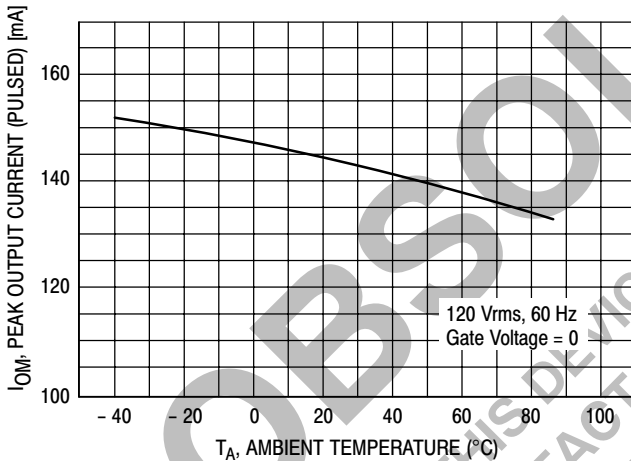


Figure 10. Peak Output Current (Pulsed) versus Ambient Temperature

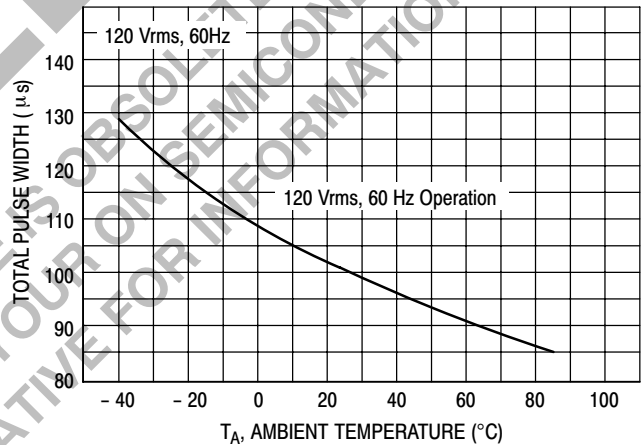


Figure 11. Total Pulse Width versus Ambient Temperature

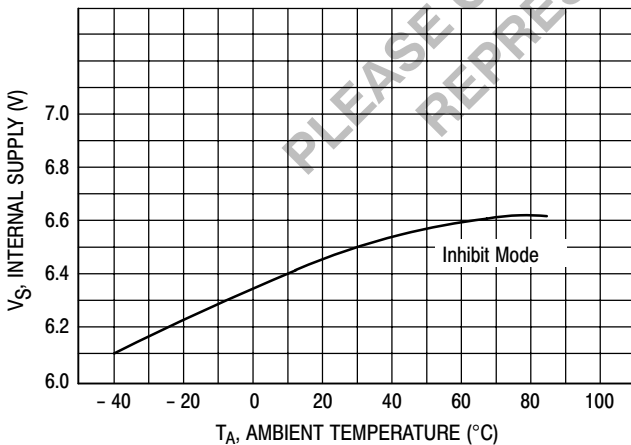


Figure 12. Internal Supply versus Ambient Temperature

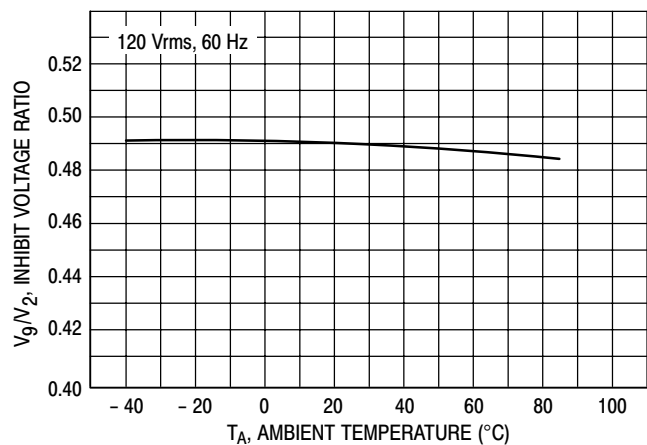


Figure 13. Inhibit Voltage Ratio versus Ambient Temperature

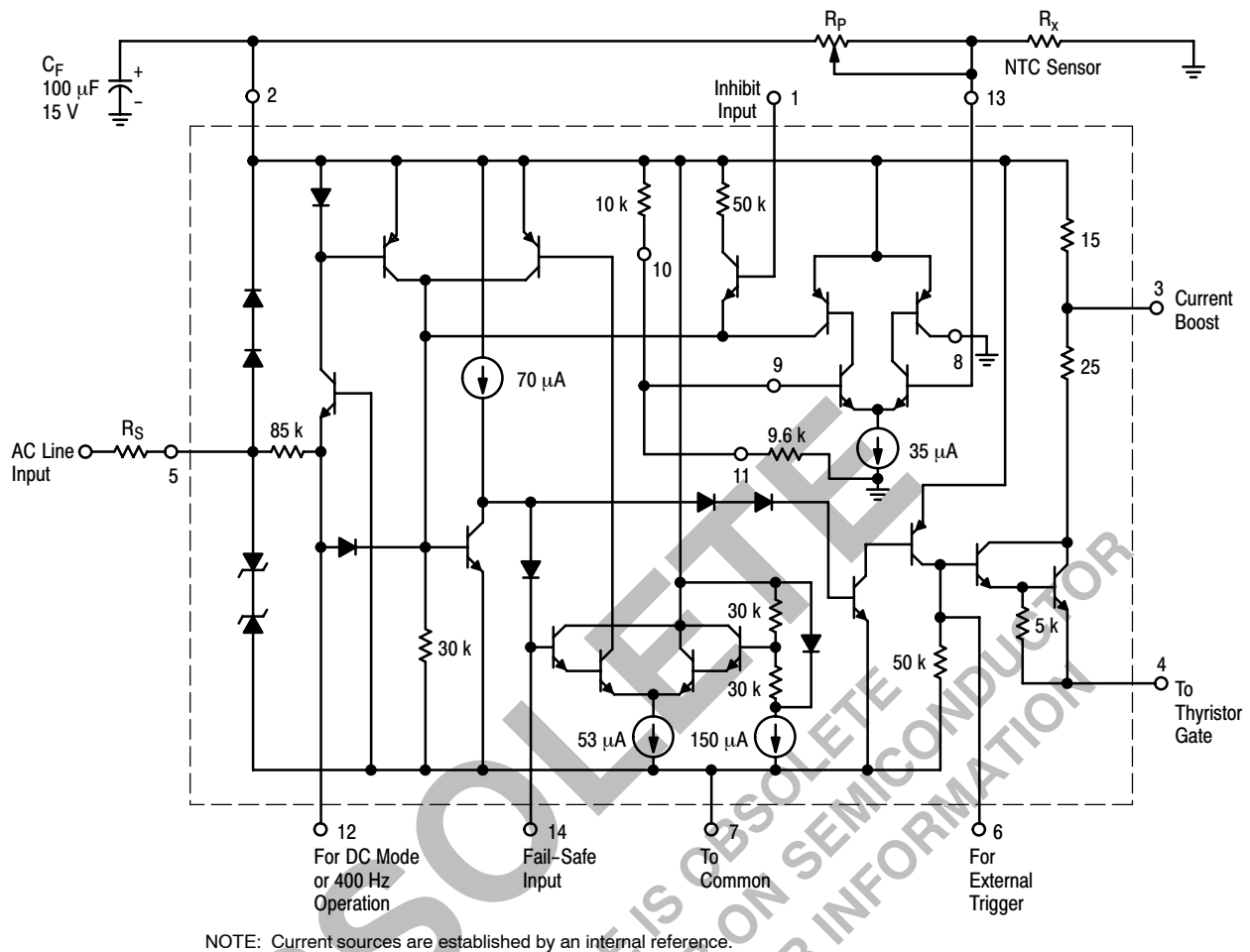


Figure 14. Circuit Schematic

APPLICATION INFORMATION

Power Supply

The CA3059 is a self-powered circuit, powered from the AC line through an appropriate dropping resistor (see Table A). The internal supply is designed to power the auxiliary power circuits.

In applications where more output current from the internal supply is required, an external power supply of higher voltage should be used. To use an external power supply, connect Pin 5 and Pin 7 together and apply the synchronizing voltage to Pin 12 and the DC supply voltage to Pin 2 as shown in Figure 4.

Operation of Protection Circuit

The protection circuit, when connected, will remove current drive from the triac if an open or shorted sensor is detected. This circuit is activated by connecting Pin 13 to Pin 14 (see Figure 1).

The following conditions should be observed when the protection circuit is utilized:

- The internal supply should be used and the external load current must be limited to 2 mA with a 5 k Ω dropping resistor.

- Sensor Resistance (R_X) and R_P values should be between 2 k Ω and 100 k Ω .
- The relationship $0.33 < R_X/R_P < 3$ must be met over the anticipated temperature range to prevent undesired activation of the circuit. A shunt or series resistor may have to be added.

External Inhibit Function

A priority inhibit command applied to Pin 1 will remove current drive from the thyristor. A command of at least +1.2 V @ 10 μ A is required. A DTL or TTL logic 1 applied to Pin 1 will activate the inhibit function.

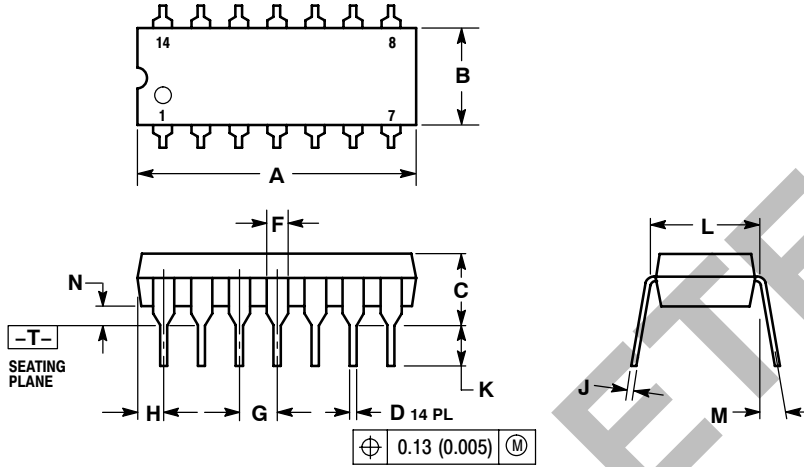
DC Gate Current Mode

When comparator operation is desired or inductive loads are being switched, Pins 7 and 12 should be connected. This connection disables the zero-crossing detector to permit the flow of gate current from the differential sensing amplifier on demand. Care should be exercised to avoid possible overloading of the internal power supply when operating the device in this mode. A resistor should be inserted between Pin 4 and the thyristor gate in order to limit the current.

CA3059

PACKAGE DIMENSIONS

PLASTIC PACKAGE
CASE 646-06
ISSUE M



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	0.715	0.770	18.16	18.80
B	0.240	0.260	6.10	6.60
C	0.145	0.185	3.69	4.69
D	0.015	0.021	0.38	0.53
F	0.040	0.070	1.02	1.78
G	0.100 BSC 2.54 BSC			
H	0.052	0.095	1.32	2.41
J	0.008	0.015	0.20	0.38
K	0.115	0.135	2.92	3.43
L	0.290	0.310	7.37	7.87
M	---	10°	---	10°
N	0.015	0.039	0.38	1.01

ON Semiconductor and **ON** are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC 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. "Typical" parameters which may be provided in SCILLC 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. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC 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 SCILLC was negligent regarding the design or manufacture of the part. SCILLC 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
P.O. Box 5163, Denver, Colorado 80217 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

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: 81-3-5773-3850

ON Semiconductor Website: www.onsemi.com
Order Literature: <http://www.onsemi.com/orderlit>

For additional information, please contact your local Sales Representative