

# Darlington Silicon Power Transistors

... designed for general-purpose amplifier and low speed switching applications.

- High DC Current Gain —  
 $h_{FE} = 3500$  (Typ) @  $I_C = 4$  Adc
- Collector–Emitter Sustaining Voltage — @ 200 mAdc  
 $V_{CEO(sus)} = 60$  Vdc (Min) — 2N6667  
 $= 80$  Vdc (Min) — 2N6668
- Low Collector–Emitter Saturation Voltage —  
 $V_{CE(sat)} = 2$  Vdc (Max) @  $I_C = 5$  Adc
- Monolithic Construction with Built-In Base–Emitter Shunt Resistors
- TO–220AB Compact Package
- Complementary to 2N6387, 2N6388

**2N6667**  
**2N6668**

**PNP SILICON**  
**DARLINGTON**  
**POWER TRANSISTORS**  
**10 AMPERES**  
**60–80 VOLTS**  
**65 WATTS**

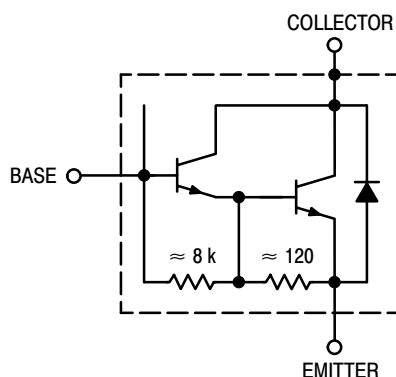
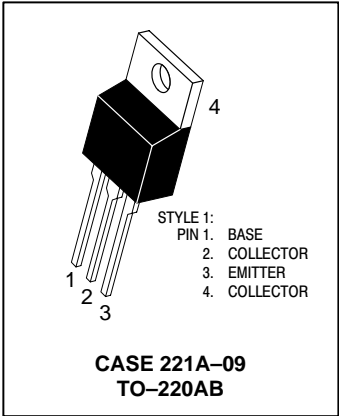


Figure 1. Darlington Schematic

**MAXIMUM RATINGS (1)**

Rating	Symbol	2N6667	2N6668	Unit
Collector–Emitter Voltage	$V_{CEO}$	60	80	Vdc
Collector–Base Voltage	$V_{CB}$	60	80	Vdc
Emitter–Base Voltage	$V_{EB}$	5		Vdc
Collector Current — Continuous — Peak	$I_C$	10 15		Adc
Base Current	$I_B$	250		mAdc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	65 0.52		watts $W/^\circ\text{C}$
Total Device Dissipation @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	2 0.016		Watts $W/^\circ\text{C}$
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	–65 to +150		$^\circ\text{C}$

(1) Indicates JEDEC Registered Data.

**THERMAL CHARACTERISTICS**

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.92	$^{\circ}C/W$
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	62.5	$^{\circ}C/W$

**\*ELECTRICAL CHARACTERISTICS** ( $T_C = 25^{\circ}C$  unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
----------------	--------	-----	-----	------

**OFF CHARACTERISTICS**

Collector–Emitter Sustaining Voltage (2) ( $I_C = 200\text{ mA}$ , $I_B = 0$ )	2N6667 2N6668	$V_{CEO(sus)}$	60 80	—	Vdc
Collector Cutoff Current ( $V_{CE} = 60\text{ Vdc}$ , $I_B = 0$ ) ( $V_{CE} = 80\text{ Vdc}$ , $I_B = 0$ )	2N6667 2N6668	$I_{CEO}$	— —	1 1	mAdc
Collector Cutoff Current ( $V_{CE} = 60\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ ) ( $V_{CE} = 80\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ ) ( $V_{CE} = 60\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ , $T_C = 125^{\circ}C$ ) ( $V_{CE} = 80\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ , $T_C = 125^{\circ}C$ )	2N6667 2N6668 2N6667 2N6668	$I_{CEX}$	— — — —	300 300 3 3	$\mu\text{Adc}$ mAdc
Emitter Cutoff Current ( $V_{BE} = 5\text{ Vdc}$ , $I_C = 0$ )		$I_{EBO}$	—	5	mAdc

**ON CHARACTERISTICS (1)**

DC Current Gain ( $I_C = 5\text{ Adc}$ , $V_{CE} = 3\text{ Vdc}$ ) ( $I_C = 10\text{ Adc}$ , $V_{CE} = 3\text{ Vdc}$ )		$h_{FE}$	1000 100	20000 —	—
Collector–Emitter Saturation Voltage ( $I_C = 5\text{ Adc}$ , $I_B = 0.01\text{ Adc}$ ) ( $I_C = 10\text{ Adc}$ , $I_B = 0.1\text{ Adc}$ )		$V_{CE(sat)}$	— —	2 3	Vdc
Base–Emitter Saturation Voltage ( $I_C = 5\text{ Adc}$ , $I_B = 0.01\text{ Adc}$ ) ( $I_C = 10\text{ Adc}$ , $I_B = 0.1\text{ Adc}$ )		$V_{BE(sat)}$	— —	2.8 4.5	Vdc

**DYNAMIC CHARACTERISTICS**

Current Gain — Bandwidth Product ( $I_C = 1\text{ Adc}$ , $V_{CE} = 5\text{ Vdc}$ , $f_{test} = 1\text{ MHz}$ )		$ h_{fe} $	20	—	—
Output Capacitance ( $V_{CB} = 10\text{ Vdc}$ , $I_E = 0$ , $f = 1\text{ MHz}$ )		$C_{ob}$	—	200	pF
Small–Signal Current Gain ( $I_C = 1\text{ Adc}$ , $V_{CE} = 5\text{ Vdc}$ , $f = 1\text{ kHz}$ )		$h_{fe}$	1000	—	—

\*Indicates JEDEC Registered Data

(2) Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

$R_B$  &  $R_C$  VARIED TO OBTAIN DESIRED CURRENT LEVELS

$D_1$ , MUST BE FAST RECOVERY TYPES e.g.,

1N5825 USED ABOVE  $I_B \approx 100\text{ mA}$

MSD6100 USED BELOW  $I_B \approx 100\text{ mA}$

FOR  $t_d$  AND  $t_r$ ,  $D_1$  IS DISCONNECTED AND  $V_2 = 0$

$t_f, t_r \leq 10\text{ ns}$

DUTY CYCLE = 1.0%

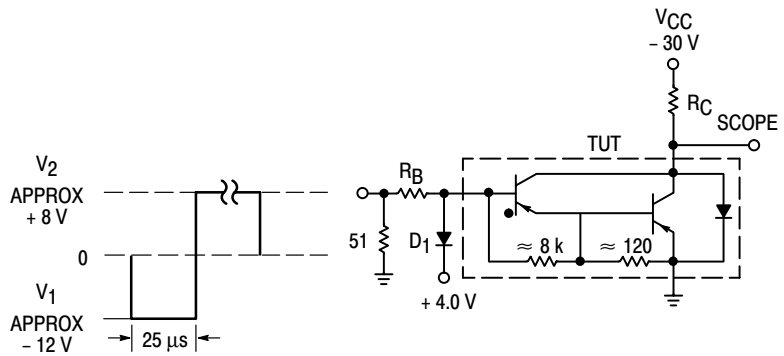


Figure 2. Switching Times Test Circuit

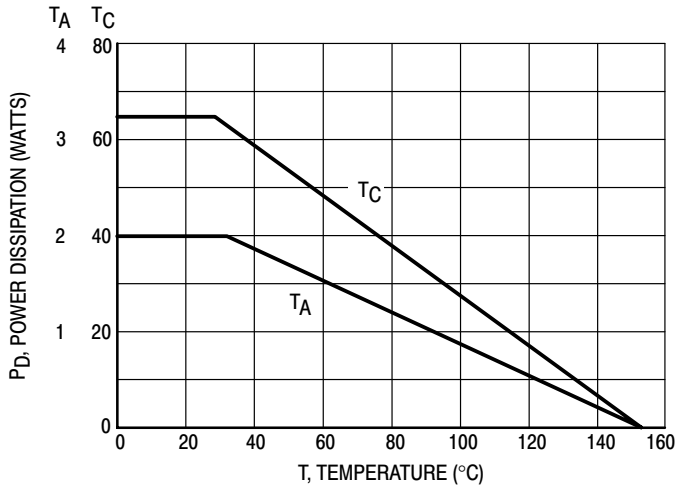


Figure 3. Power Derating

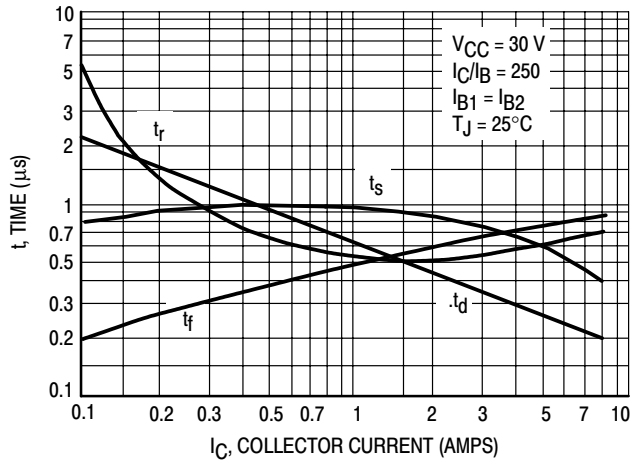


Figure 4. Typical Switching Times

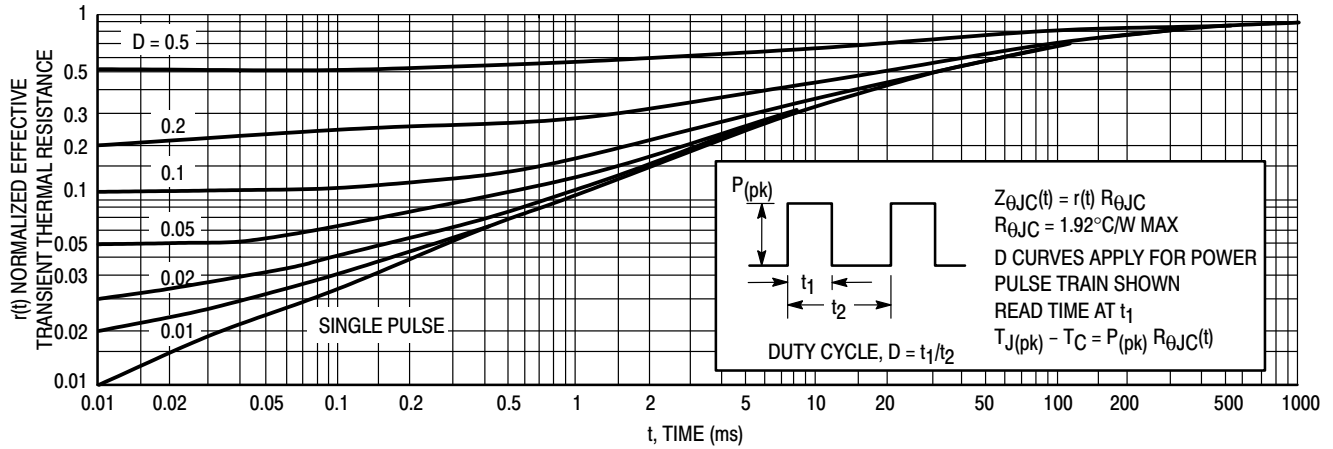


Figure 5. Thermal Response

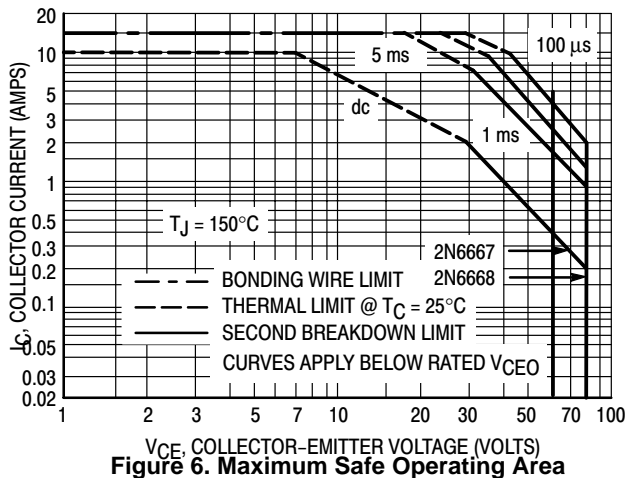


Figure 6. Maximum Safe Operating Area

There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate  $I_C - V_{CE}$  limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

The data of Figure 6 is based on  $T_{J(pk)} = 150^\circ\text{C}$ ;  $T_C$  is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided  $T_{J(pk)} < 150^\circ\text{C}$ .  $T_{J(pk)}$  may be calculated from the data in Figure 5. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

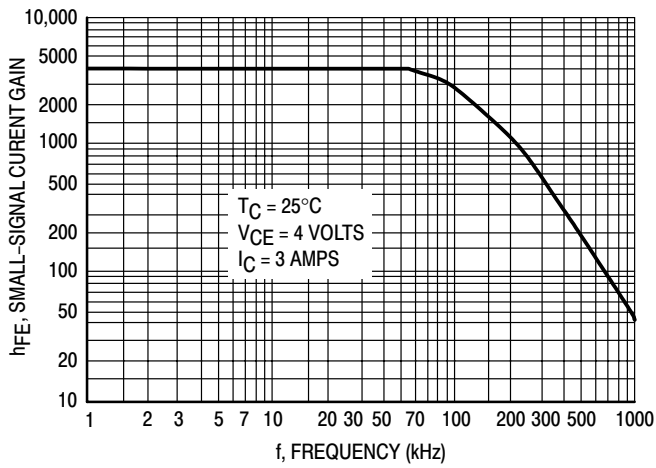


Figure 7. Typical Small-Signal Current Gain

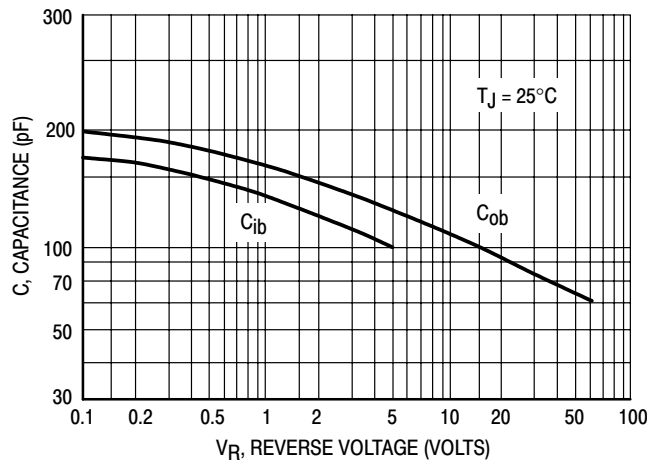


Figure 8. Typical Capacitance

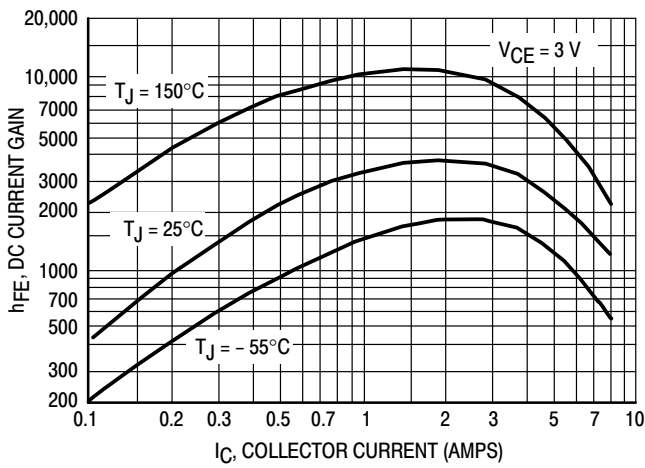


Figure 9. Typical DC Current Gain

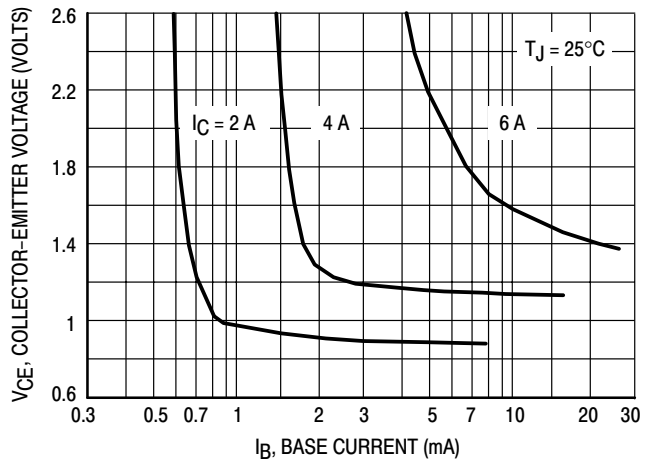


Figure 10. Typical Collector Saturation Region

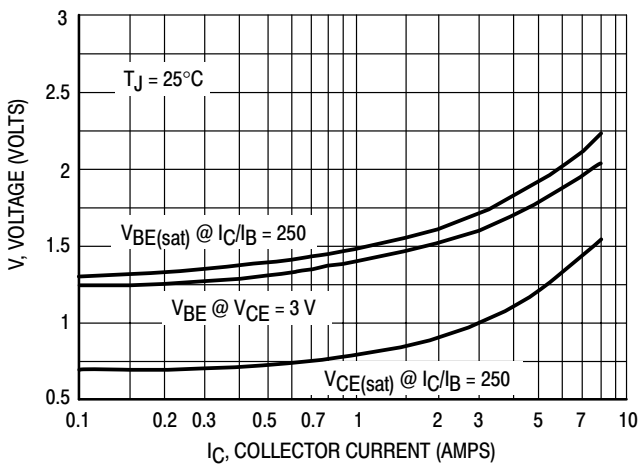


Figure 11. Typical "On" Voltages

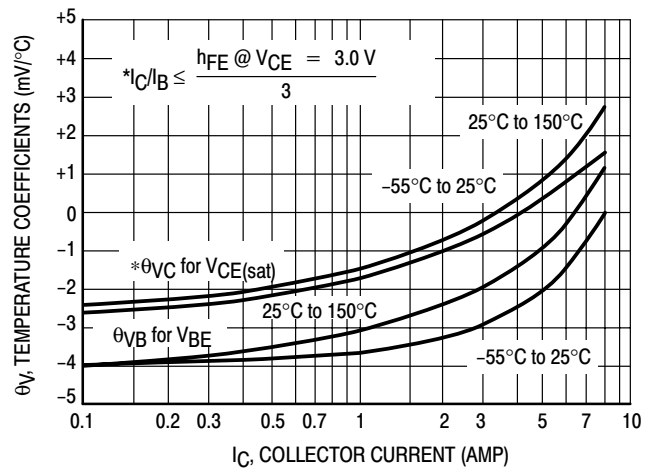


Figure 12. Typical Temperature Coefficients

# 2N6667 2N6668

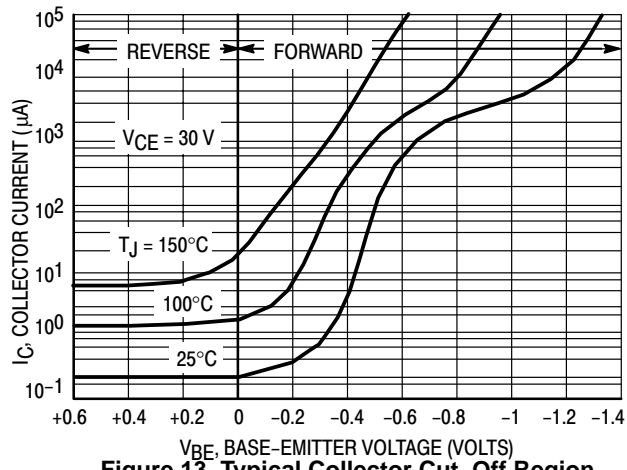
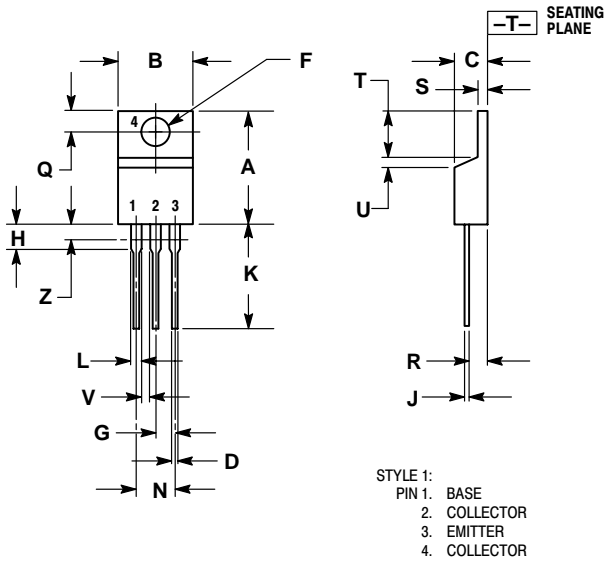


Figure 13. Typical Collector Cut-Off Region

# 2N6667 2N6668

## PACKAGE DIMENSIONS

### TO-220 CASE 221A-09 ISSUE AA



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.570	0.620	14.48	15.75
B	0.380	0.405	9.66	10.28
C	0.160	0.190	4.07	4.82
D	0.025	0.035	0.64	0.88
F	0.142	0.147	3.61	3.73
G	0.095	0.105	2.42	2.66
H	0.110	0.155	2.80	3.93
J	0.018	0.025	0.46	0.64
K	0.500	0.562	12.70	14.27
L	0.045	0.060	1.15	1.52
N	0.190	0.210	4.83	5.33
Q	0.100	0.120	2.54	3.04
R	0.080	0.110	2.04	2.79
S	0.045	0.055	1.15	1.39
T	0.235	0.255	5.97	6.47
U	0.000	0.050	0.00	1.27
V	0.045	---	1.15	---
Z	---	0.080	---	2.04

## Notes

**ON Semiconductor** and  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.

## 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:** ONlit@hibbertco.com

**N. American Technical Support:** 800-282-9855 Toll Free USA/Canada

**JAPAN:** ON Semiconductor, Japan Customer Focus Center  
4-32-1 Nishi-Gotanda, Shinagawa-ku, Tokyo, Japan 141-0031  
**Phone:** 81-3-5740-2700  
**Email:** r14525@onsemi.com

**ON Semiconductor Website:** <http://onsemi.com>

For additional information, please contact your local Sales Representative.