

MC34063A, MC33063A

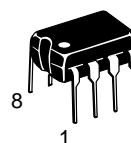
DC-to-DC Converter Control Circuits

The MC34063A Series is a monolithic control circuit containing the primary functions required for DC-to-DC converters. These devices consist of an internal temperature compensated reference, comparator, controlled duty cycle oscillator with an active current limit circuit, driver and high current output switch. This series was specifically designed to be incorporated in Step-Down and Step-Up and Voltage-Inverting applications with a minimum number of external components. Refer to Application Notes AN920A/D and AN954/D for additional design information.

- Operation from 3.0 V to 40 V Input
- Low Standby Current
- Current Limiting
- Output Switch Current to 1.5 A
- Output Voltage Adjustable
- Frequency Operation to 100 kHz
- Precision 2% Reference



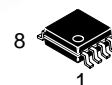
ON Semiconductor
<http://onsemi.com>



PDIP-8
P, P1 SUFFIX
CASE 626



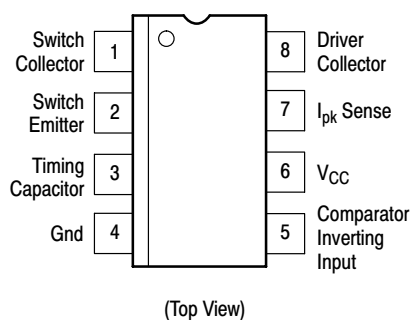
SO-8
D SUFFIX
CASE 751



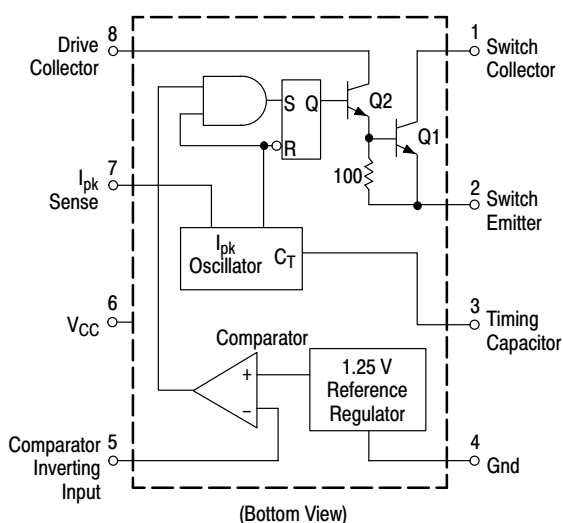
SOEIAJ-8
M SUFFIX
CASE 968

EEPW.com.cn 电子产品世界

PIN CONNECTIONS



Representative Schematic Diagram



This device contains 51 active transistors.

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 11 of this data sheet.

DEVICE MARKING INFORMATION

See general marking information in the device marking section on page 11 of this data sheet.

MC34063A, MC33063A

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Power Supply Voltage	V_{CC}	40	Vdc
Comparator Input Voltage Range	V_{IR}	-0.3 to +40	Vdc
Switch Collector Voltage	$V_{C(switch)}$	40	Vdc
Switch Emitter Voltage ($V_{P_{in\ 1}} = 40\text{ V}$)	$V_{E(switch)}$	40	Vdc
Switch Collector to Emitter Voltage	$V_{CE(switch)}$	40	Vdc
Driver Collector Voltage	$V_{C(driver)}$	40	Vdc
Driver Collector Current (Note 1.)	$I_{C(driver)}$	100	mA
Switch Current	I_{SW}	1.5	A
Power Dissipation and Thermal Characteristics			
Plastic Package, P, P1 Suffix			
$T_A = 25^\circ\text{C}$	P_D	1.25	W
Thermal Resistance	$R_{\theta JA}$	100	$^\circ\text{C/W}$
SOIC Package, D Suffix			
$T_A = 25^\circ\text{C}$	P_D	625	W
Thermal Resistance	$R_{\theta JA}$	160	$^\circ\text{C/W}$
Operating Junction Temperature	T_J	+150	$^\circ\text{C}$
Operating Ambient Temperature Range	T_A		$^\circ\text{C}$
MC34063A		0 to +70	
MC33063AV		-40 to +125	
MC33063A		-40 to +85	
Storage Temperature Range	T_{stg}	-65 to +150	$^\circ\text{C}$

1. Maximum package power dissipation limits must be observed.
2. ESD data available upon request.

MC34063A, MC33063A

ELECTRICAL CHARACTERISTICS ($V_{CC} = 5.0\text{ V}$, $T_A = T_{low}$ to T_{high} [Note 3.], unless otherwise specified.)

Characteristics	Symbol	Min	Typ	Max	Unit
OSCILLATOR					
Frequency ($V_{Pin\ 5} = 0\text{ V}$, $C_T = 1.0\text{ nF}$, $T_A = 25^\circ\text{C}$)	f_{osc}	24	33	42	kHz
Charge Current ($V_{CC} = 5.0\text{ V to }40\text{ V}$, $T_A = 25^\circ\text{C}$)	I_{chg}	24	35	42	μA
Discharge Current ($V_{CC} = 5.0\text{ V to }40\text{ V}$, $T_A = 25^\circ\text{C}$)	I_{dischg}	140	220	260	μA
Discharge to Charge Current Ratio (Pin 7 to V_{CC} , $T_A = 25^\circ\text{C}$)	I_{dischg}/I_{chg}	5.2	6.5	7.5	–
Current Limit Sense Voltage ($I_{chg} = I_{dischg}$, $T_A = 25^\circ\text{C}$)	$V_{ipk(sense)}$	250	300	350	mV

OUTPUT SWITCH (Note 4.)

Saturation Voltage, Darlington Connection ($I_{SW} = 1.0\text{ A}$, Pins 1, 8 connected)	$V_{CE(sat)}$	–	1.0	1.3	V
Saturation Voltage (Note 5.) ($I_{SW} = 1.0\text{ A}$, $R_{Pin\ 8} = 82\ \Omega$ to V_{CC} , Forced $\beta \approx 20$)	$V_{CE(sat)}$	–	0.45	0.7	V
DC Current Gain ($I_{SW} = 1.0\text{ A}$, $V_{CE} = 5.0\text{ V}$, $T_A = 25^\circ\text{C}$)	h_{FE}	50	75	–	–
Collector Off–State Current ($V_{CE} = 40\text{ V}$)	$I_{C(off)}$	–	0.01	100	μA

COMPARATOR

Threshold Voltage $T_A = 25^\circ\text{C}$ $T_A = T_{low}$ to T_{high}	V_{th}	1.225 1.21	1.25 –	1.275 1.29	V
Threshold Voltage Line Regulation ($V_{CC} = 3.0\text{ V to }40\text{ V}$) MC33063A, MC34063A MC33363AV	Reg_{line}	– –	1.4 1.4	5.0 6.0	mV
Input Bias Current ($V_{in} = 0\text{ V}$)	I_{IB}	–	–20	–400	nA

TOTAL DEVICE

Supply Current ($V_{CC} = 5.0\text{ V to }40\text{ V}$, $C_T = 1.0\text{ nF}$, Pin 7 = V_{CC} , $V_{Pin\ 5} > V_{th}$, Pin 2 = Gnd, remaining pins open)	I_{CC}	–	–	4.0	mA
--	----------	---	---	-----	----

3. $T_{low} = 0^\circ\text{C}$ for MC34063A, -40°C for MC33063A, AV $T_{high} = +70^\circ\text{C}$ for MC34063A, $+85^\circ\text{C}$ for MC33063A, $+125^\circ\text{C}$ for MC33063AV
4. Low duty cycle pulse techniques are used during test to maintain junction temperature as close to ambient temperature as possible.
5. If the output switch is driven into hard saturation (non–Darlington configuration) at low switch currents ($\leq 300\text{ mA}$) and high driver currents ($\geq 30\text{ mA}$), it may take up to $2.0\ \mu\text{s}$ for it to come out of saturation. This condition will shorten the off time at frequencies $\geq 30\text{ kHz}$, and is magnified at high temperatures. This condition does not occur with a Darlington configuration, since the output switch cannot saturate. If a non–Darlington configuration is used, the following output drive condition is recommended:

$$\text{Forced } \beta \text{ of output switch : } \frac{I_{C\ \text{output}}}{I_{C\ \text{driver}} - 7.0\text{ mA}} \geq 10$$

* The $100\ \Omega$ resistor in the emitter of the driver device requires about 7.0 mA before the output switch conducts.

MC34063A, MC33063A

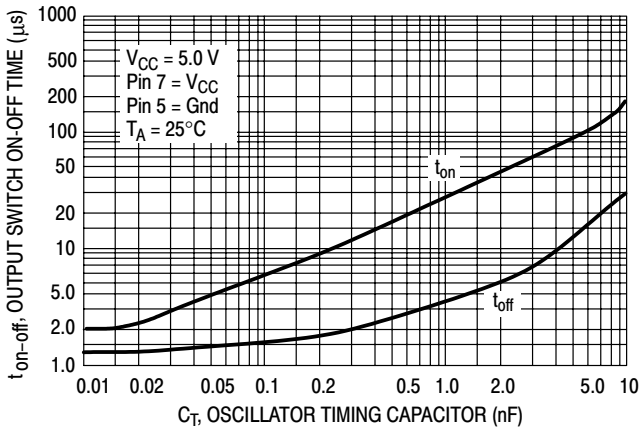


Figure 1. Output Switch On-Off Time versus Oscillator Timing Capacitor

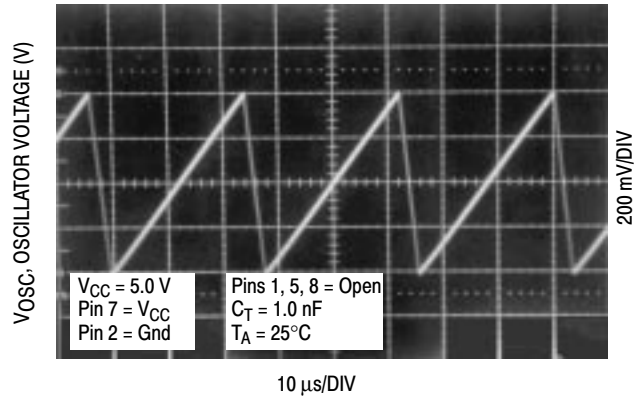


Figure 2. Timing Capacitor Waveform

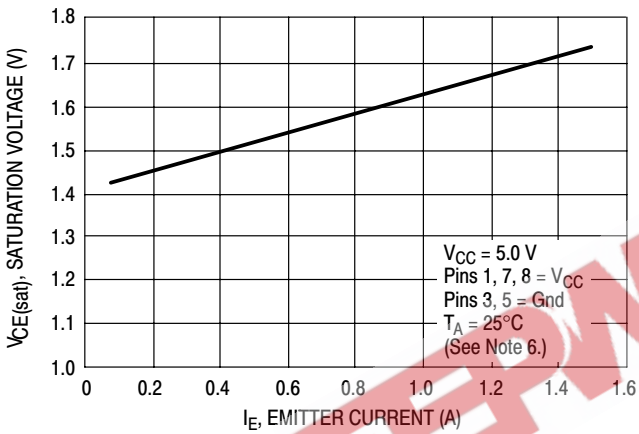


Figure 3. Emitter Follower Configuration Output Saturation Voltage versus Emitter Current

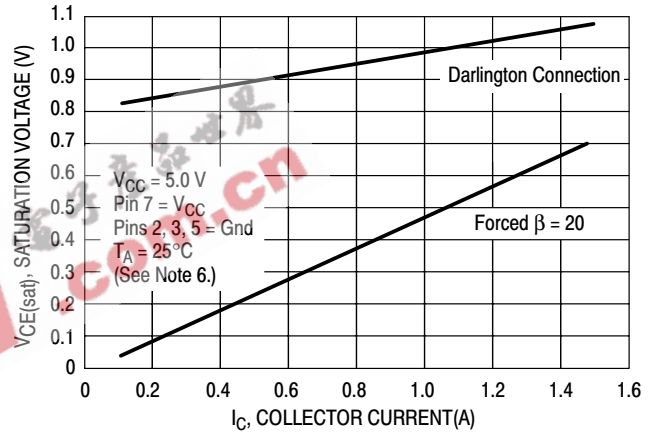


Figure 4. Common Emitter Configuration Output Switch Saturation Voltage versus Collector Current

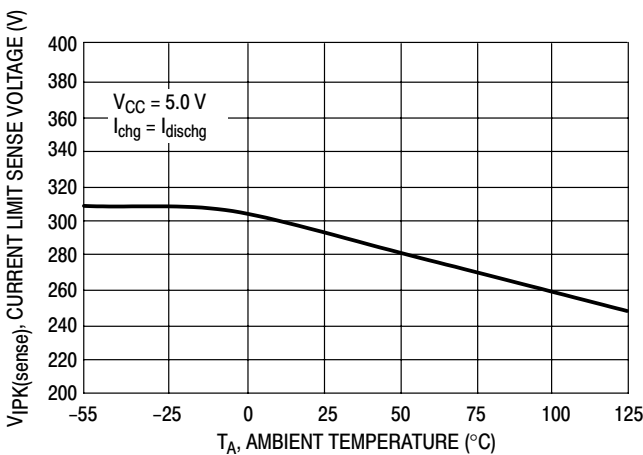


Figure 5. Current Limit Sense Voltage versus Temperature

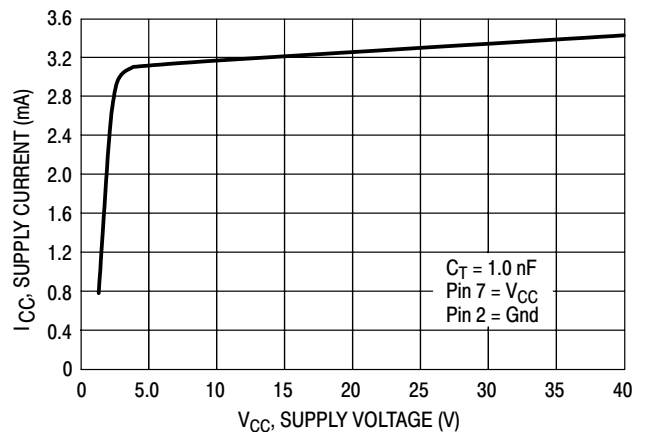
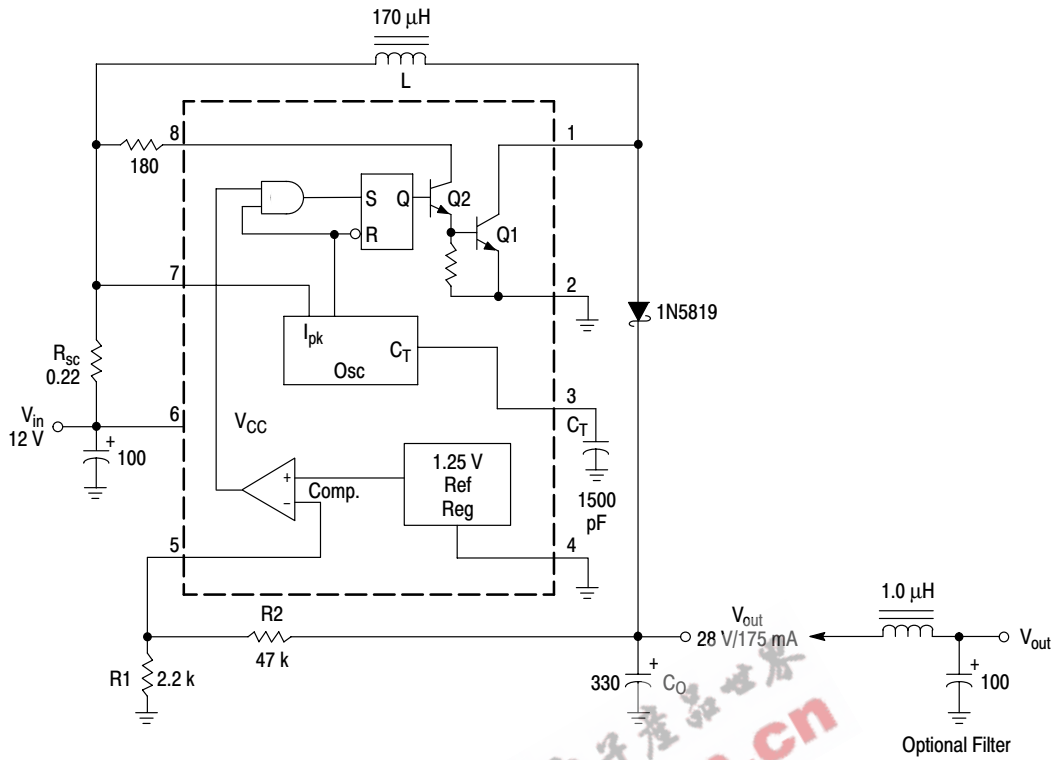


Figure 6. Standby Supply Current versus Supply Voltage

6. Low duty cycle pulse techniques are used during test to maintain junction temperature as close to ambient temperature as possible.

MC34063A, MC33063A



Test	Conditions	Results
Line Regulation	$V_{in} = 8.0\text{ V to }16\text{ V}, I_O = 175\text{ mA}$	$30\text{ mV} = \pm 0.05\%$
Load Regulation	$V_{in} = 12\text{ V}, I_O = 75\text{ mA to }175\text{ mA}$	$10\text{ mV} = \pm 0.017\%$
Output Ripple	$V_{in} = 12\text{ V}, I_O = 175\text{ mA}$	400 mVpp
Efficiency	$V_{in} = 12\text{ V}, I_O = 175\text{ mA}$	87.7%
Output Ripple With Optional Filter	$V_{in} = 12\text{ V}, I_O = 175\text{ mA}$	40 mVpp

Figure 7. Step-Up Converter

MC34063A, MC33063A

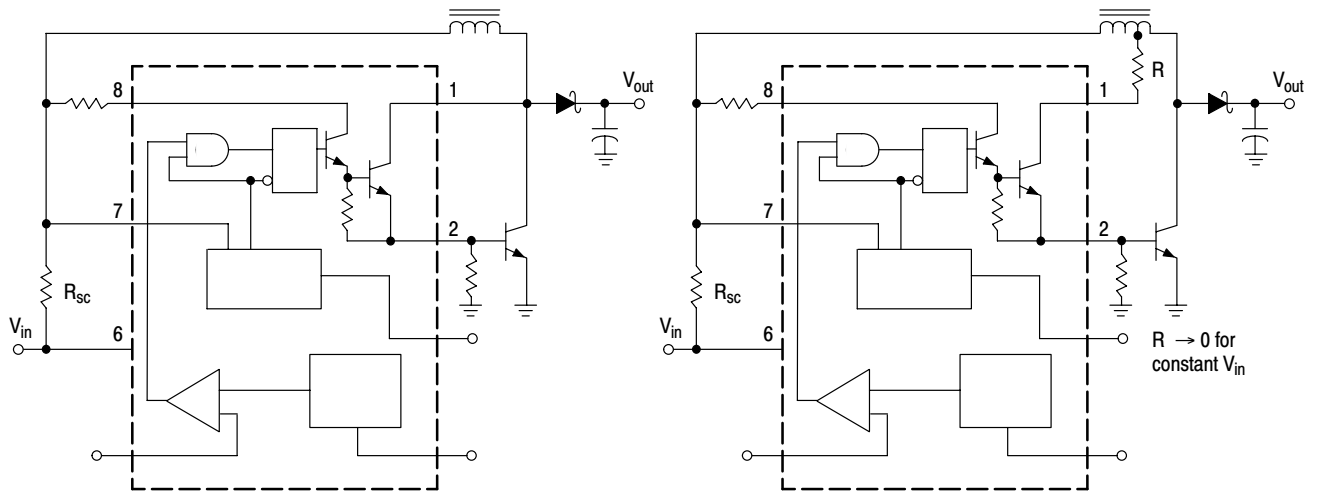


Figure 8. External Current Boost Connections for I_C Peak Greater than 1.5 A

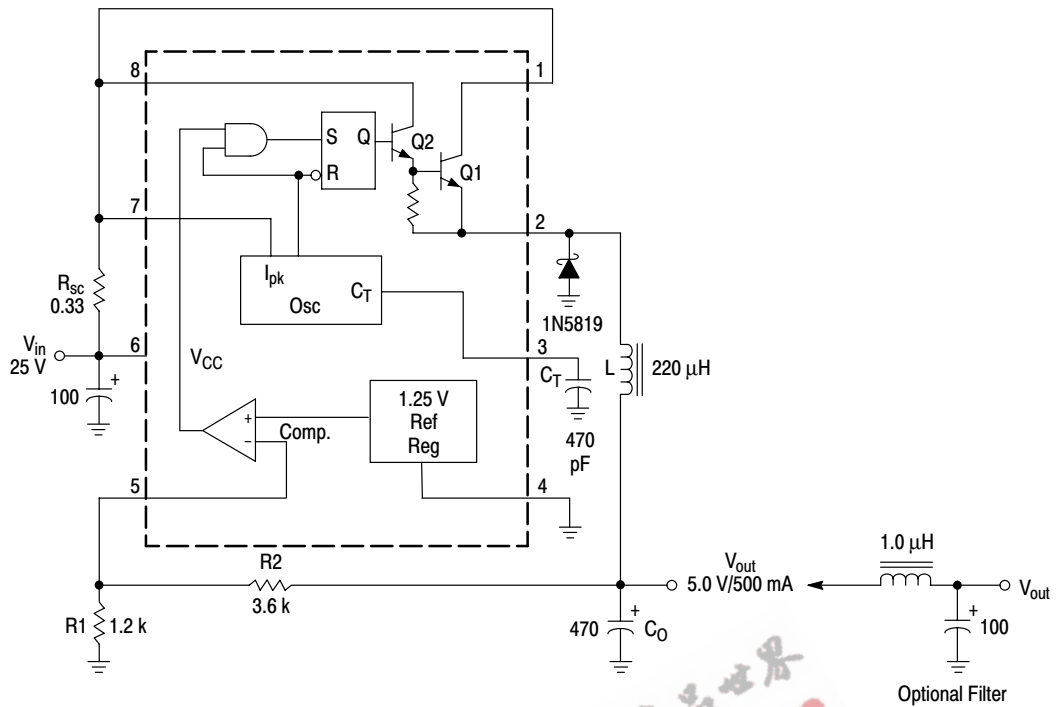
8a. External NPN Switch

8b. External NPN Saturated Switch

(See Note 7.)

7. If the output switch is driven into hard saturation (non-Darlington configuration) at low switch currents (≤ 300 mA) and high driver currents (≥ 30 mA), it may take up to $2.0 \mu\text{s}$ to come out of saturation. This condition will shorten the off time at frequencies ≥ 30 kHz, and is magnified at high temperatures. This condition does not occur with a Darlington configuration, since the output switch cannot saturate. If a non-Darlington configuration is used, the following output drive condition is recommended.

MC34063A, MC33063A



Test	Conditions	Results
Line Regulation	$V_{in} = 15\text{ V to }25\text{ V}, I_O = 500\text{ mA}$	$12\text{ mV} = \pm 0.12\%$
Load Regulation	$V_{in} = 25\text{ V}, I_O = 50\text{ mA to }500\text{ mA}$	$3.0\text{ mV} = \pm 0.03\%$
Output Ripple	$V_{in} = 25\text{ V}, I_O = 500\text{ mA}$	120 mVpp
Short Circuit Current	$V_{in} = 25\text{ V}, R_L = 0.1\ \Omega$	1.1 A
Efficiency	$V_{in} = 25\text{ V}, I_O = 500\text{ mA}$	83.7%
Output Ripple With Optional Filter	$V_{in} = 25\text{ V}, I_O = 500\text{ mA}$	40 mVpp

Figure 9. Step-Down Converter

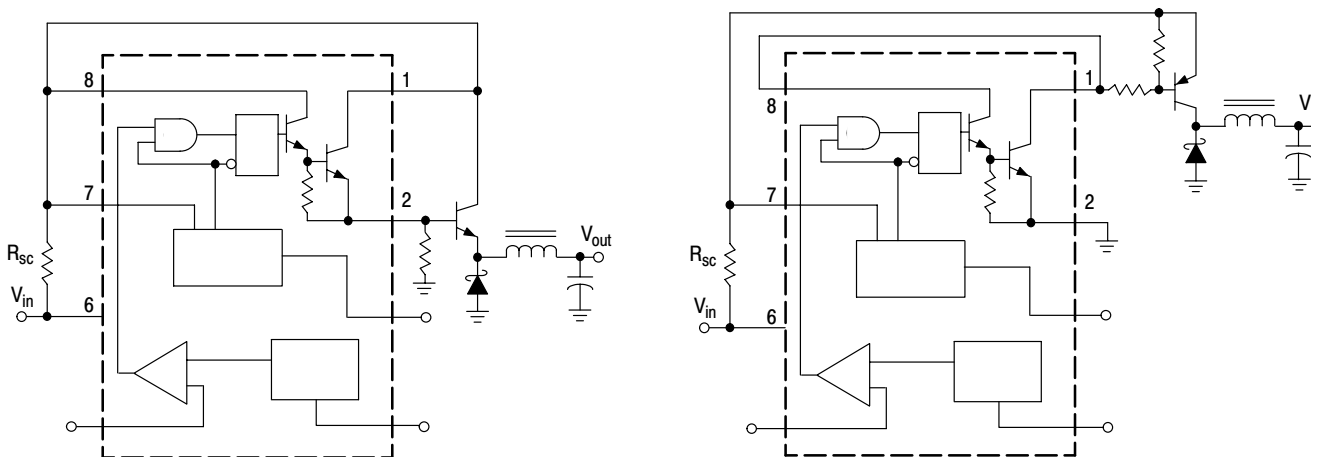
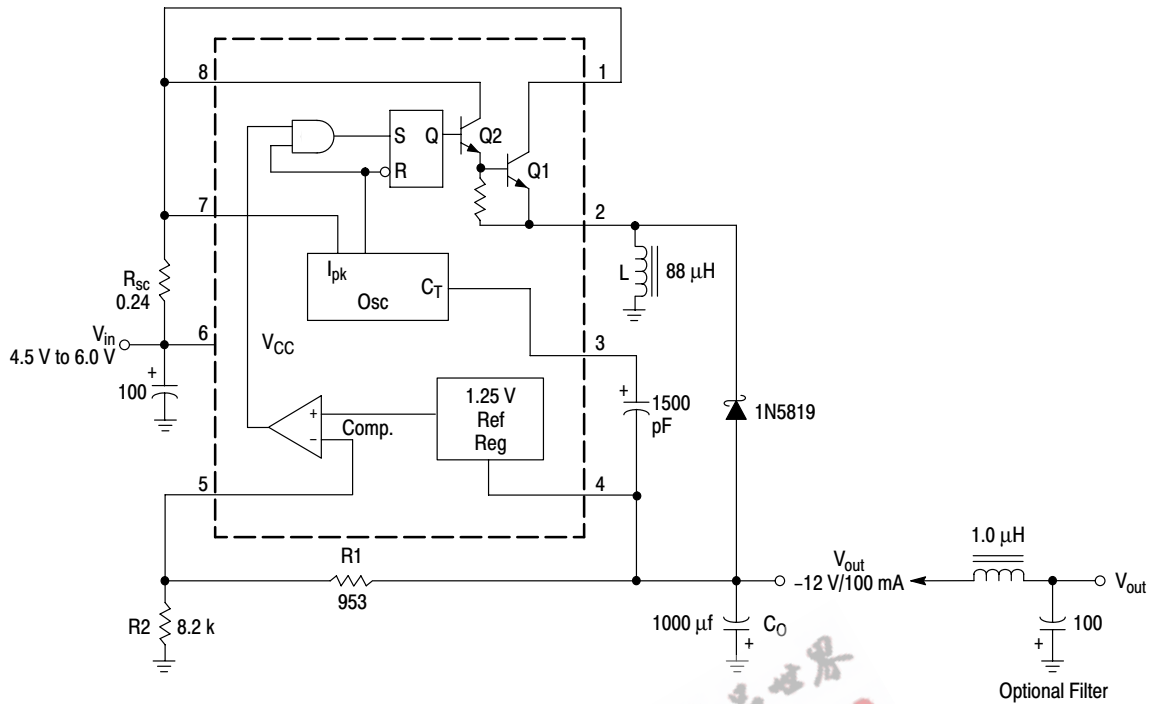


Figure 10. External Current Boost Connections for I_C Peak Greater than 1.5 A

10a. External NPN Switch

10b. External PNP Saturated Switch

MC34063A, MC33063A



Test	Conditions	Results
Line Regulation	$V_{in} = 4.5 \text{ V to } 6.0 \text{ V}, I_O = 100 \text{ mA}$	$3.0 \text{ mV} = \pm 0.012\%$
Load Regulation	$V_{in} = 5.0 \text{ V}, I_O = 10 \text{ mA to } 100 \text{ mA}$	$0.022 \text{ V} = \pm 0.09\%$
Output Ripple	$V_{in} = 5.0 \text{ V}, I_O = 100 \text{ mA}$	500 mVpp
Short Circuit Current	$V_{in} = 5.0 \text{ V}, R_L = 0.1 \Omega$	910 mA
Efficiency	$V_{in} = 5.0 \text{ V}, I_O = 100 \text{ mA}$	62.2%
Output Ripple With Optional Filter	$V_{in} = 5.0 \text{ V}, I_O = 100 \text{ mA}$	70 mVpp

Figure 11. Voltage Inverting Converter

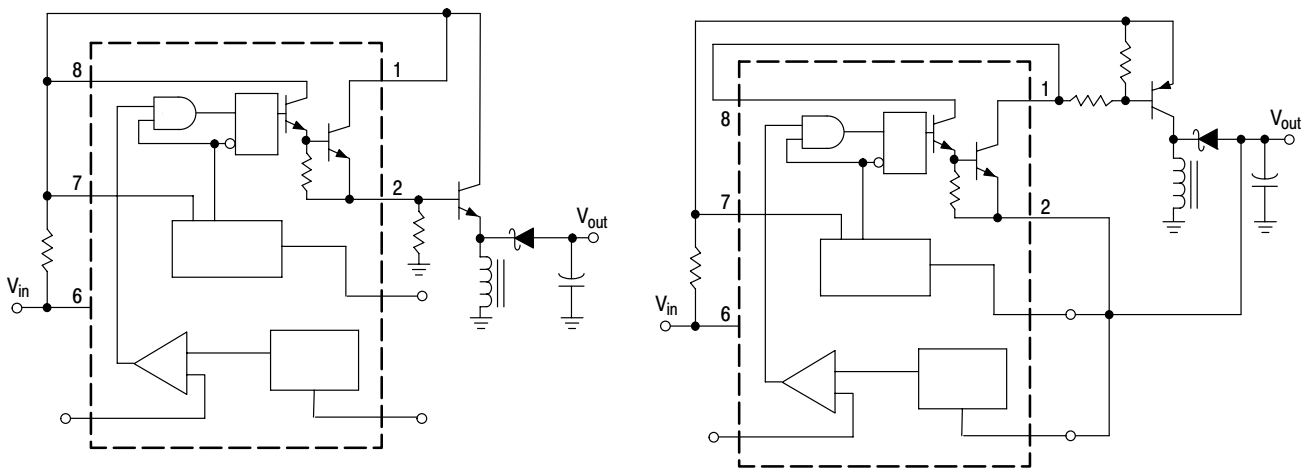
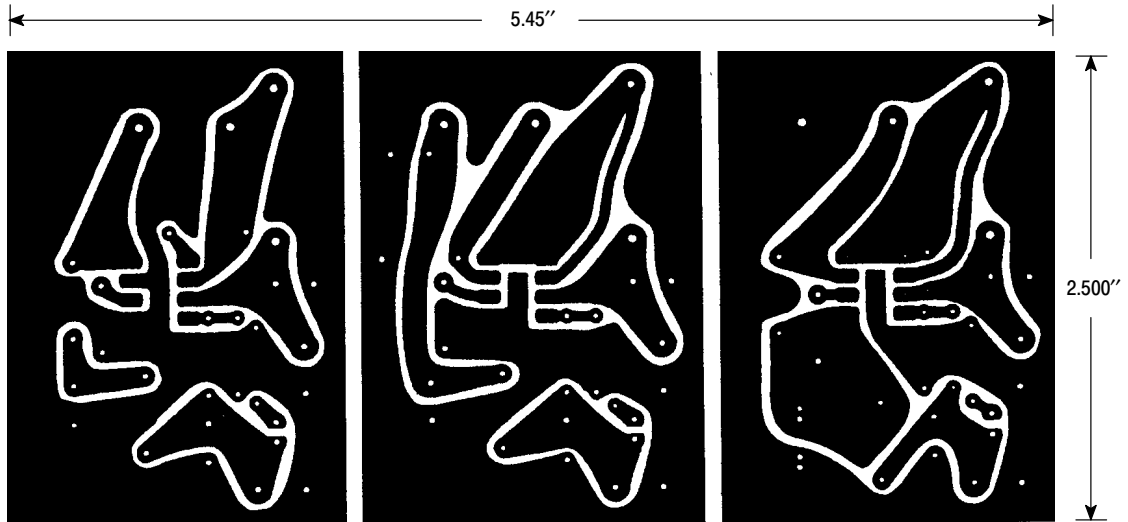


Figure 12. External Current Boost Connections for I_C Peak Greater than 1.5 A

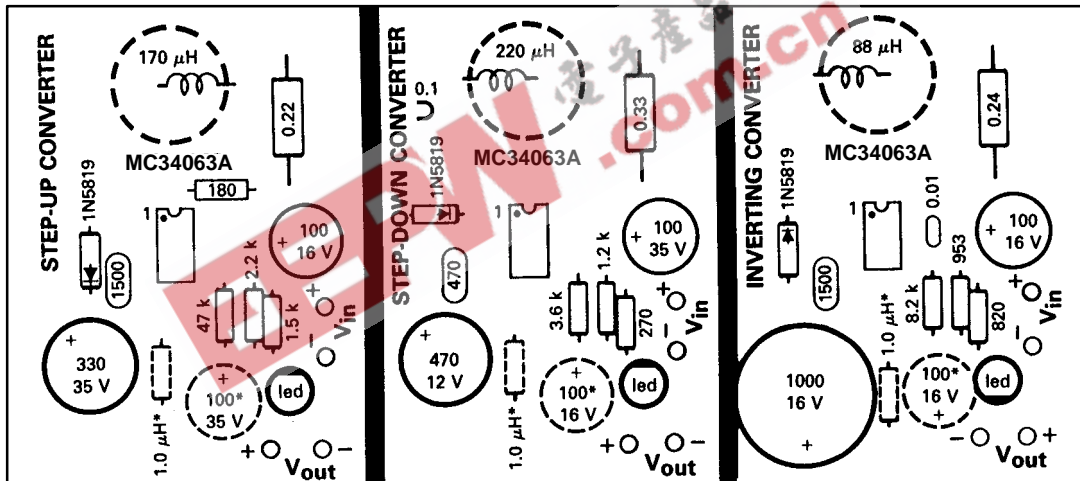
12a. External NPN Switch

12b. External PNP Saturated Switch

MC34063A, MC33063A



(Top view, copper foil as seen through the board from the component side)



(Top View, Component Side)

*Optional Filter.

Figure 13. Printed Circuit Board and Component Layout

(Circuits of Figures 7, 9, 11)

INDUCTOR DATA

Converter	Inductance (μH)	Turns/Wire
Step-Up	170	38 Turns of #22 AWG
Step-Down	220	48 Turns of #22 AWG
Voltage-Inverting	88	28 Turns of #22 AWG

All inductors are wound on Magnetics Inc. 55117 toroidal core.

MC34063A, MC33063A

Calculation	Step-Up	Step-Down	Voltage-Inverting
t_{on}/t_{off}	$\frac{V_{out} + V_F - V_{in(min)}}{V_{in(min)} - V_{sat}}$	$\frac{V_{out} + V_F}{V_{in(min)} - V_{sat} - V_{out}}$	$\frac{ V_{out} + V_F}{V_{in} - V_{sat}}$
$(t_{on} + t_{off})$	$\frac{1}{f}$	$\frac{1}{f}$	$\frac{1}{f}$
t_{off}	$\frac{t_{on} + t_{off}}{\frac{t_{on}}{t_{off}} + 1}$	$\frac{t_{on} + t_{off}}{\frac{t_{on}}{t_{off}} + 1}$	$\frac{t_{on} + t_{off}}{\frac{t_{on}}{t_{off}} + 1}$
t_{on}	$(t_{on} + t_{off}) - t_{off}$	$(t_{on} + t_{off}) - t_{off}$	$(t_{on} + t_{off}) - t_{off}$
C_T	$4.0 \times 10^{-5} t_{on}$	$4.0 \times 10^{-5} t_{on}$	$4.0 \times 10^{-5} t_{on}$
$I_{pk(switch)}$	$2I_{out(max)} \left(\frac{t_{on}}{t_{off}} + 1 \right)$	$2I_{out(max)}$	$2I_{out(max)} \left(\frac{t_{on}}{t_{off}} + 1 \right)$
R_{sc}	$0.3/I_{pk(switch)}$	$0.3/I_{pk(switch)}$	$0.3/I_{pk(switch)}$
$L_{(min)}$	$\left(\frac{V_{in(min)} - V_{sat}}{I_{pk(switch)}} \right) t_{on(max)}$	$\left(\frac{V_{in(min)} - V_{sat} - V_{out}}{I_{pk(switch)}} \right) t_{on(max)}$	$\left(\frac{V_{in(min)} - V_{sat}}{I_{pk(switch)}} \right) t_{on(max)}$
C_O	$9 \frac{I_{out} t_{on}}{V_{ripple(pp)}}$	$\frac{I_{pk(switch)}(t_{on} + t_{off})}{8V_{ripple(pp)}}$	$9 \frac{I_{out} t_{on}}{V_{ripple(pp)}}$

V_{sat} = Saturation voltage of the output switch.

V_F = Forward voltage drop of the output rectifier.

The following power supply characteristics must be chosen:

V_{in} – Nominal input voltage.

V_{out} – Desired output voltage, $|V_{out}| = 1.25 \left(1 + \frac{R2}{R1} \right)$

I_{out} – Desired output current.

f_{min} – Minimum desired output switching frequency at the selected values of V_{in} and I_{O} .

$V_{ripple(pp)}$ – Desired peak-to-peak output ripple voltage. In practice, the calculated capacitor value will need to be increased due to its equivalent series resistance and board layout. The ripple voltage should be kept to a low value since it will directly affect the line and load regulation.

NOTE: For further information refer to Application Note AN920A/D and AN954/D.

Figure 14. Design Formula Table

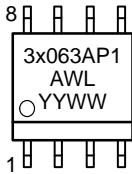
MC34063A, MC33063A

ORDERING INFORMATION

Device	Package	Shipping
MC33063AD	SO-8	98 Units / Rail
MC33063ADR2	SO-8	2500 Units / Tape & Reel
MC33063AP1	DIP-8	50 Units / Rail
MC33063AVD	SO-8	98 Units / Rail
MC33063AVDR2	SO-8	2500 Units / Tape & Reel
MC33063AVP	DIP-8	50 Units / Rail
MC34063AD	SO-8	98 Units / Rail
MC34063ADR2	SO-8	2500 Units / Tape & Reel
MC34063AP1	DIP-8	50 Units / Rail
MC34063BD	SO-8	98 Units / Rail
MC34063BDR2	SO-8	2500 Units / Tape & Reel
MC34063AM	SOEIAJ-8	94 Units / Rail
MC34063AMEL	SOEIAJ-8	1000 Units / Tape & Reel
MC34063AML1	SOEIAJ-8	1000 Units / Tape & Reel
MC34063AML2	SOEIAJ-8	2000 Units / Tape & Reel
MC34063AMR1	SOEIAJ-8	1000 Units / Tape & Reel
MC34063AMR2	SOEIAJ-8	2000 Units / Tape & Reel

MARKING DIAGRAMS

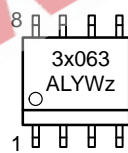
PDIP-8
P, P1 SUFFIX
CASE 626



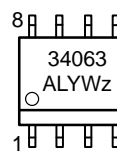
PDIP-8
P, P1 SUFFIX
CASE 626



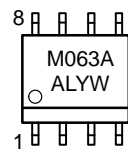
SO-8
D SUFFIX
CASE 751



SO-8
D SUFFIX
CASE 751



SOEIAJ-8
M SUFFIX
CASE 968

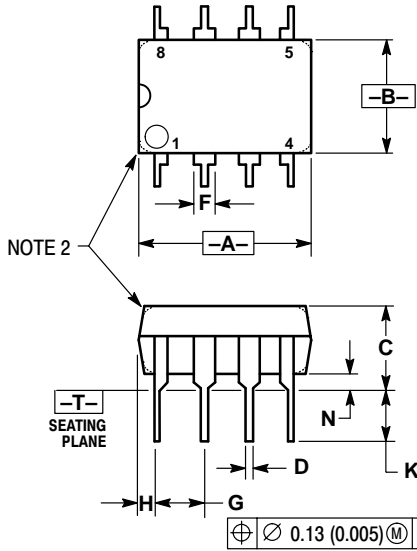


- x = 3 or 4
- z = A denotes AD suffix
J denotes BD suffix
- A = Assembly Location
- WL, L = Wafer Lot
- YY, Y = Year
- WW, W = Work Week

MC34063A, MC33063A

PACKAGE DIMENSIONS

PDIP-8
P, P1 SUFFIX
 PLASTIC PACKAGE
 CASE 626-05
 ISSUE K

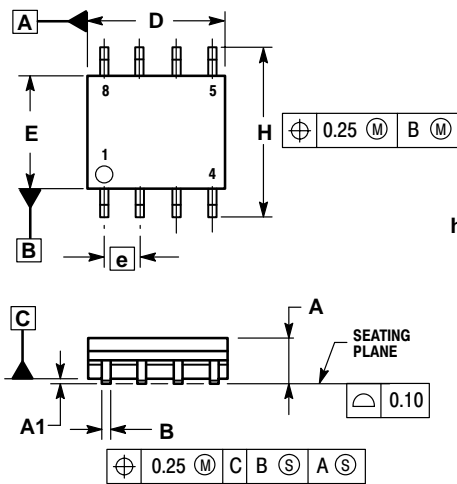


NOTES:

1. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
2. PACKAGE CONTOUR OPTIONAL (ROUND OR SQUARE CORNERS).
3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.40	10.16	0.370	0.400
B	6.10	6.60	0.240	0.260
C	3.94	4.45	0.155	0.175
D	0.38	0.51	0.015	0.020
F	1.02	1.78	0.040	0.070
G	2.54 BSC		0.100 BSC	
H	0.76	1.27	0.030	0.050
J	0.20	0.30	0.008	0.012
K	2.92	3.43	0.115	0.135
L	7.62 BSC		0.300 BSC	
M	—		10°	10°
N	0.76	1.01	0.030	0.040

SO-8
D SUFFIX
 PLASTIC PACKAGE
 CASE 751-06
 ISSUE T



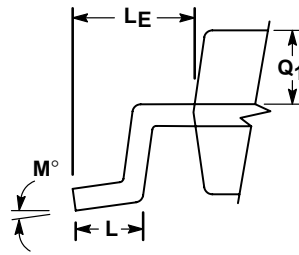
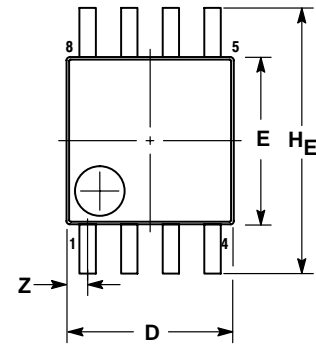
NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. DIMENSIONS ARE IN MILLIMETER.
3. DIMENSION D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 TOTAL IN EXCESS OF THE B DIMENSION AT MAXIMUM MATERIAL CONDITION.

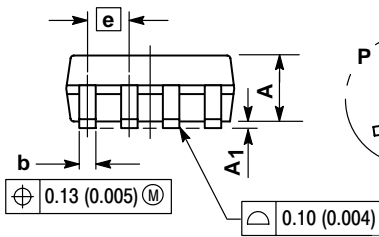
DIM	MILLIMETERS	
	MIN	MAX
A	1.35	1.75
A1	0.10	0.25
B	0.35	0.49
C	0.19	0.25
D	4.80	5.00
E	3.80	4.00
e	1.27 BSC	
H	5.80	6.20
h	0.25	0.50
L	0.40	1.25
θ	0°	7°

MC34063A, MC33063A

SOEIAJ-8
M SUFFIX
PLASTIC PACKAGE
CASE 968-01
ISSUE O



DETAIL P



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER
3. DIMENSION D AND E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
5. THE LEAD WIDTH DIMENSION (b) DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE LEAD WIDTH DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT MINIMUM SPACE BETWEEN PROTRUSIONS AND ADJACENT LEAD TO BE 0.46 (0.018).

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	---	2.05	---	0.081
A ₁	0.05	0.20	0.002	0.008
b	0.35	0.50	0.014	0.020
c	0.18	0.27	0.007	0.011
D	5.10	5.50	0.201	0.217
E	5.10	5.45	0.201	0.215
e	1.27 BSC		0.050 BSC	
HE	7.40	8.20	0.291	0.323
L	0.50	0.85	0.020	0.033
LE	1.10	1.50	0.043	0.059
M	0°	10°	0°	10°
Q ₁	0.70	0.90	0.028	0.035
Z	---	0.94	---	0.037

MC34063A, MC33063A

Notes


EEPW 电子产品世界
.com.cn

MC34063A, MC33063A

Notes

EEPW 电子产品世界
.com.cn

MC34063A, MC33063A

ON Semiconductor and  are 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

NORTH AMERICA 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
Fax Response Line: 303-675-2167 or 800-344-3810 Toll Free USA/Canada

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

EUROPE: LDC for ON Semiconductor – European Support

German Phone: (+1) 303-308-7140 (Mon–Fri 2:30pm to 7:00pm CET)
Email: ONlit-german@hibbertco.com
French Phone: (+1) 303-308-7141 (Mon–Fri 2:00pm to 7:00pm CET)
Email: ONlit-french@hibbertco.com
English Phone: (+1) 303-308-7142 (Mon–Fri 12:00pm to 5:00pm GMT)
Email: ONlit@hibbertco.com

EUROPEAN TOLL-FREE ACCESS*: 00-800-4422-3781

*Available from Germany, France, Italy, UK, Ireland

CENTRAL/SOUTH AMERICA:

Spanish Phone: 303-308-7143 (Mon–Fri 8:00am to 5:00pm MST)
Email: ONlit-spanish@hibbertco.com

ASIA/PACIFIC: LDC for ON Semiconductor – Asia Support

Phone: 303-675-2121 (Tue–Fri 9:00am to 1:00pm, Hong Kong Time)
Toll Free from Hong Kong & Singapore:
001-800-4422-3781
Email: ONlit-asia@hibbertco.com

JAPAN: ON Semiconductor, Japan Customer Focus Center
4-32-1 Nishi-Gotanda, Shinagawa-ku, Tokyo, Japan 141-0031
Phone: 81-3-5740-2745
Email: r14525@onsemi.com

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

For additional information, please contact your local Sales Representative.