

MC34063A, MC33063A, SC34063A, SC33063A, NCV33063A



ON Semiconductor®

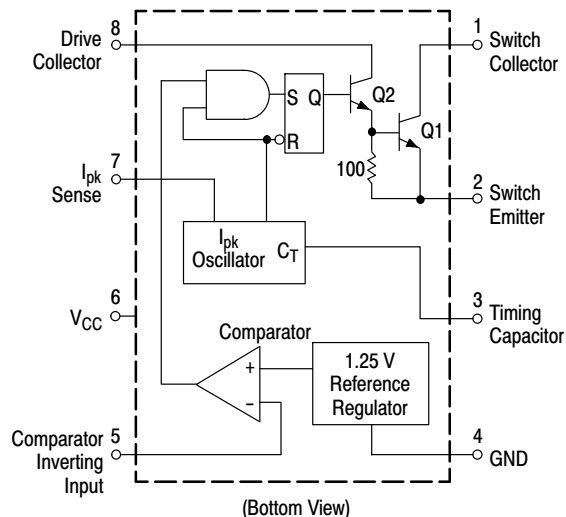
<http://onsemi.com>

1.5 A, Step-Up/Down/ Inverting Switching Regulators

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.

Features

- 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
- Pb-Free Packages are Available



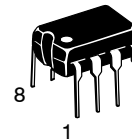
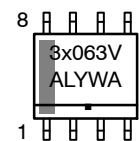
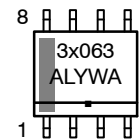
This device contains 79 active transistors.

Figure 1. Representative Schematic Diagram

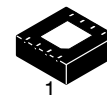
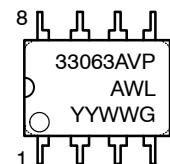
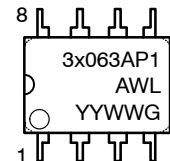
MARKING DIAGRAMS



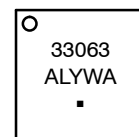
SOIC-8
D SUFFIX
CASE 751



PDIP-8
P, P1 SUFFIX
CASE 626



DFN8
CASE 488AF



- x = 3 or 4
- A = Assembly Location
- L, WL = Wafer Lot
- Y, YY = Year
- W, WW = Work Week
- G or ■ = Pb-Free Package

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 12 of this data sheet.

MC34063A, MC33063A, SC34063A, SC33063A, NCV33063A



Figure 2. Pin Connections

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 ($V_{Pin\ 1} = 40\ V$) | $V_{E(switch)}$ | 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 | | | |
| $T_A = 25^\circ C$ | P_D | 1.25 | W |
| Thermal Resistance | $R_{\theta JA}$ | 115 | $^\circ C/W$ |
| SOIC Package, D Suffix | | | |
| $T_A = 25^\circ C$ | P_D | 625 | mW |
| Thermal Resistance | $R_{\theta JA}$ | 160 | $^\circ C/W$ |
| DFN Package | | | |
| $T_A = 25^\circ C$ | P_D | 1.25 | mW |
| Thermal Resistance | $R_{\theta JA}$ | 80 | $^\circ C/W$ |
| Operating Junction Temperature | T_J | +150 | $^\circ C$ |
| Operating Ambient Temperature Range | T_A | | $^\circ C$ |
| MC34063A, SC34063A | | 0 to +70 | |
| MC33063AV, NCV33063A | | -40 to +125 | |
| MC33063A, SC33063A | | -40 to +85 | |
| Storage Temperature Range | T_{stg} | -65 to +150 | $^\circ C$ |

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. Maximum package power dissipation limits must be observed.
2. This device series contains ESD protection and exceeds the following tests: Human Body Model 4000 V per MIL-STD-883, Method 3015. Machine Model Method 400 V.
3. NCV prefix is for automotive and other applications requiring site and change control.

MC34063A, MC33063A, SC34063A, SC33063A, NCV33063A

ELECTRICAL CHARACTERISTICS ($V_{CC} = 5.0\text{ V}$, $T_A = T_{low}$ to T_{high} [Note 4], unless otherwise specified.)

| Characteristics | Symbol | Min | Typ | Max | Unit |
|-----------------|--------|-----|-----|-----|------|
|-----------------|--------|-----|-----|-----|------|

OSCILLATOR

| | | | | | |
|--|----------------------|-----|-----|-----|---------------|
| Frequency ($V_{Pin5} = 0\text{ V}$, $C_T = 1.0\text{ nF}$, $T_A = 25^\circ\text{C}$) | 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 5)

| | | | | | |
|---|---------------|----|------|-----|---------------|
| 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 6) ($I_{SW} = 1.0\text{ A}$, $R_{Pin8} = 82\ \Omega$ 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 ($V_{CC} = 3.0\text{ V to } 40\text{ V}$) MC33063, MC34063 MC33063V, NCV33063 | 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} , $V_{Pin5} > V_{th}$, Pin 2 = GND, remaining pins open) | I_{CC} | – | – | 4.0 | mA |
|---|----------|---|---|-----|----|

- $T_{low} = 0^\circ\text{C}$ for MC34063, SC34063; -40°C for MC33063, SC33063, MC33063V, NCV33063
 $T_{high} = +70^\circ\text{C}$ for MC34063, SC34063; $+85^\circ\text{C}$ for MC33063, SC33063; $+125^\circ\text{C}$ for MC33063V, NCV33063
- Low duty cycle pulse techniques are used during test to maintain junction temperature as close to ambient temperature as possible.
- 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:
Forced β 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, SC34063A, SC33063A, NCV33063A



Figure 3. Oscillator Frequency

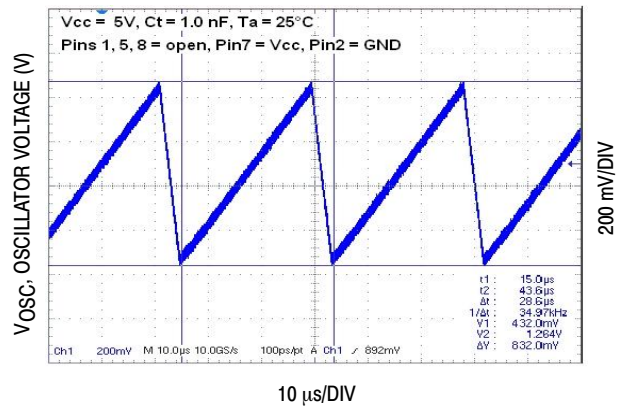


Figure 4. Timing Capacitor Waveform

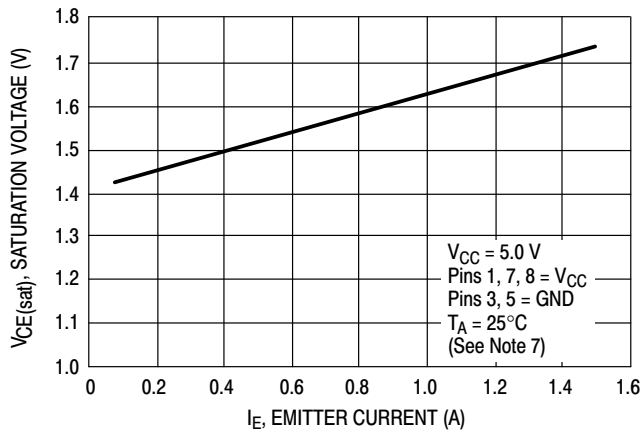


Figure 5. Emitter Follower Configuration Output Saturation Voltage versus Emitter Current

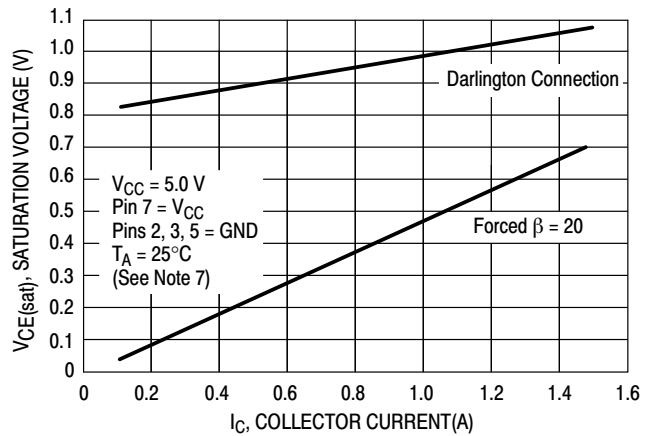


Figure 6. Common Emitter Configuration Output Switch Saturation Voltage versus Collector Current

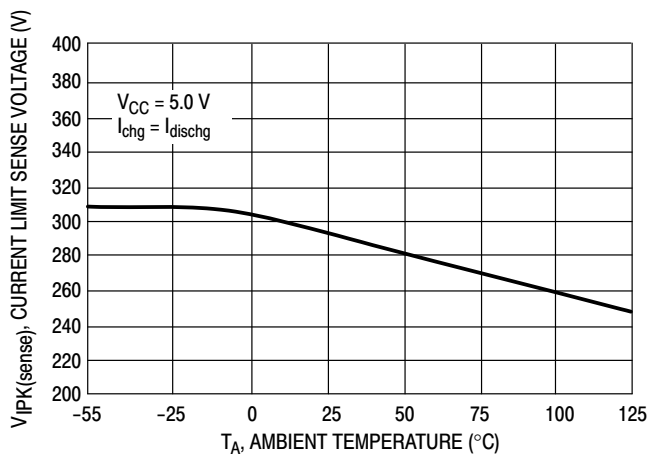


Figure 7. Current Limit Sense Voltage versus Temperature

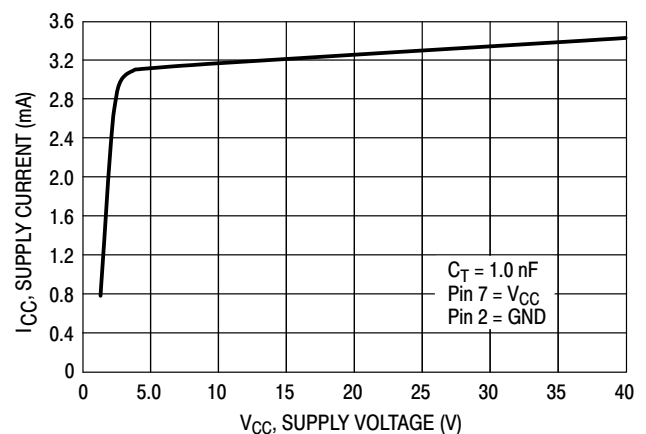
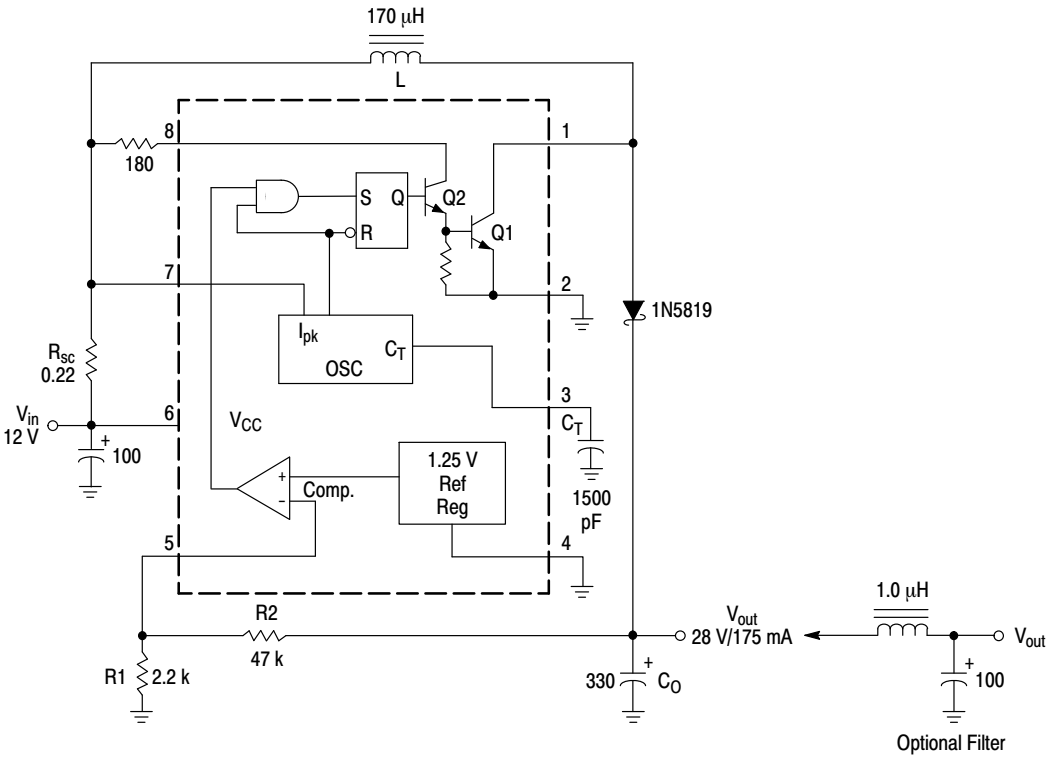


Figure 8. Standby Supply Current versus Supply Voltage

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



| 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 9. Step-Up Converter

MC34063A, MC33063A, SC34063A, SC33063A, NCV33063A



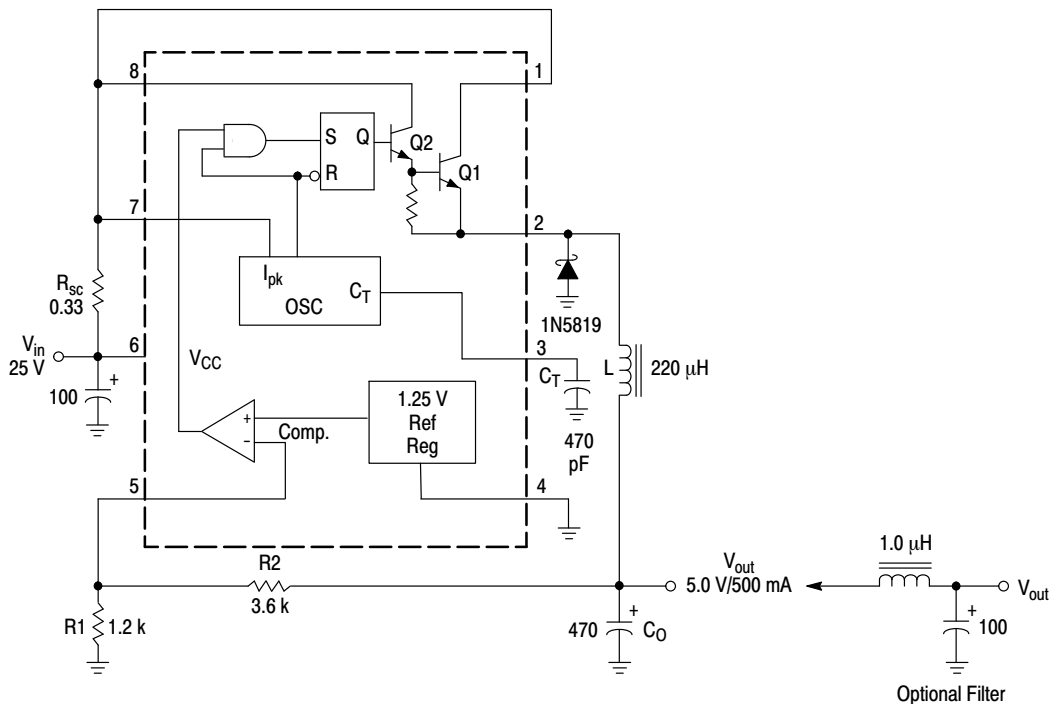
Figure 10. External Current Boost Connections for I_C Peak Greater than 1.5 A

9a. External NPN Switch

9b. External NPN Saturated Switch

(See Note 8)

8. 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.



| 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 11. Step-Down Converter

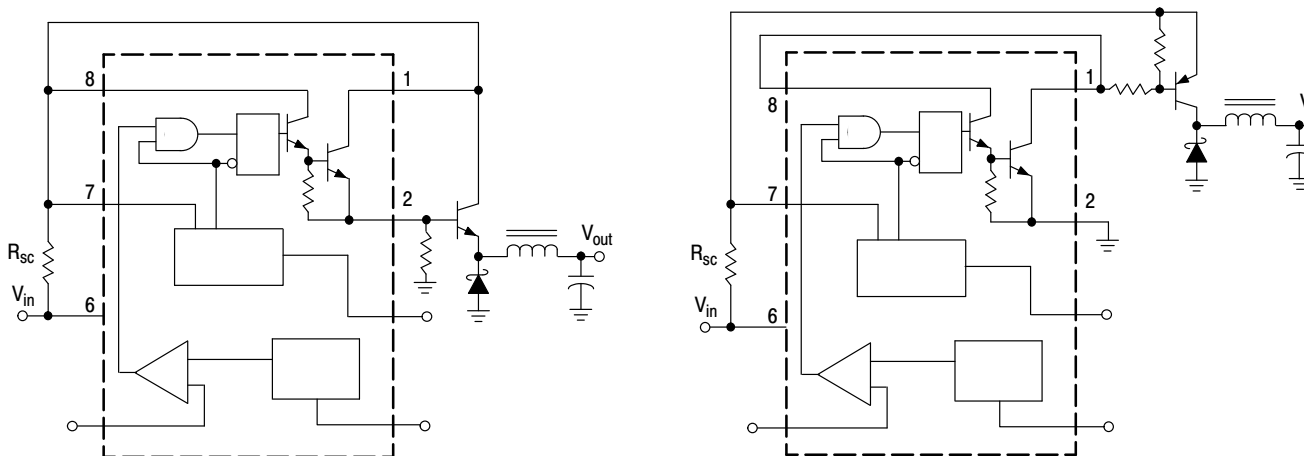
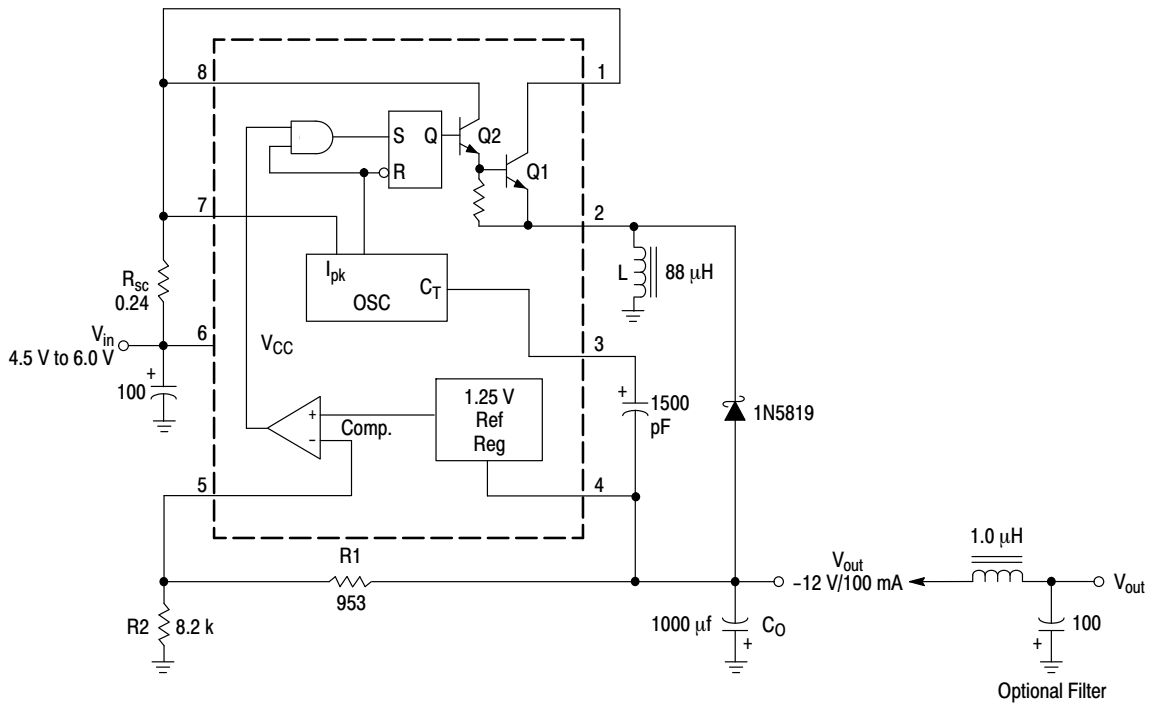


Figure 12. External Current Boost Connections for I_C Peak Greater than 1.5 A

11a. External NPN Switch

11b. External PNP Saturated Switch

MC34063A, MC33063A, SC34063A, SC33063A, NCV33063A



| 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 13. Voltage Inverting Converter

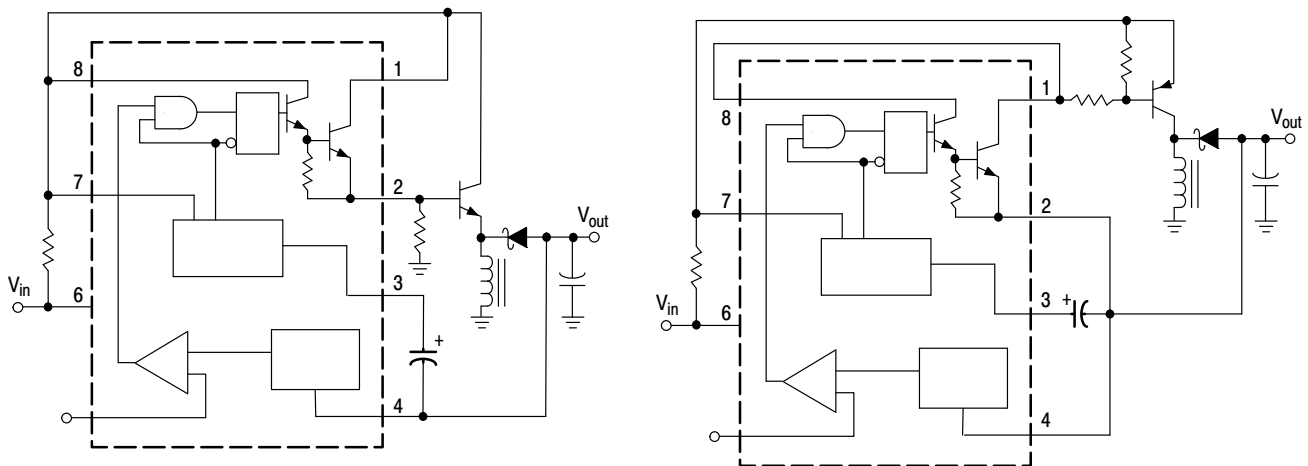
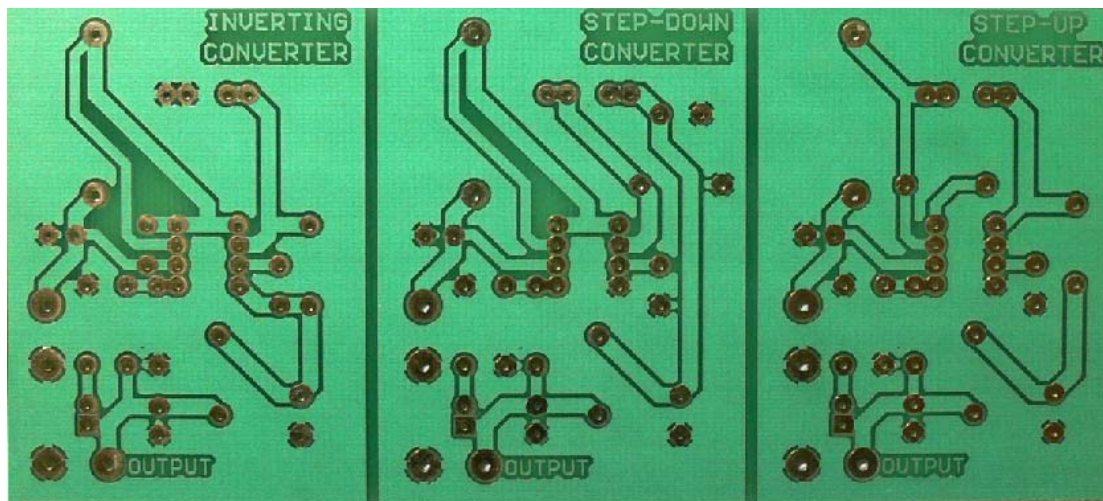


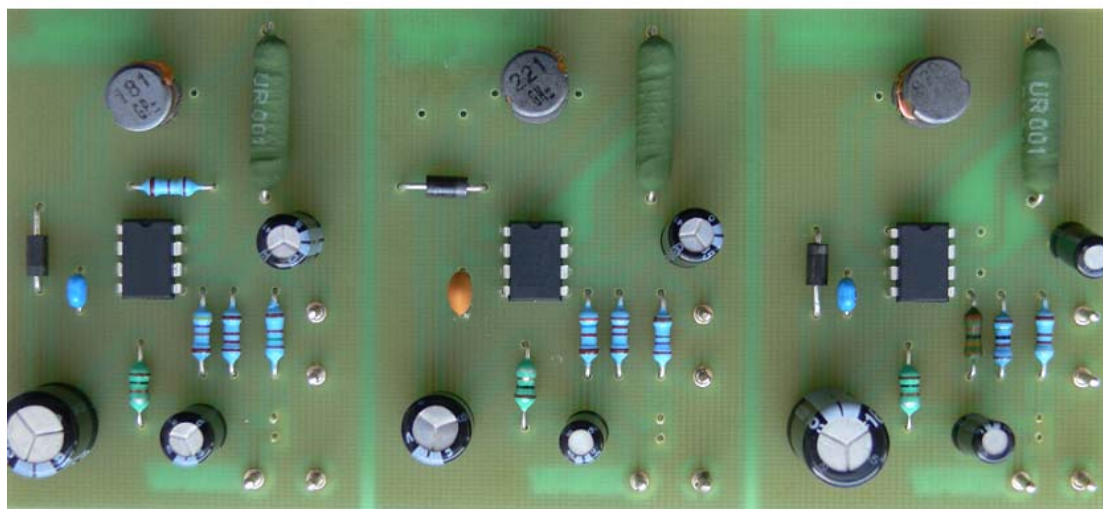
Figure 14. External Current Boost Connections for I_C Peak Greater than 1.5 A

13a. External NPN Switch

13b. External PNP Saturated Switch



(Bottom Side)



(Top View, Component Side)

Figure 15. Printed Circuit Board and Component Layout
(Circuits of Figures 9, 11, 13)

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, SC34063A, SC33063A, NCV33063A

| 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 17. Design Formula Table

MC34063A, MC33063A, SC34063A, SC33063A, NCV33063A

ORDERING INFORMATION

| Device | Package | Shipping† |
|-----------------|---------------------|--------------------------|
| MC33063AD | SOIC-8 | 98 Units / Rail |
| MC33063ADG | SOIC-8 (Pb-Free) | 98 Units / Rail |
| MC33063ADR2 | SOIC-8 | 2500 Units / Tape & Reel |
| MC33063ADR2G | SOIC-8 (Pb-Free) | 2500 Units / Tape & Reel |
| SC33063ADR2G | SOIC-8 (Pb-Free) | 2500 Units / Tape & Reel |
| MC33063AP1 | PDIP-8 | 50 Units / Rail |
| MC33063AP1G | PDIP-8 (Pb-Free) | 50 Units / Rail |
| MC33063AVD | SOIC-8 | 98 Units / Rail |
| MC33063AVDG | SOIC-8 (Pb-Free) | 98 Units / Rail |
| MC33063AVDR2 | SOIC-8 | 2500 Units / Tape & Reel |
| MC33063AVDR2G | SOIC-8 (Pb-Free) | |
| NCV33063AVDR2* | SOIC-8 | |
| NCV33063AVDR2G* | SOIC-8 (Pb-Free) | |
| MC33063AVP | PDIP-8 | 50 Units / Rail |
| MC33063AVPG | PDIP-8 (Pb-Free) | 50 Units / Rail |
| MC34063AD | SOIC-8 | 98 Units / Rail |
| MC34063ADG | SOIC-8 (Pb-Free) | 98 Units / Rail |
| MC34063ADR2 | SOIC-8 | 2500 Units / Tape & Reel |
| MC34063ADR2G | SOIC-8 (Pb-Free) | 2500 Units / Tape & Reel |
| SC34063ADR2G | SOIC-8 (Pb-Free) | 2500 Units / Tape & Reel |
| MC34063AP1 | PDIP-8 | 50 Units / Rail |
| MC34063AP1G | PDIP-8 (Pb-Free) | 50 Units / Rail |
| SC34063AP1G | PDIP-8 (Pb-Free) | 50 Units / Rail |
| MC33063MNTXG | DFN8 (Pb-Free) | 4000 Units / Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

*NCV33063A: T_{low} = -40°C, T_{high} = +125°C. Guaranteed by design. NCV prefix is for automotive and other applications requiring site and change control.

PACKAGE DIMENSIONS

SOIC-8 NB
CASE 751-07
ISSUE AJ

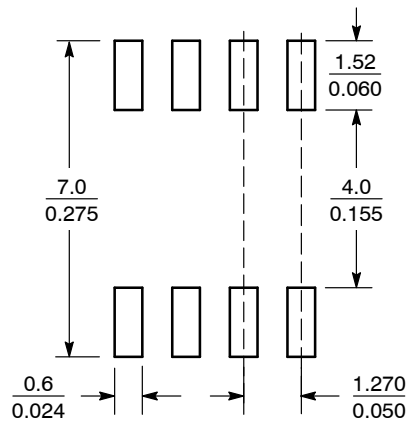


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION 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.
6. 751-01 THRU 751-06 ARE OBSOLETE. NEW STANDARD IS 751-07.

| DIM | MILLIMETERS | | INCHES | |
|-----|----------------|----------------|----------------|----------------|
| | MIN | MAX | MIN | MAX |
| A | 4.80 | 5.00 | 0.189 | 0.197 |
| B | 3.80 | 4.00 | 0.150 | 0.157 |
| C | 1.35 | 1.75 | 0.053 | 0.069 |
| D | 0.33 | 0.51 | 0.013 | 0.020 |
| G | 1.27 BSC | | 0.050 BSC | |
| H | 0.10 | 0.25 | 0.004 | 0.010 |
| J | 0.19 | 0.25 | 0.007 | 0.010 |
| K | 0.40 | 1.27 | 0.016 | 0.050 |
| M | 0 ^o | 8 ^o | 0 ^o | 8 ^o |
| N | 0.25 | 0.50 | 0.010 | 0.020 |
| S | 5.80 | 6.20 | 0.228 | 0.244 |

SOLDERING FOOTPRINT*

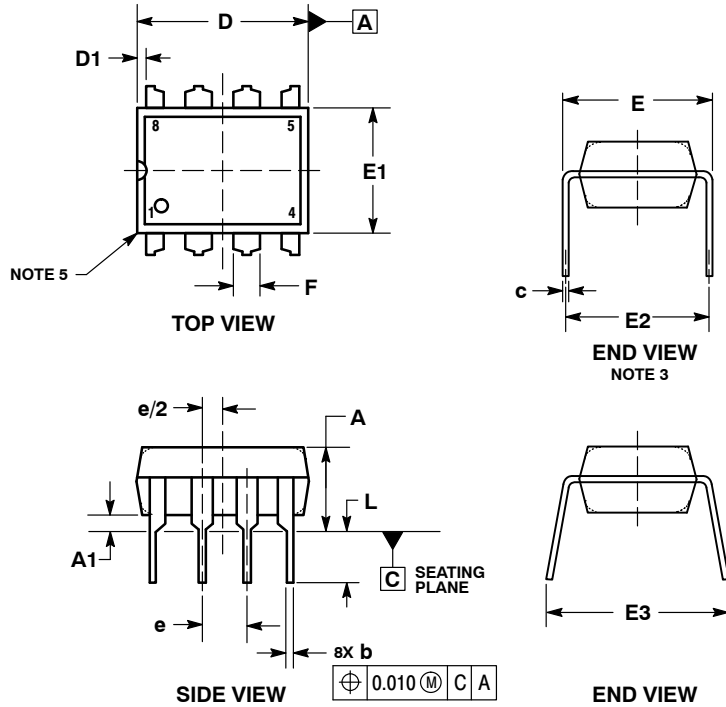


SCALE 6:1 $\left(\frac{\text{mm}}{\text{inches}}\right)$

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

PACKAGE DIMENSIONS

PDIP-8
P, P1 SUFFIX
CASE 626-05
ISSUE M



NOTES:

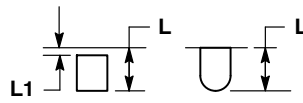
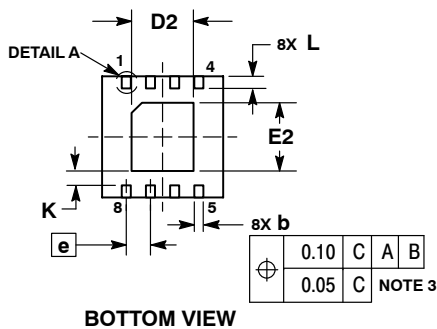
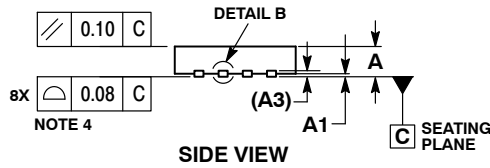
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. DIMENSION E IS MEASURED WITH THE LEADS RESTRAINED PARALLEL AT WIDTH E2.
4. DIMENSION E1 DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

| DIM | INCHES | | | MILLIMETERS | | |
|-----|-----------|-------|-------|-------------|-------|-------|
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | ----- | ----- | 0.210 | ----- | ----- | 5.33 |
| A1 | 0.015 | ----- | ----- | 0.38 | ----- | ----- |
| b | 0.014 | 0.018 | 0.022 | 0.35 | 0.46 | 0.56 |
| C | 0.008 | 0.010 | 0.014 | 0.20 | 0.25 | 0.36 |
| D | 0.355 | 0.365 | 0.400 | 9.02 | 9.27 | 10.02 |
| D1 | 0.005 | ----- | ----- | 0.13 | ----- | ----- |
| E | 0.300 | 0.310 | 0.325 | 7.62 | 7.87 | 8.26 |
| E1 | 0.240 | 0.250 | 0.280 | 6.10 | 6.35 | 7.11 |
| E2 | 0.300 BSC | | | 7.62 BSC | | |
| E3 | ----- | ----- | 0.430 | ----- | ----- | 10.92 |
| e | 0.100 BSC | | | 2.54 BSC | | |
| L | 0.115 | 0.130 | 0.150 | 2.92 | 3.30 | 3.81 |

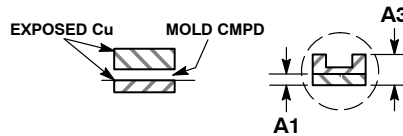
MC34063A, MC33063A, SC34063A, SC33063A, NCV33063A

PACKAGE DIMENSIONS

DFN8, 4x4
CASE 488AF-01
ISSUE C



DETAIL A
OPTIONAL
CONSTRUCTIONS



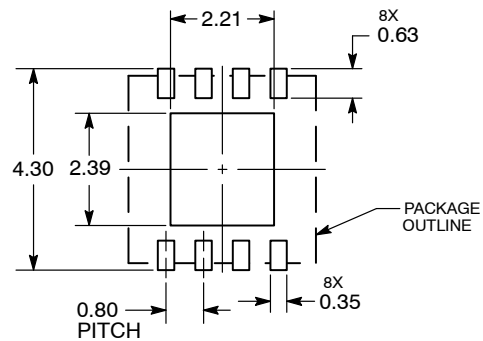
DETAIL B
ALTERNATE
CONSTRUCTIONS

NOTES:

1. DIMENSIONS AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30MM FROM TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.
5. DETAILS A AND B SHOW OPTIONAL CONSTRUCTIONS FOR TERMINALS.

| MILLIMETERS | | |
|-------------|------|------|
| DIM | MIN | MAX |
| A | 0.80 | 1.00 |
| A1 | 0.00 | 0.05 |
| A3 | 0.20 | REF |
| b | 0.25 | 0.35 |
| D | 4.00 | BSC |
| D2 | 1.91 | 2.21 |
| E | 4.00 | BSC |
| E2 | 2.09 | 2.39 |
| e | 0.80 | BSC |
| K | 0.20 | --- |
| L | 0.30 | 0.50 |
| L1 | --- | 0.15 |

SOLDERING 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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