

## MC3x063A 1.5-A Peak Boost/Buck/Inverting Switching Regulators

### 1 Features

- Wide Input Voltage Range: 3 V to 40 V
- High Output Switch Current: Up to 1.5 A
- Adjustable Output Voltage
- Oscillator Frequency Up to 100 kHz
- Precision Internal Reference: 2%
- Short-Circuit Current Limiting
- Low Standby Current

### 2 Applications

- Blood Gas Analyzers: Portable
- Cable Solutions
- HMIs (Human Machine Interfaces)
- Telecommunications
- Portable Devices
- Consumer & Computing
- Test & Measurement

### 3 Description

The MC33063A and MC34063A devices are easy-to-use ICs containing all the primary circuitry needed for building simple DC-DC converters. These devices primarily consist of an internal temperature-compensated reference, a comparator, an oscillator, a PWM controller with active current limiting, a driver, and a high-current output switch. Thus, the devices require minimal external components to build converters in the boost, buck, and inverting topologies.

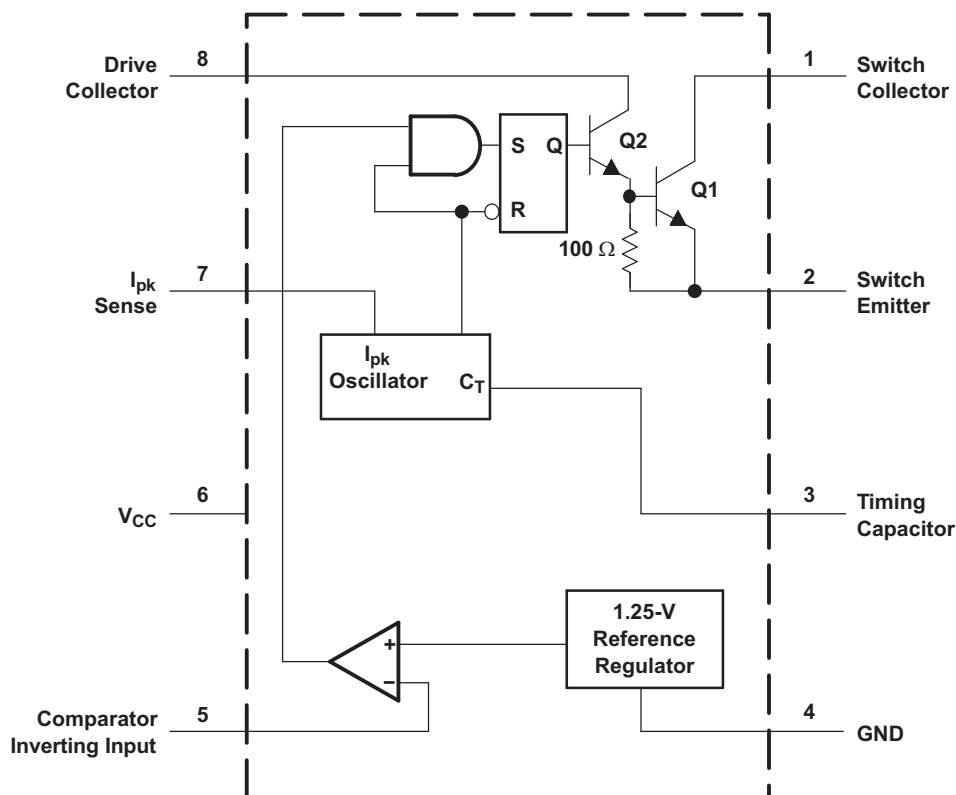
The MC33063A device is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ , while the MC34063A device is characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

#### Device Information<sup>(1)</sup>

| PART NUMBER | PACKAGE (PIN) | BODY SIZE         |
|-------------|---------------|-------------------|
| MC3x063A    | SOIC (8)      | 4.90 mm x 3.91 mm |
|             | SON (8)       | 4.00 mm x 4.00 mm |
|             | PDIP (8)      | 9.81 mm x 6.35 mm |

(1) For all available packages, see the orderable addendum at the end of the data sheet.

### 4 Simplified Schematic



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## 5 Revision History

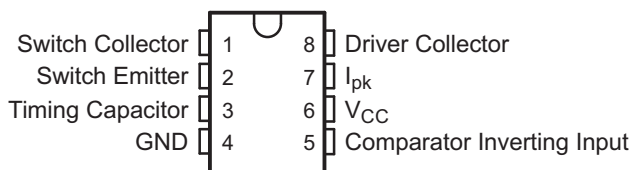
### Changes from Revision M (January 2011) to Revision N

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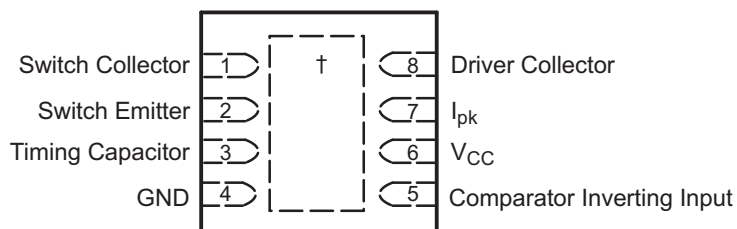
|   |          |
|---|----------|
| <ul style="list-style-type: none"> <li>Added <i>Applications</i>, <i>Device Information</i> table, <i>Pin Functions</i> table, <i>ESD Ratings</i> table, <i>Thermal Information</i> table, <i>Feature Description</i> section, <i>Device Functional Modes</i>, <i>Application and Implementation</i> section, <i>Power Supply Recommendations</i> section, <i>Layout</i> section, <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section. ....</li> </ul> | <b>1</b> |
| <ul style="list-style-type: none"> <li>Deleted <i>Ordering Information</i> table. ....</li> </ul>   | <b>1</b> |

## 6 Pin Configuration and Functions

**D (SOIC) OR P (PDIP) PACKAGE  
(TOP VIEW)**



**DRJ (QFN) PACKAGE  
(TOP VIEW)**



† The exposed thermal pad is electrically bonded internally to pin 4 (GND) .

### Pin Functions

| PIN                        |     | TYPE | DESCRIPTION   |
|----------------------------|-----|------|---|
| NAME                       | NO. |      |   |
| Switch Collector           | 1   | I/O  | High-current internal switch collector input.                   |
| Switch Emitter             | 2   | I/O  | High-current internal switch emitter output.                    |
| Timing Capacitor           | 3   | —    | Attach a timing capacitor to change the switching frequency.    |
| GND                        | 4   | —    | Ground  |
| Comparator Inverting Input | 5   | I    | Attach to a resistor divider network to create a feedback loop. |
| V <sub>CC</sub>            | 6   | I    | Logic supply voltage. Tie to V <sub>IN</sub> .                  |
| I <sub>PK</sub>            | 7   | I    | Current-limit sense input.                                      |
| Driver Collector           | 8   | I/O  | Darlington pair driving transistor collector input.             |

## 7 Specifications

### 7.1 Absolute Maximum Ratings

 over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

|                         |  | MIN  | MAX                      | UNIT |
|-------------------------|--|------|--------------------------|------|
| V <sub>CC</sub>         | Supply voltage                             |      | 40                       | V    |
| V <sub>IR</sub>         | Comparator inverting input voltage range   | -0.3 | 40                       | V    |
| V <sub>C(switch)</sub>  | Switch collector voltage                   |      | 40                       | V    |
| V <sub>E(switch)</sub>  | Switch emitter voltage                     |      | 40                       | V    |
|                         |  |      | V <sub>PIN1</sub> = 40 V |      |
| V <sub>CE(switch)</sub> | Switch collector to switch emitter voltage |      | 40                       | V    |
| V <sub>C(driver)</sub>  | Driver collector voltage                   |      | 40                       | V    |
| I <sub>C(driver)</sub>  | Driver collector current                   |      | 100                      | mA   |
| I <sub>SW</sub>         | Switch current                             |      | 1.5                      | A    |
| T <sub>J</sub>          | Operating virtual junction temperature     |      | 150                      | °C   |
| T <sub>stg</sub>        | Storage temperature range                  | -65  | 150                      | °C   |

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

### 7.2 ESD Ratings

|                    |                         | VALUE  | UNIT |
|--------------------|-------------------------|--|------|
| V <sub>(ESD)</sub> | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins <sup>(1)</sup>              | 2500 |
|                    |                         | Charged device model (CDM), per JEDEC specification JESD22-C101, all pins <sup>(2)</sup> | 1500 |
|                    |                         |  | V    |

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

### 7.3 Recommended Operating Conditions

|                 |                                | MIN      | MAX | UNIT |
|-----------------|--------------------------------|----------|-----|------|
| V <sub>CC</sub> | Supply voltage                 | 3        | 40  | V    |
| T <sub>A</sub>  | Operating free-air temperature | MC33063A | -40 | 85   |
|                 |                                | MC34063A | 0   | 70   |
|                 |                                |          |     | °C   |

### 7.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> | MC33063A                               |     |    | UNIT |      |
|-------------------------------|--|-----|----|------|------|
|                               | D                                      | DRJ | P  |      |      |
|                               | 8 PINS                                 |     |    |      |      |
| R <sub>θJA</sub>              | Junction-to-ambient thermal resistance | 97  | 41 | 85   | °C/W |

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report ([SPRA953](#)).

### 7.5 Electrical Characteristics—Oscillator

 V<sub>CC</sub> = 5 V, T<sub>A</sub> = full operating range (unless otherwise noted) (see block diagram)

| PARAMETER                             | TEST CONDITIONS                   | T <sub>A</sub>                                 | MIN  | TYP | MAX | UNIT |     |
|---------------------------------------|-----------------------------------|--|------|-----|-----|------|-----|
| f <sub>osc</sub>                      | Oscillator frequency              | V <sub>PIN5</sub> = 0 V, C <sub>T</sub> = 1 nF | 25°C | 24  | 33  | 42   | kHz |
| I <sub>chg</sub>                      | Charge current                    | V <sub>CC</sub> = 5 V to 40 V                  | 25°C | 24  | 35  | 42   | μA  |
| I <sub>dischg</sub>                   | Discharge current                 | V <sub>CC</sub> = 5 V to 40 V                  | 25°C | 140 | 220 | 260  | μA  |
| I <sub>dischg</sub> /I <sub>chg</sub> | Discharge-to-charge current ratio | V <sub>PIN7</sub> = V <sub>CC</sub>            | 25°C | 5.2 | 6.5 | 7.5  | —   |
| V <sub>lpk</sub>                      | Current-limit sense voltage       | I <sub>dischg</sub> = I <sub>chg</sub>         | 25°C | 250 | 300 | 350  | mV  |

## 7.6 Electrical Characteristics—Output Switch

 $V_{CC} = 5\text{ V}$ ,  $T_A =$  full operating range (unless otherwise noted) (see block diagram)<sup>(1)</sup>

| PARAMETER     |   | TEST CONDITIONS  | $T_A$      | MIN | TYP  | MAX | UNIT          |
|---------------|---|--|------------|-----|------|-----|---------------|
| $V_{CE(sat)}$ | Saturation voltage – Darlington connection                    | $I_{SW} = 1\text{ A}$ , pins 1 and 8 connected                                       | Full range |     | 1    | 1.3 | V             |
| $V_{CE(sat)}$ | Saturation voltage – non-Darlington connection <sup>(2)</sup> | $I_{SW} = 1\text{ A}$ , $R_{PIN8} = 82\ \Omega$ to $V_{CC}$ , forced $\beta \sim 20$ | Full range |     | 0.45 | 0.7 | V             |
| $h_{FE}$      | DC current gain   | $I_{SW} = 1\text{ A}$ , $V_{CE} = 5\text{ V}$  | 25°C       | 50  | 75   |     | —             |
| $I_{C(off)}$  | Collector off-state current                                   | $V_{CE} = 40\text{ V}$   | Full range |     | 0.01 | 100 | $\mu\text{A}$ |

(1) Low duty-cycle pulse testing is used to maintain junction temperature as close to ambient temperature as possible.

(2) In the non-Darlington configuration, if the output switch is driven into hard saturation at low switch currents ( $\leq 300\text{ mA}$ ) and high driver currents ( $\geq 30\text{ mA}$ ), it may take up to  $2\ \mu\text{s}$  for the switch to come out of saturation. This condition effectively shortens the off time at frequencies  $\geq 30\text{ kHz}$ , becoming magnified as temperature increases. The following output drive condition is recommended in the non-Darlington configuration:

Forced  $\beta$  of output switch =  $I_{C,SW} / (I_{C,driver} - 7\text{ mA}) \geq 10$ , where  $\sim 7\text{ mA}$  is required by the  $100\text{-}\Omega$  resistor in the emitter of the driver to forward bias the  $V_{be}$  of the switch.

## 7.7 Electrical Characteristics—Comparator

 $V_{CC} = 5\text{ V}$ ,  $T_A =$  full operating range (unless otherwise noted) (see block diagram)

| PARAMETER       |                                   | TEST CONDITIONS                        | $T_A$      | MIN   | TYP  | MAX   | UNIT |
|-----------------|-----------------------------------|--|------------|-------|------|-------|------|
| $V_{th}$        | Threshold voltage                 |  | 25°C       | 1.225 | 1.25 | 1.275 | V    |
|                 |                                   |  | Full range | 1.21  |      | 1.29  |      |
| $\Delta V_{th}$ | Threshold-voltage line regulation | $V_{CC} = 5\text{ V}$ to $40\text{ V}$ | Full range |       | 1.4  | 5     | mV   |
| $I_{IB}$        | Input bias current                | $V_{IN} = 0\text{ V}$                  | Full range |       | -20  | -400  | nA   |

## 7.8 Electrical Characteristics—Total Device

 $V_{CC} = 5\text{ V}$ ,  $T_A =$  full operating range (unless otherwise noted) (see block diagram)

| PARAMETER |                | TEST CONDITIONS  | $T_A$      | MIN | MAX | UNIT |
|-----------|----------------|--|------------|-----|-----|------|
| $I_{CC}$  | Supply current | $V_{CC} = 5\text{ V}$ to $40\text{ V}$ , $C_T = 1\text{ nF}$ , $V_{PIN7} = V_{CC}$ , $V_{PIN5} > V_{th}$ , $V_{PIN2} = \text{GND}$ , All other pins open | Full range |     | 4   | mA   |

## 7.9 Typical Characteristics

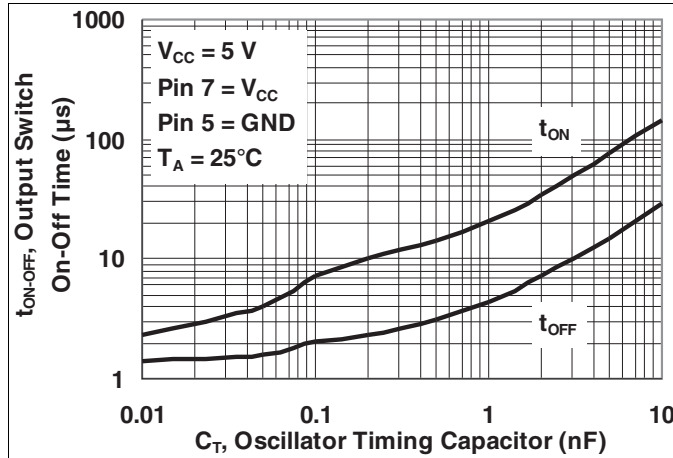


Figure 1. Output Switch On-Off Time vs Oscillator Timing Capacitor

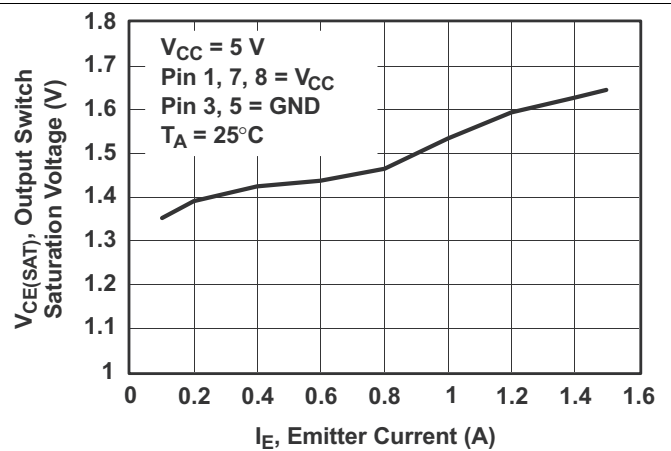


Figure 2. Output Switch Saturation Voltage vs Emitter Current (Emitter-Follower Configuration)

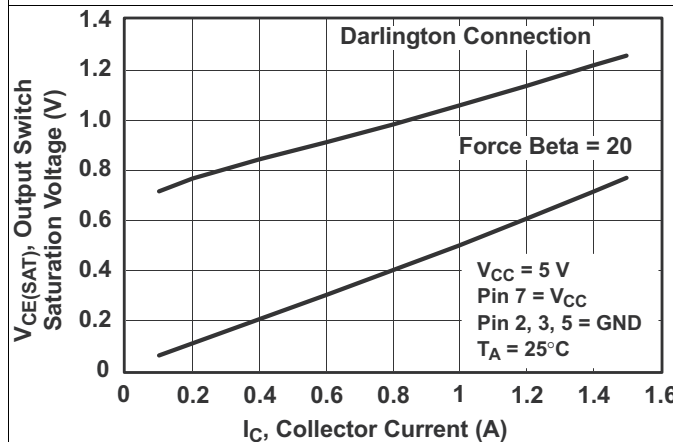


Figure 3. Output Switch Saturation Voltage vs Collector Current (Common-Emitter Configuration)

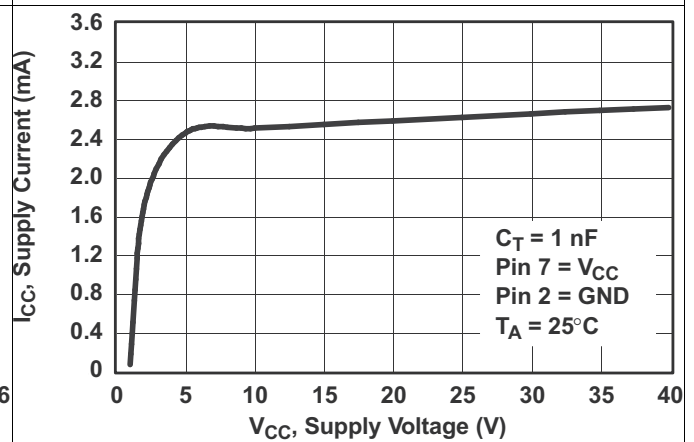


Figure 4. Standby Supply Current vs Supply Voltage

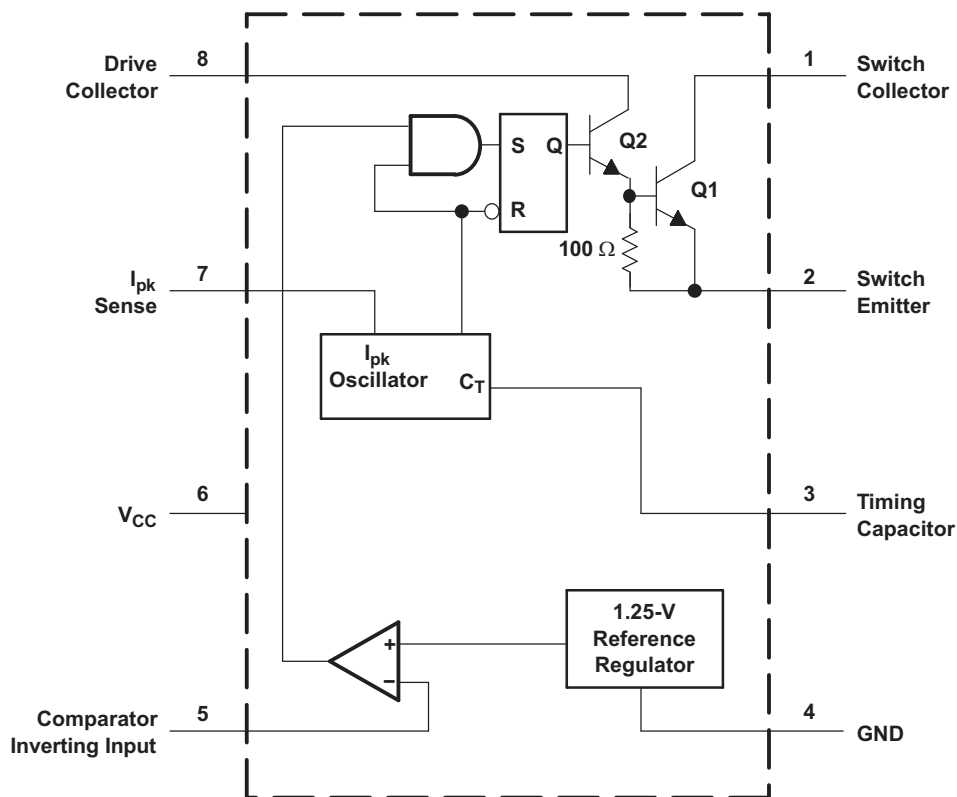
## 8 Detailed Description

### 8.1 Overview

The MC33063A and MC34063A devices are easy-to-use ICs containing all the primary circuitry needed for building simple DC-DC converters. These devices primarily consist of an internal temperature-compensated reference, a comparator, an oscillator, a PWM controller with active current limiting, a driver, and a high-current output switch. Thus, the devices require minimal external components to build converters in the boost, buck, and inverting topologies.

The MC33063A device is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ , while the MC34063A device is characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

### 8.2 Functional Block Diagram



### 8.3 Feature Description

- Wide Input Voltage Range: 3 V to 40 V
- High Output Switch Current: Up to 1.5 A
- Adjustable Output Voltage
- Oscillator Frequency Up to 100 kHz
- Precision Internal Reference: 2%
- Short-Circuit Current Limiting
- Low Standby Current

### 8.4 Device Functional Modes

#### 8.4.1 Standard operation

Based on the application, the device can be configured in multiple different topologies. See the [Application and Implementation](#) section for how to configure the device in several different operating modes.

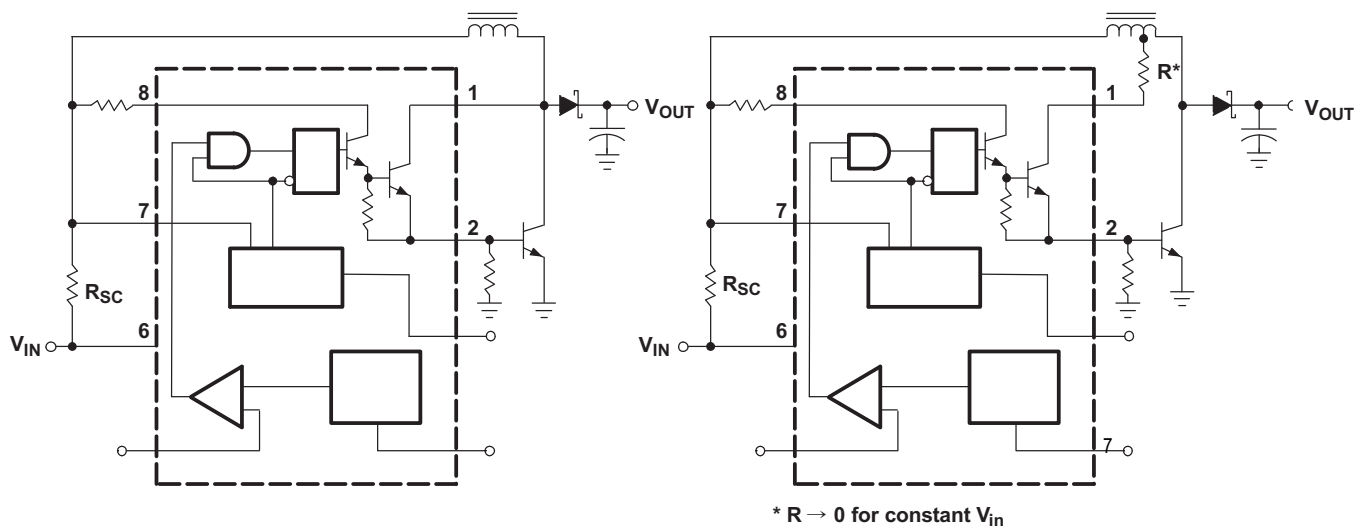
## 9 Application and Implementation

### NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

### 9.1 Application Information

#### 9.1.1 External Switch Configurations for Higher Peak Current



a) EXTERNAL npn SWITCH

b) EXTERNAL npn SATURATED SWITCH (see Note A)

- A. If the output switch is driven into hard saturation (non-Darlington configuration) at low switch currents ( $\leq 300$  mA) and high driver currents ( $\geq 30$  mA), it may take up to  $2 \mu\text{s}$  to come out of saturation. This condition will shorten the off time at frequencies  $\geq 30$  kHz and is magnified at high temperatures. This condition does not occur with a Darlington configuration because the output switch cannot saturate. If a non-Darlington configuration is used, the output drive configuration in Figure 7b is recommended.

**Figure 5. Boost Regulator Connections for  $I_C$  Peak Greater Than 1.5 A**



Application Information (continued)

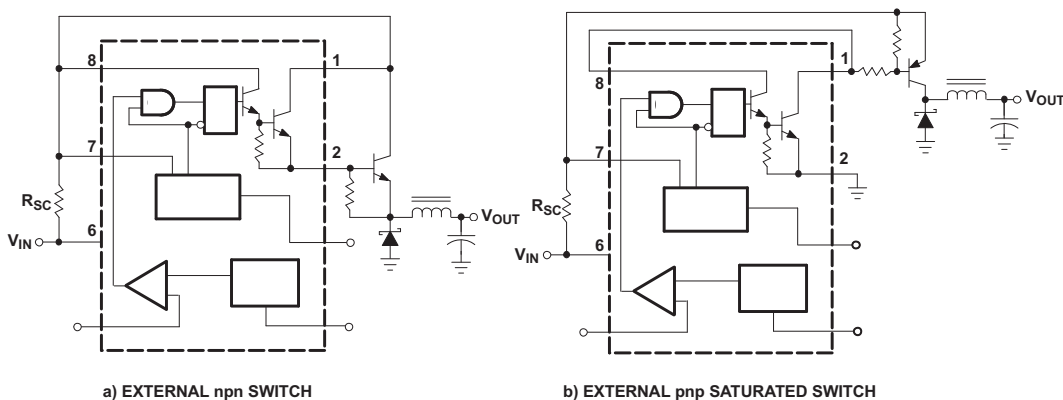


Figure 6. Buck Regulator Connections for  $I_C$  Peak Greater Than 1.5 A

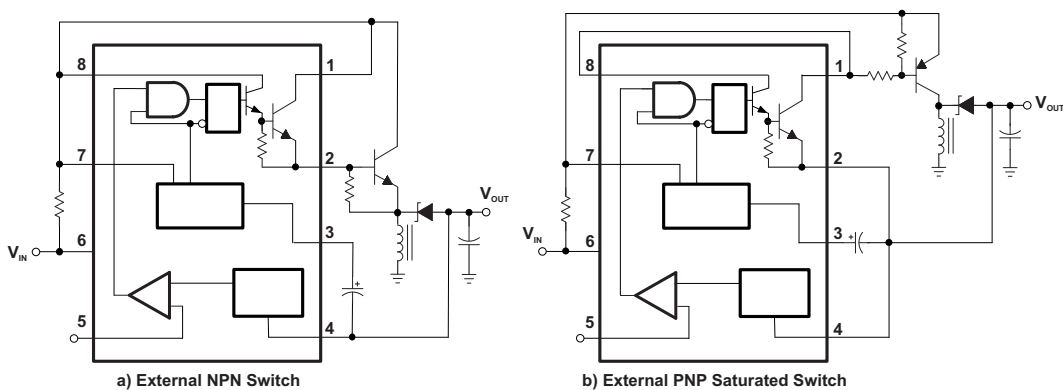
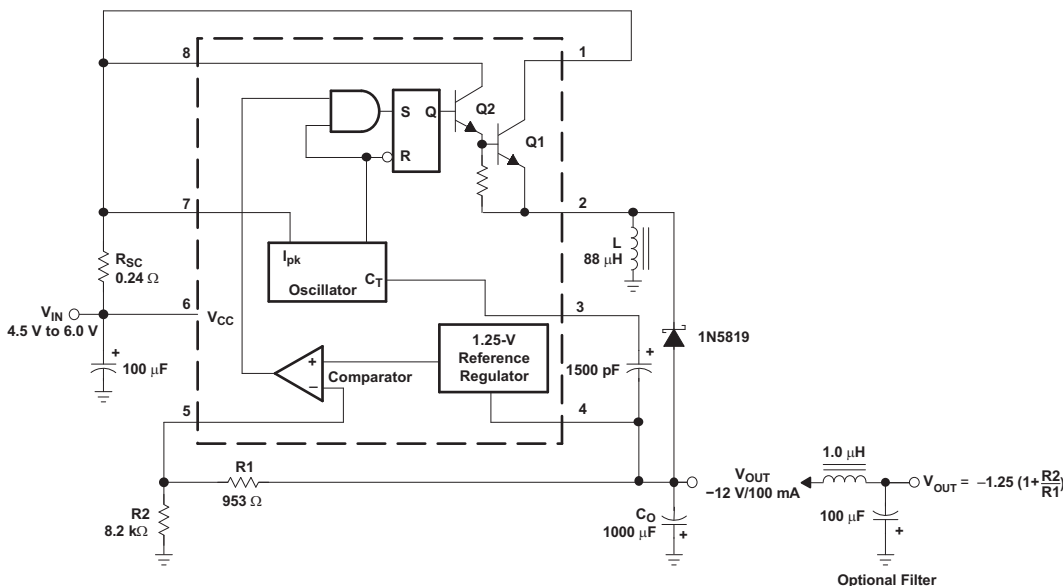


Figure 7. Inverting Regulator Connections for  $I_C$  Peak Greater Than 1.5 A

9.2 Typical Application

9.2.1 Voltage-Inverting Converter Application



**Typical Application (continued)****Figure 8. Voltage-Inverting Converter**

## Typical Application (continued)

### 9.2.1.1 Design Requirements

The user must determine the following desired parameters:

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

$V_F$  = Forward voltage drop of the chosen output rectifier

The following power-supply parameters are set by the user:

$V_{in}$  = Nominal input voltage

$V_{out}$  = Desired output voltage

$I_{out}$  = Desired output current

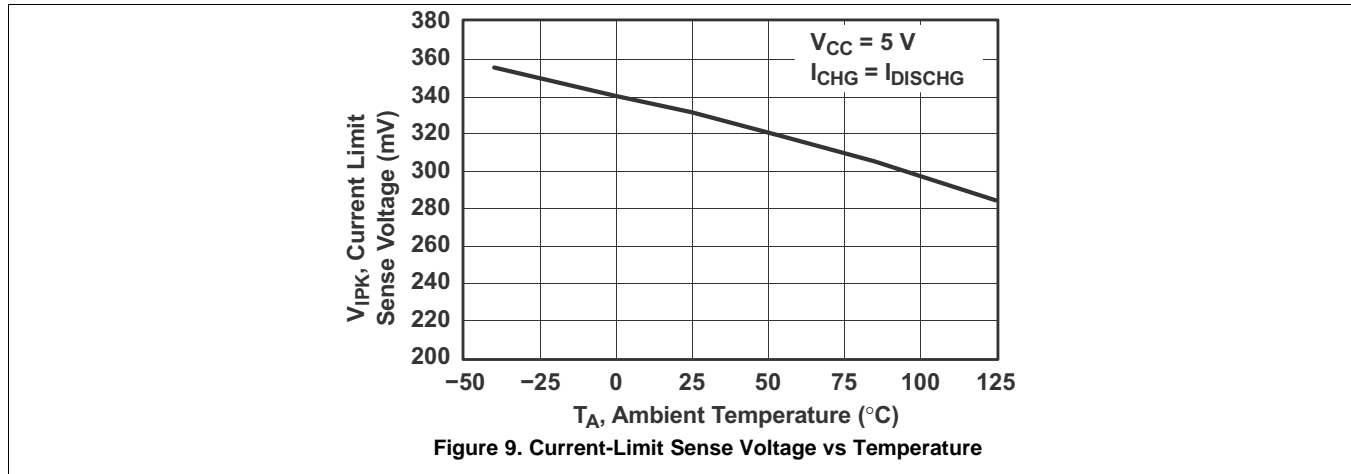
$f_{min}$  = Minimum desired output switching frequency at the selected values of  $V_{in}$  and  $I_{out}$

$V_{ripple}$  = Desired peak-to-peak output ripple voltage. The ripple voltage directly affects the line and load regulation and, thus, must be considered. In practice, the actual capacitor value should be larger than the calculated value, to account for the capacitor's equivalent series resistance and board layout.

### 9.2.1.2 Detailed Design Procedure

| CALCULATION          | VOLTAGE INVERTING   |
|----------------------|---|
| $t_{on}/t_{off}$     | $\frac{ V_{out}  + V_F}{V_{in} - V_{sat}}$                                  |
| $(t_{on} + t_{off})$ | $\frac{1}{f}$   |
| $t_{off}$            | $\frac{t_{on} + t_{off}}{\frac{t_{on}}{t_{off}} + 1}$                       |
| $t_{on}$             | $(t_{on} + t_{off}) - t_{off}$  |
| $C_T$                | $4 \times 10^{-5} t_{on}$   |
| $I_{pk(switch)}$     | $2I_{out(max)} \left( \frac{t_{on}}{t_{off}} + 1 \right)$                   |
| $R_{SC}$             | $\frac{0.3}{I_{pk(switch)}}$  |
| $L_{(min)}$          | $\left( \frac{(V_{in(min)} - V_{sat})}{I_{pk(switch)}} \right) t_{on(max)}$ |
| $C_O$                | $9 \frac{I_{out} t_{on}}{V_{ripple(pp)}}$                                   |
| $V_{out}$            | $-1.25 \left( 1 + \frac{R2}{R1} \right)$<br>See <a href="#">Figure 8</a>    |

### 9.2.1.3 Application Performance



| TEST                               | CONDITIONS   | RESULTS                     |
|------------------------------------|--|-----------------------------|
| Line regulation                    | $V_{IN} = 4.5\text{ V to }6\text{ V}, I_O = 100\text{ mA}$ | $3\text{ mV} \pm 0.12\%$    |
| Load regulation                    | $V_{IN} = 5\text{ V}, I_O = 10\text{ mA to }100\text{ mA}$ | $0.022\text{ V} \pm 0.09\%$ |
| Output ripple                      | $V_{IN} = 5\text{ V}, I_O = 100\text{ mA}$                 | $500\text{ mV}_{PP}$        |
| Short-circuit current              | $V_{IN} = 5\text{ V}, R_L = 0.1\ \Omega$                   | $910\text{ mA}$             |
| Efficiency                         | $V_{IN} = 5\text{ V}, I_O = 100\text{ mA}$                 | $62.2\%$                    |
| Output ripple with optional filter | $V_{IN} = 5\text{ V}, I_O = 100\text{ mA}$                 | $70\text{ mV}_{PP}$         |

## 9.2.2 Step-Up Converter Application

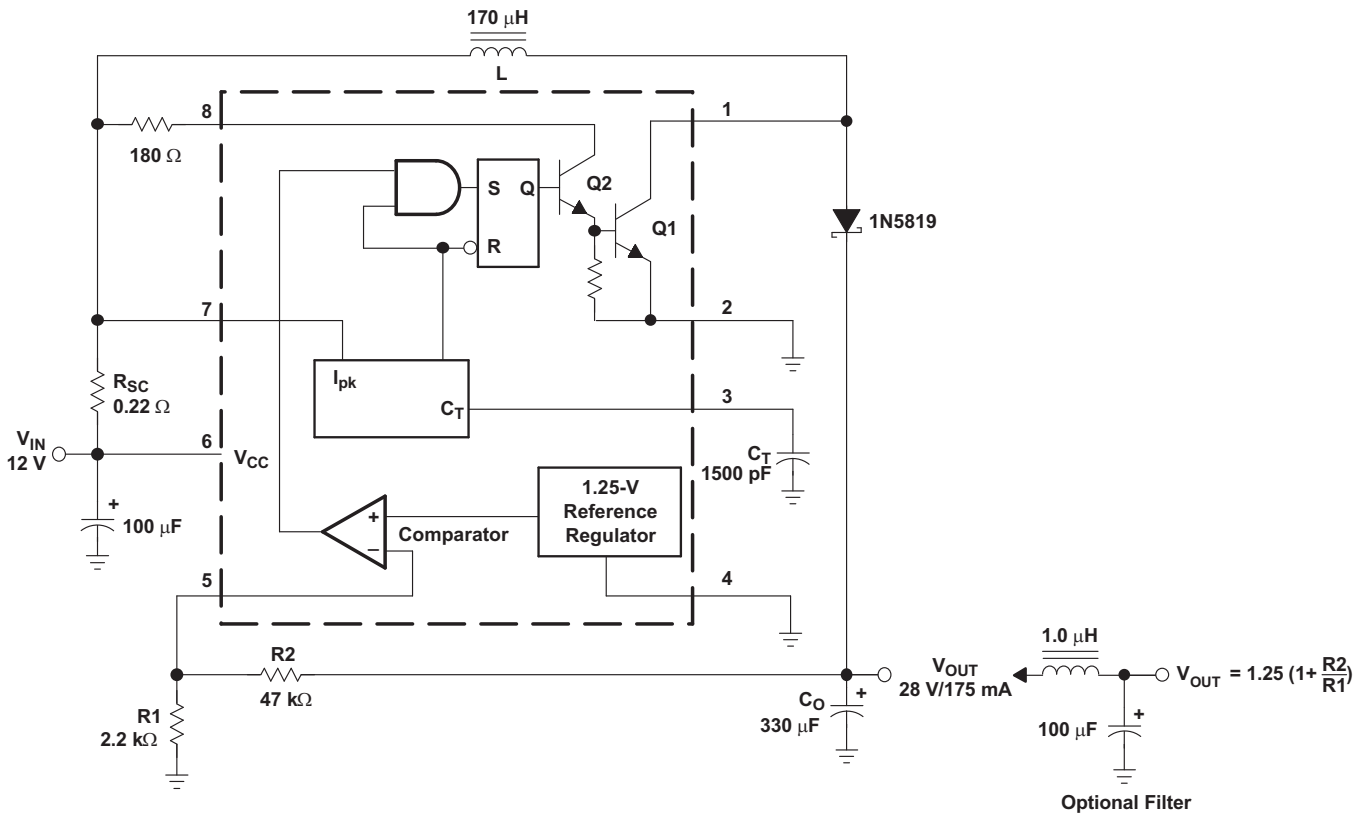


Figure 10. Step-Up Converter

### 9.2.2.1 Design Requirements

The user must determine the following desired parameters:

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

$V_F$  = Forward voltage drop of the chosen output rectifier

The following power-supply parameters are set by the user:

$V_{in}$  = Nominal input voltage

$V_{out}$  = Desired output voltage

$I_{out}$  = Desired output current

$f_{min}$  = Minimum desired output switching frequency at the selected values of  $V_{in}$  and  $I_{out}$

$V_{ripple}$  = Desired peak-to-peak output ripple voltage. The ripple voltage directly affects the line and load regulation and, thus, must be considered. In practice, the actual capacitor value should be larger than the calculated value, to account for the capacitor's equivalent series resistance and board layout.

### 9.2.2.2 Detailed Design Procedure

| CALCULATION          | STEP UP   |
|----------------------|---|
| $t_{on}/t_{off}$     | $\frac{V_{out} + V_{F-Vin(min)}}{V_{in(min)} - V_{sat}}$                  |
| $(t_{on} + t_{off})$ | $\frac{1}{f}$   |
| $t_{off}$            | $\frac{t_{on} + t_{off}}{\frac{t_{on}}{t_{off}} + 1}$                     |
| $t_{on}$             | $(t_{on} + t_{off}) - t_{off}$  |
| $C_T$                | $4 \times 10^{-5} t_{on}$   |
| $I_{pk(switch)}$     | $2I_{out(max)} \left( \frac{t_{on}}{t_{off}} + 1 \right)$                 |
| $R_{SC}$             | $\frac{0.3}{I_{pk(switch)}}$  |
| $L_{(min)}$          | $\left( \frac{V_{in(min)} - V_{sat}}{I_{pk(switch)}} \right) t_{on(max)}$ |
| $C_O$                | $9 \frac{I_{out} t_{on}}{V_{ripple(pp)}}$                                 |
| $V_{out}$            | $1.25 \left( 1 + \frac{R2}{R1} \right)$<br>See <a href="#">Figure 10</a>  |

### 9.2.2.3 Application Performance

| TEST                               | CONDITIONS  | RESULTS                     |
|------------------------------------|---|-----------------------------|
| Line regulation                    | $V_{IN} = 8 \text{ V to } 16 \text{ V}, I_O = 175 \text{ mA}$   | $30 \text{ mV} \pm 0.05\%$  |
| Load regulation                    | $V_{IN} = 12 \text{ V}, I_O = 75 \text{ mA to } 175 \text{ mA}$ | $10 \text{ mV} \pm 0.017\%$ |
| Output ripple                      | $V_{IN} = 12 \text{ V}, I_O = 175 \text{ mA}$                   | $400 \text{ mV}_{PP}$       |
| Efficiency                         | $V_{IN} = 12 \text{ V}, I_O = 175 \text{ mA}$                   | $87.7\%$                    |
| Output ripple with optional filter | $V_{IN} = 12 \text{ V}, I_O = 175 \text{ mA}$                   | $40 \text{ mV}_{PP}$        |

### 9.2.3 Step-Down Converter Application

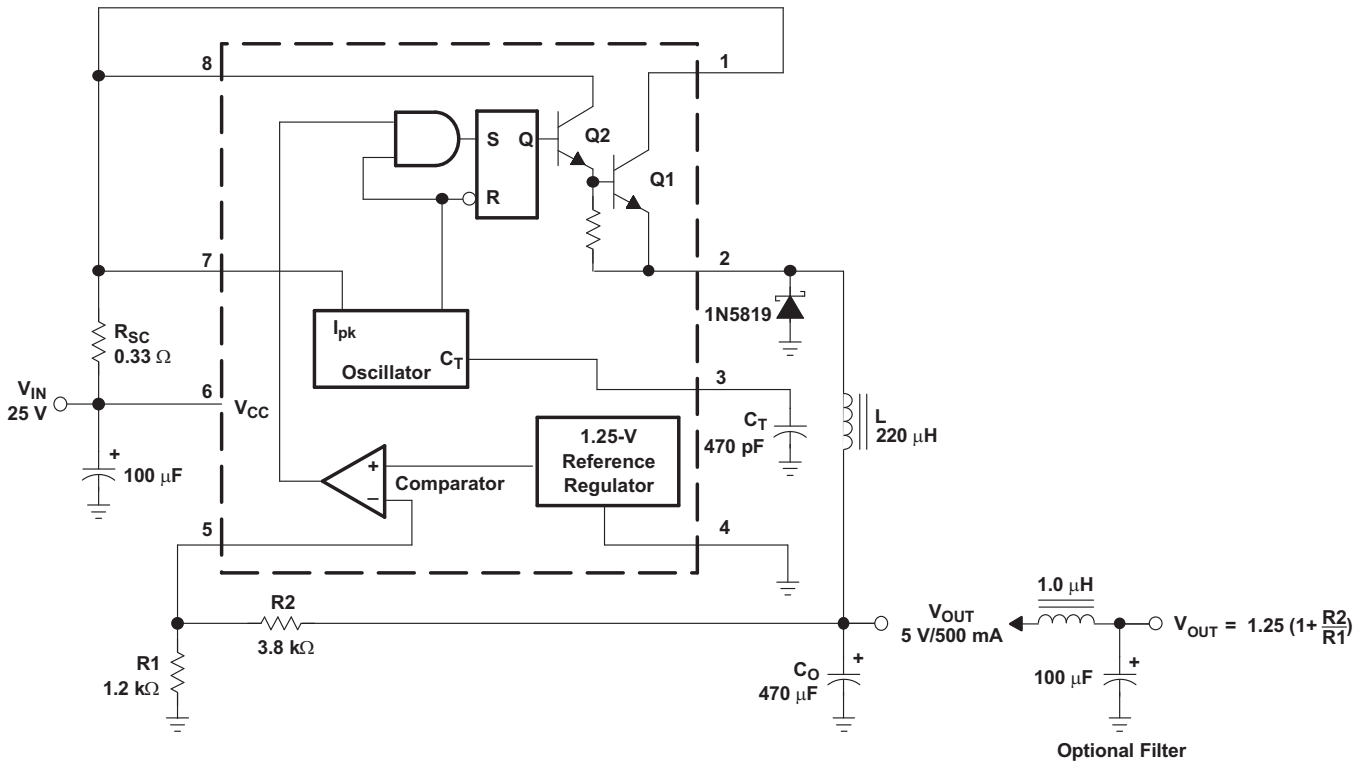


Figure 11. Step-Down Converter

#### 9.2.3.1 Design Requirements

The user must determine the following desired parameters:

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

$V_F$  = Forward voltage drop of the chosen output rectifier

The following power-supply parameters are set by the user:

$V_{in}$  = Nominal input voltage

$V_{out}$  = Desired output voltage

$I_{out}$  = Desired output current

$f_{min}$  = Minimum desired output switching frequency at the selected values of  $V_{in}$  and  $I_{out}$

$V_{ripple}$  = Desired peak-to-peak output ripple voltage. The ripple voltage directly affects the line and load regulation and, thus, must be considered. In practice, the actual capacitor value should be larger than the calculated value, to account for the capacitor's equivalent series resistance and board layout.

### 9.2.3.2 Detailed Design Procedure

| CALCULATION          | STEP DOWN   |
|----------------------|---|
| $t_{on}/t_{off}$     | $\frac{V_{out} + V_F}{V_{in(min)} - V_{sat} - V_{out}}$                                 |
| $(t_{on} + t_{off})$ | $\frac{1}{f}$   |
| $t_{off}$            | $\frac{t_{on} + t_{off}}{\frac{t_{on}}{t_{off}} + 1}$                                   |
| $t_{on}$             | $(t_{on} + t_{off}) - t_{off}$  |
| $C_T$                | $4 \times 10^{-5} t_{on}$   |
| $I_{pk( switch )}$   | $2I_{out(max)}$   |
| $R_{SC}$             | $\frac{0.3}{I_{pk( switch )}}$  |
| $L_{(min)}$          | $\left( \frac{(V_{in(min)} - V_{sat} - V_{out})}{I_{pk( switch )}} \right) t_{on(max)}$ |
| $C_O$                | $\frac{I_{pk( switch )} (t_{on} + t_{off})}{8V_{ripple(pp)}}$                           |
| $V_{out}$            | $1.25 \left( 1 + \frac{R_2}{R_1} \right)$<br>See <a href="#">Figure 11</a>              |

### 9.2.3.3 Application Performance

| 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                    | $V_{IN} = 25 \text{ V}, I_O = 50 \text{ mA to } 500 \text{ mA}$ | $3 \text{ mV} \pm 0.03\%$  |
| Output ripple                      | $V_{IN} = 25 \text{ V}, I_O = 500 \text{ mA}$                   | $120 \text{ mV}_{PP}$      |
| Short-circuit current              | $V_{IN} = 25 \text{ V}, R_L = 0.1 \Omega$                       | $1.1 \text{ A}$            |
| Efficiency                         | $V_{IN} = 25 \text{ V}, I_O = 500 \text{ mA}$                   | $83.7\%$                   |
| Output ripple with optional filter | $V_{IN} = 25 \text{ V}, I_O = 500 \text{ mA}$                   | $40 \text{ mV}_{PP}$       |



## 10 Power Supply Recommendations

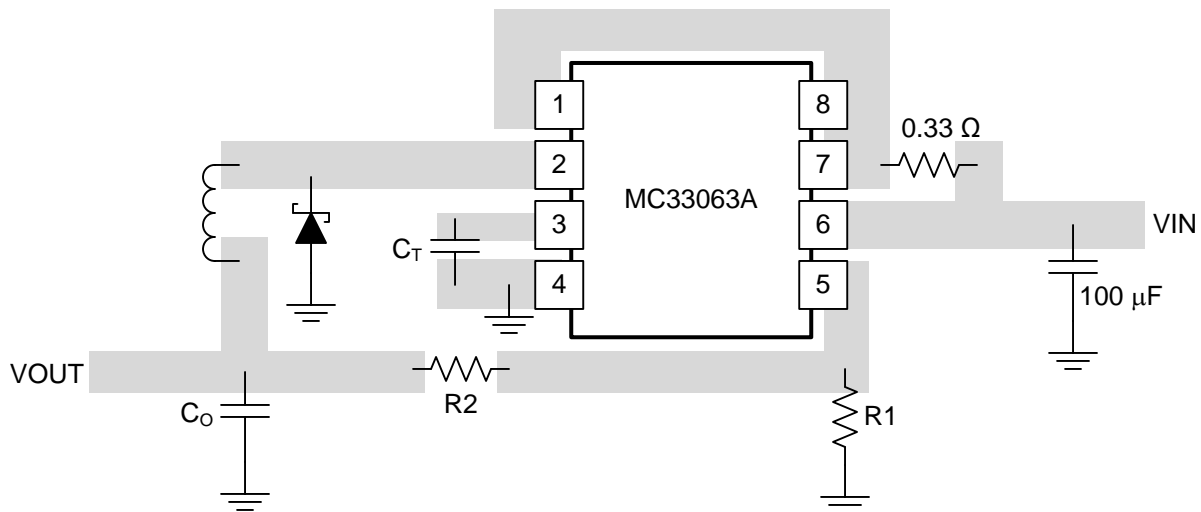
This device accepts 3 V to 40 V on the input. It is recommended to have a 1000- $\mu$ F decoupling capacitor on the input.

## 11 Layout

### 11.1 Layout Guidelines

Keep feedback loop layout trace lengths to a minimum to avoid unnecessary IR drop. In addition, the loop for the decoupling capacitor at the input should be as small as possible. The trace from  $V_{IN}$  to pin 1 of the device should be thicker to handle the higher current.

### 11.2 Layout Example



**Figure 12. Layout Example for a Step-Down Converter**

## 12 Device and Documentation Support

### 12.1 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

Table 1. Related Links

| PARTS    | PRODUCT FOLDER             | SAMPLE & BUY               | TECHNICAL DOCUMENTS        | TOOLS & SOFTWARE           | SUPPORT & COMMUNITY        |
|----------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| MC33063A | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| MC34063A | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |

### 12.2 Trademarks

All trademarks are the property of their respective owners.

### 12.3 Electrostatic Discharge Caution



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

### 12.4 Glossary

[SLYZ022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

## 13 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2) | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| MC33063AD        | ACTIVE        | SOIC         | D               | 8    | 75          | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | M33063A                 | <a href="#">Samples</a> |
| MC33063ADE4      | ACTIVE        | SOIC         | D               | 8    | 75          | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | M33063A                 | <a href="#">Samples</a> |
| MC33063ADG4      | ACTIVE        | SOIC         | D               | 8    | 75          | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | M33063A                 | <a href="#">Samples</a> |
| MC33063ADR       | ACTIVE        | SOIC         | D               | 8    | 2500        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | M33063A                 | <a href="#">Samples</a> |
| MC33063ADRE4     | ACTIVE        | SOIC         | D               | 8    | 2500        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | M33063A                 | <a href="#">Samples</a> |
| MC33063ADRG4     | ACTIVE        | SOIC         | D               | 8    | 2500        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | M33063A                 | <a href="#">Samples</a> |
| MC33063ADRJR     | ACTIVE        | SON          | DRJ             | 8    | 1000        | RoHS & Green    | NIPDAU                               | Level-3-260C-168 HR  | -40 to 85    | ZYF                     | <a href="#">Samples</a> |
| MC33063AP        | ACTIVE        | PDIP         | P               | 8    | 50          | RoHS & Green    | NIPDAU                               | N / A for Pkg Type   | -40 to 85    | MC33063AP               | <a href="#">Samples</a> |
| MC33063APE4      | ACTIVE        | PDIP         | P               | 8    | 50          | RoHS & Green    | NIPDAU                               | N / A for Pkg Type   | -40 to 85    | MC33063AP               | <a href="#">Samples</a> |
| MC34063AD        | ACTIVE        | SOIC         | D               | 8    | 75          | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | M34063A                 | <a href="#">Samples</a> |
| MC34063ADE4      | ACTIVE        | SOIC         | D               | 8    | 75          | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | M34063A                 | <a href="#">Samples</a> |
| MC34063ADG4      | ACTIVE        | SOIC         | D               | 8    | 75          | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | M34063A                 | <a href="#">Samples</a> |
| MC34063ADR       | ACTIVE        | SOIC         | D               | 8    | 2500        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | M34063A                 | <a href="#">Samples</a> |
| MC34063ADRJR     | ACTIVE        | SON          | DRJ             | 8    | 1000        | RoHS & Green    | NIPDAU                               | Level-3-260C-168 HR  | 0 to 70      | ZYF                     | <a href="#">Samples</a> |
| MC34063ADRJRG4   | ACTIVE        | SON          | DRJ             | 8    | 1000        | RoHS & Green    | NIPDAU                               | Level-3-260C-168 HR  | 0 to 70      | ZYF                     | <a href="#">Samples</a> |
| MC34063AP        | ACTIVE        | PDIP         | P               | 8    | 50          | RoHS & Green    | NIPDAU                               | N / A for Pkg Type   | 0 to 70      | MC34063AP               | <a href="#">Samples</a> |
| MC34063APE4      | ACTIVE        | PDIP         | P               | 8    | 50          | RoHS & Green    | NIPDAU                               | N / A for Pkg Type   | 0 to 70      | MC34063AP               | <a href="#">Samples</a> |

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of  $\leq 1000$ ppm threshold. Antimony trioxide based flame retardants must also meet the  $\leq 1000$ ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**OTHER QUALIFIED VERSIONS OF MC33063A :**

- Automotive : [MC33063A-Q1](#)

NOTE: Qualified Version Definitions:

- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**

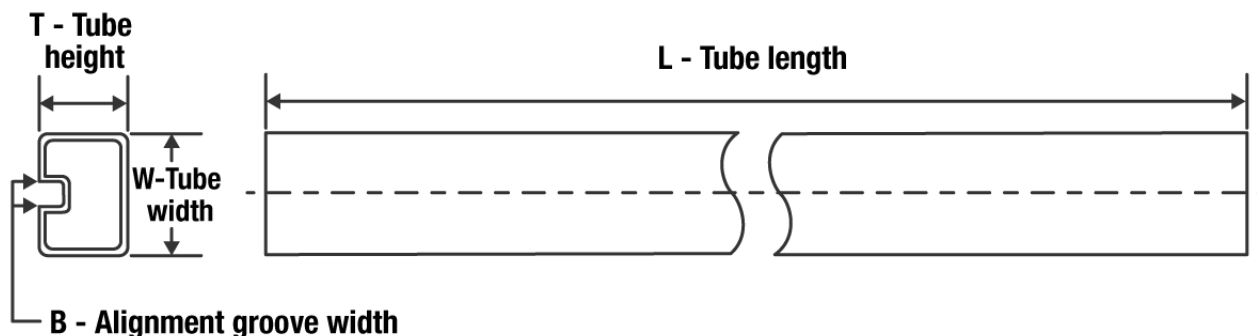

\*All dimensions are nominal

| Device       | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| MC33063ADR   | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| MC33063ADR   | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| MC33063ADRJR | SON          | DRJ             | 8    | 1000 | 330.0              | 12.4               | 4.25    | 4.25    | 1.15    | 8.0     | 12.0   | Q2            |
| MC34063ADR   | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| MC34063ADRJR | SON          | DRJ             | 8    | 1000 | 180.0              | 12.4               | 4.25    | 4.25    | 1.15    | 8.0     | 12.0   | Q2            |

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

| Device       | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| MC33063ADR   | SOIC         | D               | 8    | 2500 | 340.5       | 336.1      | 25.0        |
| MC33063ADR   | SOIC         | D               | 8    | 2500 | 367.0       | 367.0      | 35.0        |
| MC33063ADRJR | SON          | DRJ             | 8    | 1000 | 367.0       | 367.0      | 35.0        |
| MC34063ADR   | SOIC         | D               | 8    | 2500 | 340.5       | 336.1      | 25.0        |
| MC34063ADRJR | SON          | DRJ             | 8    | 1000 | 210.0       | 185.0      | 35.0        |

**TUBE**


\*All dimensions are nominal

| Device      | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|-------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| MC33063AD   | D            | SOIC         | 8    | 75  | 507    | 8      | 3940   | 4.32   |
| MC33063AD   | D            | SOIC         | 8    | 75  | 506.6  | 8      | 3940   | 4.32   |
| MC33063ADE4 | D            | SOIC         | 8    | 75  | 507    | 8      | 3940   | 4.32   |
| MC33063ADE4 | D            | SOIC         | 8    | 75  | 506.6  | 8      | 3940   | 4.32   |
| MC33063ADG4 | D            | SOIC         | 8    | 75  | 506.6  | 8      | 3940   | 4.32   |
| MC33063ADG4 | D            | SOIC         | 8    | 75  | 507    | 8      | 3940   | 4.32   |
| MC33063AP   | P            | PDIP         | 8    | 50  | 506    | 13.97  | 11230  | 4.32   |
| MC33063APE4 | P            | PDIP         | 8    | 50  | 506    | 13.97  | 11230  | 4.32   |
| MC34063AD   | D            | SOIC         | 8    | 75  | 507    | 8      | 3940   | 4.32   |
| MC34063ADE4 | D            | SOIC         | 8    | 75  | 507    | 8      | 3940   | 4.32   |
| MC34063ADG4 | D            | SOIC         | 8    | 75  | 507    | 8      | 3940   | 4.32   |
| MC34063AP   | P            | PDIP         | 8    | 50  | 506    | 13.97  | 11230  | 4.32   |
| MC34063APE4 | P            | PDIP         | 8    | 50  | 506    | 13.97  | 11230  | 4.32   |

P (R-PDIP-T8)

PLASTIC DUAL-IN-LINE PACKAGE



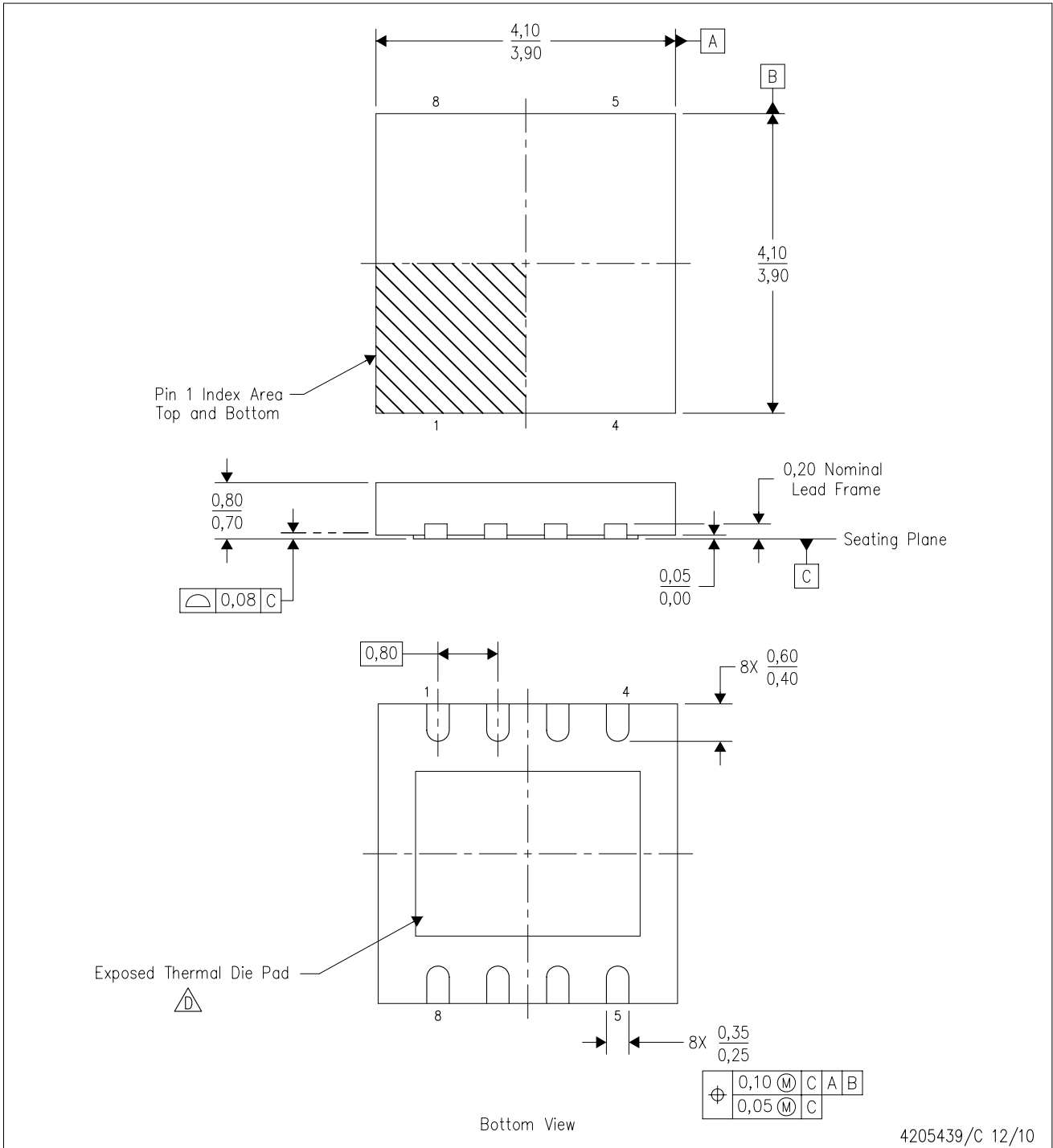
4040082/E 04/2010

- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Falls within JEDEC MS-001 variation BA.




DRJ (S-PWSON-N8)

PLASTIC SMALL OUTLINE NO-LEAD



4205439/C 12/10

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. SON (Small Outline No-Lead) package configuration.
  -  The package thermal pad must be soldered to the board for thermal and mechanical performance. See the Product Data Sheet for details regarding the exposed thermal pad dimensions.
  - E. Package complies to JEDEC MO-229 variation WGGB.

## THERMAL PAD MECHANICAL DATA

DRJ (S-PWSON-N8)

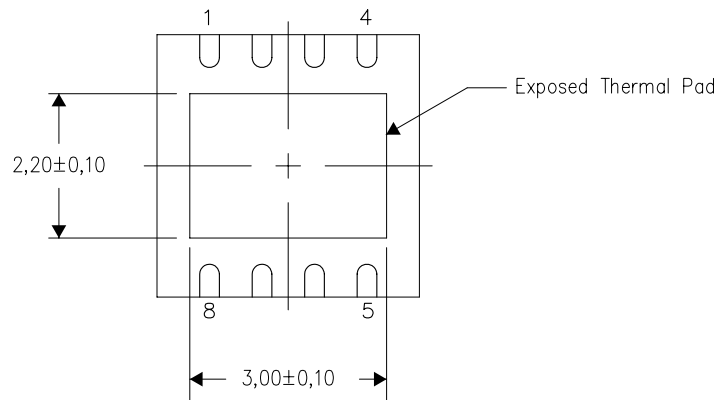
PLASTIC SMALL OUTLINE NO-LEAD

### THERMAL INFORMATION

This package incorporates an exposed thermal pad that is designed to be attached directly to an external heatsink. The thermal pad must be soldered directly to the printed circuit board (PCB). After soldering, the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to the appropriate copper plane shown in the electrical schematic for the device, or alternatively, can be attached to a special heatsink structure designed into the PCB. This design optimizes the heat transfer from the integrated circuit (IC).

For information on the Quad Flatpack No-Lead (QFN) package and its advantages, refer to Application Report, QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271. This document is available at [www.ti.com](http://www.ti.com).

The exposed thermal pad dimensions for this package are shown in the following illustration.



Bottom View

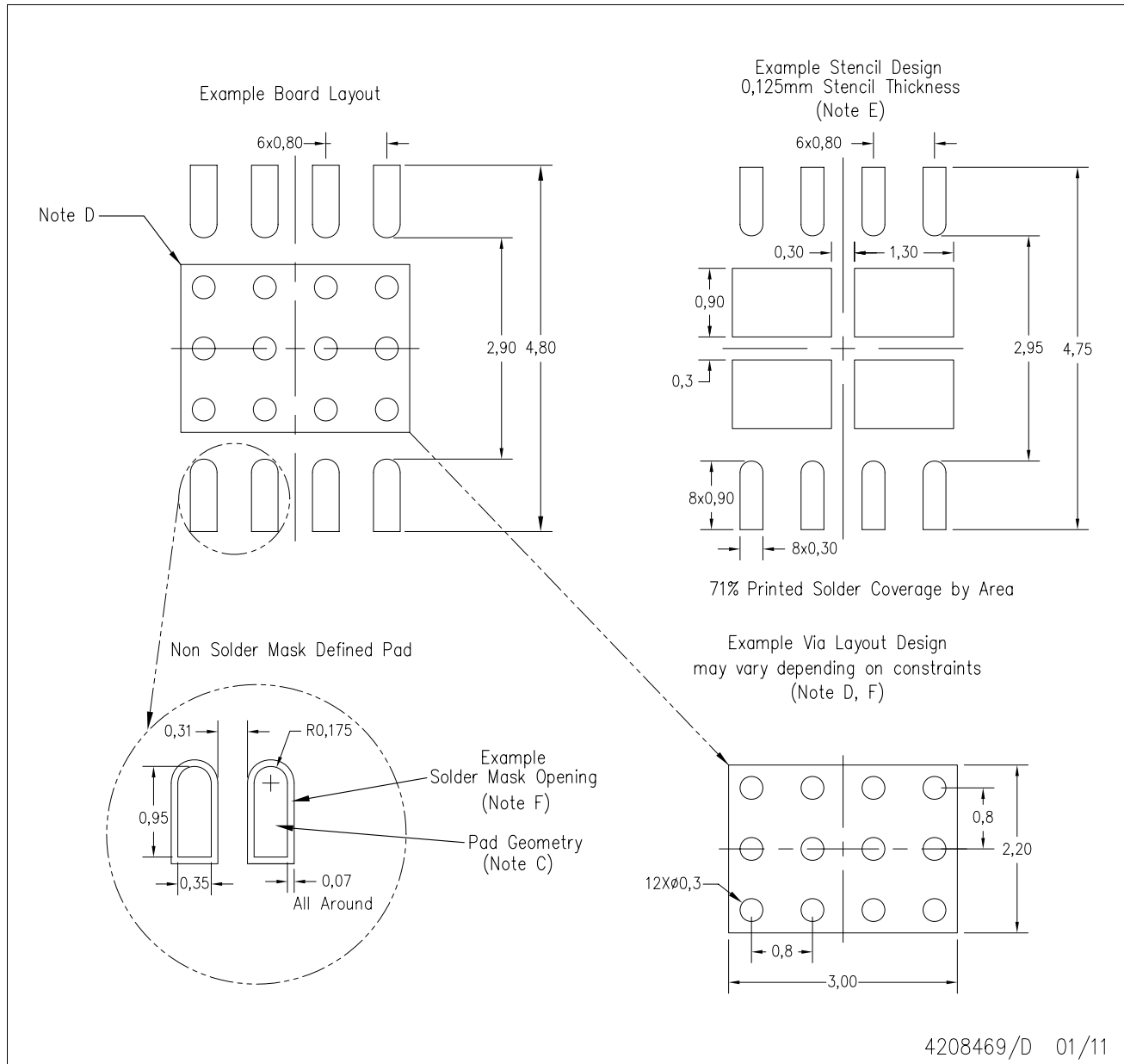
Exposed Thermal Pad Dimensions

4206882/F 01/11

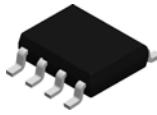
NOTE: All linear dimensions are in millimeters

DRJ (S-PWSON-N8)

SMALL PACKAGE OUTLINE NO-LEAD



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate designs.
  - D. This package is designed to be soldered to a thermal pad on the board. Refer to Application Note, Quad Flat-Pack Packages, Texas Instruments Literature No. SLUA271, and also the Product Data Sheets for specific thermal information, via requirements, and recommended board layout. These documents are available at [www.ti.com](http://www.ti.com) <<http://www.ti.com>>.
  - E. Laser cutting apertures with electropolish and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC 7525 for stencil design considerations.
  - F. Customers should contact their board fabrication site for solder mask tolerances and vias tenting recommendations for vias placed in the thermal pad.

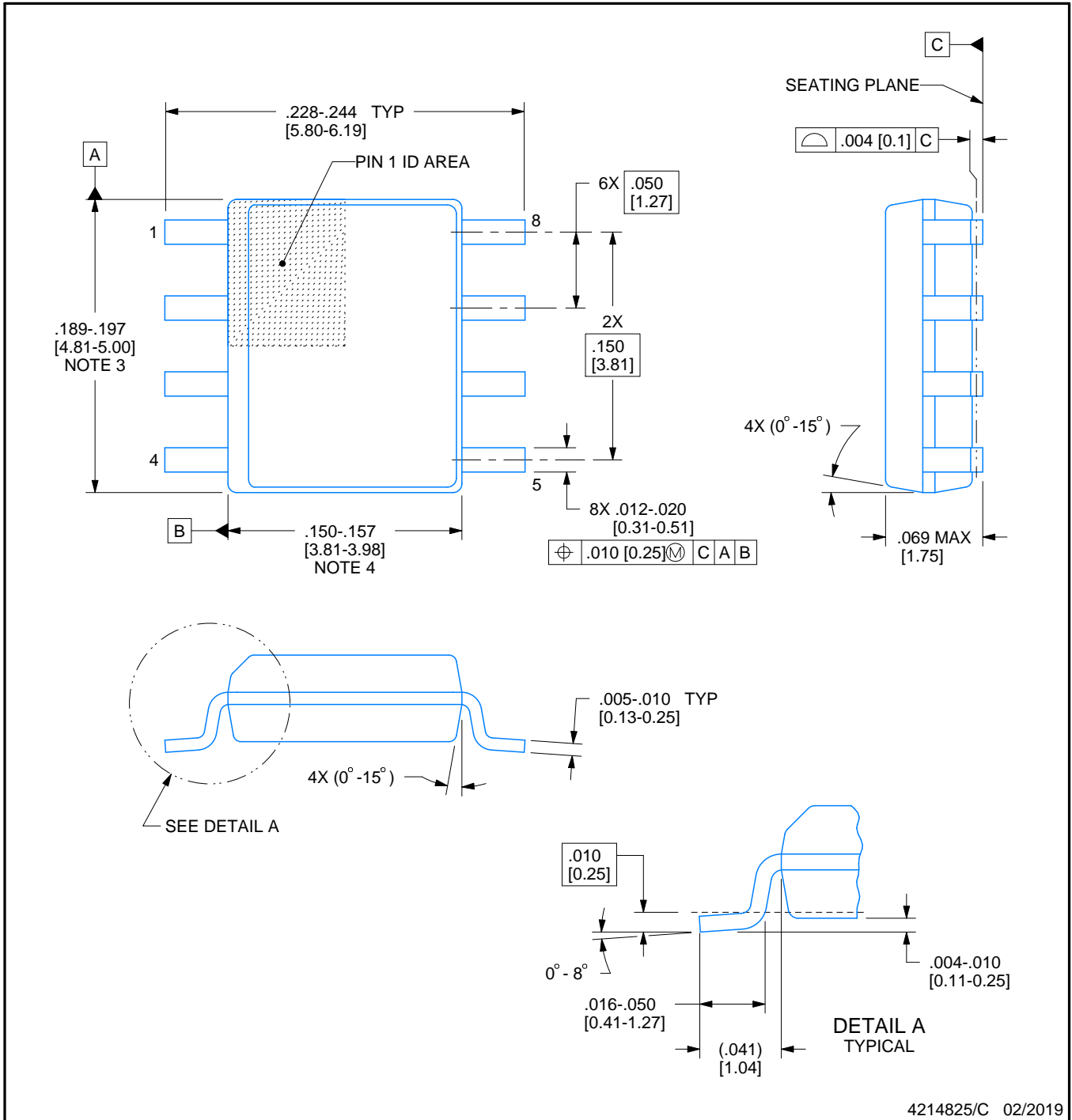


D0008A

**PACKAGE OUTLINE**

**SOIC - 1.75 mm max height**

SMALL OUTLINE INTEGRATED CIRCUIT



**NOTES:**

1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 [0.15] per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.

# EXAMPLE BOARD LAYOUT

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE  
 EXPOSED METAL SHOWN  
 SCALE:8X



SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE  
BASED ON .005 INCH [0.125 MM] THICK STENCIL  
SCALE:8X

4214825/C 02/2019

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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