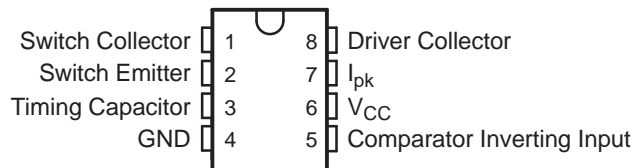


1.5-A PEAK BOOST/BUCK/INVERTING SWITCHING REGULATORS

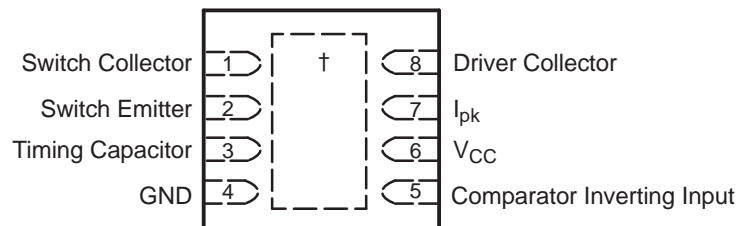
FEATURES

- 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

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) .

DESCRIPTION/ORDERING INFORMATION

The MC33063A and MC34063A 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 is characterized for operation from -40°C to 85°C , while the MC34063A is characterized for operation from 0°C to 70°C .



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

Absolute Maximum Ratings⁽¹⁾

over operating free-air temperature range (unless otherwise noted)

		MIN	MAX	UNIT
V _{CC}	Supply voltage		40	V
V _{IR}	Comparator Inverting Input voltage range	–0.3	40	V
V _{C(switch)}	Switch Collector voltage		40	V
V _{E(switch)}	Switch Emitter voltage	V _{PIN1} = 40 V	40	V
V _{CE(switch)}	Switch Collector to Switch Emitter voltage		40	V
V _{C(driver)}	Driver Collector voltage		40	V
I _{C(driver)}	Driver Collector current		100	mA
I _{SW}	Switch current		1.5	A
θ _{JA}	Package thermal impedance ⁽²⁾⁽³⁾	D package	97	°C/W
		DRJ package	41	
		P package	85	
T _J	Operating virtual junction temperature		150	°C
T _{stg}	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.
- (2) Maximum power dissipation is a function of T_{J(max)}, θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is P_D = (T_{J(max)} – T_A)/θ_{JA}. Operating at the absolute maximum T_J of 150°C can affect reliability.
- (3) The package thermal impedance is calculated in accordance with JESD 51-7.

Recommended Operating Conditions

		MIN	MAX	UNIT	
V _{CC}	Supply voltage	3	40	V	
T _A	Operating free-air temperature	MC33063A	–40	85	°C
		MC34063A	0	70	

Electrical Characteristics

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

Oscillator

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

Output Switch⁽¹⁾

PARAMETER		TEST CONDITIONS	T _A	MIN	TYP	MAX	UNIT
V _{CE(sat)}	Saturation voltage – Darlington connection	I _{SW} = 1 A, pins 1 and 8 connected	Full range		1	1.3	V
V _{CE(sat)}	Saturation voltage – non-Darlington connection ⁽²⁾	I _{SW} = 1 A, R _{PIN8} = 82 Ω to V _{CC} , forced β ~ 20	Full range		0.45	0.7	V
h _{FE}	DC current gain	I _{SW} = 1 A, V _{CE} = 5 V	25°C	50	75		
I _{C(off)}	Collector off-state current	V _{CE} = 40 V	Full range		0.01	100	μA

- (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 (≤300 mA) and high driver currents (≥30 mA), it may take up to 2 μs for the switch to come out of saturation. This condition effectively shortens the off time at frequencies ≥30 kHz, becoming magnified as temperature increases. The following output drive condition is recommended in the non-Darlington configuration:
Forced β of output switch = I_{C,SW} / (I_{C,driver} – 7 mA) ≥ 10, where ~7 mA is required by the 100-Ω resistor in the emitter of the driver to forward bias the V_{be} of the switch.

Comparator

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	
ΔV _{th}	Threshold-voltage line regulation	V _{CC} = 5 V to 40 V	Full range		1.4	5	mV
I _{IB}	Input bias current	V _{IN} = 0 V	Full range		–20	–400	nA

Total Device

PARAMETER		TEST CONDITIONS	T _A	MIN	MAX	UNIT
I _{CC}	Supply current	V _{CC} = 5 V to 40 V, C _T = 1 nF, V _{PIN7} = V _{CC} , V _{PIN5} > V _{th} , V _{PIN2} = GND, All other pins open	Full range		4	mA

TYPICAL CHARACTERISTICS

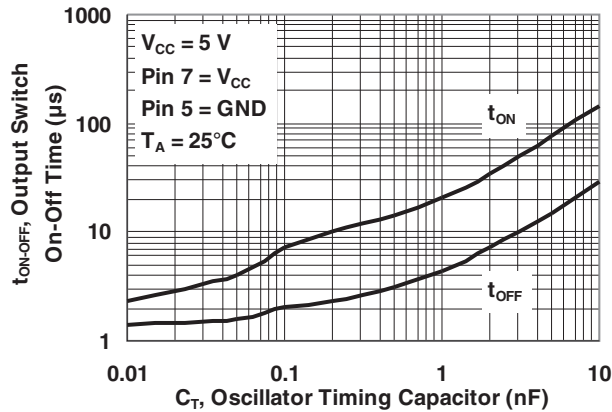


Figure 1. Output Switch On-Off Time vs Oscillator Timing Capacitor

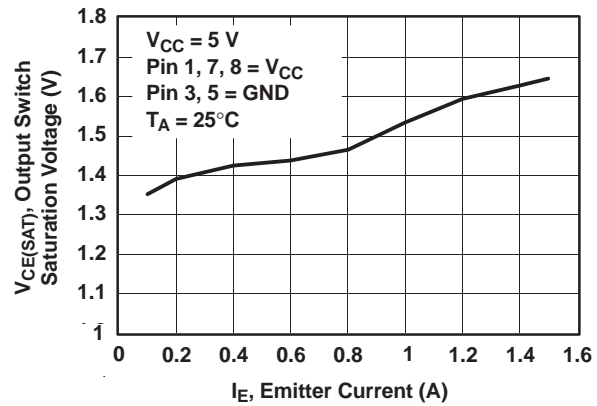


Figure 2. Output Switch Saturation Voltage vs Emitter Current (Emitter-Follower Configuration)

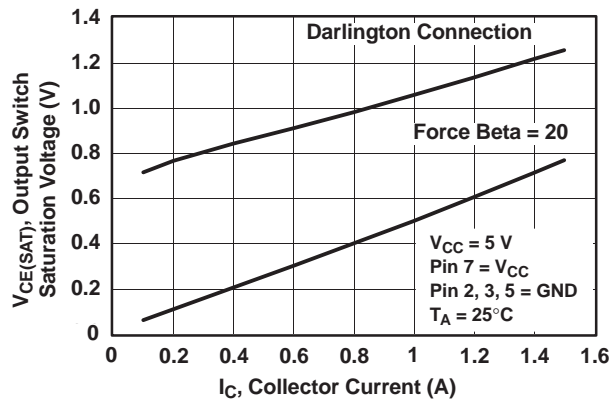


Figure 3. Output Switch Saturation Voltage vs Collector Current (Common-Emitter Configuration)

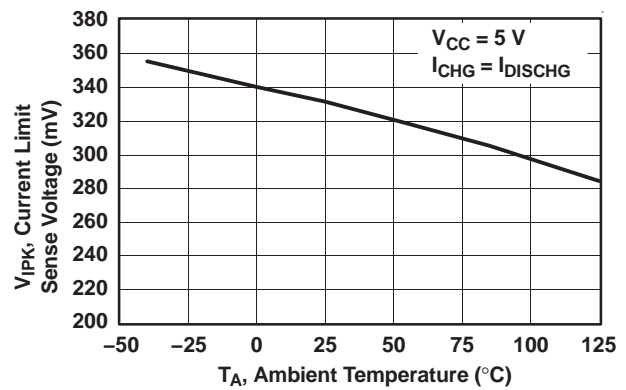


Figure 4. Current-Limit Sense Voltage vs Temperature

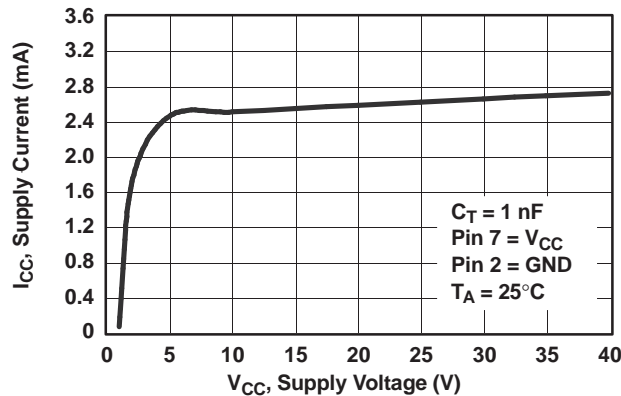


Figure 5. Standby Supply Current vs Supply Voltage

TYPICAL CHARACTERISTICS (continued)

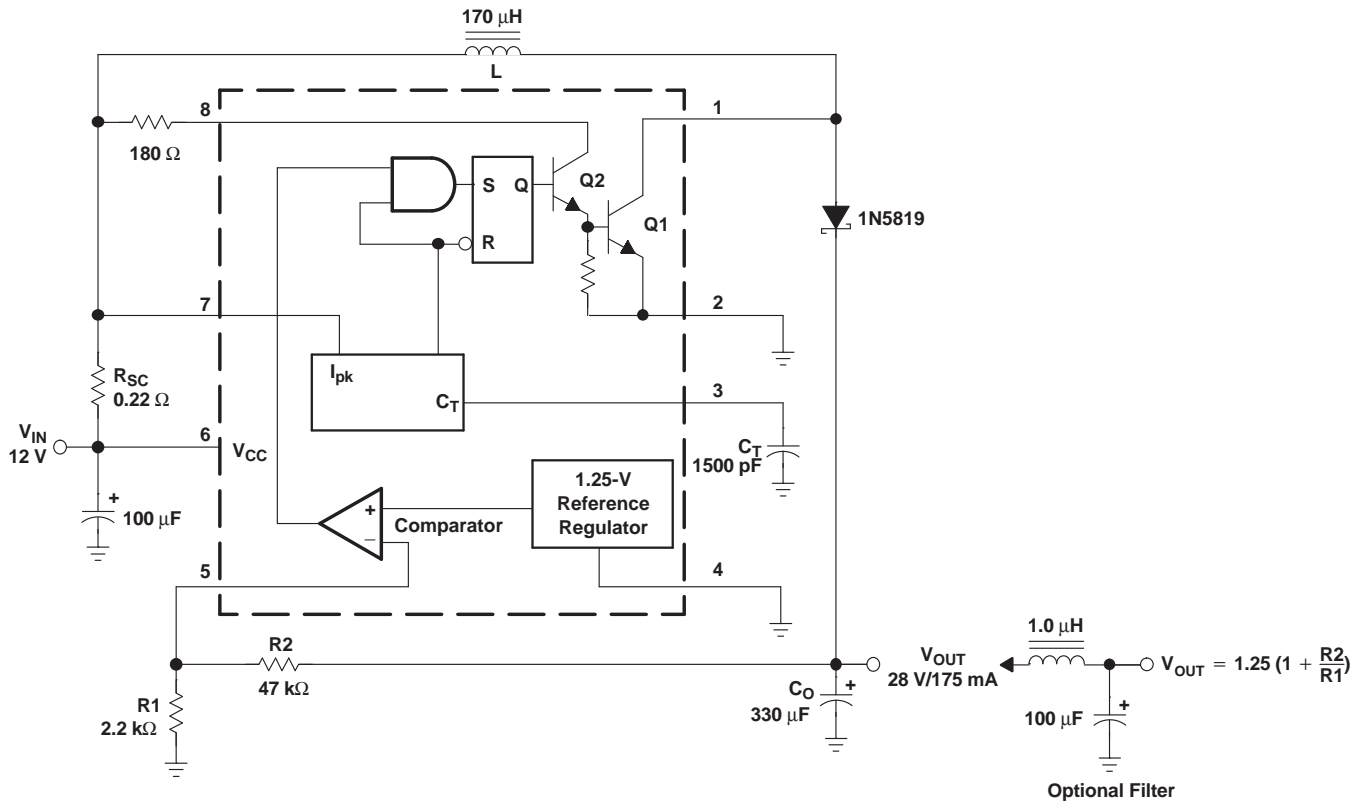
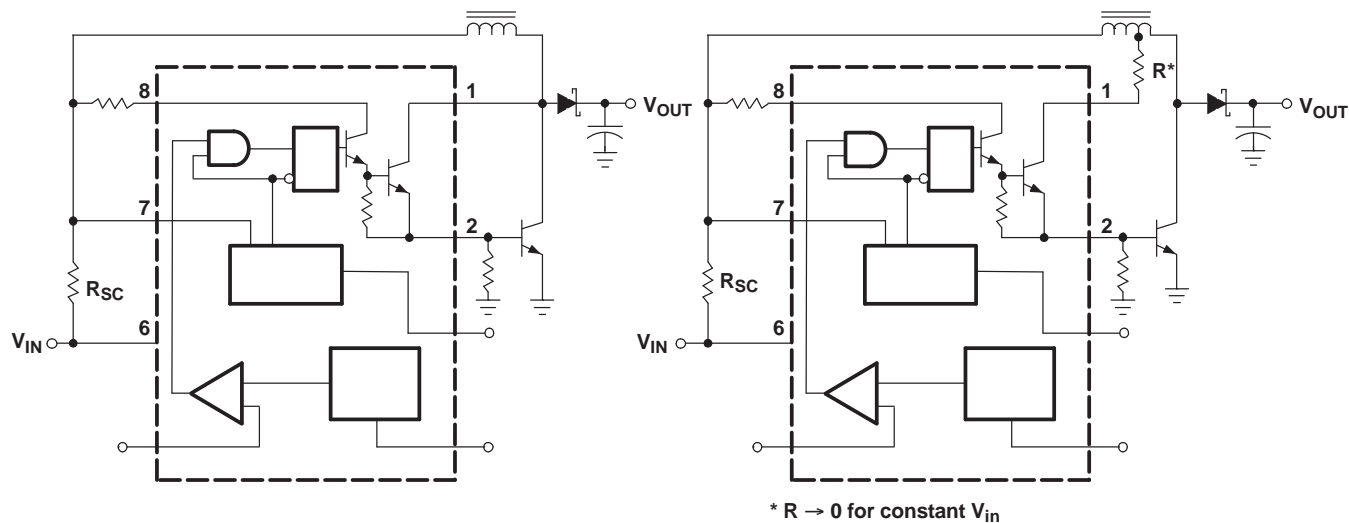


Figure 6. Step-Up Converter

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



a) EXTERNAL npn SWITCH

b) EXTERNAL pnp SATURATED SWITCH (see Note A)

- A. 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 $2 \mu\text{s}$ 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 because the output switch cannot saturate. If a non-Darlington configuration is used, the output drive configuration in Figure 7b is recommended.

Figure 7. External Current-Boost Connections for I_C Peak Greater Than 1.5 A

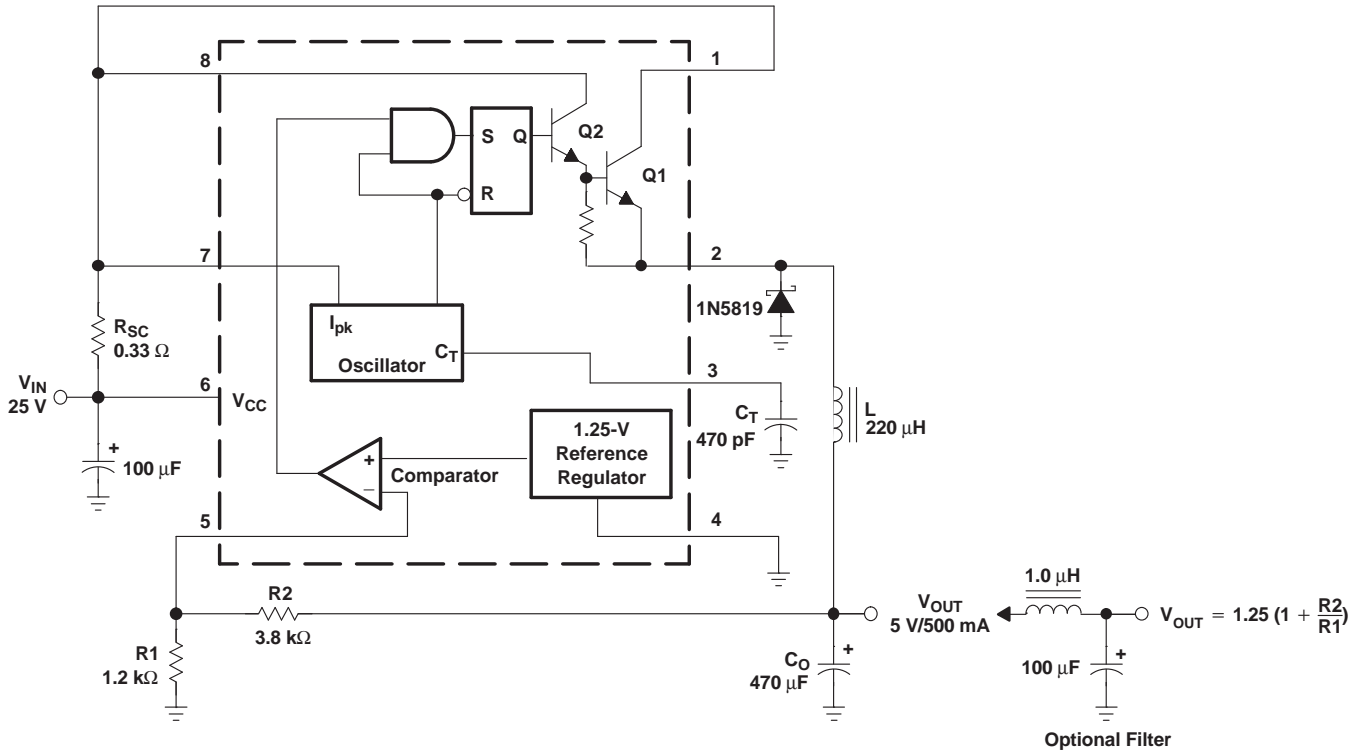


Figure 8. Step-Down Converter

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 mV_{PP}
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 mV_{PP}

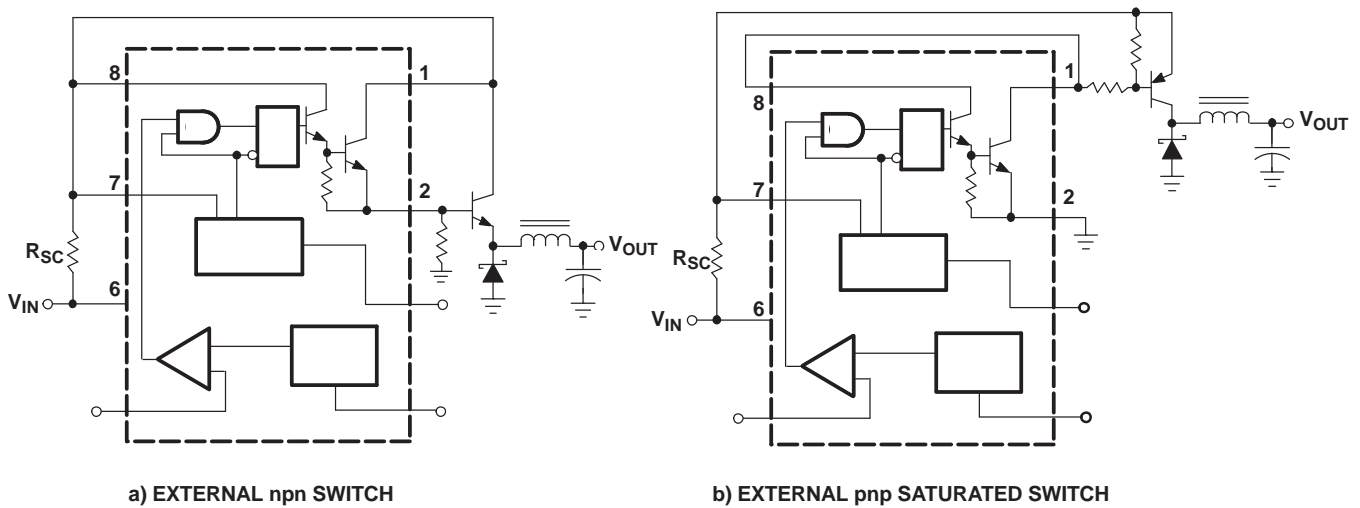


Figure 9. External Current-Boost Connections for I_C Peak Greater Than 1.5 A

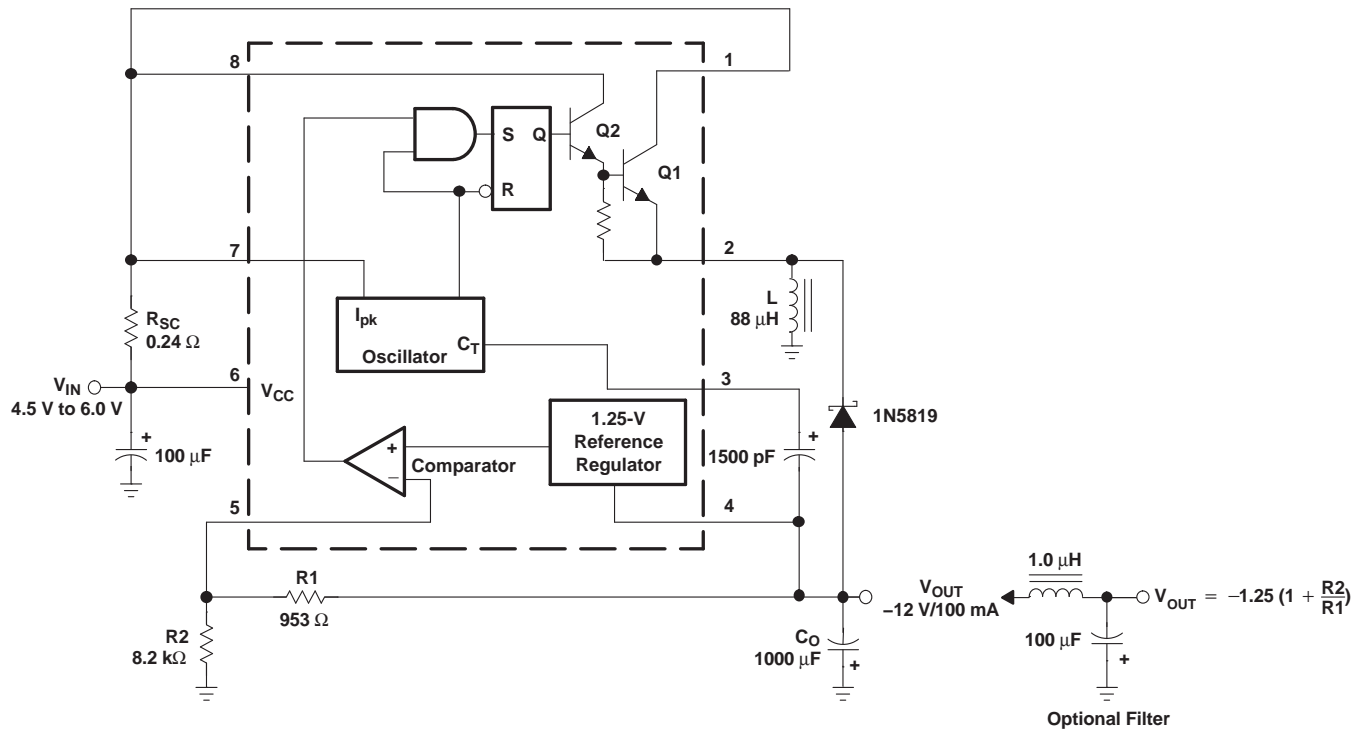


Figure 10. Voltage-Inverting Converter

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 mV_{PP}
Short-circuit current	$V_{IN} = 5\text{ V}, R_L = 0.1\ \Omega$	910 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 mV_{PP}

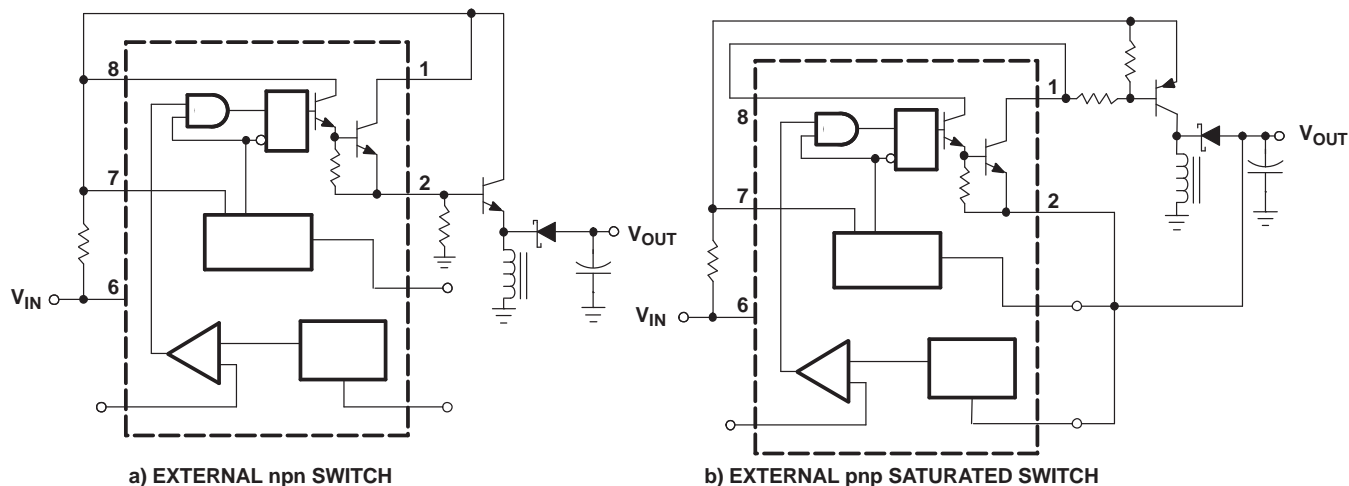


Figure 11. External Current-Boost Connections for I_C Peak Greater Than 1.5 A

APPLICATION INFORMATION

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	$4 \times 10^{-5} t_{on}$	$4 \times 10^{-5} t_{on}$	$4 \times 10^{-5} t_{on}$
$I_{pk(switch)}$	$2I_{out(max)} \left(\frac{t_{on}}{t_{off}} + 1 \right)$	$2I_{out(max)}$	$2I_{out(max)} \left(\frac{t_{on}}{t_{off}} + 1 \right)$
R_{SC}	$\frac{0.3}{I_{pk(switch)}}$	$\frac{0.3}{I_{pk(switch)}}$	$\frac{0.3}{I_{pk(switch)}}$
$L_{(min)}$	$\left(\frac{(V_{in(min)} - V_{sat})}{I_{pk(switch)}} \right) t_{on(max)}$	$\left(\frac{(V_{in(min)} - V_{sat} - V_{out})}{I_{pk(switch)}} \right) t_{on(max)}$	$\left(\frac{(V_{in(min)} - V_{sat})}{I_{pk(switch)}} \right) t_{on(max)}$
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_{out}	$1.25 \left(1 + \frac{R_2}{R_1} \right)$ See Figure 6	$1.25 \left(1 + \frac{R_2}{R_1} \right)$ See Figure 8	$-1.25 \left(1 + \frac{R_2}{R_1} \right)$ See Figure 10

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.

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
MC33063AD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC33063ADE4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC33063ADG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC33063ADR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC33063ADRE4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC33063ADRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC33063ADRJR	ACTIVE	SON	DRJ	8	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR
MC33063ADRJRG4	ACTIVE	SON	DRJ	8	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR
MC33063AP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
MC33063APE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
MC34063AD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC34063ADE4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC34063ADG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC34063ADR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC34063ADRE4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC34063ADRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC34063ADRJR	ACTIVE	SON	DRJ	8	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR
MC34063ADRJRG4	ACTIVE	SON	DRJ	8	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR
MC34063AP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
MC34063APE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type

⁽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⁾ Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

Important Information and Disclaimer:The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

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.

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
MC33063ADRJR	SON	DRJ	8	1000	330.0	12.4	4.3	4.3	1.5	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	4.3	4.3	1.5	8.0	12.0	Q2

TAPE AND REEL BOX DIMENSIONS

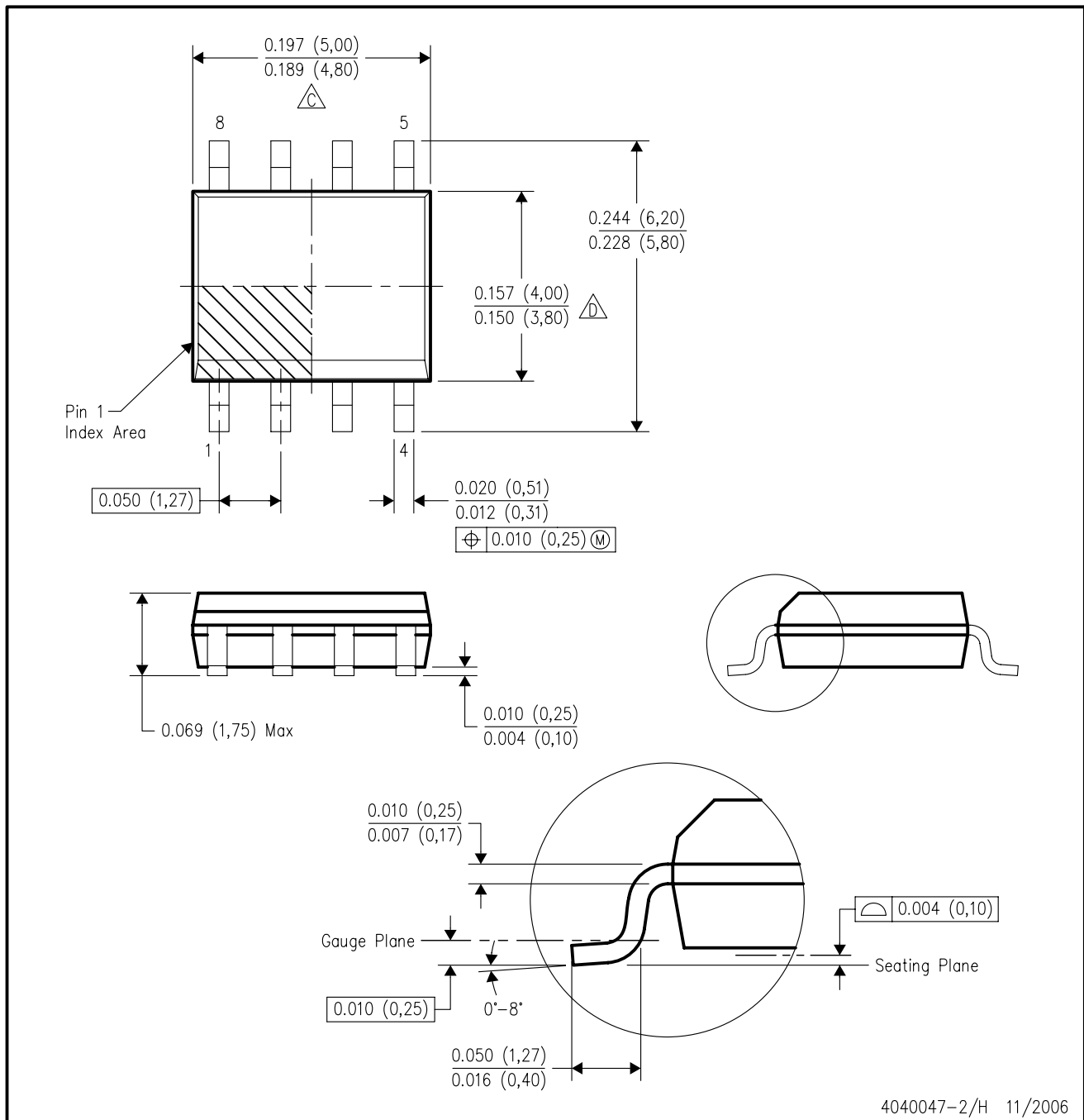


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
MC33063ADR	SOIC	D	8	2500	340.5	338.1	20.6
MC33063ADRJR	SON	DRJ	8	1000	346.0	346.0	29.0
MC34063ADR	SOIC	D	8	2500	340.5	338.1	20.6
MC34063ADRJR	SON	DRJ	8	1000	190.5	212.7	31.8

D (R-PDSO-G8)

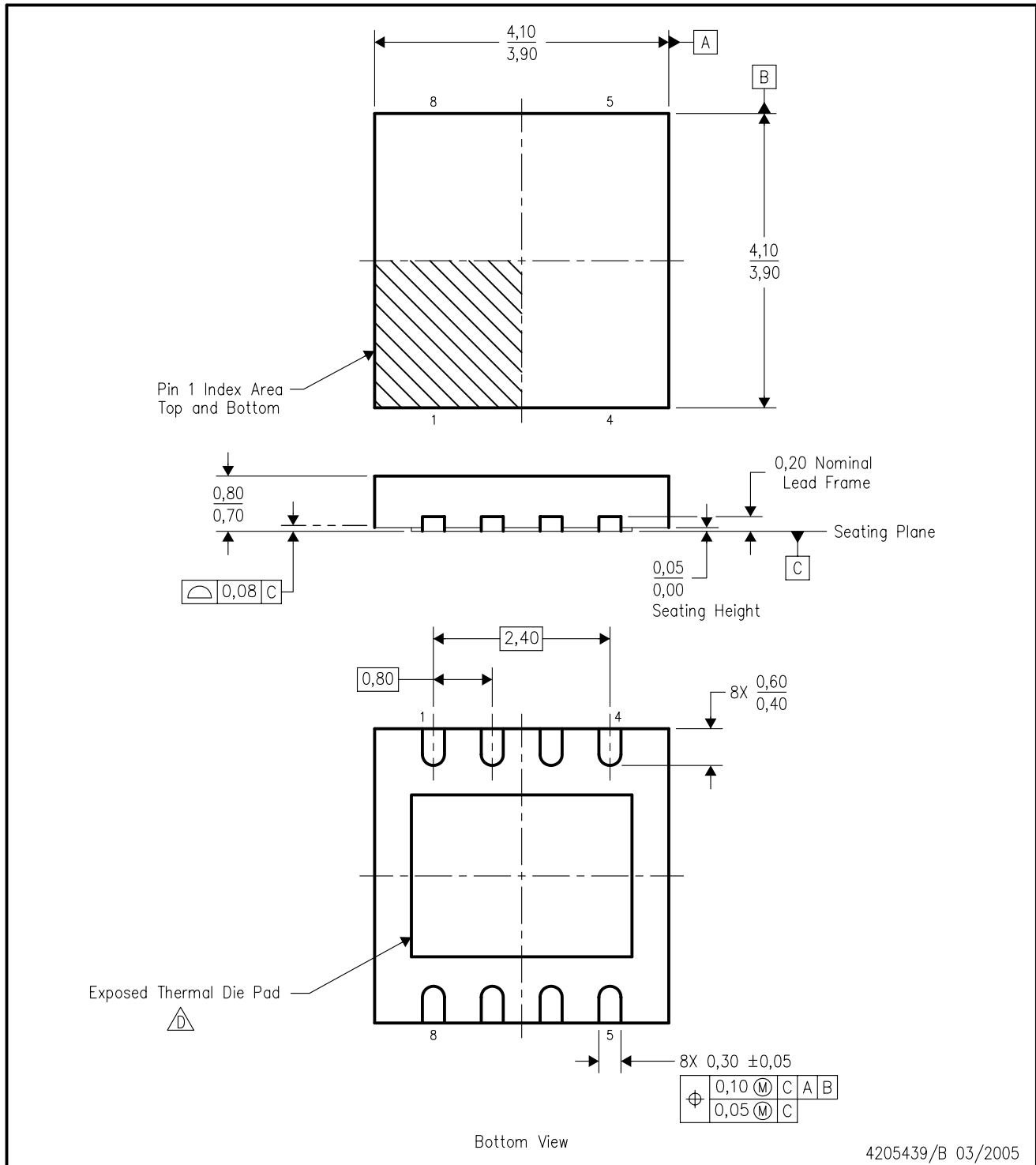
PLASTIC SMALL-OUTLINE PACKAGE




- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
 - D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
 - E. Reference JEDEC MS-012 variation AA.

DRJ (S-PDSO-N8)

PLASTIC SMALL OUTLINE



4205439/B 03/2005

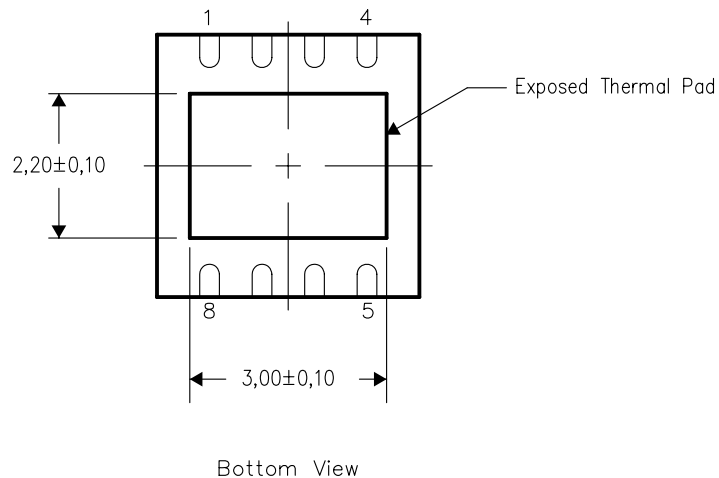
- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. SON (Small Outline No-Lead) package configuration.
 -  The package thermal pad must be soldered to the board for thermal and mechanical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

THERMAL 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, Quad Flatpack No-Lead Logic Packages, Texas Instruments Literature No. SCBA017. This document is available at www.ti.com.

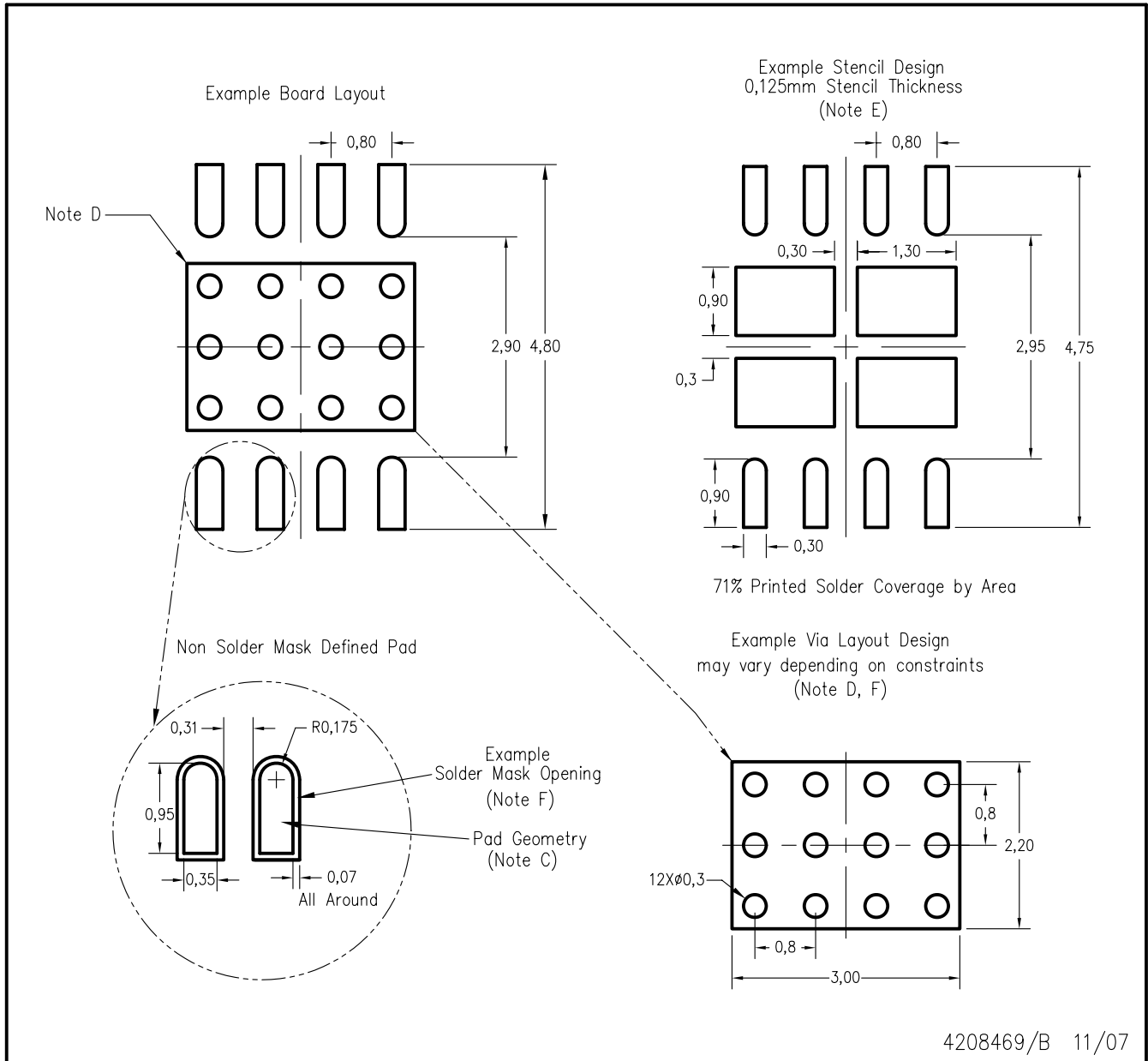
The exposed thermal pad dimensions for this package are shown in the following illustration.



NOTE: All linear dimensions are in millimeters

Exposed Thermal Pad Dimensions

DRJ (S-PDSO-N8)



- 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. SCBA017, 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>>.
 - 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.

P (R-PDIP-T8)

PLASTIC DUAL-IN-LINE



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

For the latest package information, go to http://www.ti.com/sc/docs/package/pkg_info.htm



IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products

Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
RF/IF and ZigBee® Solutions	www.ti.com/lprf

Applications

Audio	www.ti.com/audio
Automotive	www.ti.com/automotive
Broadband	www.ti.com/broadband
Digital Control	www.ti.com/digitalcontrol
Medical	www.ti.com/medical
Military	www.ti.com/military
Optical Networking	www.ti.com/opticalnetwork
Security	www.ti.com/security
Telephony	www.ti.com/telephony
Video & Imaging	www.ti.com/video
Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2008, Texas Instruments Incorporated