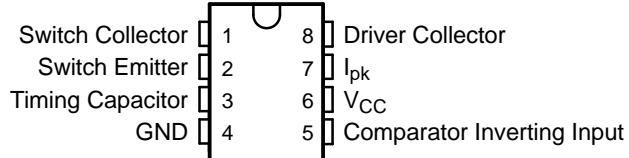


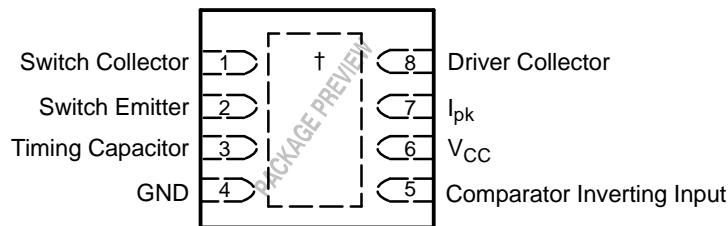
FEATURES

- 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)**



† Exposed thermal pad is connected internally to GND via die attach.

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 .

ORDERING INFORMATION

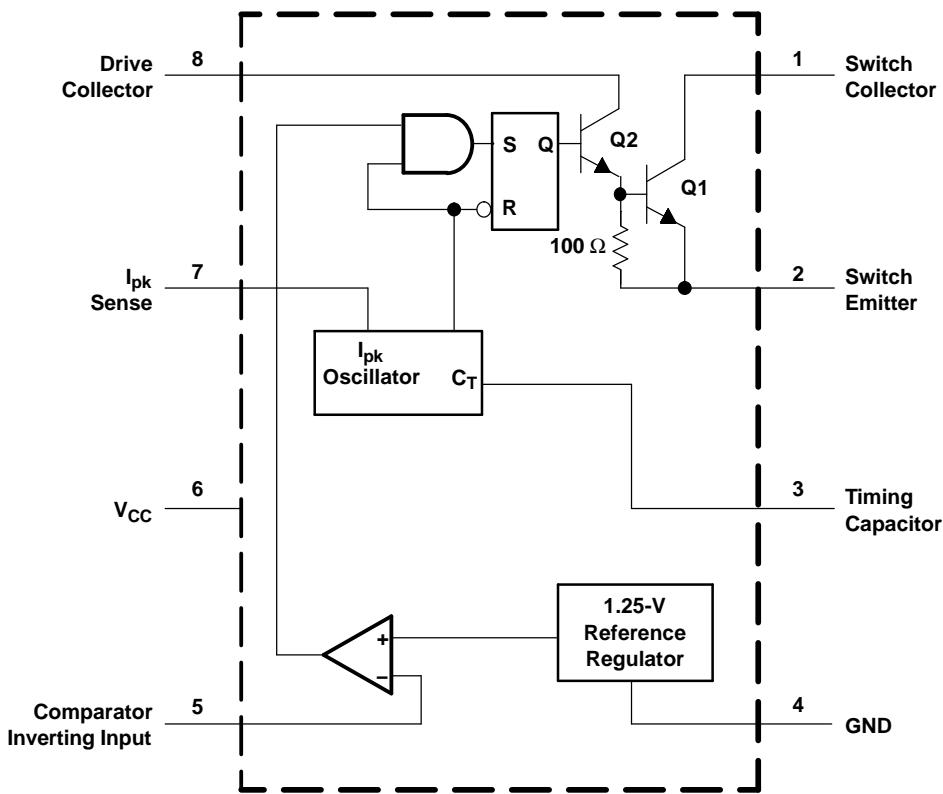
T_A	PACKAGE⁽¹⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 85°C	PDIP – P	Tube of 50	MC33063AP	MC33063AP
	QFN – DRJ	Reel of 1000	MC33063ADRJR	PREVIEW
	SOIC – D	Tube of 75	MC33063AD	
		Reel of 2500	MC33063ADR	M33063A
0°C to 70°C	PDIP – P	Tube of 50	MC34063AP	MC34063AP
	QFN – DRJ	Reel of 1000	MC34063ADRJR	PREVIEW
	SOIC – D	Tube of 75	MC34063AD	
		Reel of 2500	MC34063ADR	M34063A

(1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.



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.

FUNCTIONAL BLOCK DIAGRAM



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		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	TBD	
		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 $P_D = (T_J(\max) - T_A)/\theta_{JA}$. 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

PARAMETER	TEST CONDITIONS	MIN	MAX	UNIT
V_{CC}	Supply voltage	3	40	V
T_A	Operating free-air temperature	MC33063A	-40	85
		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}	$V_{PIN5} = 0$ V, $C_T = 1$ nF	25°C	24	33	42	kHz
I_{chg}	$V_{CC} = 5$ V to 40 V	25°C	24	35	42	μA
I_{dischg}	$V_{CC} = 5$ V to 40 V	25°C	140	220	260	μA
I_{dischg}/I_{chg}	$V_{PIN7} = V_{CC}$	25°C	5.2	6.5	7.5	
V_{Ipk}	$I_{dischg} = I_{chg}$	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 $\beta \sim 20$	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}		25°C	1.225	1.25	1.275	V
		Full range	1.21		1.29	
ΔV_{th}	$V_{CC} = 5$ V to 40 V	Full range		1.4	5	mV
I_{IB}	$V_{IN} = 0$ V	Full range		-20	-400	nA

Total Device

PARAMETER	TEST CONDITIONS	T_A	MIN	MAX	UNIT
I_{CC}	$V_{CC} = 5$ 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

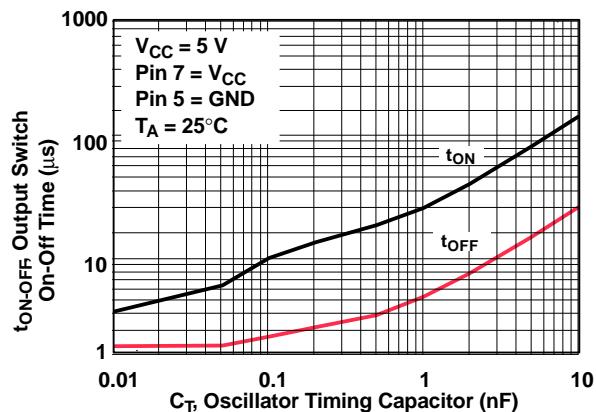


Figure 1. Output Switch On-Off Time vs
Oscillator Timing Capacitor

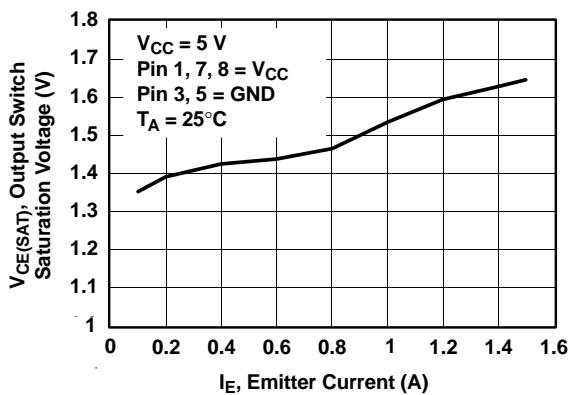


Figure 2. Output Switch Saturation Voltage vs
Emitter Current (Emitter-Follower Configuration)

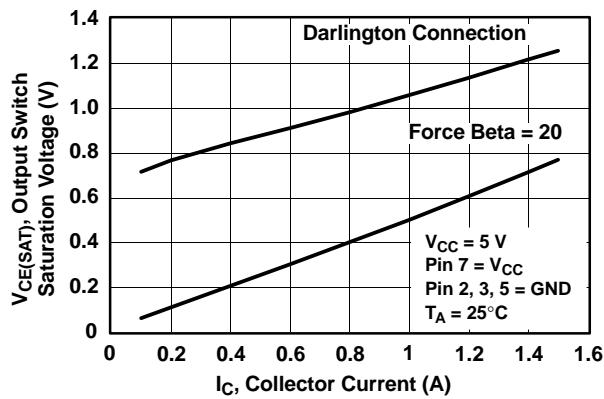


Figure 3. Output Switch Saturation Voltage vs
Collector Current (Common-Emitter Configuration)

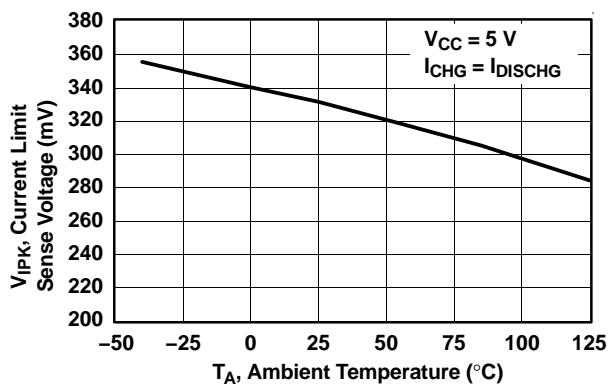


Figure 4. Current-Limit Sense Voltage vs Temperature

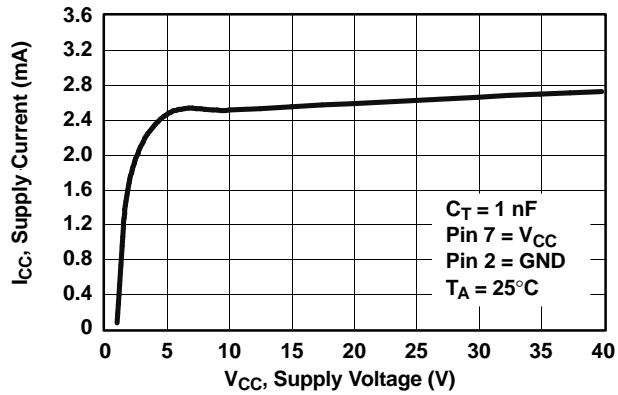


Figure 5. Standby Supply Current vs Supply Voltage

TYPICAL CHARACTERISTICS (continued)

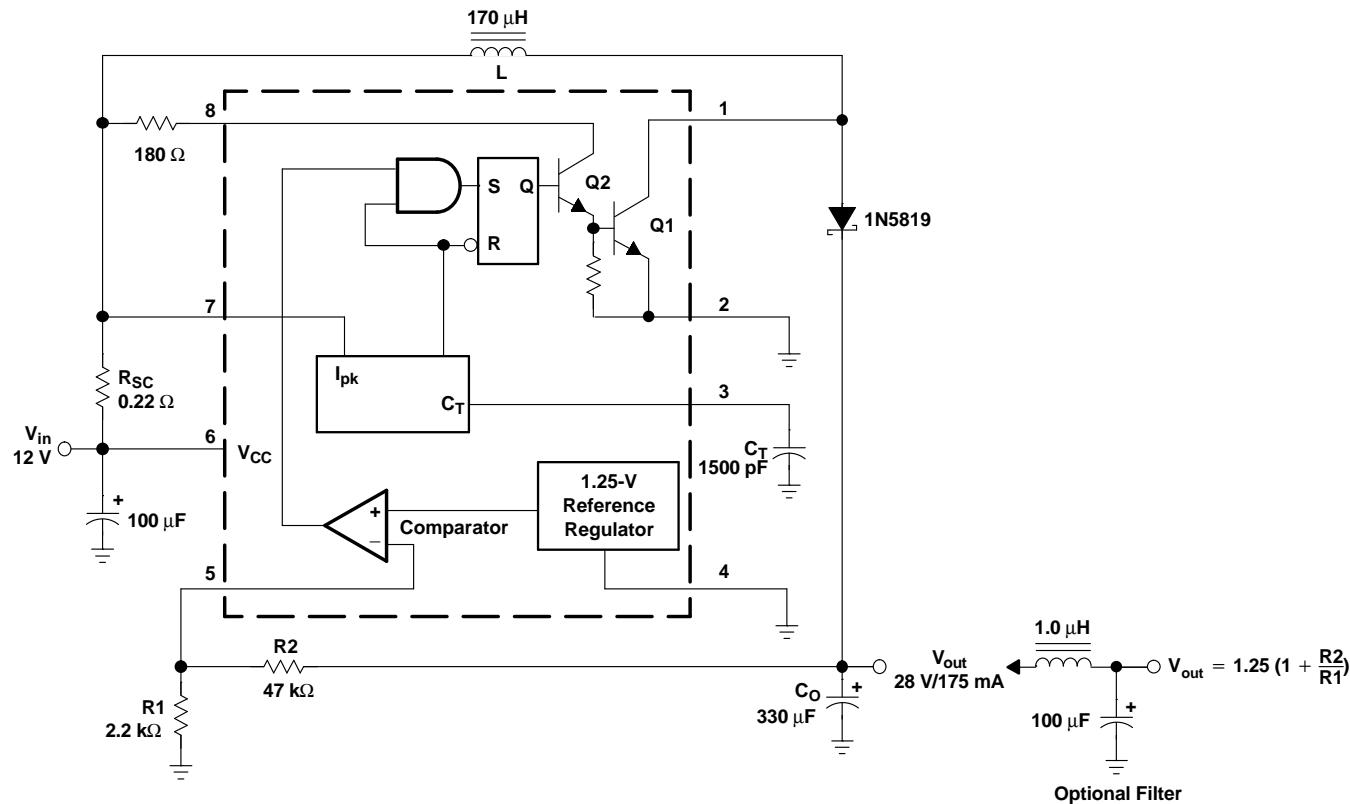


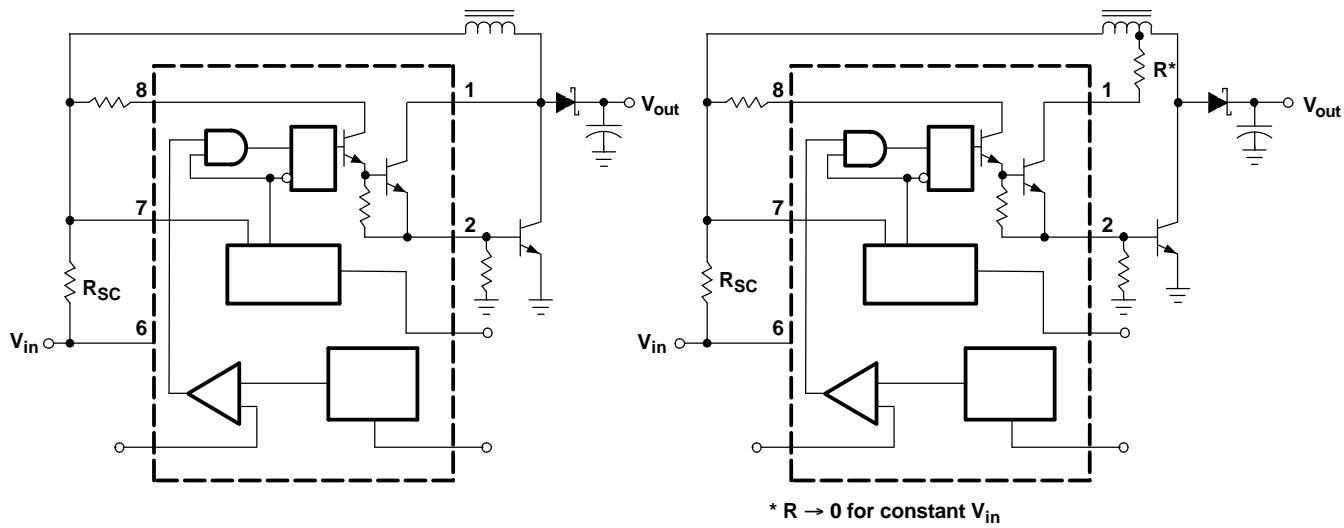
Figure 6. Step-Up Converter

TEST	CONDITIONS	RESULTS
Line regulation	$V_{IN} = 8 \text{ V to } 16 \text{ V}, I_O = 175 \text{ mA}$	$30 \text{ mV} \pm 0.05\%$
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 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}

MC33063A, MC34063A
1.5-A PEAK BOOST/BUCK/INVERTING SWITCHING REGULATORS

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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 μ 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

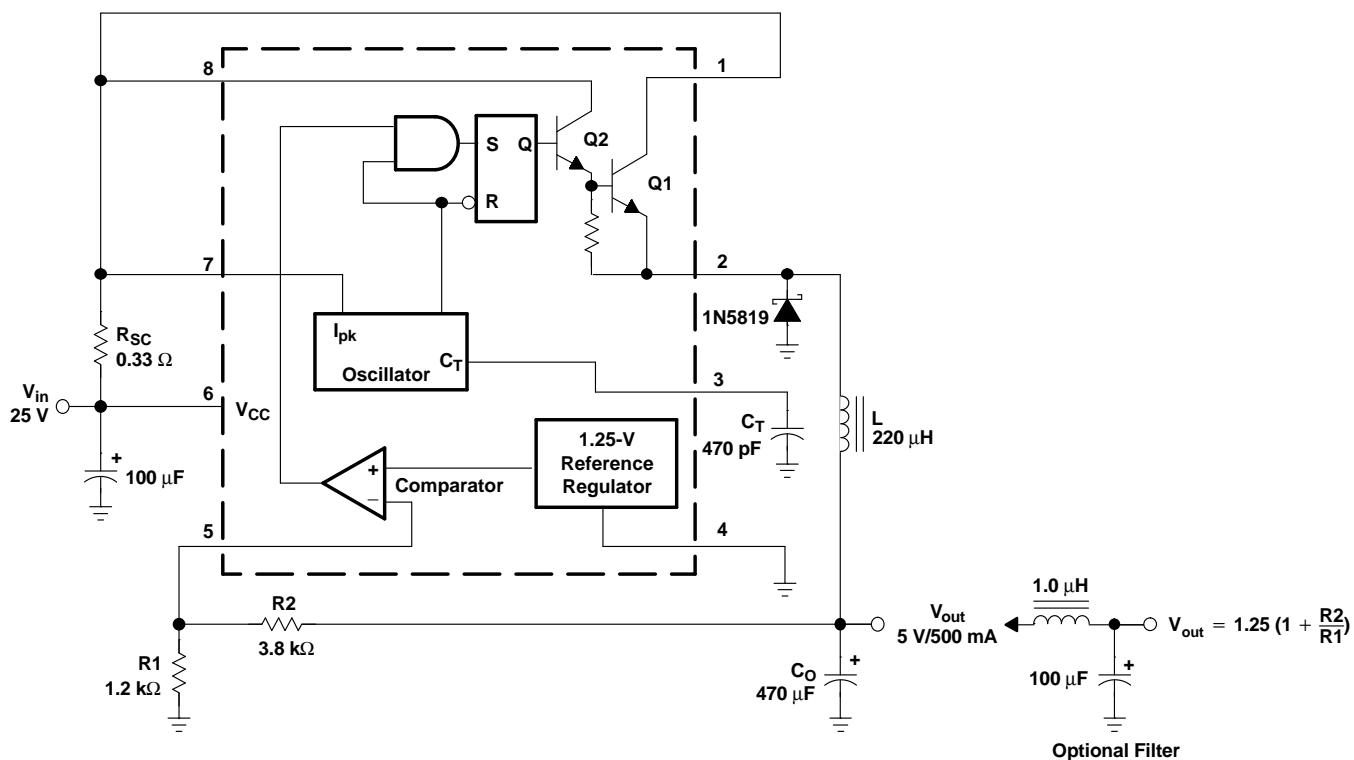


Figure 8. Step-Down Converter

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	$V_{IN} = 25 \text{ V}, R_L = 0.1 \text{ } \Omega$	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}

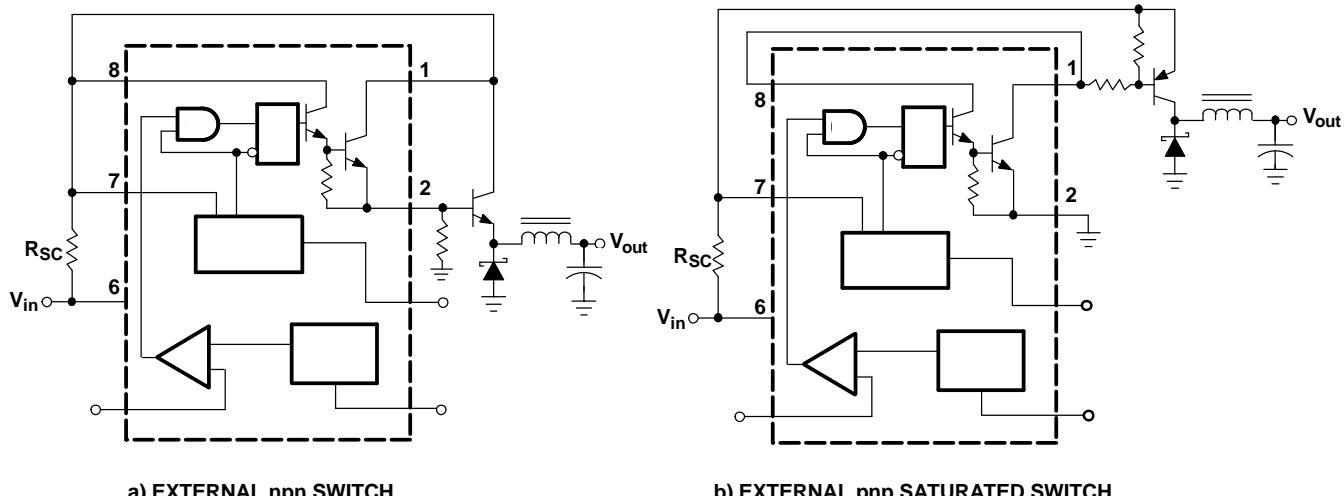


Figure 9. External Current-Boost Connections for I_C Peak Greater Than 1.5 A

MC33063A, MC34063A
1.5-A PEAK BOOST/BUCK/INVERTING SWITCHING REGULATORS

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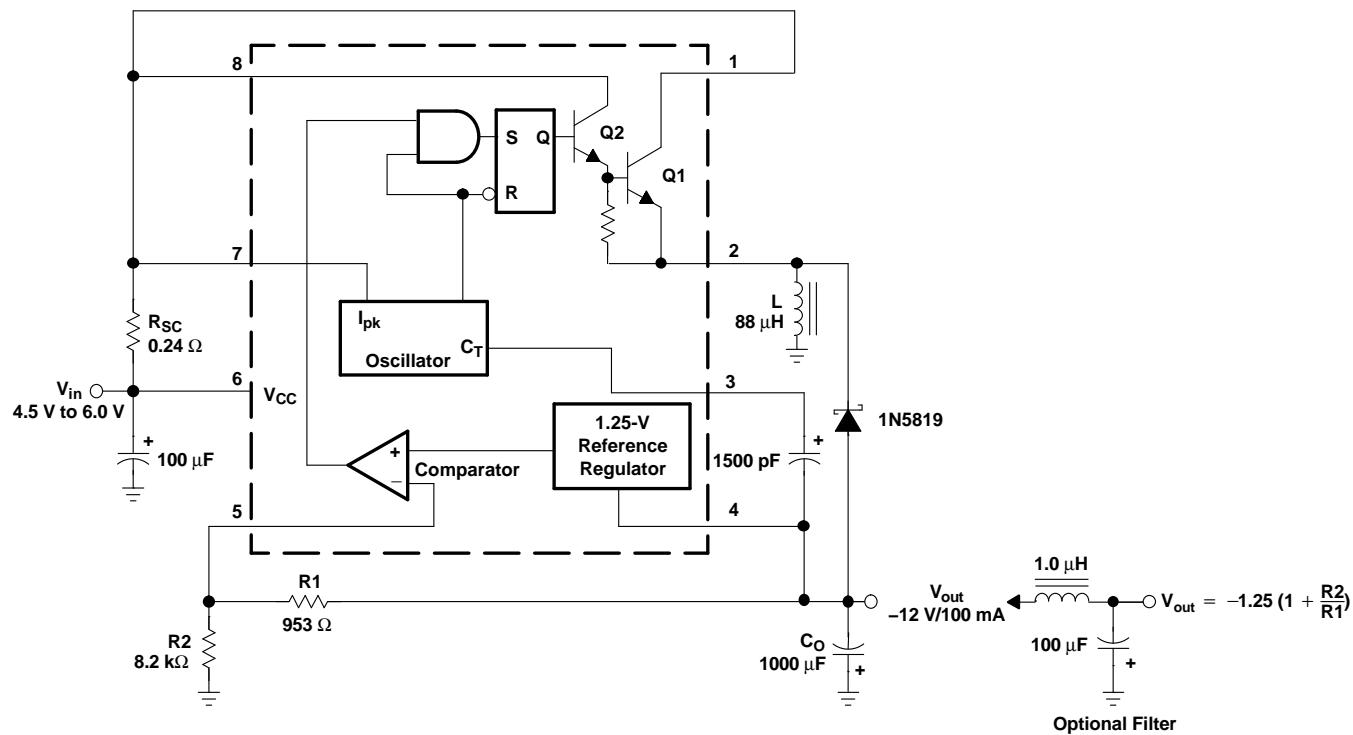


Figure 10. Voltage-Inverting Converter

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

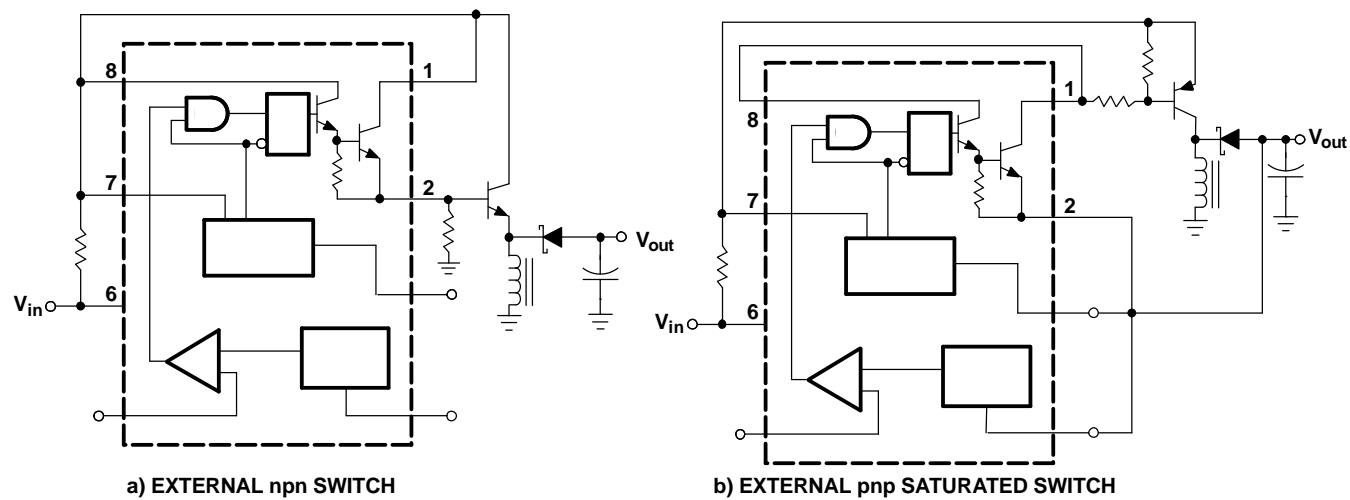


Figure 11. External Current-Boost Connections for I_C Peak Greater Than 1.5 A

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}	$1.25(1 + \frac{R2}{R1})$ See Figure 6	$1.25(1 + \frac{R2}{R1})$ See Figure 8	$-1.25(1 + \frac{R2}{R1})$ 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.

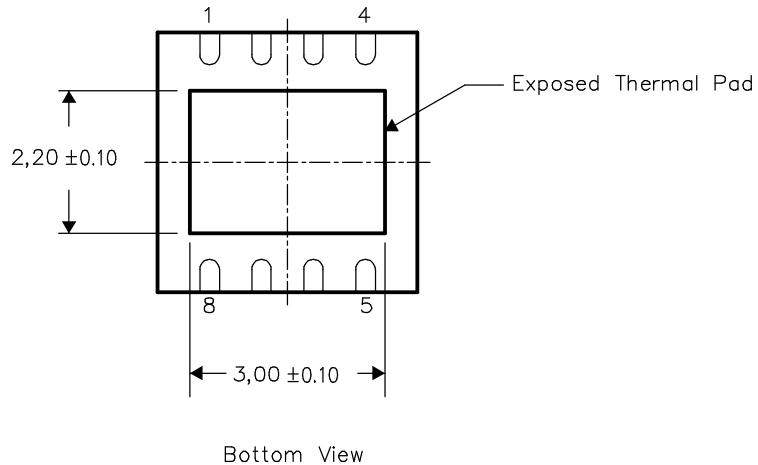
**THERMAL PAD MECHANICAL DATA
DRJ (S-PDSO-N8)**

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), the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to a ground plane or 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.



Bottom View

NOTE: All linear dimensions are in millimeters

Exposed Thermal Pad Dimensions

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
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
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
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
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)

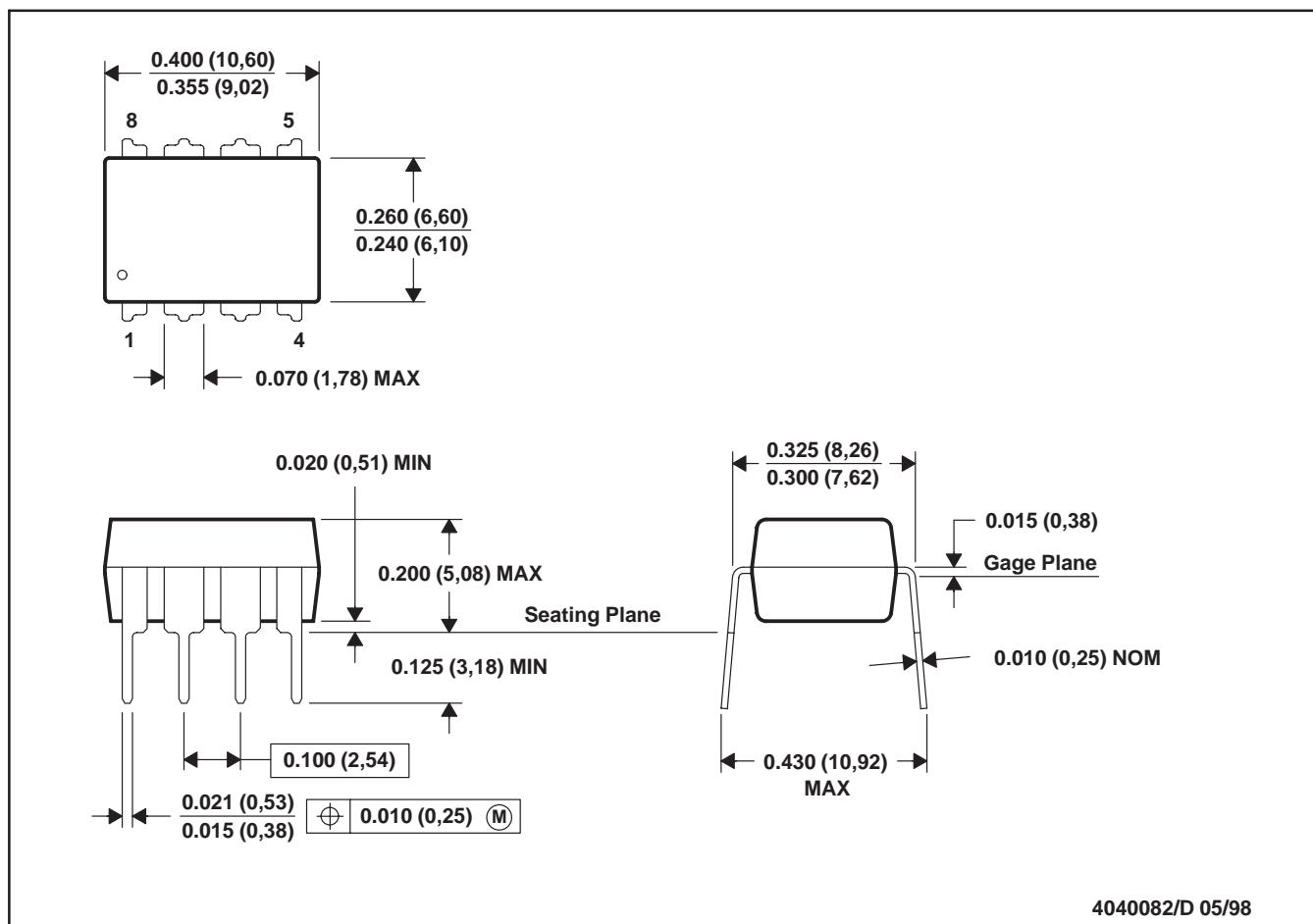
⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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P (R-PDIP-T8)

PLASTIC DUAL-IN-LINE

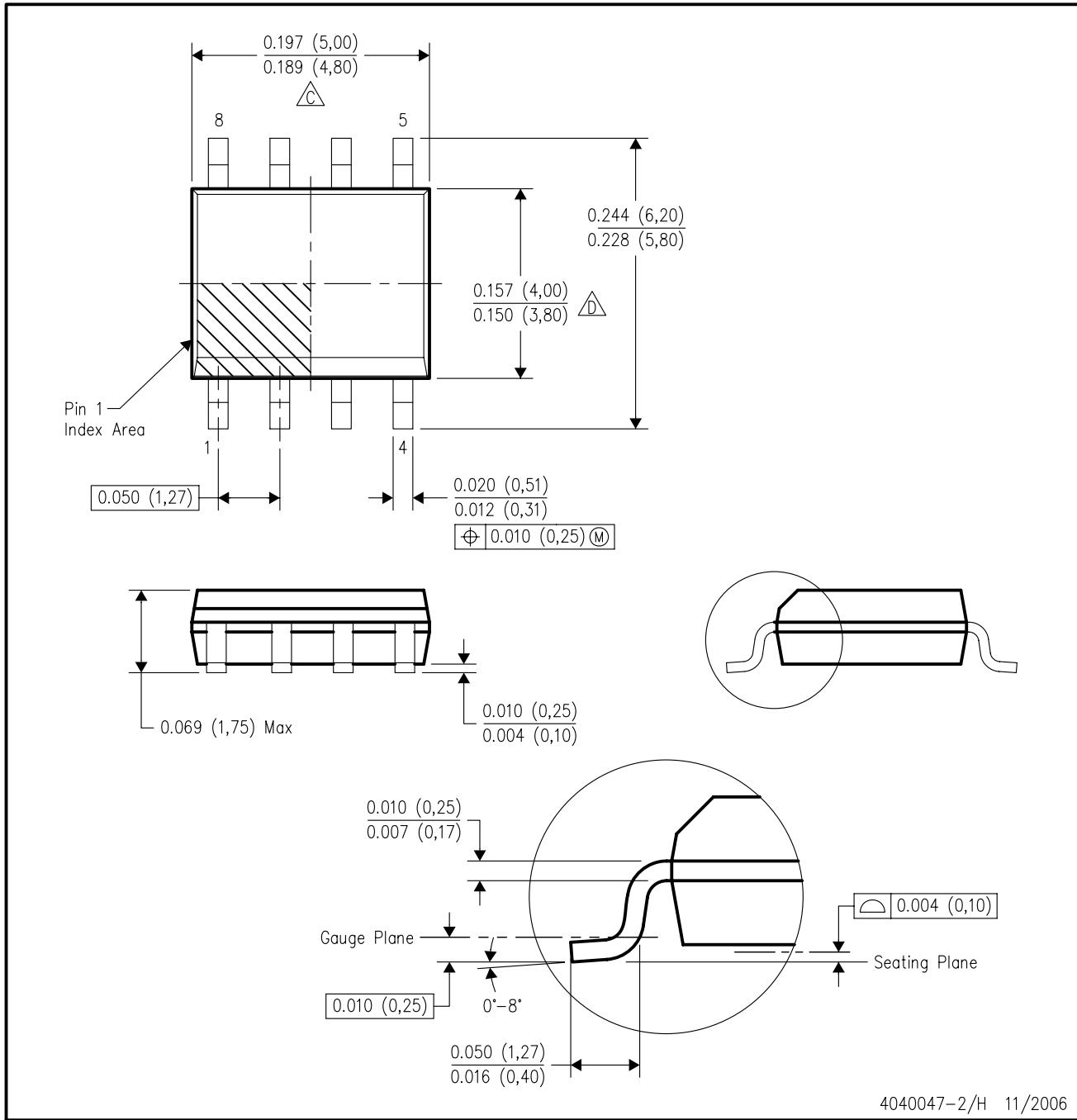


NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. Falls within JEDEC MS-001

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

D (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE



4040047-2/H 11/2006

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.

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