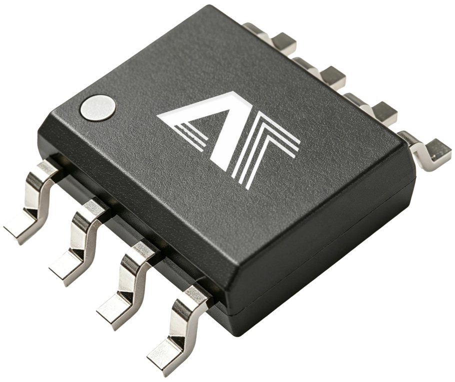
AOTE
SEMICONDUCTOR



A Peak Boost/Buck/Inverting Switching Regulators

MC33063A(AT)

Product Data Sheet

AOTE DCC
RELEASE

Summary ：

The MC33063 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 MC33063 device is characterized for operation from 0℃ to 70℃.

Product features

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

Applications

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

Device Information (1)

PART NUMBER	PACKAGE (PIN)	BODY SIZE
MC33063	SOIC(8)	4.90 mm × 3.91 mm

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

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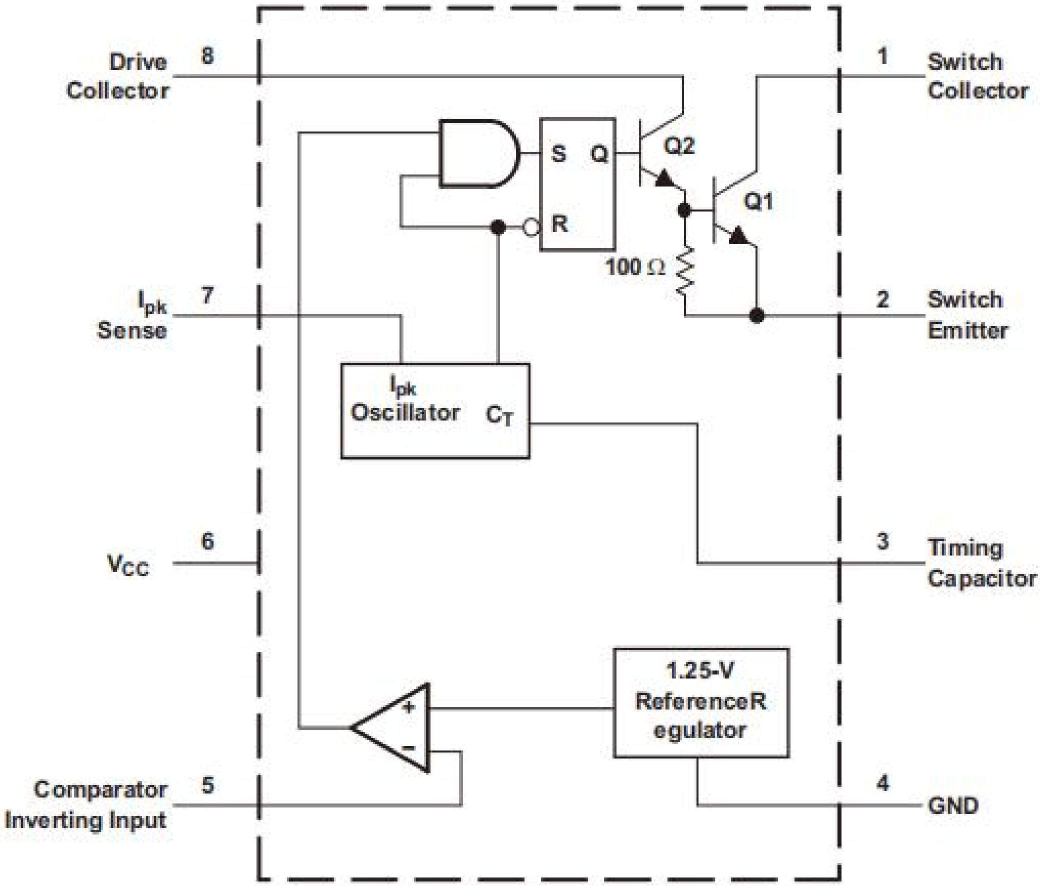
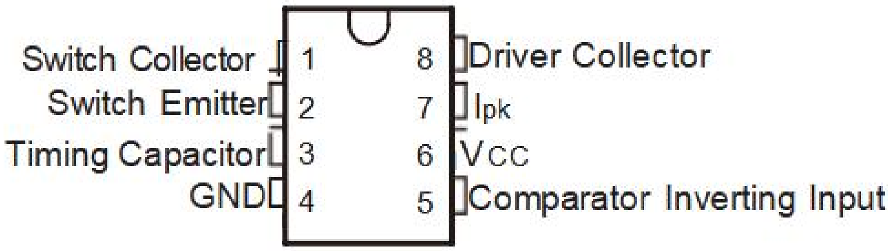
Simplified Schematic



Pin Configuration and Functions

D (SOIC) PACKAGE
(TOP VIEW)



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

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Pin Functions

PIN		TYPE	DESCRIPTION
NAME	NO.		
Switch Collector	1	I/0	High-current internal switch collector input
Switch Emitter	2	I/0	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_{CC}	6	I	Logic supply voltage.Tie to V_{IN}
I_{PK}	7	I	Current-limit sense input
Driver Collector	8	I/0	Darlington pair driving transistor collector input

Specifications

Absolute Maximum Ratings 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
$V_{E(switch)}$	Witch emitter voltage	V_{PIN1}=40V	-	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
T_J	Operating virtual junction temperature		-	150	℃
T_{stg}	Storage temperature range		-65	150	℃

(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

(2) Recommended Operating Conditions is not implied.Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDECJS-001,all pins(1)	2500	V
		Charged device model(CDM),per JEDEC specification JESD22-C101,all pins(2)	1500	

(1)JEDEC document EP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

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

Recommended Operating Conditions

-	-		MIN	MAX	UNIT
V_{CC}	Supply voltage		3	40	V
T_A	Operating free-air temperature	MC33063	-40	125	℃

Thermal Information

-	-	MC33063			UNIT
		D	DRJ	P	
		8PINS			
$R_{\theta JA}$	Junction-to-ambient thermal resistance	97	41	85	℃/W

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

Electrical Characteristics—Oscillator

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

-	PARAMETER	TEST CONDITIONS	T_A	MIN	TYP	MAX	UNIT
f_{osc}	Oscillator frequency	V_{PIN5}=0V, C_T=1nF	25℃	24	33	42	kHz
I_{chg}	Charge current	V_{CC}=5V to 40V	25℃	24	35	42	μA
I_{dischg}	Discharge current	V_{CC}=5V to 40V	25℃	140	220	260	μA
I_{dischg}/I_{chg}	Discharge-to-charge current ratio	$V_{PIN7}=V_{CC}$	25℃	5.2	6.5	7.5	-
V_{Ipk}	Current-limit sense voltage	$I_{dischg}=I_{chg}$	25℃	250	300	350	mV

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Electrical Characteristics—Output Switch

V_{CC}=5V,T_A=full operating range(unless otherwise noted)(see block diagram)(1)

PARAMETER		TEST CONDITIONS	T_A	MIN	TYP	MAX	UNIT
$V_{CE(sat)}$	Saturation voltage– Darlington connection	I_{SW}=1A,pins 1 and 8 connected	Full range	-	1	1.3	V
$V_{CE(sat)}$	Saturation voltage – non-Darlington connection (2)	I_{SW}=1A ~,R_{PIN8}=82Ωto V_{CC}, Forced β20	Full range	-	0.45	0.7	V
h_{FE}	DC current gain	I_{SW}=1A,V_{CE}=5V	25℃	50	75	-	-
$I_{C(off)}$	Collector off-state current	V_{CE}=40V	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=$I_{C,SW}$/($I_{C,\ driver}$ –7mA) ≥10,where ~7mA is required by the 100-Ω resistor in the emitter of the driver to forward bias the V_{be} of the switch.

Electrical Characteristics—Comparator

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

-	PARAMETER	TEST	T_A	MIN	TYP	MAX	UNIT
V_{th}	Threshold voltage	-	25℃	1.225	1.25	1.275	V
			Full range	1.21	-	1.29	
ΔV_{th}	Threshold-voltage line regulation	V_{CC}=5V to 40V	Full range	-	1.4	5	mV
I_B	Input bias current	V_{IN}=0V	Full range	-	-20	-400	nA

Electrical Characteristics—Total Device

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

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

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Typical Characteristics

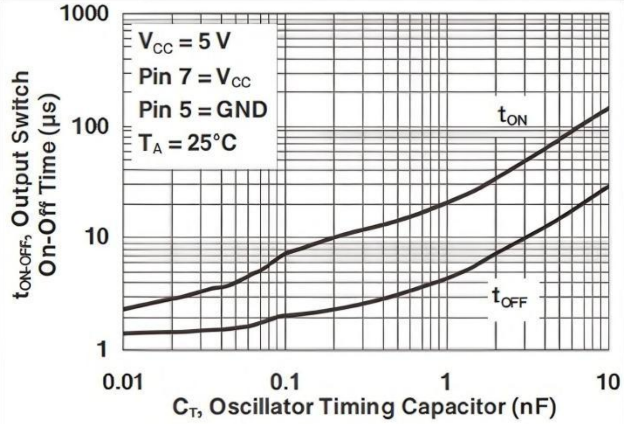

Figure 1. Output Switch On-Off Time vs Oscillator Timing Capacitor

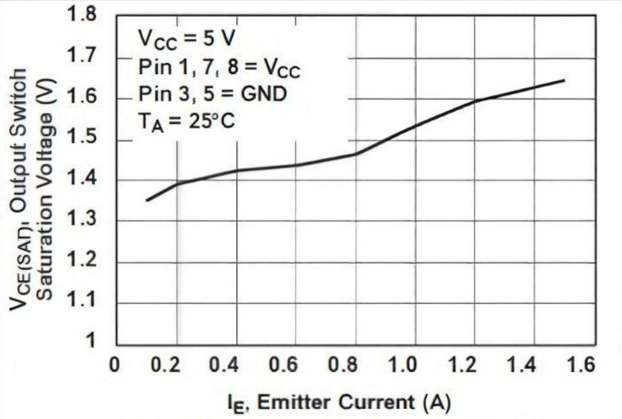

Figure 2. Output Switch Saturation Voltage vs Emitter Current (Emitter-Follower Configuration)

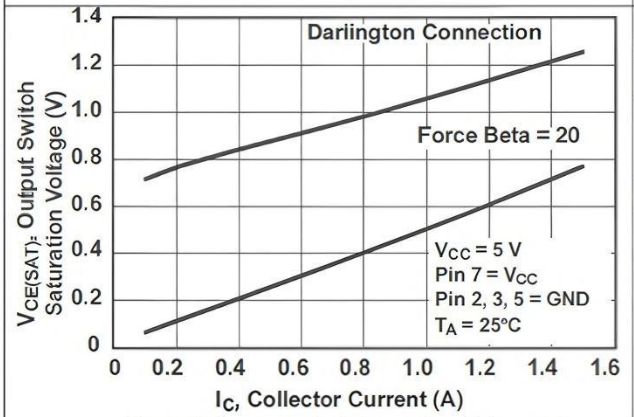

Figure 3. Output Switch Saturation Voltage vs Collector Current (Common-Emitter Configuration)

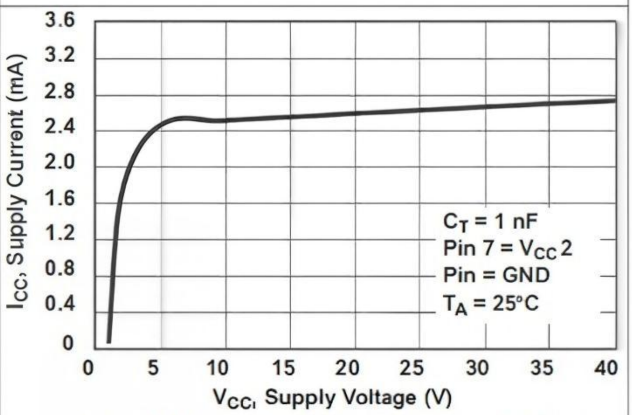

Figure 4. Standby Supply Current vs Supply Voltage

Detailed Description

Overview

The MC33063 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 MC33063 device is characterized for operation from 0℃ to 70℃.

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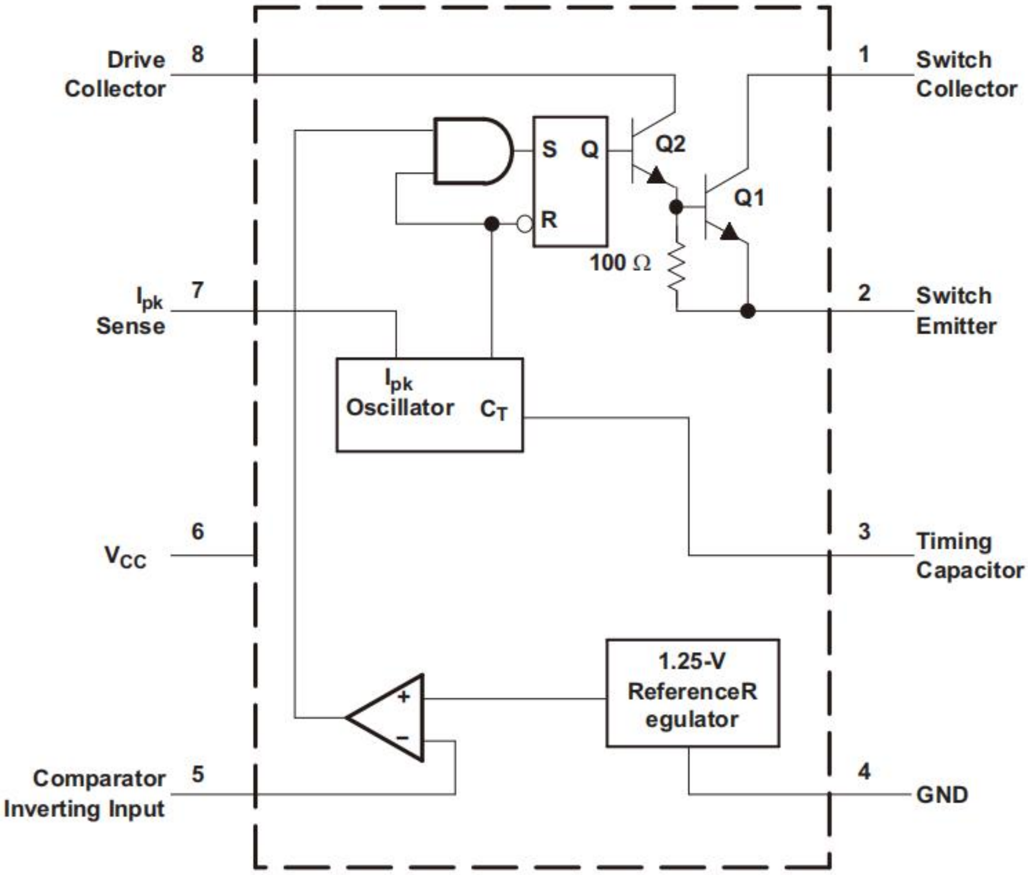
Functional Block Diagram



Feature Description

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

Device Functional Modes Standard operation block diagram

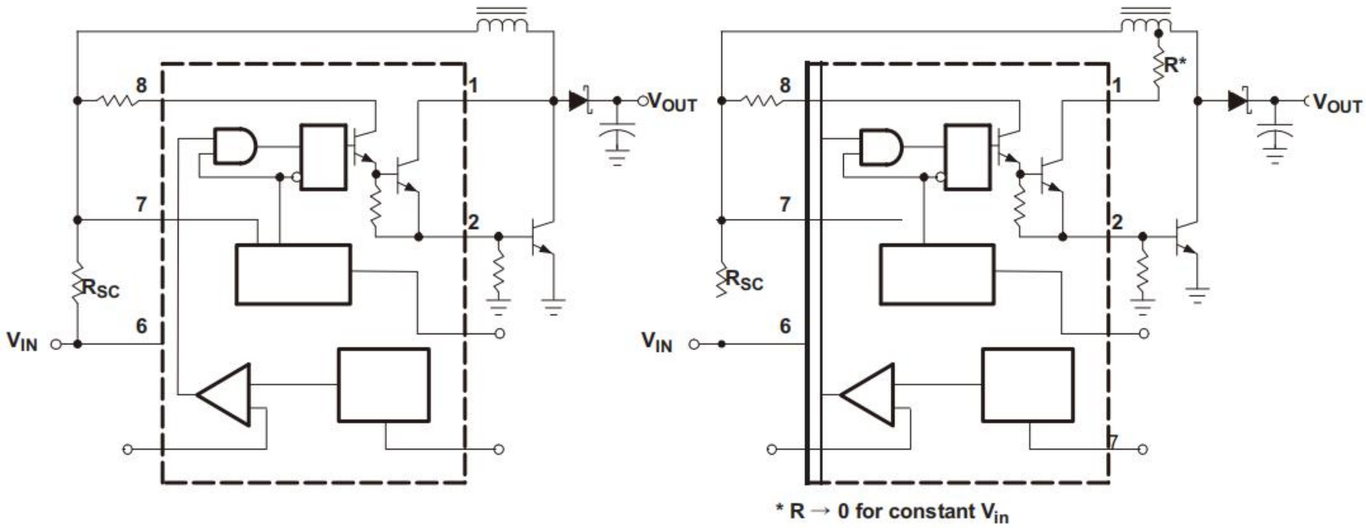
Based on the application, the device can be configured in multiple different topologies. See the Application and Implementation section for how to configure the device in several different operating modes.

◆ Application and Implementation

Attention:

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

◆ Application Information 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 (≤300 mA) and high driver currents (≥30 mA), it may take up to 2 µs 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 5. Boost Regulator Connections for I_C Peak Greater Than 1.5 A

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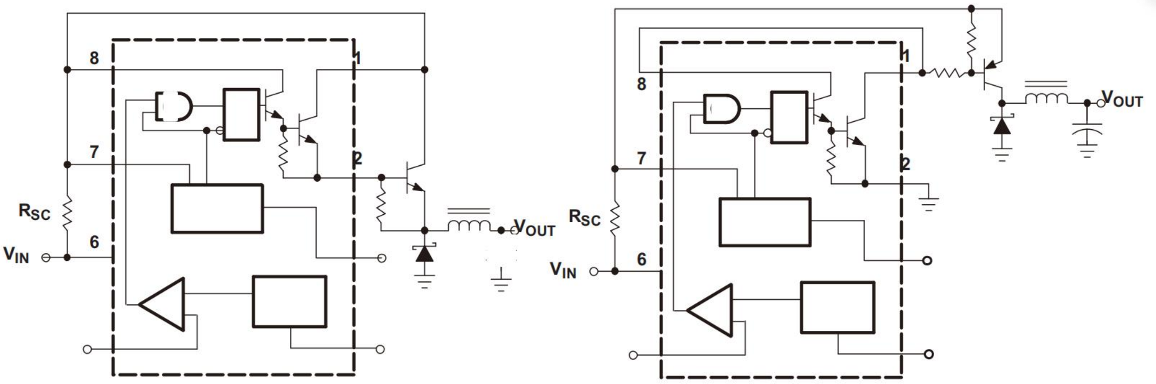
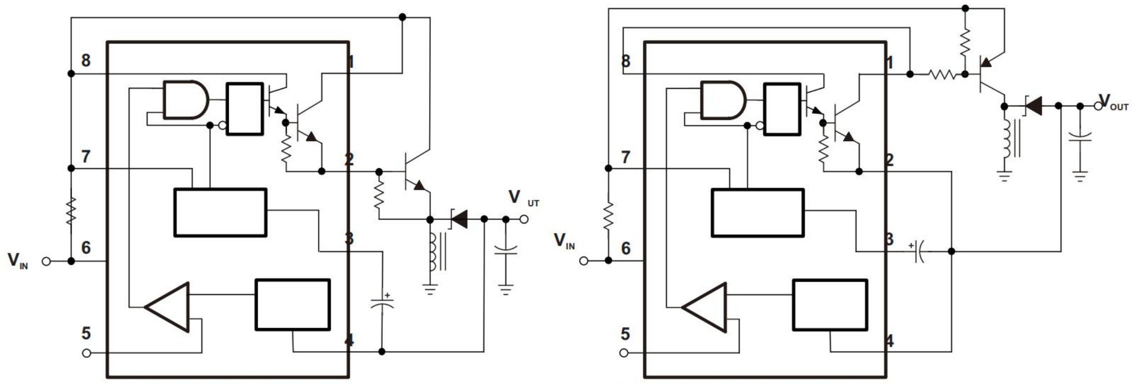
Application Information(continued)



a) EXTERNAL npn SWITCH b) EXTERNAL pnp SATURATED SWITCH

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



a) External NPN Switch b) External PNP Saturated Switch

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

Typical Application Voltage-Inverting Converter Application

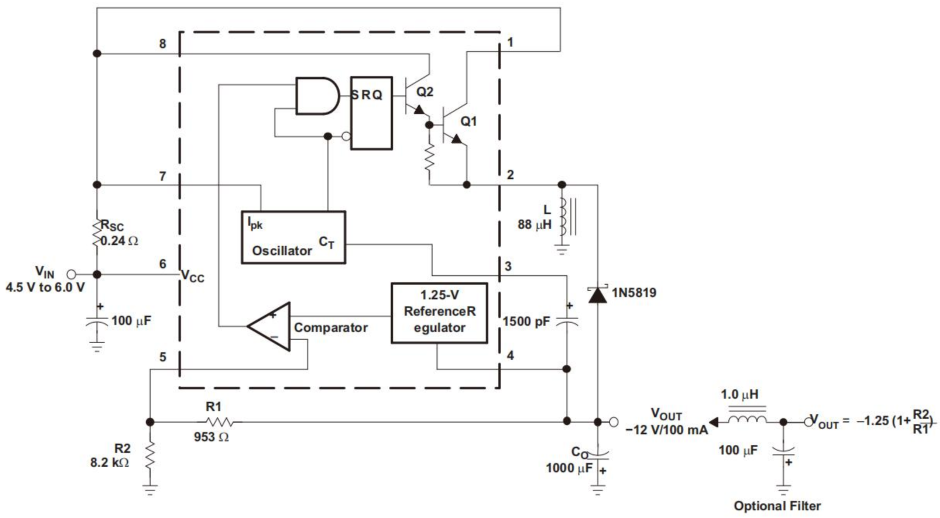


Figure 8. Voltage-Inverting Converter

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Typical Application(continued)

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 Vin and Iout

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

Detailed Design Procedure

CALCULATION	VOLTAGE INVERTING
t_{on}/t_{off}	$\frac{V_{out} + V_{F\text{-}Vin(min)}}{V_{in(min)} - V_{sat}}$
$(t_{on}+t_{off})$	$\frac{1}{f}$
t_{off}	$\frac{t_{on} + t_{off}}{\frac{t_{on}}{t_{off}} + 1}$
t_{on}	$(t_{on} + t_{off}) - t_{off}$
C_T	$4\times10^{-5}t_{on}$
$I_{pk(switch)}$	$2I_{out(max)}\left(\frac{t_{on}}{t_{off}}+1\right)$
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}	$1.25\left(1+\frac{R2}{R1}\right)$ See Figure 10

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Application Performance

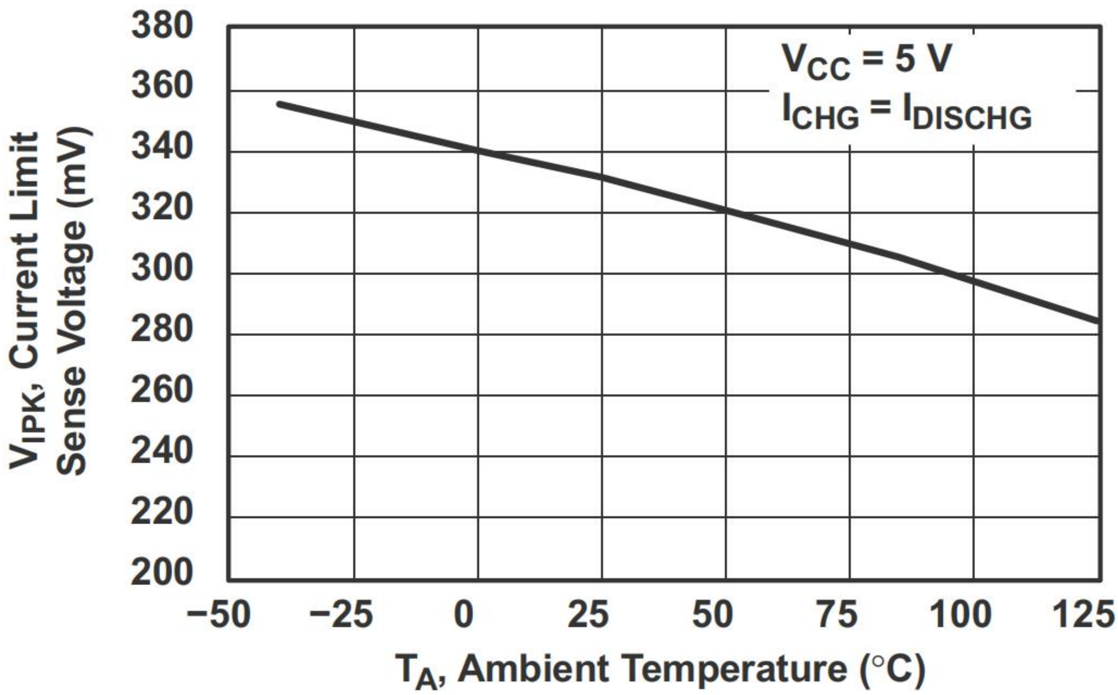

Figure 9. Current-Limit Sense Voltage vs Temperature

TEST	CONDITIONS	RESULTS
Line regulation	V_{IN}=4.5V to 6V,I_0=100mA	3mV±0.12%
Load regulation	V_{IN}=5V,I0=10mA to 100mA	0.022V±0.09%
Output ripple	V_{IN}=5V,I_0=100mA	500mVpp
Short-circuit current	V_{IN}=5V, R_L=0.1Ω	910mA
Efficiency	V_{IN}=5V,I_0=100mA	62.2%
Output ripple with optional filter	V_{IN}=5V,I_0=100mA	70mV_{PP}

Step-Up Converter Application

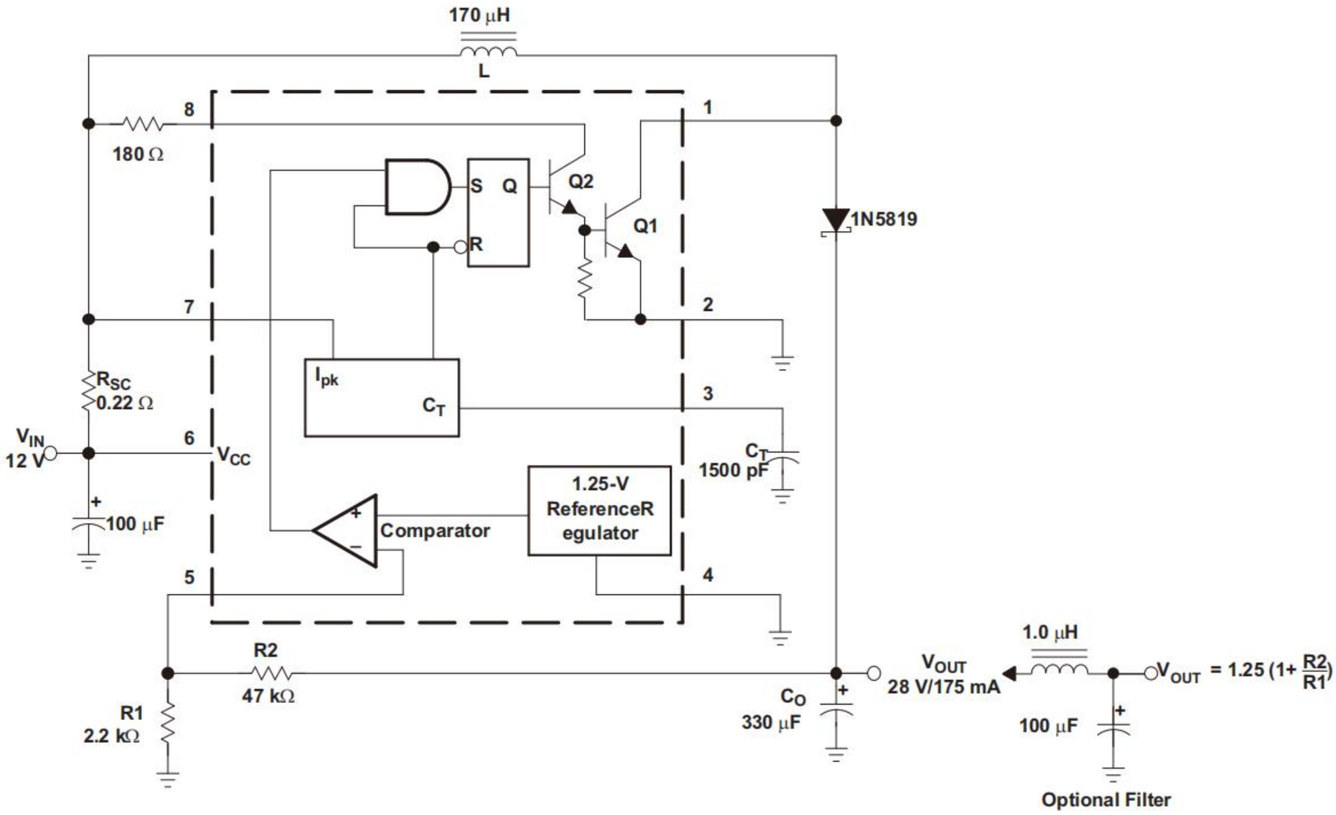

Figure 10. Step-Up Converter

Design Requirements

The user must determine the following desired parameters:

Vsat = Saturation voltage of the output switch

VF = Forward voltage drop of the chosen output rectifier

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

Vin = Nominal input voltage

Vout = Desired output voltage

Iout = Desired output current

fmin = Minimum desired output switching frequency at the selected values of Vin and Iout. Vripple = 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.

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Detailed Design Procedure

CALCULATION	STEPUP
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_0	$9 \frac{I_{out} t_{on}}{V_{ripple(pp)}}$
V_{out}	$1.25\left(1+\frac{R2}{R1}\right)$ See Figure 10

Application Performance

TEST	CONDITIONS	RESULTS
Line regulation	V_{IN}=8V to 16V,I_0=175mA	30mV±0.05%
Load regulation	V_{IN}=12V,I_0=75mA to 175mA	10mV±0.017%
Output ripple	V_{IN}=12V,I_0=175mA	400mVpp
Efficiency	V_{IN}=12V,I_0=175mA	87.7%
Output ripple with optional filter	V_{IN}=12V,I_0=175mA	40mV$_{PP}$

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◆ Step-Down Converter Application

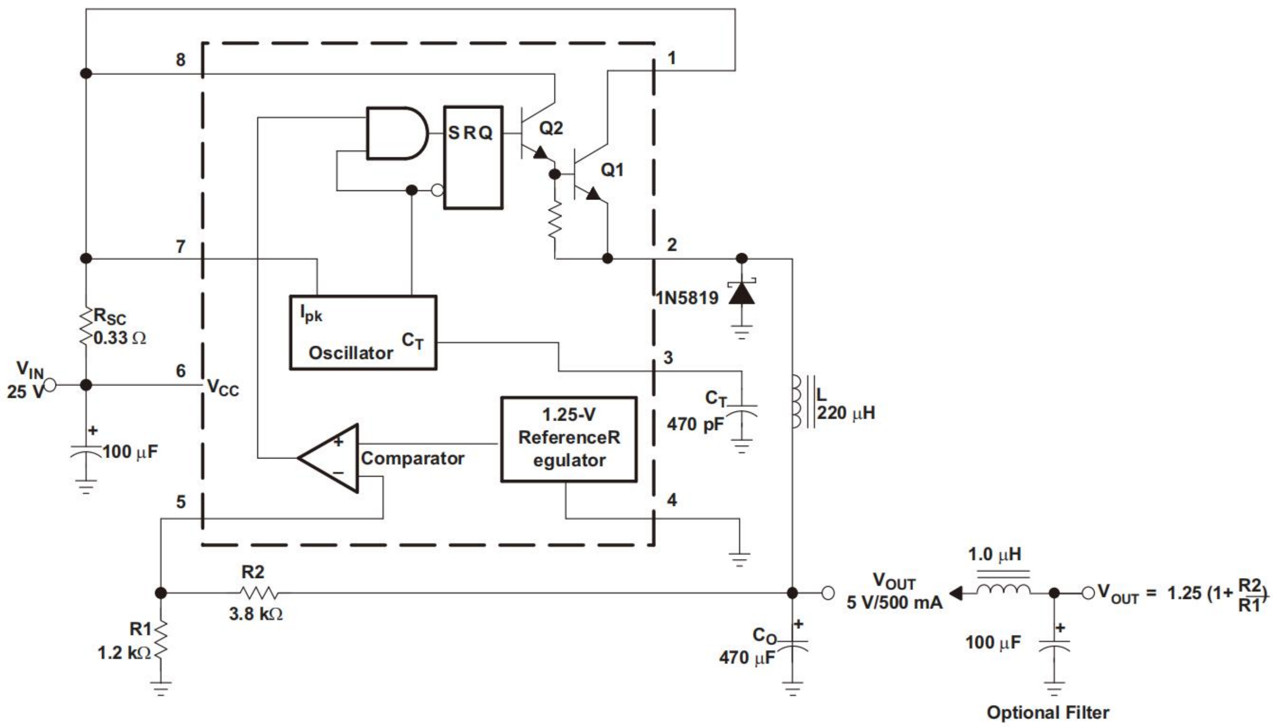

Figure 11. Step-Down Converter

Design Requirements

The user must determine the following desired parameters:

Vsat = 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 Vin and Iout. Vripple = 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.

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Detailed Design Procedure

CALCULATION	STEPUP
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	$4\times10^{-5}t_{on}$
$I_{pk(switch)}$	$2I_{out(max)}$
R_{SC}	$\frac{0.3}{I_{pk(switch)}}$
$L_{(min)}$	$\left(\frac{(V_{in(min)}-V_{sat}-V_{out})}{I_{pk(switch)}}\right)t_{on(max)}$
Co	$\frac{I_{pk(switch)}(t_{on}+t_{off})}{8V_{ripple(pp)}}$
V_{out}	$1.25\left(1+\frac{R2}{R1}\right)$ See Figure 11

Application Performance

TEST	CONDITIONS	RESULTS
Linere gulation	V_{IN}=15V to 25V,I_O=500mA	12mV±0.12%
Loadre gulation	V_{IN}=25V,I_O=50mA to 500mA	3mV±0.03%
Output ripple	V_{IN}=25V,I_O=500mA	120mV_{PP}
Short-circuit current	V_{IN}=25V,R_L=0.1 Ω	1.1%
Efficiency	V_{IN}=25V,I_O=500mA	83.7%
Output ripple with optional filter	V_{IN}=25V,I_O=500mA	40mV_{PP}

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◆ Power Supply Recommendations

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

Layout

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 VIN to pin1 of the device should be thicker to handle the higher current.

Layout Example

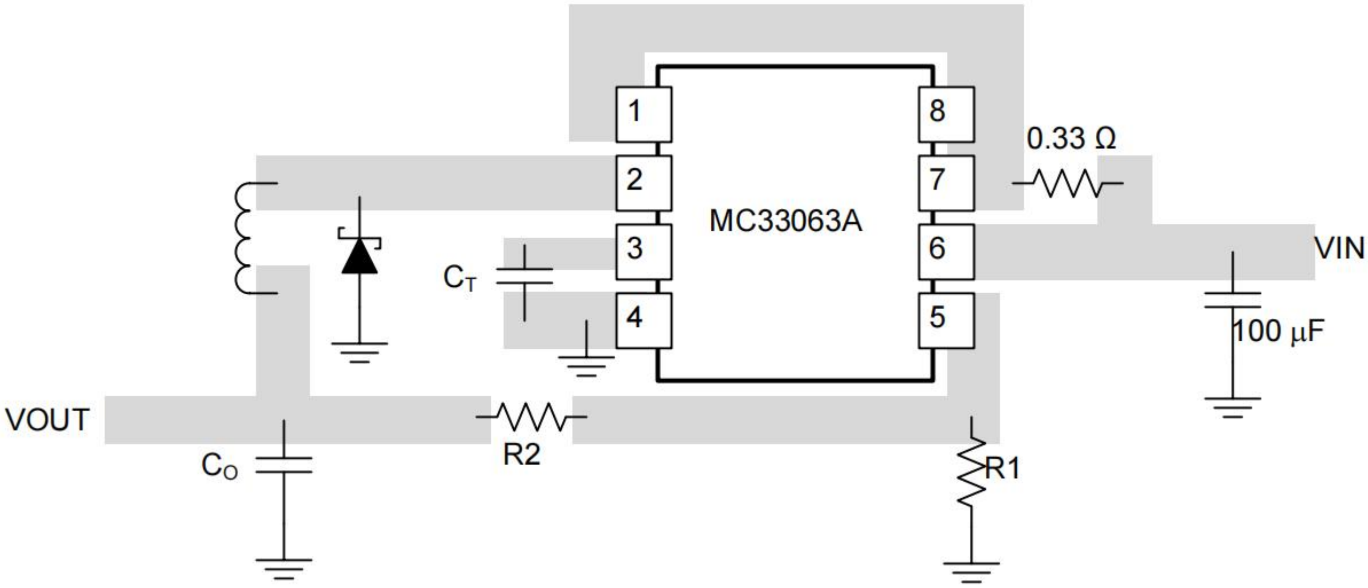


Figure 12. Layout Example for a Step-Down Converter

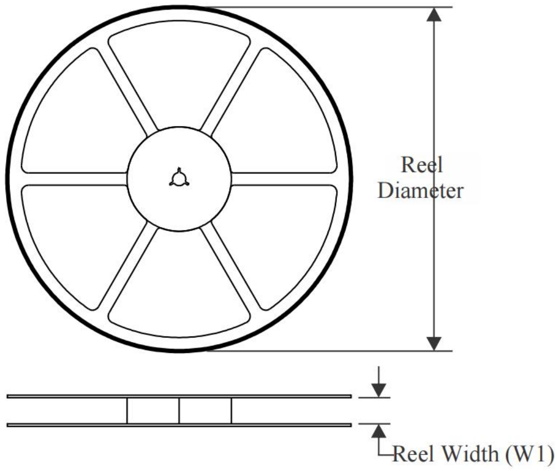
◆ Electrostatic Discharge Caution

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.

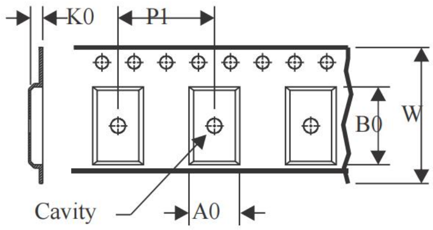
Orderable part number	Status	Material type	Package|Pins	Package qty|Carrier	RoHS	Lead finish/Ball material	MSL rating/Peak reflow	Optemp (℃)	Part marking
MC33063AD	NRND	Production	SOIC (D)| 8	75|TUBE	Yes	NIPDAU	Level-1 260C-UNLIM	0 to 70	M33063A
MC33063AD.A	NRND	Production	SOIC (D)| 8	75|TUBE	Yes	NIPDAU	Level-1 260C-UNLIM	0 to 70	M33063A
MC33063ADE4	NRND	Production	SOIC (D)| 8	75|TUBE	Yes	NIPDAU	Level-1 260C-UNLIM	0 to 70	M33063A
MC33063ADG4	NRND	Production	SOIC (D)| 8	75|TUBE	Yes	NIPDAU	Level-1 260C-UNLIM	0 to 70	M33063A
MC33063ADR	Active	Production	SOIC (D)| 8	2500 | LARGE T&R	Yes	NIPDAU	Level-1 260C-UNLIM	0 to 70	M33063A
MC33063ADR.A	Active	Production	SOIC (D)| 8	2500 | LARGE T&R	Yes	NIPDAU	Level-1 260C-UNLIM	0 to 70	M33063A

◆ TAPE AND REEL INFORMATION

REEL DIMENSIONS

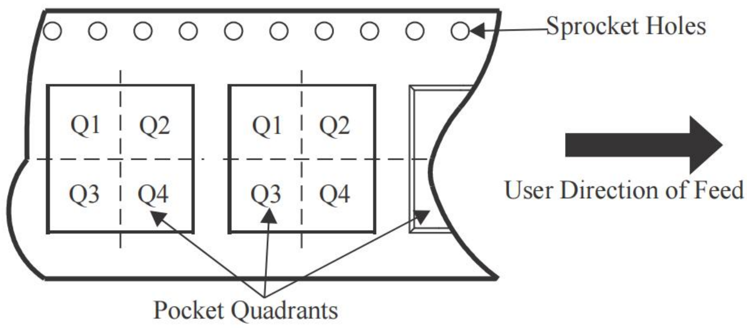


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



All dimensions are nominal

Device	Package Type	PackageDrawing	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

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Attention

- AOTE implements dynamic technical updates. Specifications are subject to change. Refer to the official website for the latest version.
- Users must strictly adhere to specified conditions. Failures caused by misuse (overload, high temperature, incompatible circuits) are excluded from warranty.
- Contact technical support for customized validation in critical applications (medical devices, industrial control).
- This document is valid until December 31, 2026. Updates will be notified on the official website.
- For further clarification on technical specifications or application solutions, please contact us through official channels: