

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°C to 70°C.

◆ 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 Stand by Current

◆ Applications

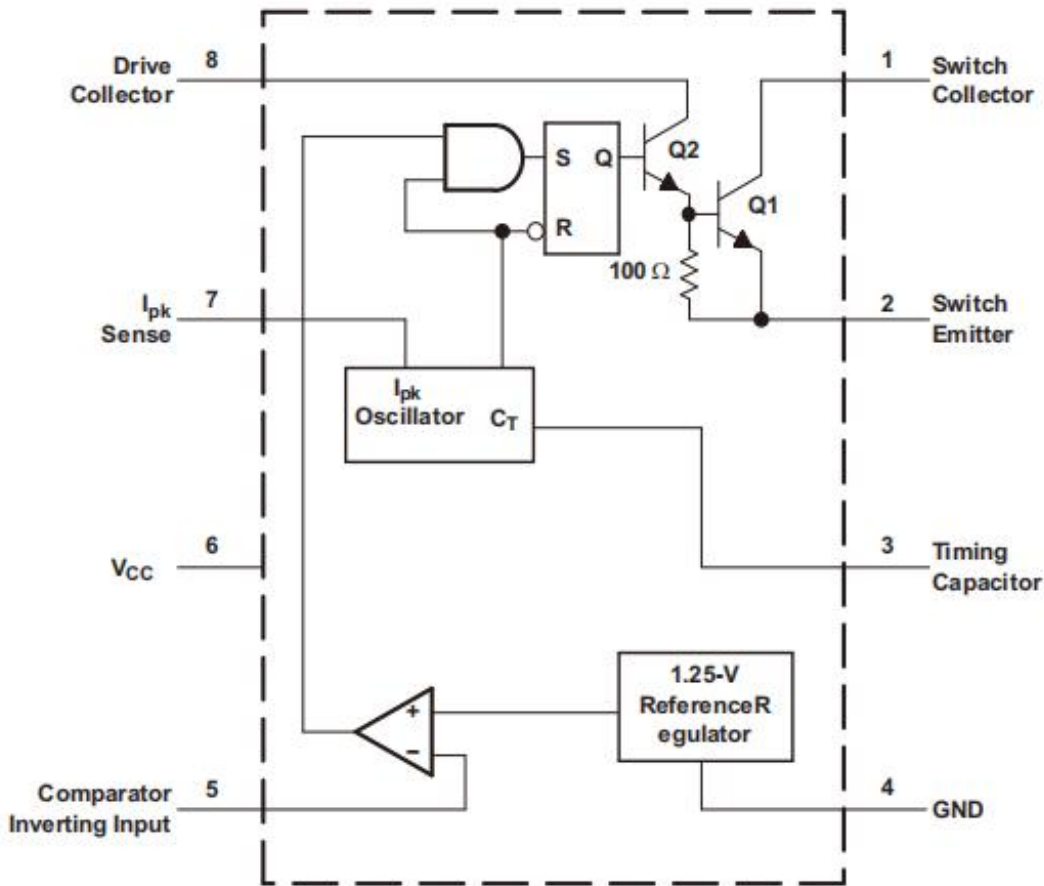
- Blood Gas Analyzers: Portable
- Cable Solutions
- HMIs (Human Machine Interfaces)
- Telecommunications
- Portable Devices
- Consumer & Computing
- Test & Measurement

◆ Device Information(1)

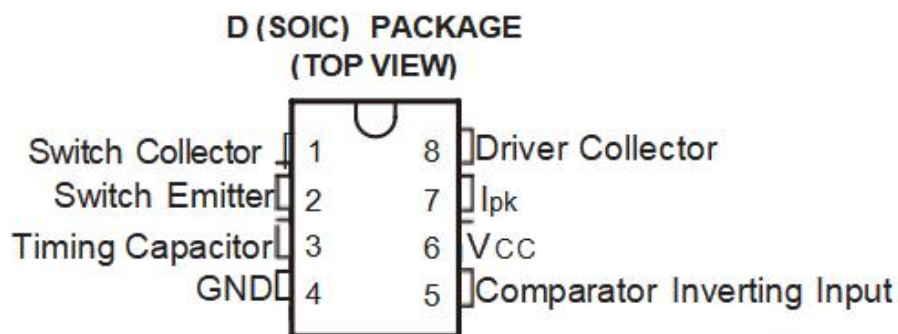
PART NUMBER	PACKAGE(PIN)	BODY SIZE
MC33063	SOIC(8)	4.90mm×3.91mm

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

◆ **Simplified Schematic**



◆ **Pin Configuration and Functions**



† 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 _{CC}	6	I	Logic supply voltage. Tie to V _{IN}
I _{PK}	7	I	Current-limit sense input
Driver Collector	8	I/O	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)}	Switch emitter voltage		40	V
			V _{PIN1} = 40V	
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	°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

(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	MC34063	0	70	°C

◆ Thermal Information

-	-	MC33063			UNIT
		D	DRJ	P	
		8PINS			
$R_{\theta JA}$	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).

◆ 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°C	24	33	42	kHz
I_{chg}	Charge current	$V_{CC}=5V$ to 40V	25°C	24	35	42	μA
I_{dischg}	Discharge current	$V_{CC}=5V$ to 40V	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

◆ Electrical Characteristics—Output Switch

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

PARAMETER		TEST CONDITIONS	T_A	MIN	TYP	MAX	UNIT
$V_{CE(sat)}$ Saturation voltage– Darlington connection		$I_{SW}=1A, \text{pins 1 and 8 connected}$	Full range	-	1	1.3	V
$V_{CE(sat)}$ Saturation voltage – non-Darlington connection ⁽²⁾		$I_{SW}=1A \sim, R_{PIN8}=82\Omega \text{ to } V_{CC}, \text{ Forced } \beta 20$	Full range	-	0.45	0.7	V
h_{FE}	DC current gain	$I_{SW}=1A, V_{CE}=5V$	25°C	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 ($\leq 300mA$) and high driver currents ($\geq 30mA$), it may take up to 2 μs for the switch to come out of saturation. This condition effectively shortens the off time at frequencies $\geq 30kHz$, becoming magnified as temperature increases. The following output drive condition is recommended in the non-Darlington configuration: Forced β of output switch = $I_{C,SW} / (I_{C,driver} - 7mA) \geq 10$, where $\sim 7mA$ 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

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

-	PARAMETER	TEST	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	$V_{CC}=5V \text{ to } 40V$	Full range	-	1.4	5	mV
I_B	Input bias current	$V_{IN}=0V$	Full range	-	-20	-400	nA

◆ Electrical Characteristics—Total Device

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

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

◆ **Typical Characteristics**

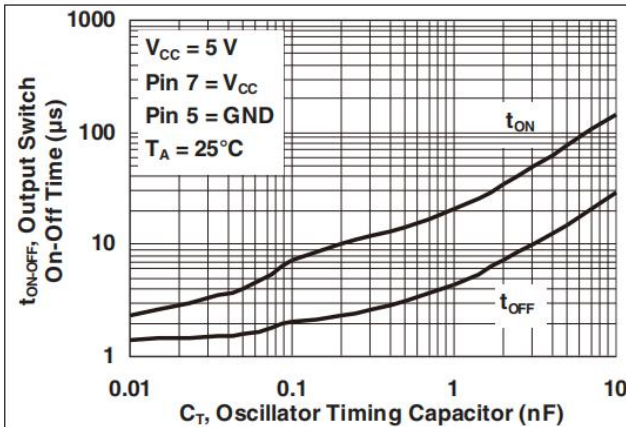


Figure 1. Output Switch On-Off Time vs Oscillator Timing Capacitor

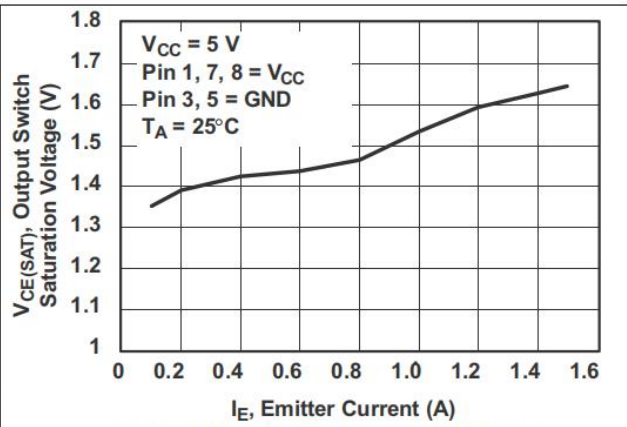


Figure 2. Output Switch Saturation Voltage vs Emitter Current (Emitter-Follower Configuration)

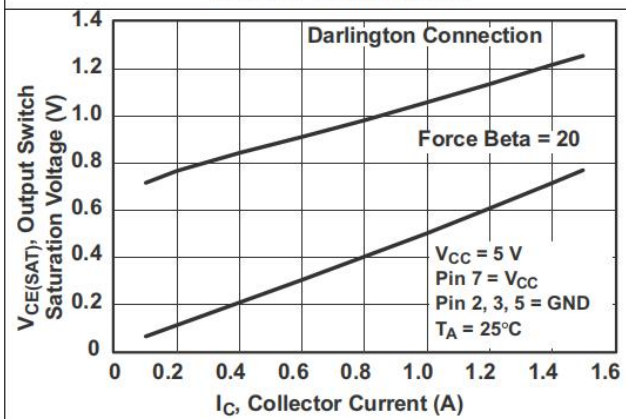


Figure 3. Output Switch Saturation Voltage vs Collector Current (Common-Emitter Configuration)

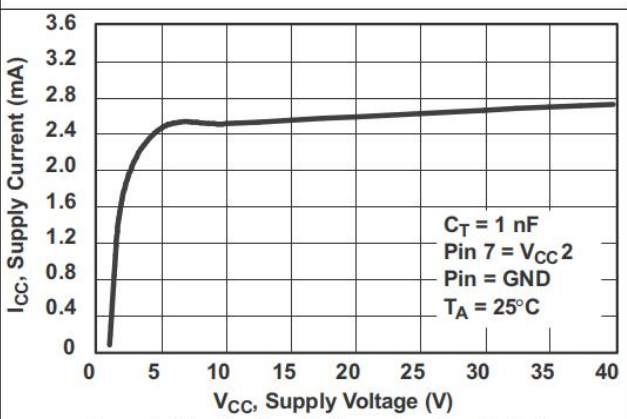


Figure 4. Standby Supply Current vs Supply Voltage

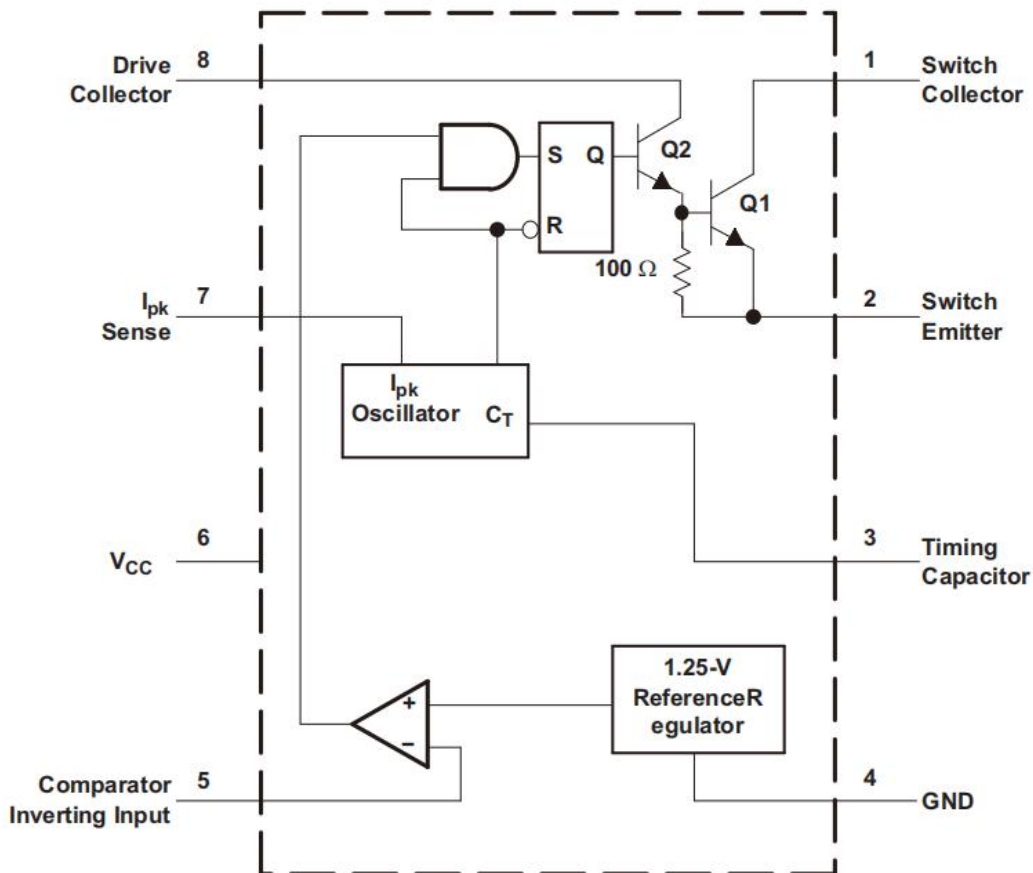
◆ **Detailed Description**

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°C to 70°C.

◆ **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**

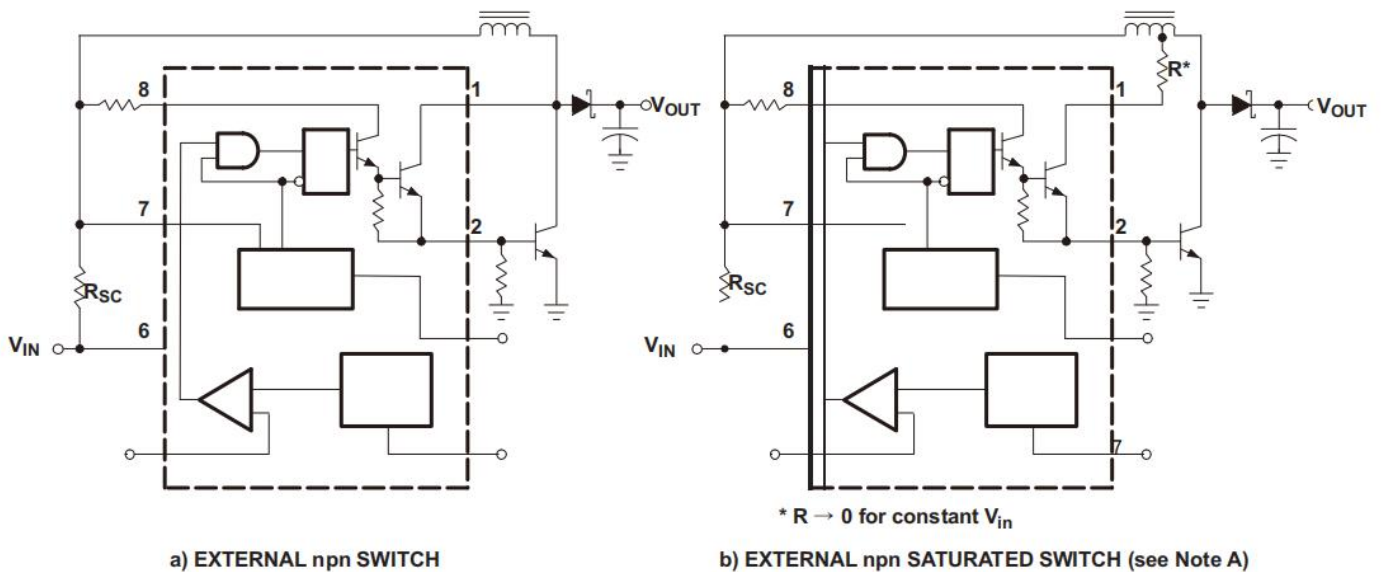
Based on the application,the device can be configured in multiple different to pologies.See the Application and Implementation section for how to configure the device in several different operating modes.

◆ **Application and Implementation**

Attention:

Information in the following applications 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 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. 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 5. Boost Regulator Connections for I_C Peak Greater Than 1.5 A

◆ **Application Information(continued)**

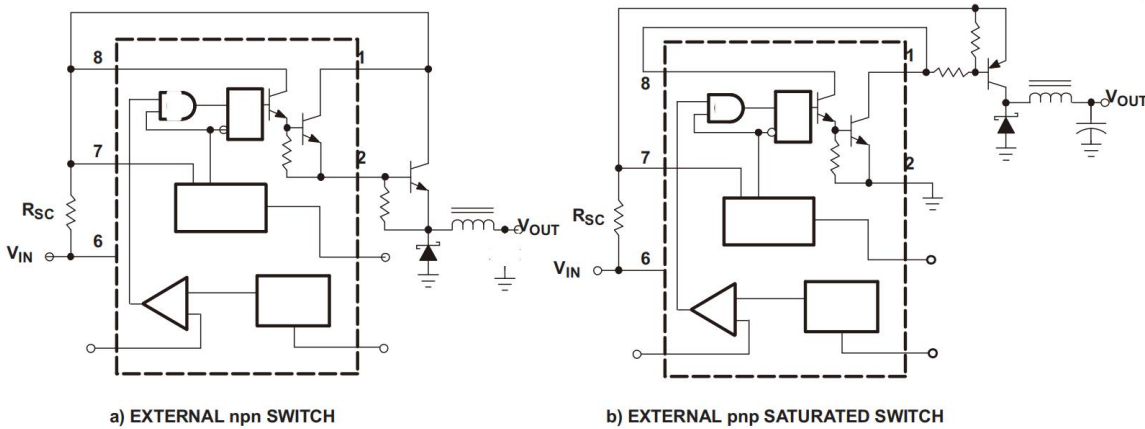


Figure 6. Buck Regulator Connections for I_C Peak Greater Than 1.5 A

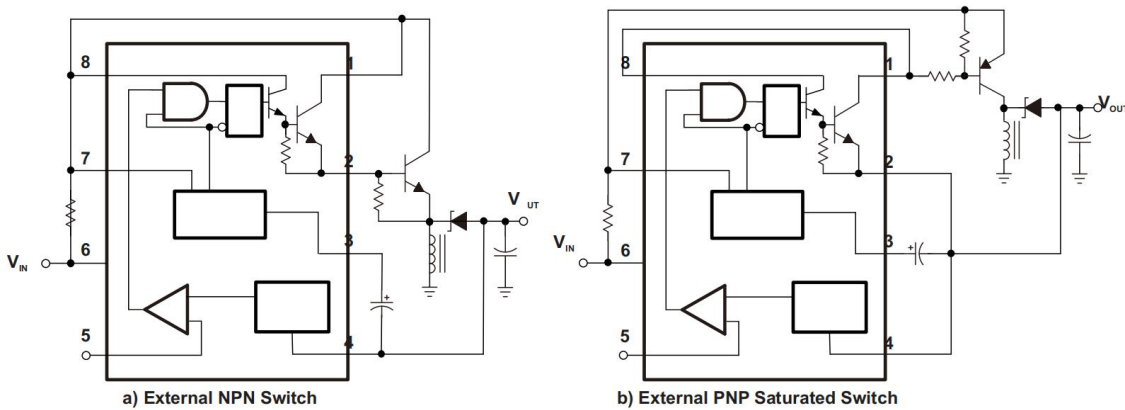


Figure 7. Inverting Regulator Connections for I_C Peak Greater Than 1.5 A

◆ **Typical Application Voltage-Inverting Converter Application**

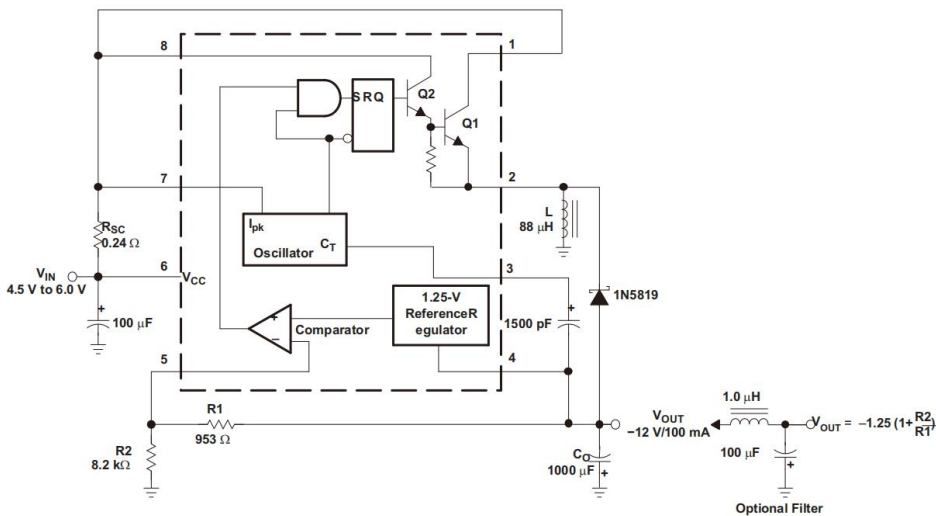


Figure 8. Voltage-Inverting Converter

◆ 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 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.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}	$\frac{V_{out} + V_{F-Vin(min)}}{V_{in(min)} - V_{sat}}$
$(t_{on} + t_{off})$	$\frac{1}{f}$
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}	$1.25 \left(1 + \frac{R2}{R1} \right)$ See Figure 10

◆ **Application Performance**

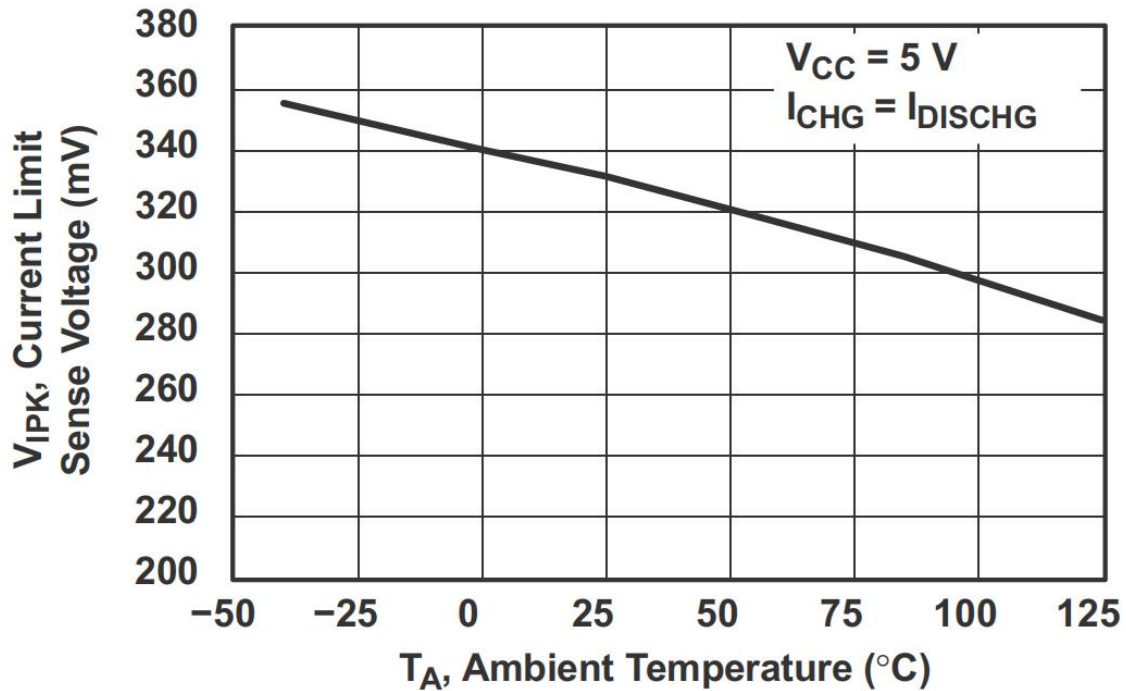


Figure 9. Current-Limit Sense Voltage vs Temperature

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

Step Up Converter Application

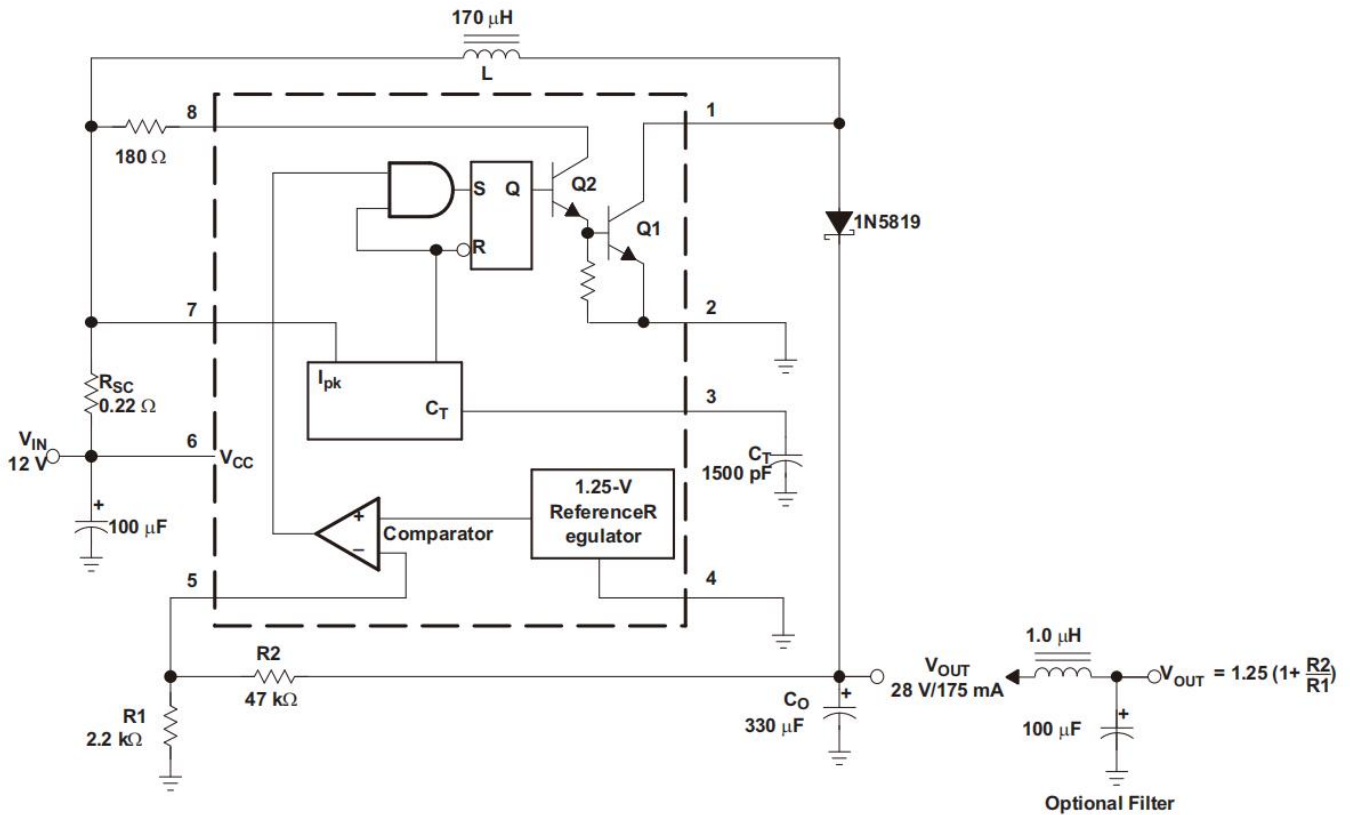


Figure 10. Step-Up Converter

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.

◆ 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	$4 \times 10^{-5} t_{on}$
$I_{pk(switch)}$	$2I_{out(max)} \left(\frac{t_{on} + 1}{t_{off}} \right)$
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 $16V, I_0=175mA$	$30mV \pm 0.05\%$
Load regulation	$V_{IN}=12V, I_0=75mA$ to $175mA$	$10mV \pm 0.017\%$
Output ripple	$V_{IN}=12V, I_0=175mA$	$400mV_{pp}$
Efficiency	$V_{IN}=12V, I_0=175mA$	87.7%
Output ripple with optional filter	$V_{IN}=12V, I_0=175mA$	$40mV_{pp}$

◆ **Step Down Converter Application**

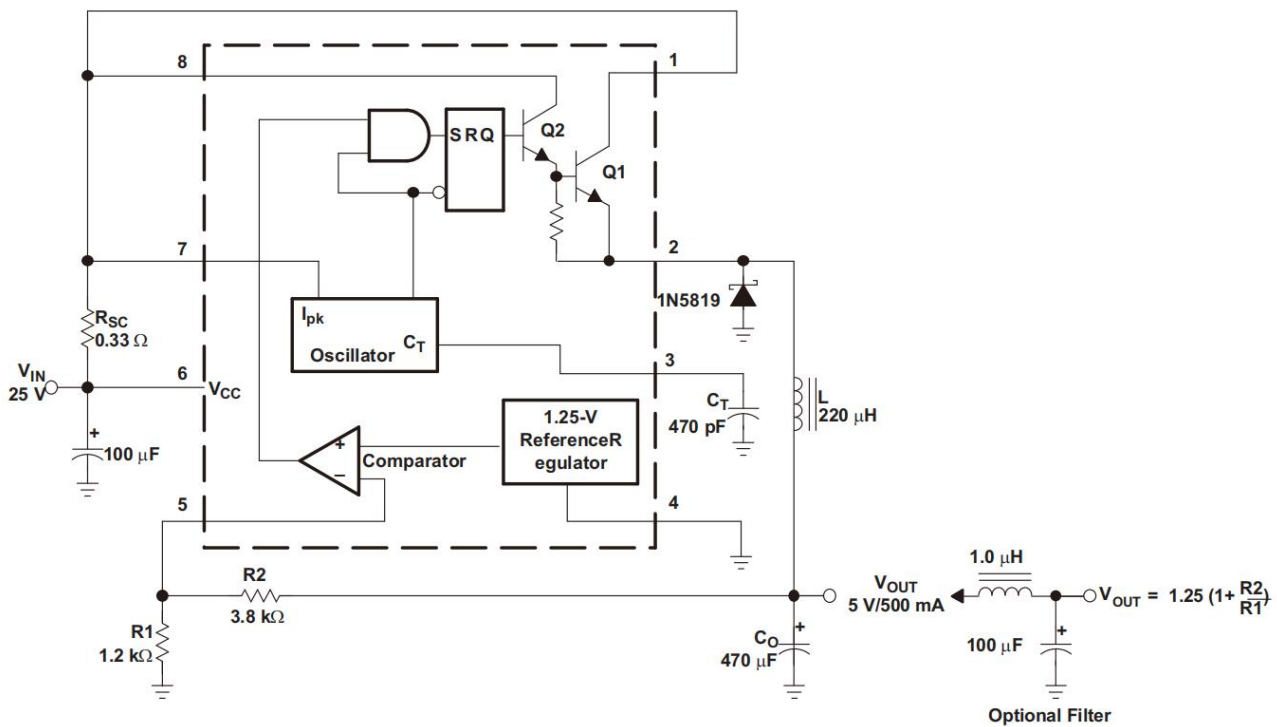


Figure 11. Step-Down Converter

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.

◆ 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	$4 \times 10^{-5} t_{on}$
$I_{pk(switch)}$	$2I_{out(max)}$
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}	$1.25 \left(1 + \frac{R2}{R1} \right)$ See Figure 11

◆ Application Performance

TEST	CONDITIONS	RESULTS
Line regulation	$V_{IN}=15V$ to $25V, I_o=500mA$	$12mV \pm 0.12\%$
Load regulation	$V_{IN}=25V, I_o=50mA$ to $500mA$	$3mV \pm 0.03\%$
Output ripple	$V_{IN}=25V, I_o=500mA$	$120mV_{pp}$
Short-circuit current	$V_{IN}=25V, R_L=0.1 \Omega$	1.1%
Efficiency	$V_{IN}=25V, I_o=500mA$	83.7%
Output ripple with optional filter	$V_{IN}=25V, I_o=500mA$	$40mV_{pp}$

◆ **Power Supply Recommendations**

This device accepts 3V to 40V on the input. It is recommended to have a 1000- μ F 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

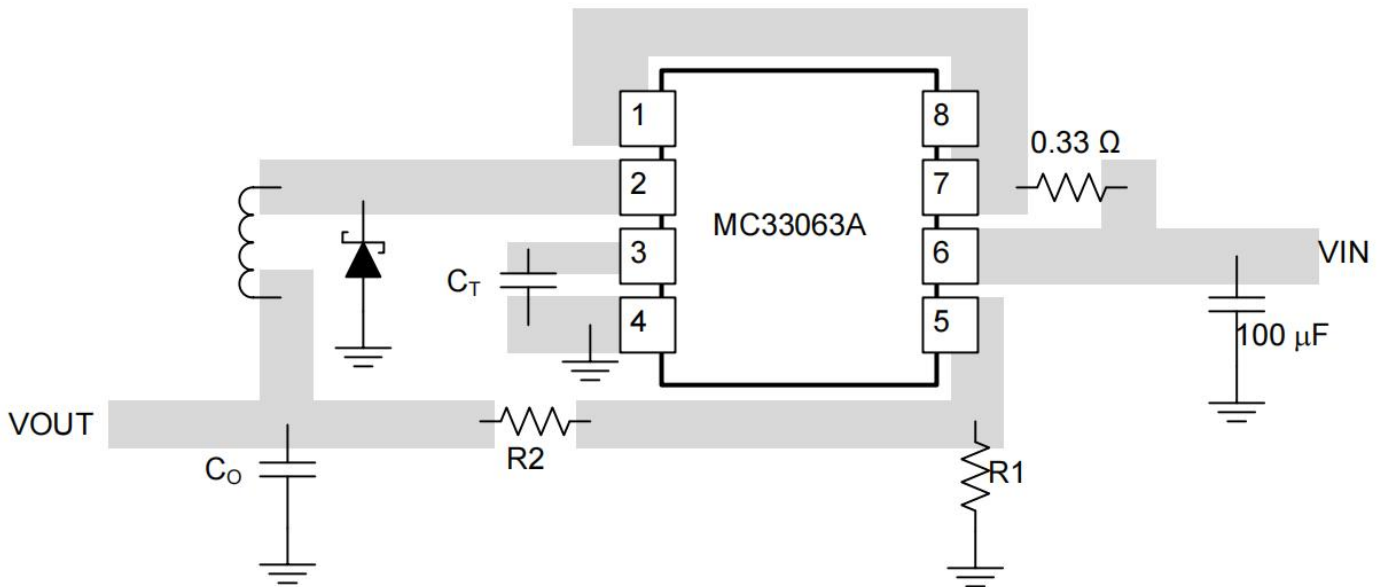


Figure 12. Layout Example for a Step-Down Converter

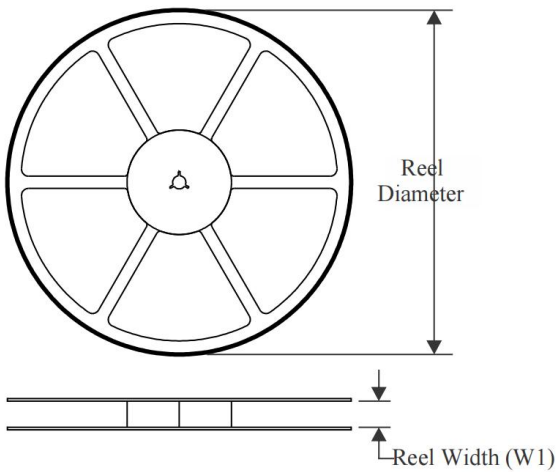
◆ Electrostatic Discharge Caution

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.

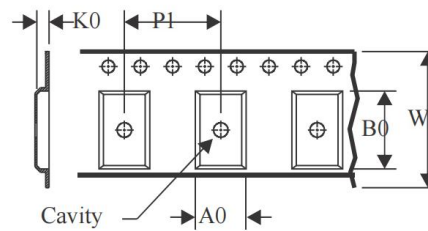
Orderable part number	Status	Material type	Package Pins	Package qty Carrier	Ro HS	Lead finish/Ball material	MSL rating/ Peak reflow	Optemp(°C)	Part marking
MC33063 AD	NR ND	Production	SOIC (D) 8	75 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	M33063A
MC33063 AD.A	NR ND	Production	SOIC (D) 8	75 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	M33063A
MC33063 ADE4	NR ND	Production	SOIC (D) 8	75 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	M33063A
MC33063 ADG4	NR ND	Production	SOIC (D) 8	75 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	M33063A
MC33063 ADR	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	M33063A
MC33063 ADR.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

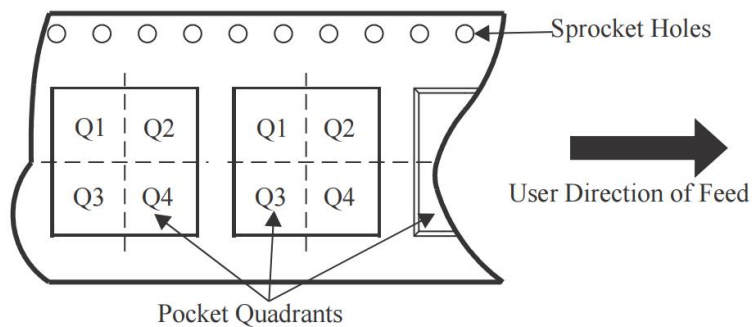


TAPE DIMENSIONS



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	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

◆ 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: