



500mA Fixed Output CMOS LDO with Shutdown

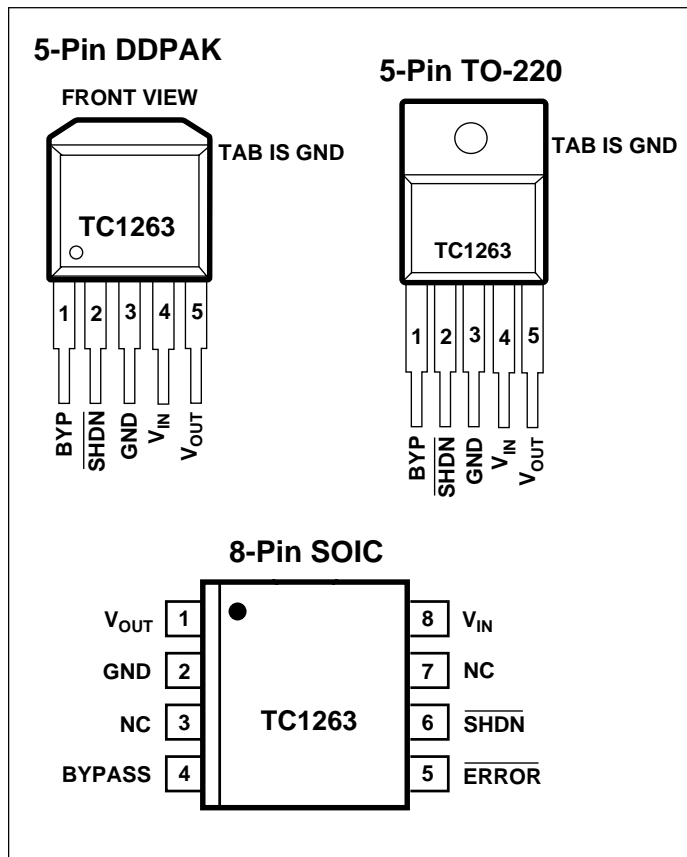
FEATURES

- Very Low Dropout Voltage
- Guaranteed 500mA Output
- High Output Voltage Accuracy
- Standard or Custom Output Voltages
- Over-Current and Over-Temperature Protection
- SHDN Input for Active Power Management
- ERROR Output to Detect Low Battery (SOIC Only)

APPLICATIONS

- Battery-Operated Systems
- Portable Computers
- Medical Instruments
- Instrumentation
- Cellular / GSM / PHS Phones
- Linear Post-Regulator for SMPS
- Pagers

PIN CONFIGURATION



GENERAL DESCRIPTION

The TC1263 is a fixed output, high accuracy (typically $\pm 0.5\%$) CMOS low dropout regulator. Designed specifically for battery-operated systems, the TC1263's CMOS construction eliminates wasted ground current, significantly extending battery life. Total supply current is typically 80 μ A at full load (20 to 60 times lower than in bipolar regulators).

TC1263 key features include ultra low noise, very low dropout voltage (typically 350mV at full load), and fast response to step changes in load. The TC1263 incorporates both over-temperature and over-current protection. The TC1263 is stable with an output capacitor of only 1 μ F and has a maximum output current of 500mA. It is available in 8-Pin SOIC, 5-Pin TO-220, and 5-Pin DDPAK packages.

ORDERING INFORMATION

Part Number	Package	Junction Temp. Range
TC1263-xxVOA	8-Pin SOIC	-40°C to +125°C
TC1263-xxVAT	5-Pin TO-220	-40°C to +125°C
TC1263-xxVET	5-Pin DDPAK	-40°C to +125°C

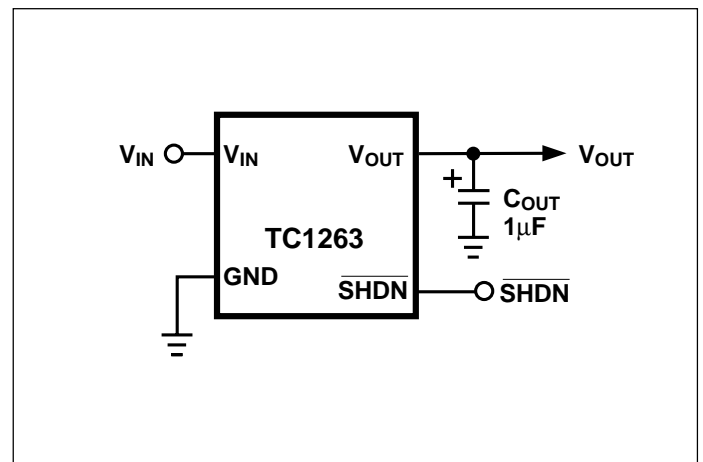
Available Output Voltages:

2.5, 2.8, 3.0, 3.3, 5.0

xx indicates output voltages

Other output voltages are available. Please contact Microchip Technology Inc. for details.

TYPICAL APPLICATION



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TC1263

ABSOLUTE MAXIMUM RATINGS*

Input Voltage	6.5V
Output Voltage	(V _{SS} – 0.3) to (V _{IN} + 0.3)
Power Dissipation	Internally Limited (Note 7)
Operating Temperature	– 40°C < T _J < 125°C
Storage Temperature	– 65°C to +150°C

Maximum Voltage on Any Pin V_{IN} + 0.3V to – 0.3V
 Lead Temperature (Soldering, 10 Sec.) +260°C

*Absolute Maximum Ratings indicate device operation limits beyond damage may occur. Device operation beyond the limits listed in Electrical Characteristics is not recommended.

ELECTRICAL CHARACTERISTICS: V_{IN} = V_{OUT} + 1V, I_L = 100 μA, C_L = 3.3μF, $\overline{\text{SHDN}} > V_{IH}$, T_A = 25°C, unless otherwise specified. **BOLDFACE** type specifications apply for junction temperatures of – 40°C to +125°C.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
V _{IN}	Input Operating Voltage		—	—	6.0	V
I _{OUTMAX}	Maximum Output Current	(SOIC-8 TBD)	500	—	—	mA
V _{OUT}	Output Voltage	Note 1	— V_R – 2.5%	V _R ± 0.5% —	— V_R + 2.5%	V
ΔV _{OUT} /ΔT	V _{OUT} Temperature Coefficient	Note 2	—	40	—	ppm/°C
ΔV _{OUT} /ΔV _{IN}	Line Regulation	(V _R + 1V) ≤ V _{IN} ≤ 6V	—	0.05	0.35	%
ΔV _{OUT} /V _{OUT}	Load Regulation	I _L = 0.1mA to I _{OUTMAX} (Note 3)	—	0.002	0.01	%/mA
V _{IN} – V _{OUT}	Dropout Voltage	I _L = 100μA I _L = 100mA I _L = 300mA I _L = 500mA (Note 4)	— — — —	20 60 200 350	30 130 390 650	mV
I _{DD}	Supply Current	$\overline{\text{SHDN}} = V_{IH}$, I _L = 0	—	80	130	μA
I _{SHDN}	Shutdown Supply Current	$\overline{\text{SHDN}} = 0V$	—	0.05	1	μA
PSRR	Power Supply Rejection Ratio	F _{RE} ≤ 1KHz	—	64	—	dB
I _{OUTSC}	Output Short Circuit Current	V _{OUT} = 0V	—	1200	1400	mA
ΔV _{OUT} /ΔP _D	Thermal Regulation	Note 5	—	0.04	—	V/W
eN	Output Noise	I _L = I _{OUTMAX}	—	260	—	nV/√Hz
SHDN Input						
V _{IH}	SHDN Input High Threshold		60	—	—	%V _{IN}
V _{IL}	SHDN Input Low Threshold		—	—	15	%V _{IN}
ERROR Output (SOIC Only)						
V _{MIN}	Minimum Operating Voltage		1.0	—	—	V
V _{OL}	Output Logic Low Voltage	1mA Flows to $\overline{\text{ERROR}}$	—	—	400	mV
V _{TH}	$\overline{\text{ERROR}}$ Threshold Voltage		—	0.95 x V _R	—	V
V _{HYS}	$\overline{\text{ERROR}}$ Positive Hysteresis	Note 7	—	50	—	mV

NOTES: 1. V_R is the regulator output voltage setting.

2. T_C V_{OUT} = $\frac{(V_{OUTMAX} - V_{OUTMIN}) \times 10^6}{V_{OUT} \times \Delta T}$

3. Regulation is measured at a constant junction temperature using low duty cycle pulse testing. Load regulation is tested over a load range from 0.1mA to the maximum specified output current. Changes in output voltage due to heating effects are covered by the thermal regulation specification.

4. Dropout voltage is defined as the input to output differential at which the output voltage drops 2% below its nominal value measured at a 1V differential.

5. Thermal Regulation is defined as the change in output voltage at a time T after a change in power dissipation is applied, excluding load or line regulation effects. Specifications are for a current pulse equal to I_{LMAX} at V_{IN} = 6V for T = 10msec.

6. The maximum allowable power dissipation is a function of ambient temperature, the maximum allowable junction temperature, and the thermal resistance from junction-to-air (i.e. T_A, T_J, θ_{JA}). Exceeding the maximum allowable power dissipation causes the device to initiate thermal shutdown. Please see *Thermal Considerations* section of this data sheet for more details.

7. Hysteresis voltage is referenced to V_R.

DETAILED DESCRIPTION

The TC1263 is a precision, fixed output LDO. Unlike bipolar regulators, the TC1263 supply current does not increase with load current. In addition, V_{OUT} remains stable and within regulation at very low load currents (an important consideration in RTC and CMOS RAM battery backup applications). Figure 1 shows a typical application circuit.

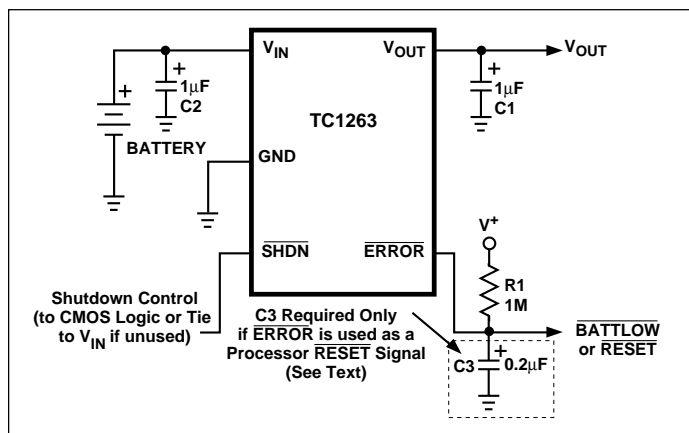


Figure 1: Typical Application Circuit

Output Capacitor

A 1µF (min) capacitor from V_{OUT} to ground is required. The output capacitor should have an effective series resistance of 5Ω or less, and a resonant frequency above 1 MHz. A 1µF capacitor should be connected from V_{IN} to GND if there is more than 10 inches of wire between the regulator and the AC filter capacitor, or if a battery is used as the power source. Aluminum electrolytic or tantalum capacitor types can be used. (Since many aluminum electrolytic capacitors freeze at approximately -30°C , solid tantalums are recommended for applications operating below -25°C .) When operating from sources other than batteries, supply-noise rejection and transient response can be improved by increasing the value of the input and output capacitors and employing passive filtering techniques.

ERROR Output

$\overline{\text{ERROR}}$ is driven low whenever V_{OUT} falls out of regulation by more than -5% (typical). This condition may be caused by low input voltage, output current limiting, or thermal limiting.

The $\overline{\text{ERROR}}$ threshold is 5% below rated V_{OUT} regardless of the programmed output voltage value (e.g., $\overline{\text{ERROR}} = V_{OL}$ at 4.75V (typ) for a 5.0V regulator and 2.85V (typ) for a 3.0V regulator). $\overline{\text{ERROR}}$ output operation is shown in Figure 2. Note that $\overline{\text{ERROR}}$ is active when V_{OUT} is at or below V_{TH} , and inactive when V_{OUT} is above $V_{TH} + V_H$.

As shown in Figure 1, $\overline{\text{ERROR}}$ can be used as a battery low flag, or as a processor RESET signal (with the addition

of timing capacitor C3). $R1 \times C3$ should be chosen to maintain $\overline{\text{ERROR}}$ below V_{IH} of the processor RESET input for at least 200 msec to allow time for the system to stabilize. Pull-up resistor R1 can be tied to V_{OUT} , V_{IN} or any other voltage less than $(V_{IN} + 0.3V)$.

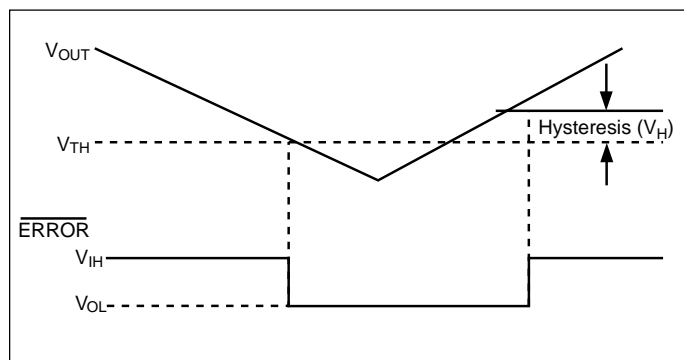


Figure 2: ERROR Output Operation

Thermal Considerations

Thermal Shutdown

Integrated thermal protection circuitry shuts the regulator off when die temperature exceeds 160°C . The regulator remains off until the die temperature drops to approximately 150°C .

Power Dissipation

The amount of power the regulator dissipates is primarily a function of input and output voltage, and output current. The following equation is used to calculate worst case *actual* power dissipation:

$$P_D \approx (V_{INMAX} - V_{OUTMIN}) I_{LOADMAX}$$

Where: P_D = worst case actual power dissipation
 V_{INMAX} = maximum voltage on V_{IN}
 V_{OUTMIN} = minimum regulator output voltage
 $I_{LOADMAX}$ = maximum output (load) current

Equation 1.

The maximum *allowable* power dissipation (Equation 2) is a function of the maximum ambient temperature (T_{AMAX}), the maximum allowable die temperature (125°C) and the thermal resistance from junction-to-air (θ_{JA}).

$$P_{DMAX} = \frac{(T_{JMAX} - T_{AMAX})}{\theta_{JA}}$$

Where all terms are previously defined.

Equation 2.

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Table 1 shows various values of θ_{JA} for the TC1263 mounted on a 1/16 inch, 2-layer PCB with 1 oz. copper foil.

Table 1. Thermal Resistance Guidelines for TC1263 in 8-Pin SOIC Package

Copper Area (Topside)*	Copper Area (Backside)	Board Area	Thermal Resistance (θ_{JA})
2500 sq mm	2500 sq mm	2500 sq mm	60°C/W
1000 sq mm	2500 sq mm	2500 sq mm	60°C/W
225 sq mm	2500 sq mm	2500 sq mm	68°C/W
100 sq mm	2500 sq mm	2500 sq mm	74°C/W

NOTES: *Pin 2 is ground. Device is mounted on topside.

Table 2. Thermal Resistance Guidelines for TC1263 in 3-Pin DPAK/TO-220 Package

Copper Area (Topside)*	Copper Area (Backside)	Board Area	Thermal Resistance (θ_{JA})
2500 sq mm	2500 sq mm	2500 sq mm	25°C/W
1000 sq mm	2500 sq mm	2500 sq mm	27°C/W
125 sq mm	2500 sq mm	2500 sq mm	35°C/W

NOTES: *Tab of device attached to topside copper

Equation 1 can be used in conjunction with Equation 2 to ensure regulator thermal operation is within limits. For example:

GIVEN: $V_{INMAX} = 3.3V \pm 10\%$
 $V_{OUTMIN} = 2.7V \pm 0.5\%$
 $I_{LOAD} = 275mA$
 $T_{AMAX} = 95^{\circ}C$
 $\theta_{JA} = 59^{\circ}C/W$

- FIND: 1. Actual power dissipation
 2. Maximum allowable dissipation

Actual power dissipation:

$$P_D \approx (V_{INMAX} - V_{OUTMIN})I_{LOADMAX}$$

$$= [(3.3 \times 1.1) - (2.7 \times .995)]275 \times 10^{-3}$$

$$= \underline{260mW}$$

Maximum allowable power dissipation:

$$P_{DMAX} = \frac{(T_{JMAX} - T_{AMAX})}{\theta_{JA}}$$

$$= \frac{(125 - 95)}{59}$$

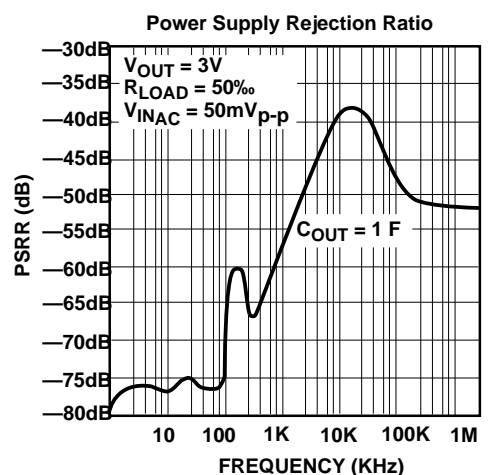
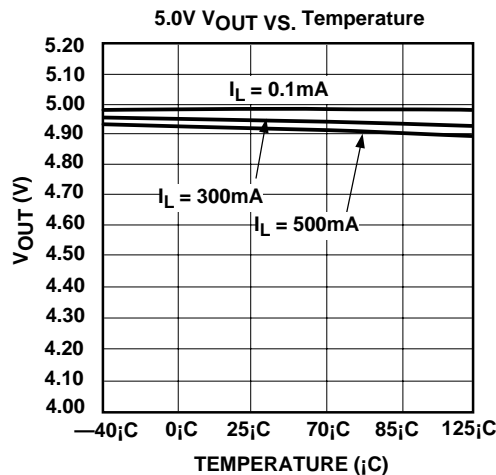
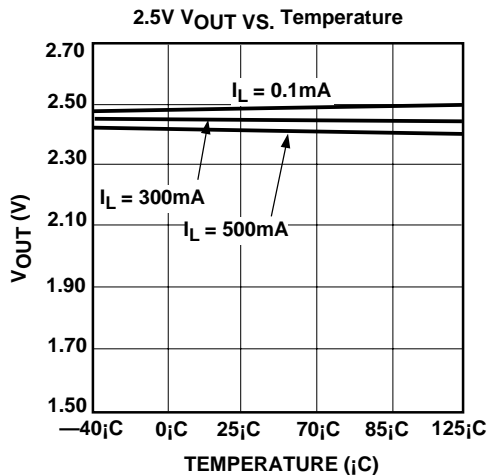
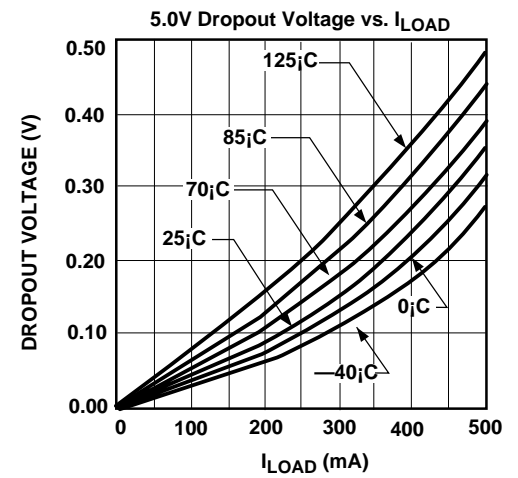
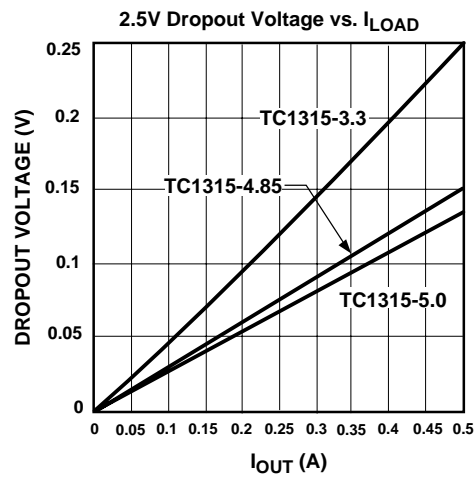
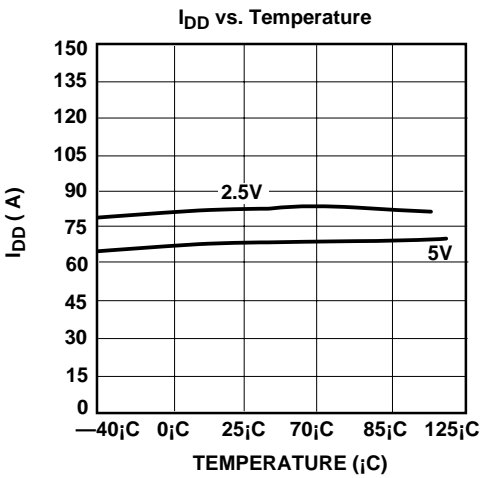
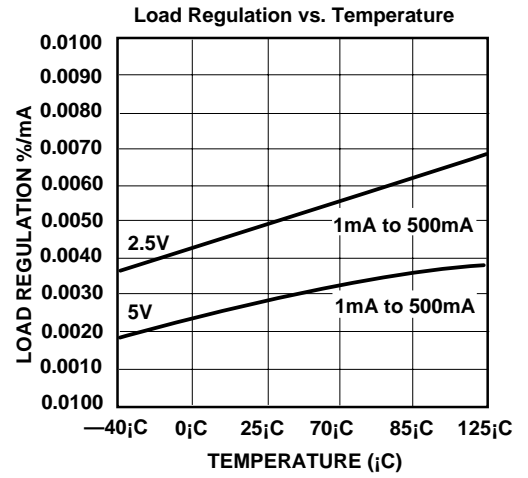
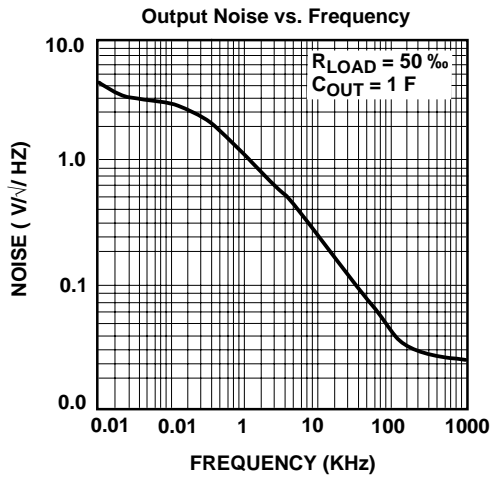
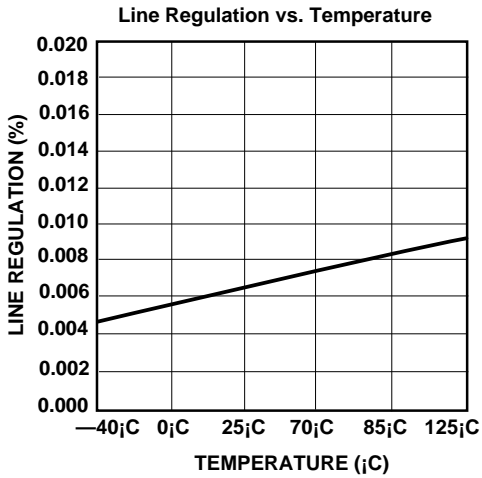
$$= \underline{508mW}$$

In this example, the TC1263 dissipates a maximum of only 260mW; far below the allowable limit of 508 mW. In a similar manner, Equation 1 and Equation 2 can be used to calculate maximum current and/or input voltage limits. For example, the maximum allowable V_{IN} is found by substituting the maximum allowable power dissipation of 508mW into Equation 1, from which $V_{INMAX} = 4.6V$.

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TYPICAL CHARACTERISTICS

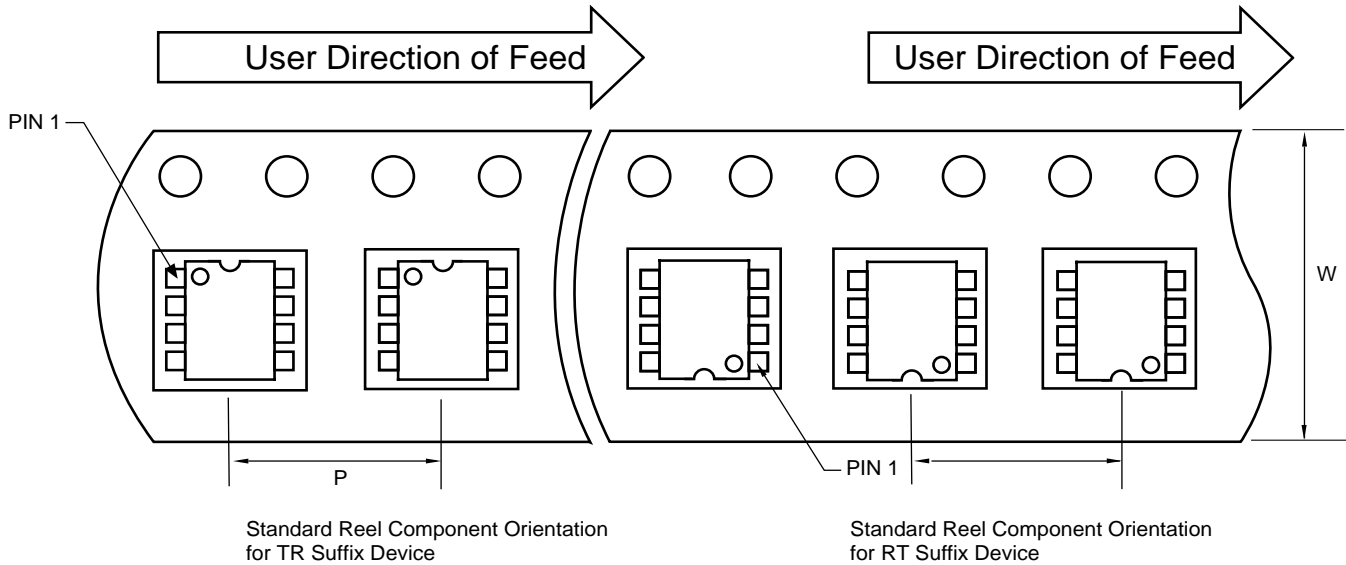


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TAPING FORM

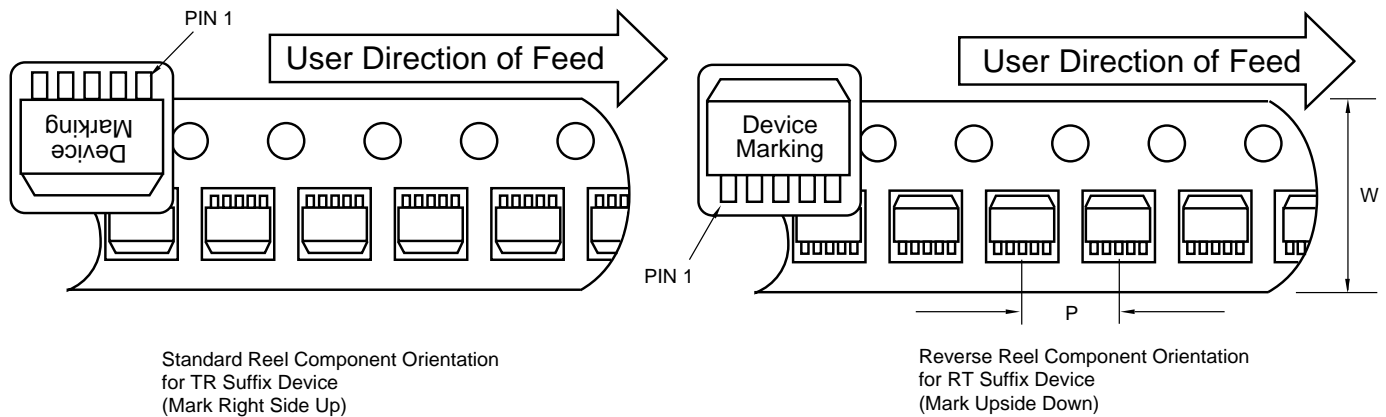
Component Taping Orientation for 8-Pin SOIC (Narrow) Devices



Carrier Tape, Number of Components Per Reel and Reel Size

Package	Carrier Width (W)	Pitch (P)	Part Per Full Reel	Reel Size
8-Pin SOIC (N)	12 mm	8 mm	2500	13 in

Component Taping Orientation for 5-Pin DDPAK Devices



Carrier Tape, Number of Components Per Reel and Reel Size

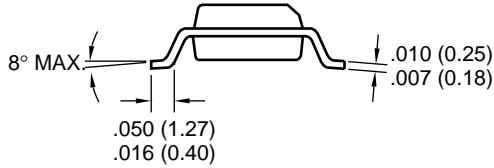
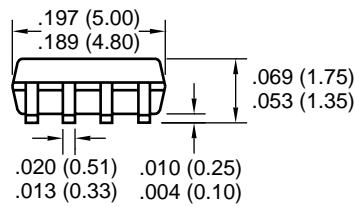
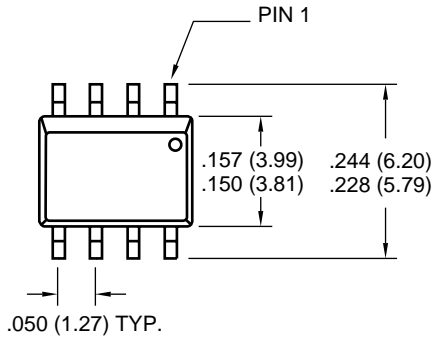
Package	Carrier Width (W)	Pitch (P)	Part Per Full Reel	Reel Size
5-Pin DDPAK	24 mm	16 mm	750	13 in

500mA Fixed Output CMOS LDO with Shutdown

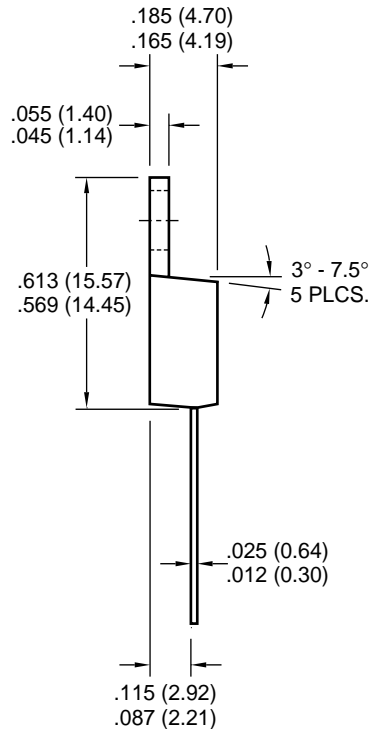
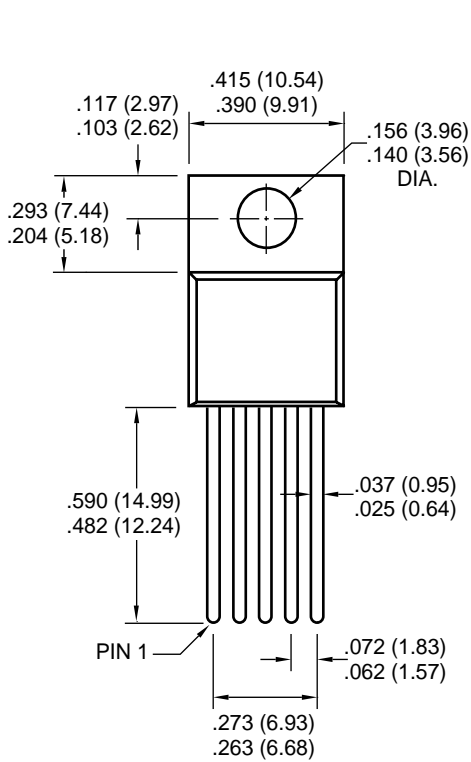
TC1263

PACKAGE DIMENSIONS

8-Pin SOIC (Narrow)



5-Pin TO-220

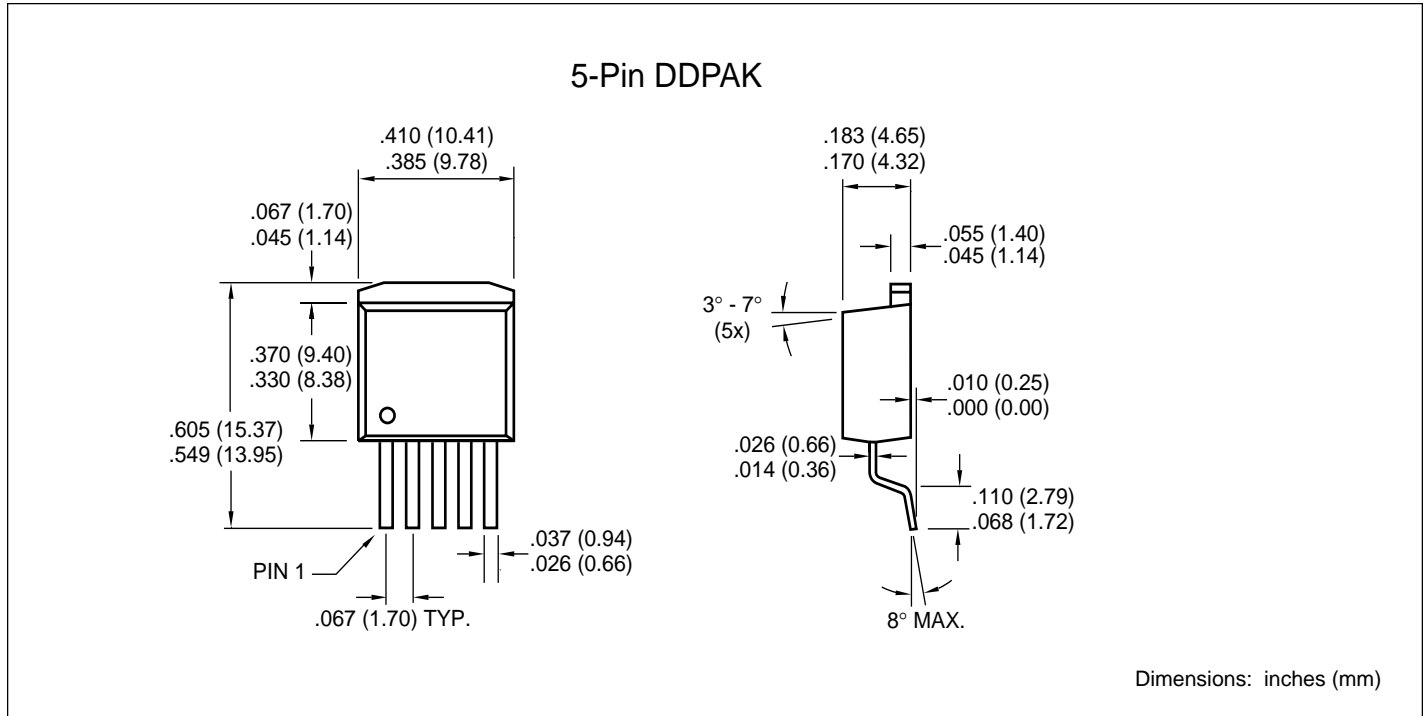


Dimensions: inches (mm)

500mA Fixed Output CMOS LDO with Shutdown

TC1263

PACKAGE DIMENSIONS





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