TC1262

500 mA Fixed Output CMOS LDO

Features

- AEC-Q100 Automotive Qualified, See **Product Identification System**
- Very Low Dropout Voltage
- 500 mA Output Current
- High Output Voltage Accuracy
- Standard or Custom Output Voltages
- Overcurrent and Overtemperature Protection

Applications

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

Device Selection Table

Part Number	Package	Junction Temp. Range
TC1262-xxVDB	3-Pin SOT-223	-40°C to +125°C
TC1262-xxVAB	3-Pin TO-220	-40°C to +125°C
TC1262-xxVEB	3-Pin DDPAK	-40°C to +125°C

Note: xx indicates output voltages. Available Output Voltages: 2.5, 2.8, 3.0, 3.3, 5.0. Other output voltages are available. Please contact Microchip Technology Inc. for details.

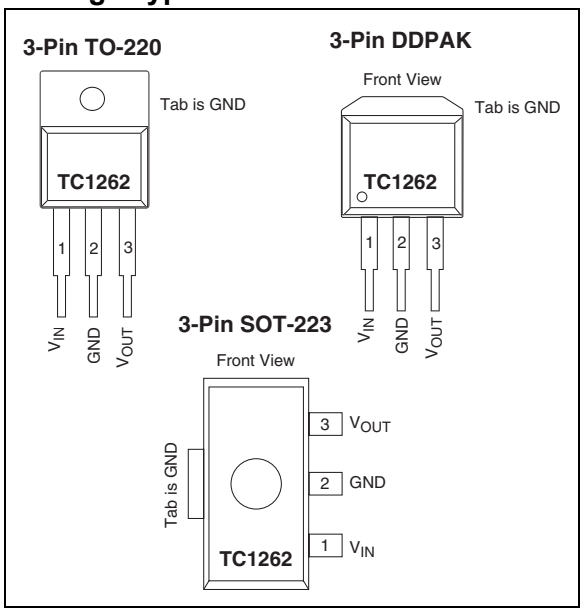
General Description

The TC1262 is a fixed output, high accuracy (typically ±0.5%) CMOS low dropout regulator. Designed specifically for battery-operated systems, the TC1262's CMOS construction eliminates wasted ground current, significantly extending battery life. Total supply current is typically 80 µA at full load (20 to 60 times lower than in bipolar regulators).

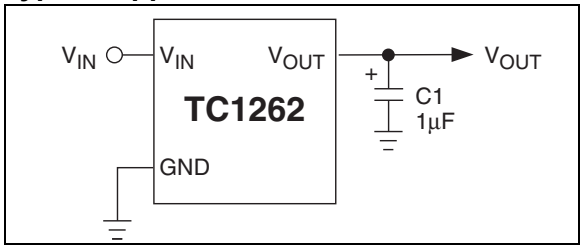
TC1262 key features include ultra low noise operation, very low dropout voltage (typically 350 mV at full load), and fast response to step changes in load.

The TC1262 incorporates both over temperature and over current protection. The TC1262 is stable with an output capacitor of only 1 µF and has a maximum output current of 500 mA. It is available in 3-Pin SOT-223, 3-Pin TO-220 and 3-Pin DDPAK packages.

Package Type



Typical Application



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1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings†

Input Voltage 6.5V
Output Voltage ..... (V_{SS} – 0.3V) to (V_{IN} + 0.3V)
Power Dissipation..... Internally Limited **(Note 6)**
Maximum Voltage on Any Pin ..... V_{IN} + 0.3V to -0.3V
Operating Temperature Range..... -40°C < T_J < 125°C
Storage Temperature..... -65°C to +150°C
ESD Protection on all pins(1):
HBM ..... ±4000V
MM ..... ±200V
CDM ..... ±2000V

† **Notice:** Stresses above 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 above those indicated in the operation sections of the specifications is not implied. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.

Note 1: Testing was performed per AEC-Q100 Standards. ESD CDM was tested on the 3L TO-220 package. For additional information please contact your local Microchip sales office.

TC1262 ELECTRICAL SPECIFICATIONS

Electrical Characteristics: V_{IN} = V_{OUT} + 1V, I_L = 100 µA, C_L = 3.3 µF, T_A = 25°C, unless otherwise noted. **Boldface** type specifications apply for junction temperatures of -40°C to +125°C.

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Input Operating Voltage	V_{IN}	**2.7**	—	**6.0**	V	**Note 7**
Maximum Output Current	I_{OUTMAX}	**500**	—	—	mA	
Output Voltage	V_{OUT}	— **V_R – 2.5%**	V_R ±0.5% —	— **V_R + 2.5%**	V	**Note 1**
V_{OUT} Temperature Coefficient	$\Delta V_{OUT}/\Delta T$	—	40	—	ppm/°C	**Note 2**
Line Regulation	$\Delta V_{OUT}/\Delta V_{IN}$	—	.003	**0.35**	%	(V_R + 1V) ≤ V_{IN} ≤ 6V, I_{OUT} = 0.1 mA
Load Regulation	$(\Delta V_{OUT}/V_{OUT})/I_{OUTMAX}$	—	0.002	**0.01**	%/mA	I_L = 0.1 mA to I_{OUTMAX} **(Note 3)**
Dropout Voltage	V_{IN}-V_{OUT}	— — — 	20 60 200 350	**30** **130** **390** **650**	mV	I_L = 100 µA I_L = 100 mA I_L = 300 mA I_L = 500 mA **(Note 4)**
Supply Current	I_{DD}	—	80	**130**	µA	I_L = 0
Power Supply Rejection Ratio	PSRR	—	64	—	dB	F_{RE} ≤ 1 kHz
Output Short Circuit Current	I_{OUTSC}	—	1200	—	mA	V_{OUT} = 0V
Thermal Regulation	$\Delta V_{OUT}/\Delta P_D$	—	0.04	—	V/W	**Note 5**
Output Noise	eN	—	260	—	nV/√Hz	I_L = I_{OUTMAX}, F_{RE} = 10 kHz

Note 1: V_R is the regulator output voltage setting.

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

3: Regulation is measured at a constant junction temperature using low duty cycle pulse testing. Load regulation is tested over a load range from 0.1 mA 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 = 10 msec.

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 **Section 4.0 "Thermal Considerations"** for more details.

7: The minimum V_{IN} has to justify the conditions: $V_{IN} \geq V_R + V_{DROPOUT}$ and $V_{IN} \geq 2.7V$ for I_L = 0.1 mA to I_{OUTMAX}.

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2.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in Table 2-1.

TABLE 2-1: PIN FUNCTION TABLE

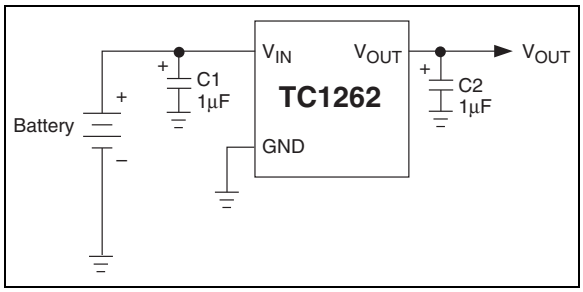
Pin No. (3-Pin SOT-223) (3-Pin TO-220) (3-Pin DDPAK)	Symbol	Description
1	V_{IN}	Unregulated supply input.
2	GND	Ground terminal.
3	V_{OUT}	Regulated voltage output.

3.0 DETAILED DESCRIPTION

The TC1262 is a precision, fixed output LDO. Unlike bipolar regulators, the TC1262's supply current does not increase with load current. In addition, V_{OUT} remains stable and within regulation over the entire 0mA to $I_{LOADMAX}$ load current range (an important consideration in RTC and CMOS RAM battery back-up applications).

Figure 3-1 shows a typical application circuit.

FIGURE 3-1: TYPICAL APPLICATION CIRCUIT



3.1 Output Capacitor

A 1 µF (min) capacitor from V_{OUT} to ground is required. The output capacitor should have an effective series resistance greater than 0.1Ω and less than 5Ω, and a resonant frequency above 1 MHz. A 1 µF 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.

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4.0 THERMAL CONSIDERATIONS

4.1 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.

4.2 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:

EQUATION 4-1:

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

Where:

P_D	=	Worst case actual power dissipation
V_{INMAX}	=	Maximum voltage on V_{IN}
V_{OUTMIN}	=	Minimum output voltage
$I_{LOADMAX}$	=	Maximum output (load) current

The maximum allowable power dissipation (Equation 4-2) is a function of the maximum ambient temperature (T_{AMAX}), the maximum allowable die temperature (TJ_{MAX}) and the thermal resistance from junction-to-air (θ_{JA}).

EQUATION 4-2:

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

Where all terms are previously defined.

Table 4-1 and Table 4-2 show various values of θ_{JA} for the TC1262 packages.

TABLE 4-1: THERMAL RESISTANCE GUIDELINES FOR TC1262 IN SOT-223 PACKAGE

Copper Area (Topside)*	Copper Area (Backside)	Board Area	Thermal Resistance (θ_{JA})
2500 sq mm	2500 sq mm	2500 sq mm	45°C/W
1000 sq mm	2500 sq mm	2500 sq mm	45°C/W
225 sq mm	2500 sq mm	2500 sq mm	53°C/W
100 sq mm	2500 sq mm	2500 sq mm	59°C/W
1000 sq mm	1000 sq mm	1000 sq mm	52°C/W
1000 sq mm	0 sq mm	1000 sq mm	55°C/W

*Tab of device attached to topside copper

TABLE 4-2: THERMAL RESISTANCE GUIDELINES FOR TC1262 IN 3-PIN DDPAK/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

*Tab of device attached to topside copper

Equation 4-1 can be used in conjunction with Equation 4-2 to ensure regulator thermal operation is within limits. For example:

Given:

V_{INMAX} = 3.3V ± 10%
V_{OUTMIN} = 2.7V ± 0.5%
$I_{LOADMAX}$ = 275 mA
T_{JMAX} = 125°C
T_{AMAX} = 95°C
θ_{JA} = 59°C/W (SOT-223)

Find: 1. Actual power dissipation
2. Maximum allowable dissipation

Actual power dissipation:

$P_D \approx (V_{INMAX} - V_{OUTMIN})I_{LOADMAX}$
$= [(3.3 \times 1.1) - (2.7 \times .995)]275 \times 10^{-3}$
$= 260$ mW

Maximum allowable power dissipation:

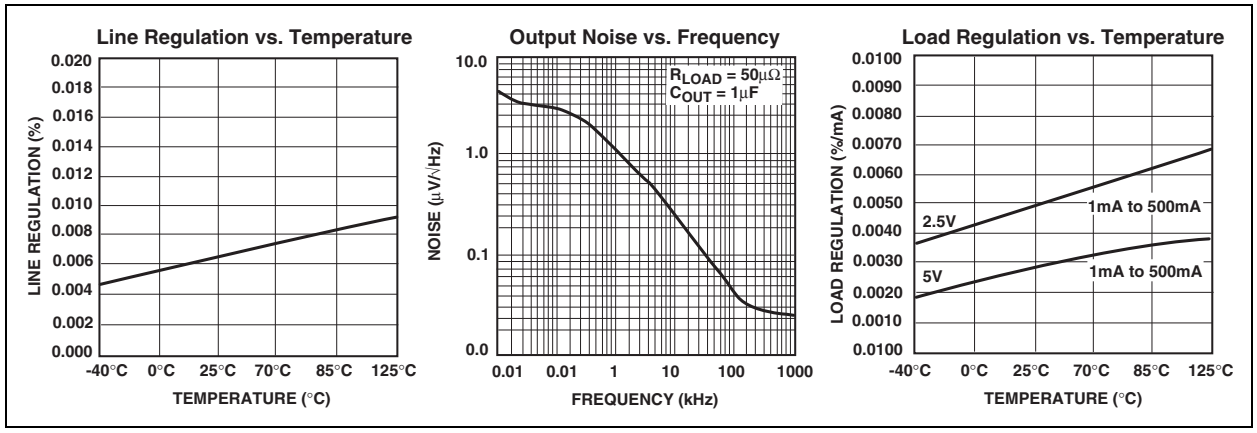
$$P_{DMAX} = \frac{(T_{JMAX} - T_{AMAX})}{\theta_{JA}} = \frac{(125 - 95)}{59} = 508mW$$

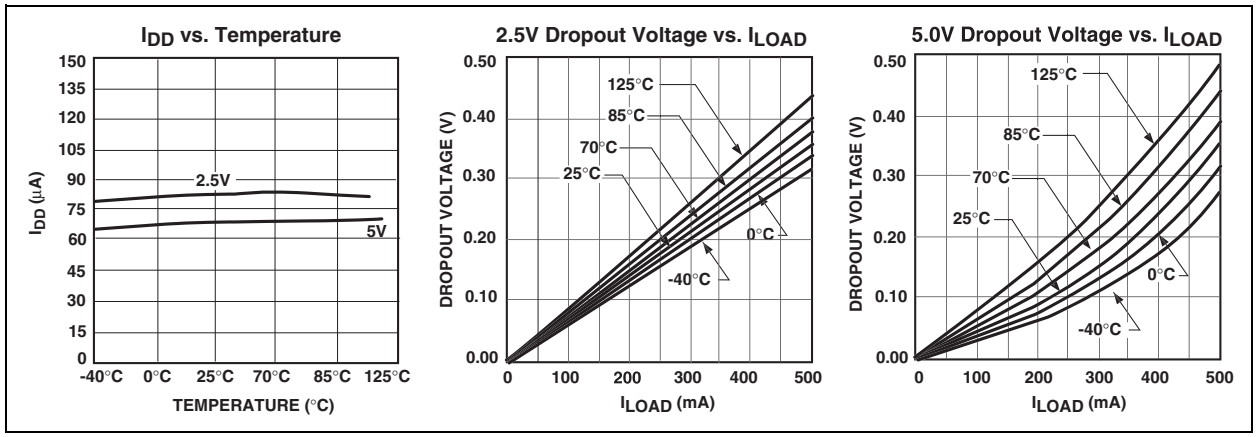
In this example, the TC1262 dissipates a maximum of 260 mW; below the allowable limit of 508 mW. In a similar manner, Equation 4-1 and Equation 4-2 can be used to calculate maximum current and/or input voltage limits. For example, the maximum allowable V_{IN}, is found by substituting the maximum allowable power dissipation of 508 mW into Equation 4-1, from which V_{INMAX} = 4.6V.

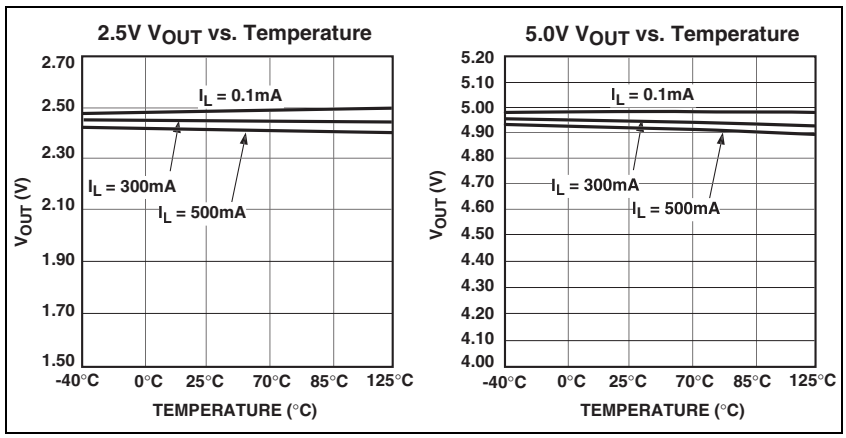
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5.0 TYPICAL CHARACTERISTICS

Note: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g., outside specified power supply range) and therefore outside the warranted range.



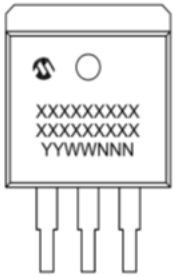




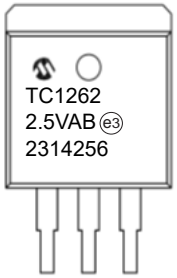
6.0 PACKAGING INFORMATION

6.1 Package Marking Information

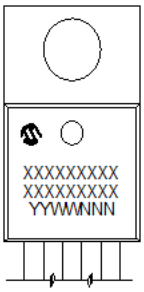
3-Pin DDPAK



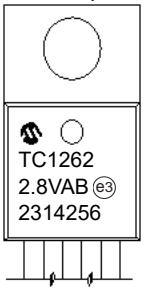
Example



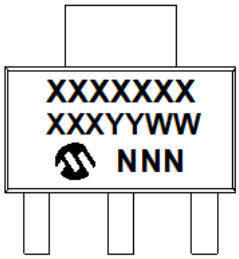
3-Pin TO-220



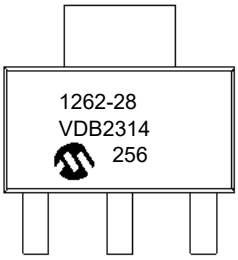
Example



3-Pin SOT-223



Example



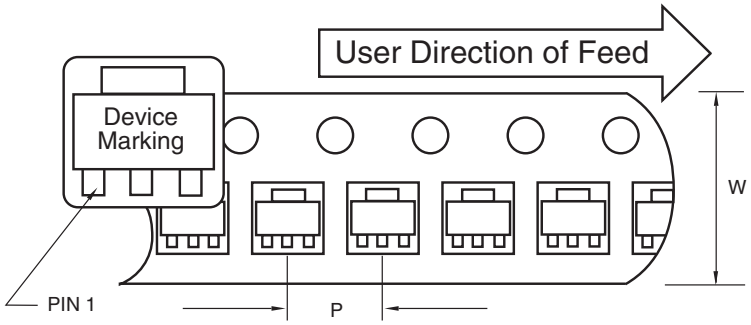
Legend:	XX...X	Customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)l
	WW	Week code (week of January 1 is week ‘01’)
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator ((e3)) can be found on the outer packaging for this package.

Note: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information.

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6.2 Taping Form

Component Taping Orientation for 3-Pin SOT-223 Devices

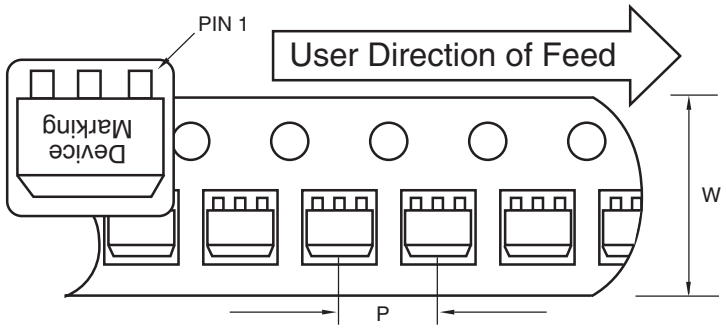


Standard Reel Component Orientation
for TR Suffix Device
(Mark Right Side Up)

Carrier Tape, Number of Components Per Reel and Reel Size

Package	Carrier Width (W)	Pitch (P)	Part Per Full Reel	Reel Size
3-Pin SOT-223	12 mm	8 mm	4000	13 in

Component Taping Orientation for 3-Pin DDPAK Devices



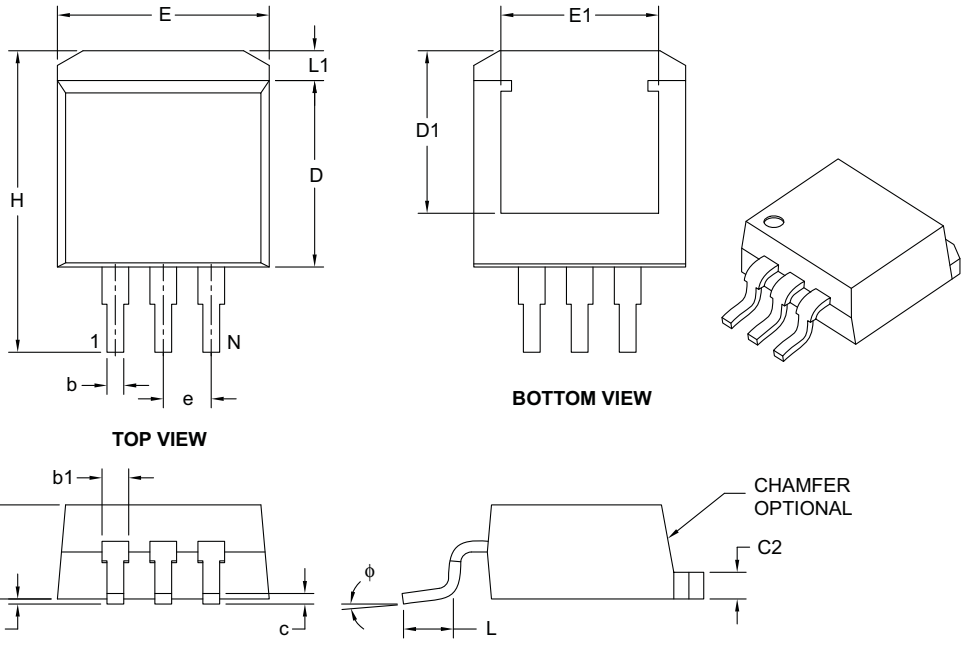
Standard Reel Component Orientation
for TR Suffix Device
(Mark Right Side Up)

Carrier Tape, Number of Components Per Reel and Reel Size

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

3-Lead Plastic (EB) [DDPAK]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Units		INCHES		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		3	
Pitch	e		.100 BSC	
Overall Height	A	.160	–	.190
Standoff §	A1	.000	–	.010
Overall Width	E	.380	–	.420
Exposed Pad Width	E1	.245	–	–
Molded Package Length	D	.330	–	.380
Overall Length	H	.549	–	.625
Exposed Pad Length	D1	.270	–	–
Lead Thickness	c	.014	–	.029
Pad Thickness	C2	.045	–	.065
Lower Lead Width	b	.020	–	.039
Upper Lead Width	b1	.045	–	.070
Foot Length	L	.068	–	.110
Pad Length	L1	–	–	.067
Foot Angle	ϕ	0°	–	8°

Notes:

1. § Significant Characteristic.
2. Dimensions D and E do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .005" per side.
3. Dimensioning and tolerancing per ASME Y14.5M.

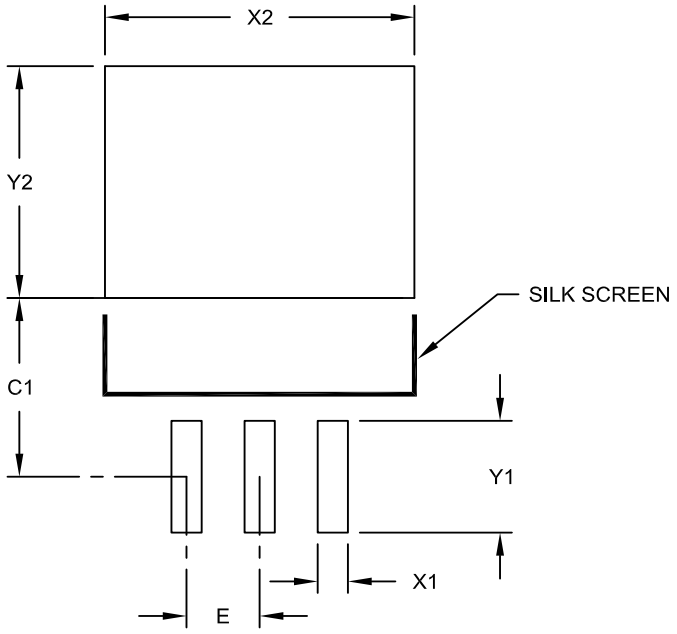
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing C04-011B

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3-Lead Plastic (EB) [DDPAK]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



RECOMMENDED LAND PATTERN

Units		INCHES		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E		.100 BSC	
Pad Width	X2			.423
Pad Length	Y2			.327
Contact Pad Spacing	C1		.252	
Contact Pad Width (X3)	X1			.041
Contact Pad Length (X3)	Y1			.157

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

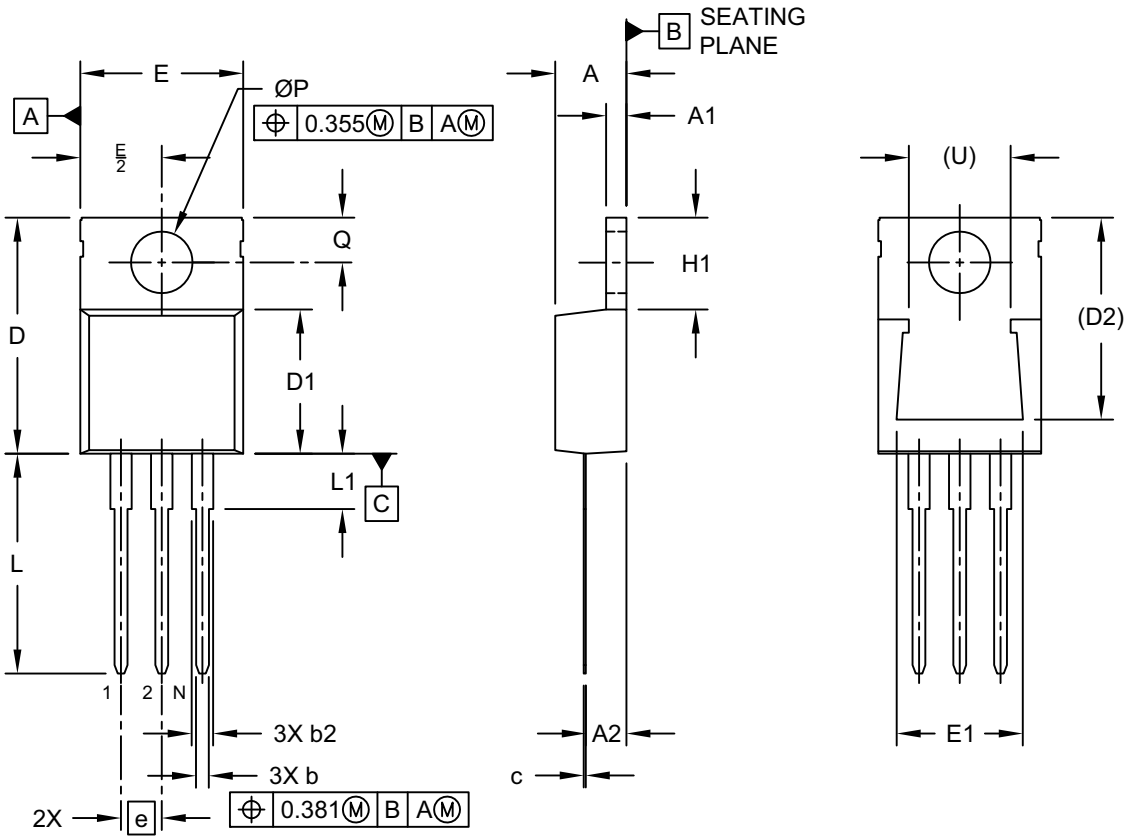
BSC: Basic Dimension. Theoretically exact value shown without tolerances.

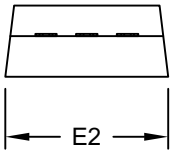
Microchip Technology Drawing No. C04-2011A

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3-Lead Transistor Outline Package (AB) - [TO-220]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



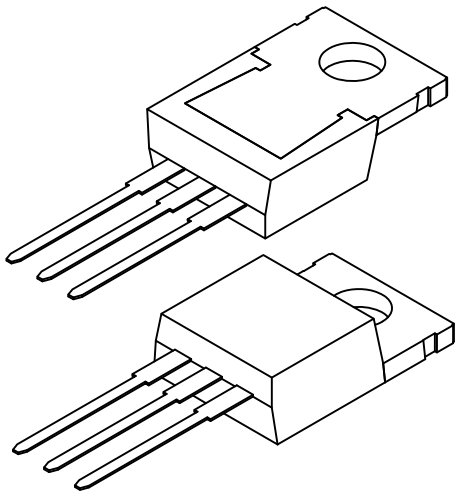


Microchip Technology Drawing C04-034-AB Rev C Sheet 1 of 2

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3-Lead Transistor Outline Package (AB) - [TO-220]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Terminals	N		3	
Terminal Pitch	e		2.54 BSC	
Overall Height	A	4.064	4.445	4.826
Tab Thickness	A1	1.143	1.270	1.397
Base to Lead	A2	2.032	2.540	3.048
Terminal Width	b	0.635	0.826	1.016
Shoulder Width	b2	1.143	1.334	1.524
Terminal Thickness	c	0.305	0.432	0.559
Overall Length	D	13.730	14.730	15.730
Molded Package Length	D1	8.850	9.000	9.150
Exposed Pad Length	D2		12.6 REF	
Overall Width	E	9.652	10.160	10.668
Exposed Pad Width	U		6.35 REF	
Exposed Pad Width	E1	6.858	7.874	8.890
Body Width	E2	9.779	10.224	10.668
Tab Length	H1	5.842	6.350	6.858
Terminal Length	L	12.700	13.716	14.732
Terminal Shoulder Length	L1	3.050	3.455	3.860
Mounting Hole Diameter	P	3.708	3.835	3.962
Mounting Hole Center	Q	2.540	2.794	3.048

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

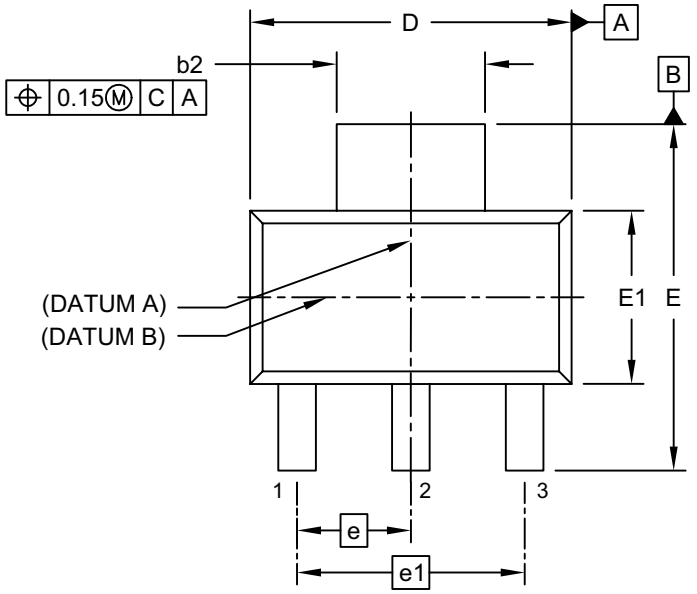
   REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-034-AB Rev C Sheet 2 of 2

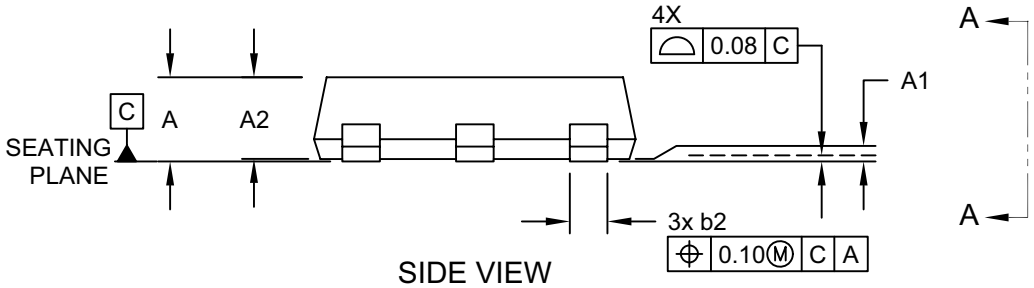
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3-Lead Plastic Small Outline Transistor (DB) [SOT-223]

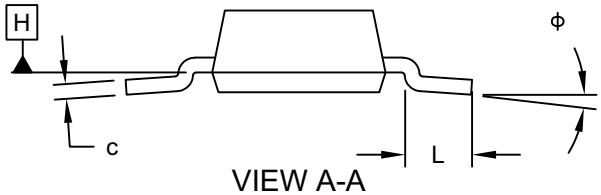
Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



TOP VIEW



SIDE VIEW



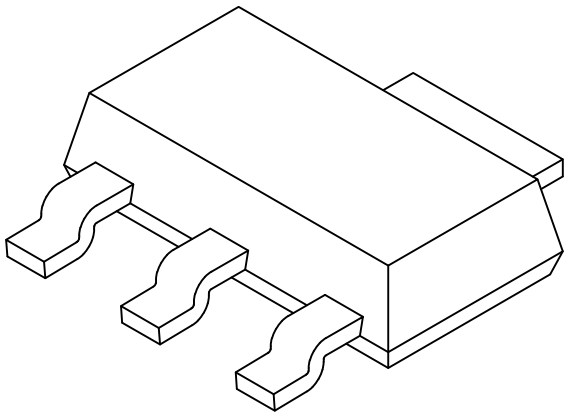
VIEW A-A

Microchip Technology Drawing C04-032 Rev D Sheet 1 of 2

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3-Lead Plastic Small Outline Transistor (DB) [SOT-223]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Leads	N		3	
Lead Pitch	e		2.30 BSC	
Outside lead pitch	e1		4.60 BSC	
Overall Height	A	-	-	1.80
Standoff	A1	0.02	-	0.10
Molded Package Height	A2	1.50	1.60	1.70
Overall Width	E	6.70	7.00	7.30
Molded Package Width	E1	3.30	3.50	3.70
Overall Length	D	6.30	6.50	6.70
Lead Thickness	c	0.23	0.30	0.35
Lead Width	b1	0.60	0.76	0.84
Tab Lead Width	b2	2.90	3.00	3.10
Foot Length	L	0.75	-	-
Lead Angle	ϕ	0°	-	10°

Notes:

1. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.127mm per side.
2. Dimensioning and tolerancing per ASME Y14.5M

   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

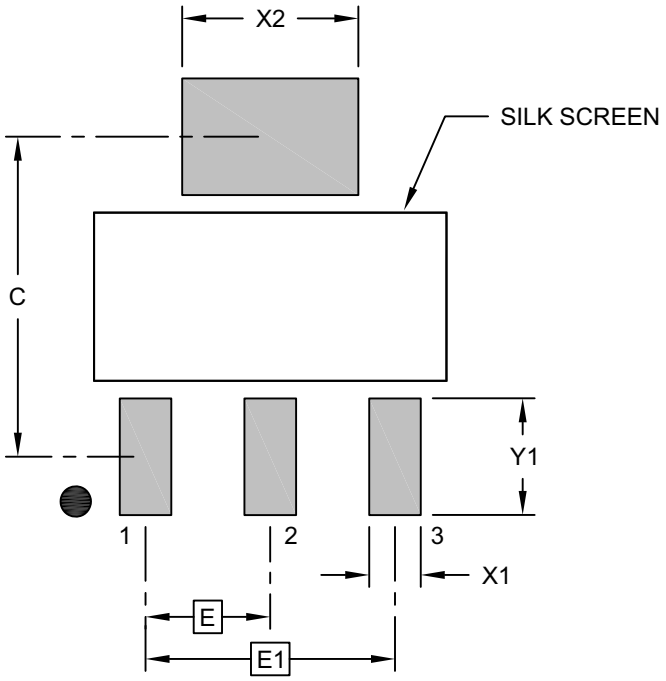
   REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-032 Rev D Sheet 2 of 2

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3-Lead Plastic Small Outline Transistor (DB) [SOT-223]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E		2.30 BSC	
Contact Pitch	E1		4.60 BSC	
Contact Pad Spacing	C		5.90	
Contact Pad Width (X3)	X1			0.95
Contact Pad Width	X2			3.25
Contact Pad Length (X4)	Y1			2.15

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing C04-2032 Rev D

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APPENDIX A: REVISION HISTORY

Revision D (October 2023)

- Added automotive qualification to **"Features"**.
- Updated and added examples to **"Product Identification System"**.
- Updated **"Absolute Maximum Ratings†"** to better describe the part.
- Updated **"TC1262 Electrical Specifications"**
- Updated **Section 6.0, Packaging Information**.
- Minor text and format changes throughout.

Revision C (November 2012)

- Added a note to each package outline drawing.

Revision B (May 2002)

- Change logs unavailable.

Revision A (January 2001)

- Original release of this document.

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PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

PART NO.	-X.X	X	XX	XX(1)	-XXX
Device	Output Voltage	Temperature Range	Package	Tape and Reel	Qual.

Device:	TC1262: 500 mA Fixed Output CMOS LDO
Output Voltage:	2.5 = 2.5V 2.8 = 2.8V 3.0 = 3.0V 3.3 = 3.3V 5.0 = 5.0V
Temperature Range:	V = -40° C to +125° C
Package:	EB = Double Deca-Watt Package (DDPAK), 3-lead, DB = Plastic Small Outline Transistor (SOT-223), 3-lead AB = Transistor Outline (TO-220), 3-lead
Tape and Reel Option:	Blank = Tube TR = Tape and Reel
Qualification*:	Blank = Standard Part VAO = AEC-Q100 Automotive Qualified *Contact your local Microchip sales office to request automotive qualified part variants.

Examples:

a) TC1262-2.5VEB: 2.5V, -40° C to +125° C, DDPAK package

b) TC1262-2.8VDB: 2.8V, -40° C to +125° C, SOT-223 package

c) TC1262-3.0VAB: 3.0V, -40° C to +125°C, TO-220 package

d) TC1262-3.3VEBTR: Tape and Reel, 3.3V, -40° C to +125°C, DDPAK package

e) TC1262-5.0VDBTR: Tape and Reel, 5.0V, -40° C to +125° C, SOT-223 package

f) TC1262-3.3VABTR-VAO**: Tape and Reel, 3.3V, -40° C to +125° C, TO-220 package, AEC-Q100 Automotive Qualified.

Note 1: Tape and Reel identifier only appears in the catalog part number description. This identifier is used for ordering purposes and is not printed on the device package. Check with your Microchip Sales Office for package availability with the Tape and Reel option.

** Example of automotive part that can be set up.

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