

RC1584

Fixed Low Dropout GTL+ Bus Regulator

1.5V Output Voltage, 6A Output Current

Features

- Fast transient response
- Low dropout voltage at up to 6A
- Load regulation: 0.05% typical
- Trimmed current limit
- On-chip thermal limiting
- Standard TO-220 and TO-263 packages

Applications

- Pentium® II GTL+ bus supply
- Low voltage logic supply

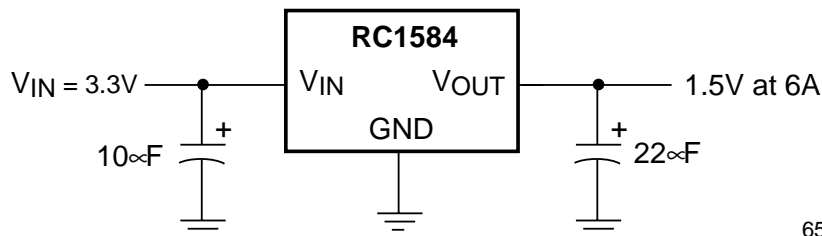
Description

The RC1584 is a low dropout three-terminal regulator with 6A output current capability. This device has been optimized for low voltage applications including V_{TT} bus termination, where transient response and minimum input voltage are critical. The RC1584 offers fixed 1.5V with 6A current capability for GTL+ bus V_{TT} termination.

Current limit is trimmed to ensure specified output current and controlled short-circuit current. On-chip thermal limiting provides protection against any combination of overload and ambient temperature that would create excessive junction temperatures.

The RC1584 is available in the industry-standard TO-220 and TO-263 power packages.

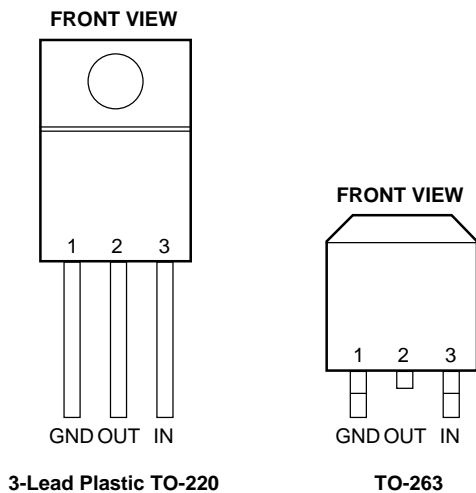
Block Diagram



65-1584-01

Preliminary Information

Pin Assignments



Absolute Maximum Ratings

Parameter	Min.	Max.	Unit
V _{IN}		7	V
Operating Junction Temperature Range			
Control Section	0	125	°C
Power Transistor	0	150	°C
Storage Temperature Range	-65	150	°C
Lead Temperature (Soldering, 10 seconds)		300	°C

Electrical Characteristics

Preconditioning: 100% Thermal Limit Functional Test. $T_j = 25^\circ\text{C}$ unless otherwise specified.

The • denotes specifications which apply over the specified operating temperature range.

Parameter	Conditions		Min.	Typ.	Max	Units
Output Voltage	$V_{IN} = 3.3V \pm 0.1$ $0\text{mA} \leq I_{OUT} \leq 6\text{A}$	•	1.47 (-2%)	1.5	1.53 (+2%)	V
Line Regulation ^{1, 2}	$3V \leq V_{IN} \leq 7V$, $I_{OUT} = 0\text{mA}$	•		0.005	0.2	%
Load Regulation ^{1, 2, 3}	$V_{IN} = 5V$ $10\text{mA} \leq I_{OUT} \leq 6\text{A}$	•		0.05	0.5	%
Dropout Voltage	$\Delta V_{REF\%} = 1\%$, $I_{OUT} = 6\text{A}$	•		1.150	1.300	V
Current Limit ³		•	6.1		7.5	A
Quiescent Current	$V_{IN} = 5V$	•		3.14	13	mA
Ripple Rejection	$f = 120\text{Hz}$, $C_{OUT} = 22\mu\text{F}$ Tantalum, $(V_{IN} - V_{OUT}) = 1.8V$, $I_{OUT} = 6\text{A}$		60	72		dB
Thermal Regulation	$T_A = 25^\circ\text{C}$, 30ms pulse			0.004	0.02	%/W
Temperature Stability		•		0.5		%
Long-Term Stability	$T_A = 125^\circ\text{C}$, 1000 hrs.			0.03	1.0	%
RMS Output Noise (% of V_{OUT})	$T_A = 25^\circ\text{C}$, $10\text{Hz} \leq f \leq 10\text{kHz}$			0.003		%
Thermal Resistance, Junction to Case	Control Section				0.7	$^\circ\text{C}/\text{W}$
	Power Transistor				3.0	$^\circ\text{C}/\text{W}$
Shut off Temperature				150		$^\circ\text{C}$

Notes:

1. See thermal regulation specifications for changes in output voltage due to heating effects. Load and line regulation are measured at a constant junction temperature by low duty cycle pulse testing.
2. Line and load regulation are guaranteed up to the maximum power dissipation (18W). Power dissipation is determined by input/output differential and the output current. Guaranteed maximum output power will not be available over the full input/output voltage range.
3. The RC1584 has a current limit which is independent of changes in input-to-output voltage.

Applications Information

General

The RC1584 is a three-terminal regulator optimized for GTL+ VTT termination applications. This device is short-circuit protected, safe area protected, and offers thermal shutdown to turn off the regulator when the junction temperature exceeds about 150°C. The RC1584 provides low dropout voltage and fast transient response. Frequency compensation uses capacitors with low ESR while still maintaining stability. This is critical in addressing the needs of low voltage high speed microprocessor buses like GTL+.

Stability

The RC1584 requires an output capacitor as a part of the frequency compensation. It is recommended to use a 22µF solid tantalum or a 100µF aluminum electrolytic on the output to ensure stability. The frequency compensation of this device optimizes the frequency response with low ESR capacitors. In general, it is suggested to use capacitors with an ESR of <math><1\Omega</math>.

Protection Diodes

A protection diode between the input and output pins is usually not needed. An internal diode between the input and output pins on the RC1584 can handle microsecond surge currents of 50A to 100A. Even with large value output capacitors it is difficult to obtain those values of surge currents in normal operation. Only with large values of output capacitance, such as 1000µF to 5000µF, and with the input pin instantaneously shorted to ground can damage occur. A crowbar circuit at the input of the RC1584 can generate those levels of current; a diode from output to input is then recommended, as shown in Figure 1. Usually, normal power supply cycling or system “hot plugging and unplugging” will not generate current large enough to do any damage.

As with any IC regulator, exceeding the maximum input-to-output voltage differential causes the internal transistors to break down and none of the protection circuitry is then functional.

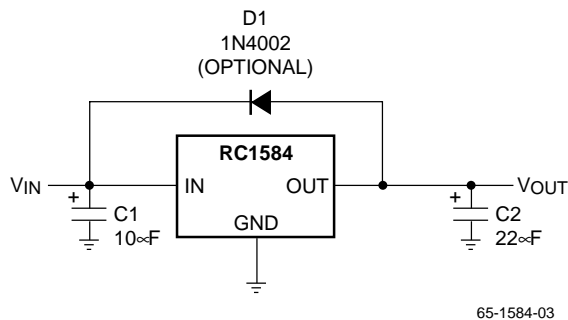


Figure 1. Optional Protection Diode

Load Regulation

It is not possible to provide true remote load sensing because the RC1584 is a three-terminal device. Load regulation is limited by the resistance of the wire connecting the regulator to the load. Load regulation per the data sheet specification is measured at the bottom of the package.

For fixed voltage devices, negative side sensing is a true Kelvin connection with the ground pin of the device returned to the negative side of the load. This is illustrated in Figure 2.

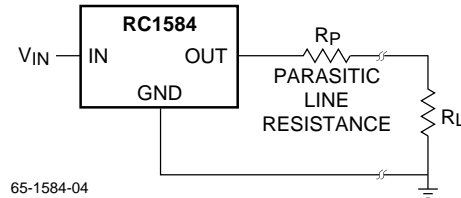


Figure 2. Connection for Best Load Regulation

Thermal Considerations

The RC1584 protects itself under overload conditions with internal power and thermal limiting circuitry. However, for normal continuous load conditions, do not exceed maximum junction temperature ratings. It is important to consider all sources of thermal resistance from junction-to-ambient. These sources include the junction-to-case resistance, the case-to-heatsink interface resistance, and the heat sink resistance. Thermal resistance specifications have been developed to more accurately reflect device temperature and ensure safe operating temperatures. The electrical characteristics section provides a separate thermal resistance and maximum junction temperature for both the control circuitry and the power transistor. Calculate the maximum junction temperature for both sections to ensure that both thermal limits are met.

For example, look at using an RC1584T to generate 6A from a $3.3V \pm 5\%$ source.

Assumptions:

- $V_{IN} = 3.465V$ worst case
- $V_{OUT} = 1.47V$ worst case
- $I_{OUT} = 6A$ continuous
- $T_A = 45^\circ C$
- $\theta_{Case-to-Ambient} = 5^\circ C/W$ (assuming both a heatsink and a thermally conductive material)

The power dissipation in this application is:

$$P_D = (V_{IN} - V_{OUT}) * (I_{OUT}) = (3.465 - 1.47) * 6 = 11.97W$$

From the specification table, for the power section:

$$T_J = T_A + (P_D) * (\theta_{Case-to-Ambient} + \theta_{JC}) \\ = 45 + (11.97) * (5 + 3) = 141^\circ C$$

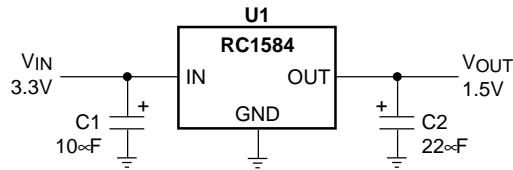
For the control section:

$$T_J = T_A + (P_D) * (\theta_{\text{Case-to-Ambient}} + \theta_{\text{JC}})$$

$$= 45 + (11.97) * (5 + 0.7) = 113^{\circ}\text{C}$$

In each case, the junction temperature is below the maximum rating for both respective sections.

Junction-to-case thermal resistance is specified from the IC junction to the bottom of the case directly below the die. This is the lowest resistance path for heat flow. Proper mounting ensures the best thermal flow from this area of the package to the heat sink. Use of a thermally conductive material at the case-to-heat sink interface is recommended. Use a thermally conductive spacer if the case of the device must be electrically isolated and include its contribution to the total thermal resistance. The case of the RC1584 is directly connected to the output of the device.



65-1584-05

Figure 3. Application Circuit

Table 2. Bill of Materials for Application Circuit for the RC1584

Item	Quantity	Manufacturer	Part Number	Description
C1	1	Xicon	L10V10	10µF, 10V Aluminum
C2	1	Xicon	L63V22	22µF, 6.3V Aluminum
U1	1	Fairchild	RC1584T	6A Regulator

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Preliminary Information

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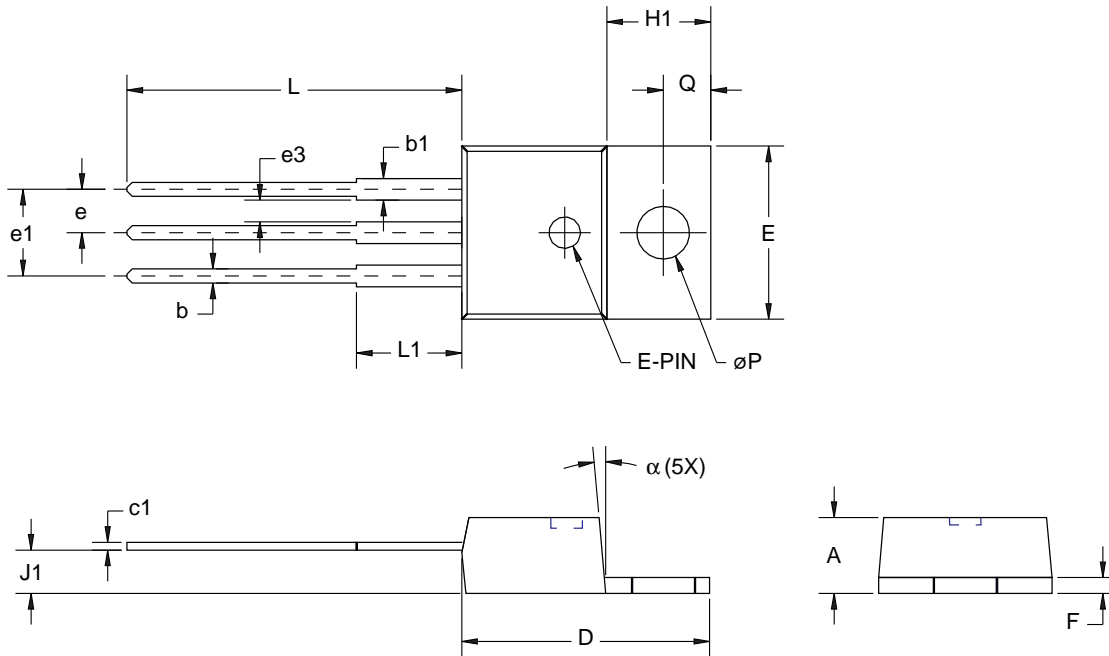
Mechanical Dimensions

3-Lead TO-220 Package

Preliminary Information

Symbol	Inches		Millimeters		Notes
	Min.	Max.	Min.	Max.	
A	.140	.190	3.56	4.83	
b	.015	.040	.38	1.02	
b1	.045	.070	1.14	1.78	
c1	.014	.022	.36	.56	
øP	.139	.161	3.53	4.09	
D	.560	.650	14.22	16.51	
E	.380	.420	9.65	10.67	
e	.090	.110	2.29	2.79	
e1	.190	.210	4.83	5.33	
e3	.045	—	1.14	—	
F	.020	.055	.51	1.40	
H1	.230	.270	5.94	6.87	
J1	.080	.115	2.04	2.92	
L	.500	.580	12.70	14.73	
L1	.250 BSC		6.35 BSC		
Q	.100	.135	2.54	3.43	
α	3°	7°	3°	7°	

Notes:
 1. Dimension c1 apply for lead finish.



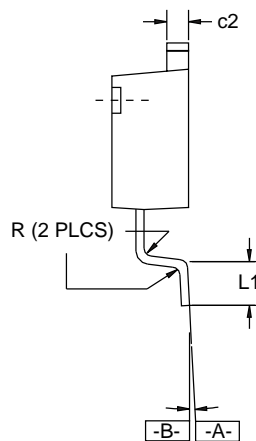
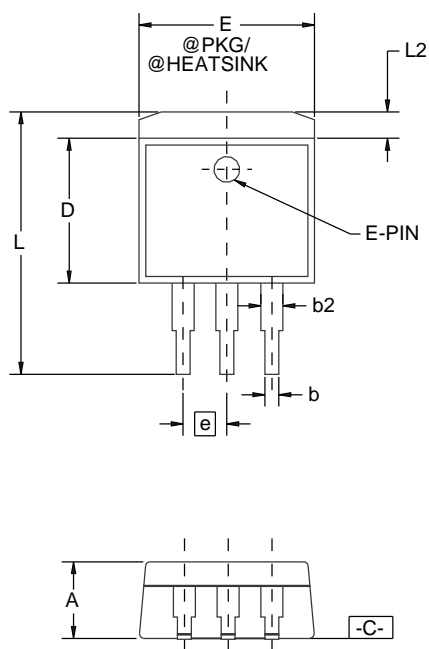
Mechanical Dimensions (continued)

3-Lead TO-263 Package

Symbol	Inches		Millimeters		Notes
	Min.	Max.	Min.	Max.	
A	.160	.190	4.06	4.83	
b	.020	.039	0.51	0.99	
b2	.049	.051	1.25	1.30	
c2	.045	.055	1.14	1.40	
D	.340	.380	8.64	9.65	
E	.380	.405	9.65	10.29	
e	.100 BSC		2.54 BSC		
L	.575	.625	14.61	10.88	
L1	.090	.100	2.29	2.79	
L2	—	.055	—	1.40	
R	.017	.019	0.43	0.48	
α	0°	8°	0°	8°	

Notes:

1. Dimensions are exclusive of mold flash and metal burrs.
2. Standoff-height is measured from lead tip with ref. to Datum -B-.
3. Foot length is measured with ref. to Datum -A- with lead surface (at inner R).
4. Dimension exclusive of dambar protrusion or intrusion.
5. Formed leads to be planar with respect to one another at seating place -C-.



Preliminary Information

Ordering Information

Product Number	Package
RC1584T	TO-220
	TO-263

Preliminary Information

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