10A Positive Adjustable Voltage Regulator

FEATURES

- *Guaranteed* 0.8% Initial Tolerance
- *Guaranteed* 0.4% Load Regulation
- *Guaranteed* 10A Output Current
- 100% Thermal Limit Burn-In
- 24A Transient Output Current
- Standard Adjustable Pinout
- Operates to 35V

APPLICATIONS

- System Power Supplies
- High Power Linear Regulator
- Battery Chargers
- Power Driver
- Constant Current Regulator

DESCRIPTION

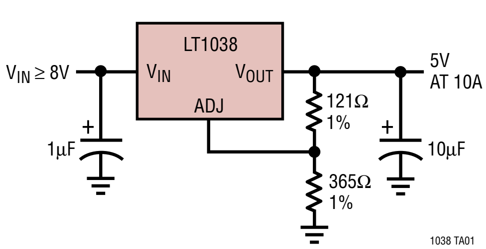
The LT®1038 is a three terminal regulator which is capable of providing in excess of 10A output current over 1.2V to 32V range. The device is packaged in a standard T0-3 power package and is plug-in compatible with industry standard adjustable regulators, such as the LM117 and LM138. Also, the LT1038 is a functional replacement for the LM396.

In addition to excellent load and line regulations, the LT1038 is fully protected by current limiting, safe area protection and thermal shutdown. New current limiting circuitry allows transient load currents up to 24A to be supplied for 500µs without causing the regulator to current limit and drop out of regulation during the transient.

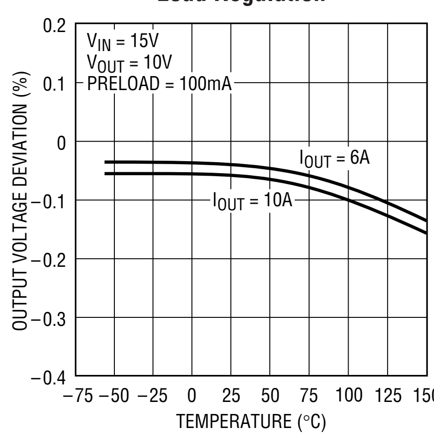
On-chip trimming of initial reference voltage to ±0.8% combined with 0.4% load regulation minimize errors in all high current applications. Further, the LT1038 is manufactured with standard bipolar processing and has Linear Technology's high reliability.

TYPICAL APPLICATIONS

5V, 10A Regulator



Load Regulation

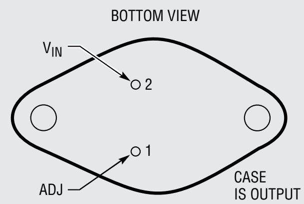


ABSOLUTE MAXIMUM RATINGS

(Note 1)

Power Dissipation .... Internally Limited
Input to Output Voltage Differential 35V
Operating Junction Temperature Range
  LT1038M Control Circuitry .... –55°C to 150°C
  LT1038M Power Transistor .... –55°C to 200°C
  LT1038C Control Circuitry .... 0°C to 125°C
  LT1038C Power Transistor .... 0°C to 175°C
Storage Temperature Range .... –65°C to 150°C
Lead Temperature (Soldering, 10 sec) .... 300°C

PACKAGE/ORDER INFORMATION



K PACKAGE
2-LEAD TO-3 METAL CAN
T_{JMAX} = 3°C, θ_{JA} = 35°C/W

OBSOLETE PACKAGE

ORDER PART NUMBER
LT1038MK LT1038CK

PRECONDITIONING

100% Thermal Limit Burn-in

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at T_A = 25°C. (Note 2)

SYMBOL	PARAMETER	CONDITIONS		LT1038M MIN	LT1038M TYP	LT1038M MAX	LT1038C MIN	LT1038C TYP	LT1038C MAX	UNITS
V_{REF}	Reference Voltage	I_{OUT} = 20mA, T_j = 25°C		1.24	1.25	1.26	1.23	1.25	1.275	V
		$3V \le (V_{IN} - V_{OUT}) \le 35V$ $20mA \le I_{OUT} \le 10A$, $P \le 75W$	●	1.22	1.25	1.285	1.22	1.25	1.285	V
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Line Regulation	$3V \le (V_{IN} - V_{OUT}) \le 35V$, I_{OUT} = 20mA (Note 3)	 ●		0.005 0.02	0.01 0.03		0.005 0.02	0.02 0.03	%/V %/V
$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	Load Regulation	$20mA \le I_{OUT} \le 10A$ (Note 3) $3V \le (V_{IN} - V_{OUT}) \le 35V$ $3V \le (V_{IN} - V_{OUT}) \le 35V$	 ●		 0.1 0.3	 0.4 0.8		 0.1 0.3	 0.6 1.0	 % %
	Thermal Regulation	20ms Pulse			0.002	0.005		0.002	0.01	%/W
	Ripple Rejection	V_{OUT} = 10V, f = 120Hz C_{ADJ} = 0µF C_{ADJ} = 10µF	 ● ●	 60	 60 75		 60	 60 75		 dB dB
I_{ADJ}	Adjust Pin Current		●		50	100		50	100	µA
ΔI_{ADJ}	Adjust Pin Current Change	$20mA \le I_{OUT} \le 10A$ $3V \le (V_{IN} - V_{OUT}) \le 35V$	 ●		 0.2	 3		 0.2	 3	 µA
	Minimum Load Current	$(V_{IN} - V_{OUT})$ = 35V $(V_{IN} - V_{OUT}) \le 20V$	● ●		7	20 10		7	20 10	mA mA
I_{SC}	Current Limit	$(V_{IN} - V_{OUT}) \le 10V$ DC Transient (0.5ms)	 ●	 10 14	 14 22		 10 12	 14 22		 A A
		$(V_{IN} - V_{OUT})$ = 30V, T_j = 25°C		1	2		1	2		A
$\frac{\Delta V_{OUT}}{\Delta Temp}$	Temperature Stability		●		1	2		1		%
$\frac{\Delta V_{OUT}}{\Delta Time}$	Long Term Stability	T_A = 125°C, 1000 Hours			0.3	1		0.3	1	%
e_n	RMS Output Noise (% of V_{OUT})	$10Hz \le f \le 10kHz$			0.001			0.001		%
θ_{JC}	Thermal Resistance Junction to Case	Power Transistor Control Circuitry	●			1 0.5			1 0.5	°C/W °C/W

ELECTRICAL CHARACTERISTICS

Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

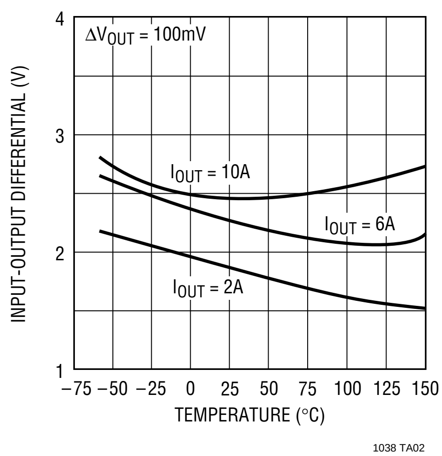
Note 2: Unless otherwise specified, these specifications apply:

$V_{IN} - V_{OUT}$ = 5V and I_{OUT} = 5A. These specifications are applicable for power dissipations up to 75W. At input-output voltage differentials greater than 10V, achievable output current and power dissipation decrease due to protection circuitry.

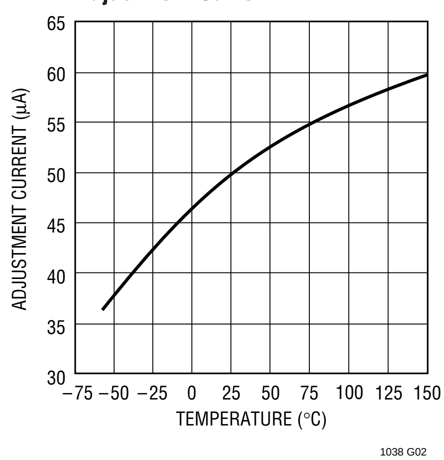
Note 3: See thermal regulation specifications for changes in output voltage due to heating effects. Load and line regulation are measured at a constant junction temperature by low duty cycle pulse testing.

TYPICAL PERFORMANCE CHARACTERISTICS

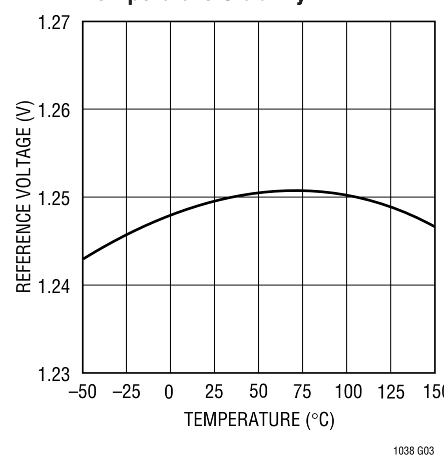
Dropout Voltage



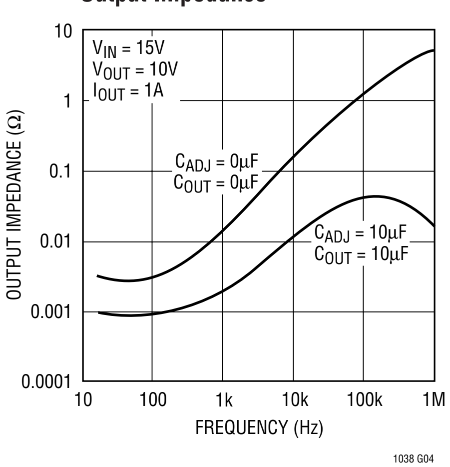
Adjustment Current



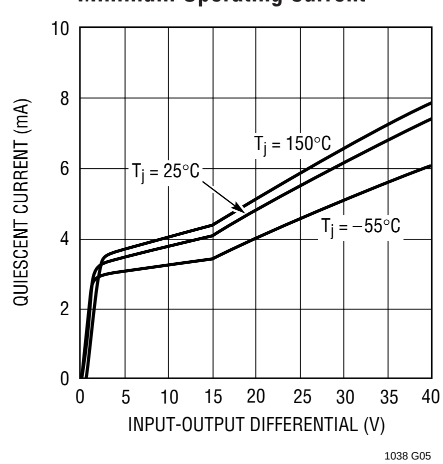
Temperature Stability



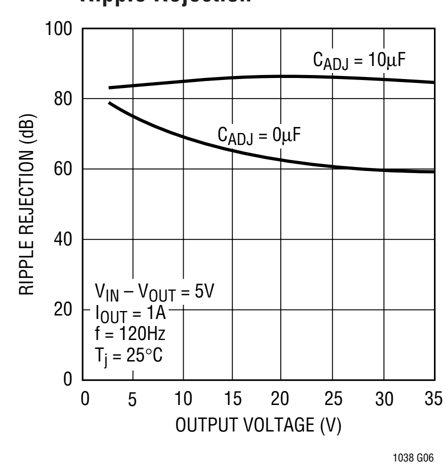
Output Impedance



Minimum Operating Current

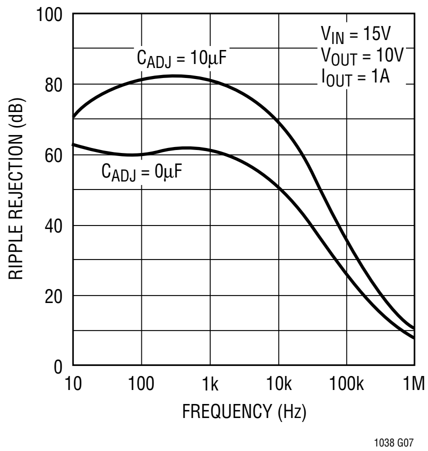


Ripple Rejection

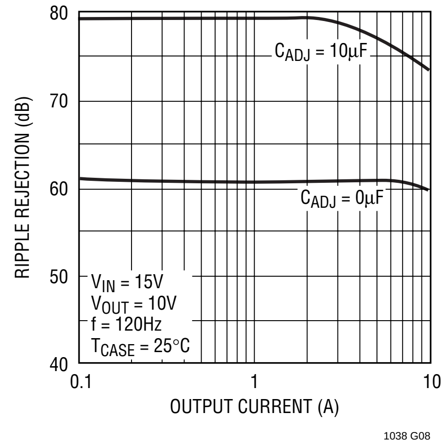


TYPICAL PERFORMANCE CHARACTERISTICS

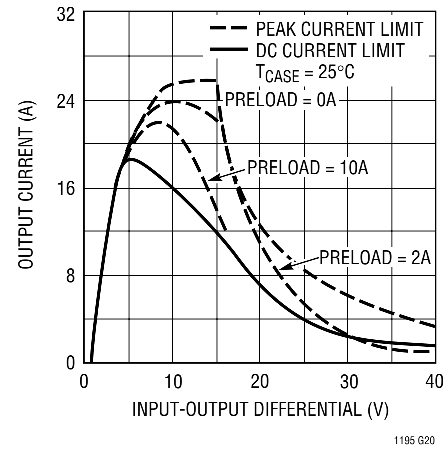
Ripple Rejection



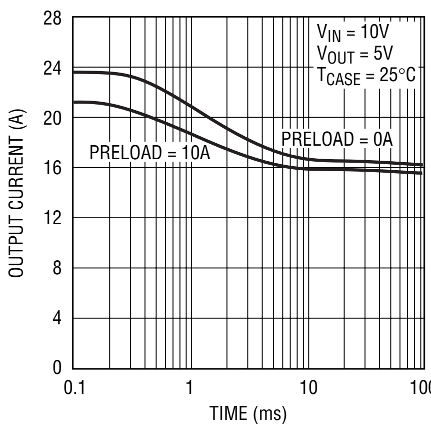
Ripple Rejection



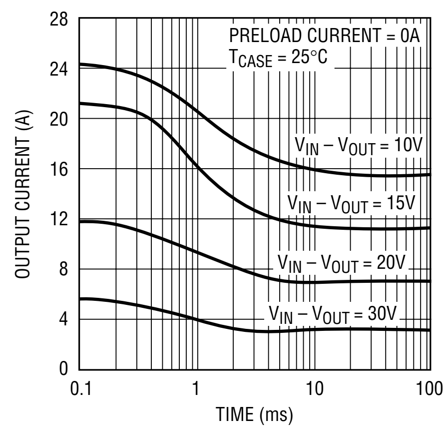
Current Limit



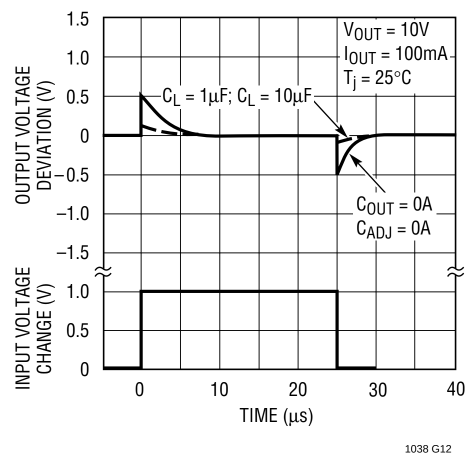
Current Limit



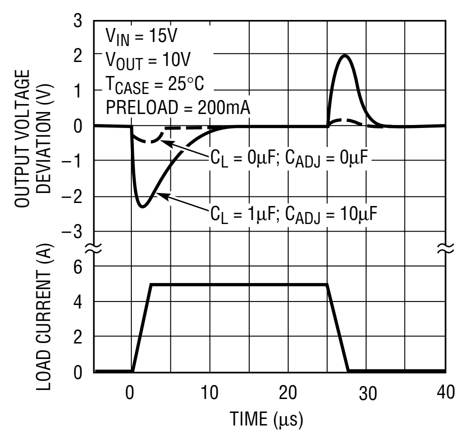
Current Limit



Line Transient Response



Load Transient Response



APPLICATIONS INFORMATION

General

The LT1038 develops a 1.25V reference voltage between the output and the adjustment terminal (see Figure 1). By placing a resistor, R1, between these two terminals, a constant current is caused to flow through R1 and down through R2 to set the overall output voltage. Normally this current is the specified minimum load current of 10mA or 20mA. Because I_{ADJ} is very small and constant when compared with the current through R1, it represents a small error and can usually be ignored.

Bypass Capacitors

Input bypassing using a 1µF tantalum or 25µF electrolytic is recommended when the input filter capacitors are more than 5 inches from the device. Improved ripple rejection (80dB) can be accomplished by adding a 10µF capacitor from the ADJ pin to ground. Increasing the size of the capacitor to 20µF will help ripple rejection at low output voltage since the reactance of this capacitor should be small compared to the voltage setting resistor, R2. For improved AC transient response and to prevent the possibility of oscillation due to unknown reactive load, a 1µF capacitor is also recommended at the output. Because of their low impedance at high frequencies, the best type of capacitor to use is solid tantalum.

Protection Diodes

The LT1038 does not require a protection diode from the adjustment terminal to the output (see Figure 2). Improved internal circuitry eliminates the need for this diode when the adjustment pin is bypassed with a capacitor to improve ripple rejection.

If a very large output capacitor is used, such as a 100µF shown in Figure 2, the regulator could be damaged or destroyed if the input is accidentally shorted to ground or crowbarred, due to the output capacitor discharging into the output terminal of the regulator. To prevent this, a diode, D1 as shown, is recommended to safely discharge the capacitor.

Load Regulation

Because the LT1038 is a three-terminal device, it is not possible to provide true remote load sensing. Load regulation will be limited by the resistance of the wire connecting the regulator to the load. The data sheet specification for load regulation is measured at the bottom of the package. Negative side sensing can be a true Kelvin connection if the bottom of resistor R2 is returned to the negative side of the load. Although it may not be immediately obvious, best load regulation is obtained when the top of the resistor divider, R1, is connected *directly* to the case, *not to the load*. This is illustrated in Figure 3. If R1 were connected to the load, the effective resistance between the regulator and the load would be:

$$R_p \bullet \left(\frac{R2 + R1}{R1}\right) \quad R_p = \text{Parasitic Line Resistance}$$

Connected as shown, R_p is not multiplied by the divider ratio. R_p is about 0.004Ω per foot using 16 gauge wire. This translates to 4mV/ft at 1A load current, so it is important to keep the lead between the regulator and the load as short as possible, and use large wire or PC board traces.

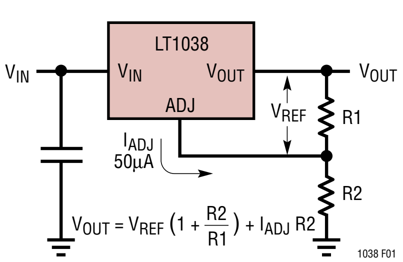


Figure 1. Basic Adjustable Regulator

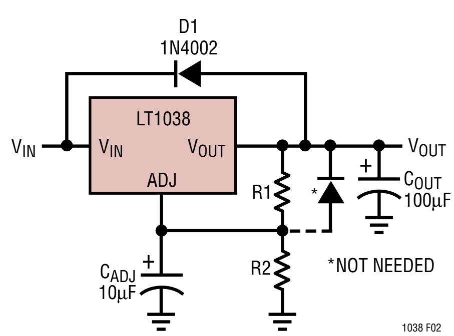


Figure 2

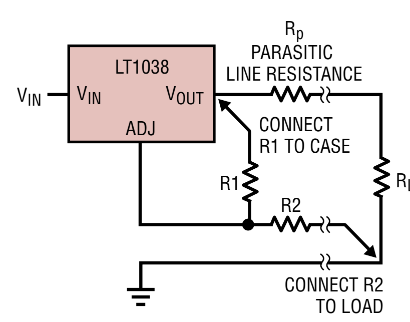
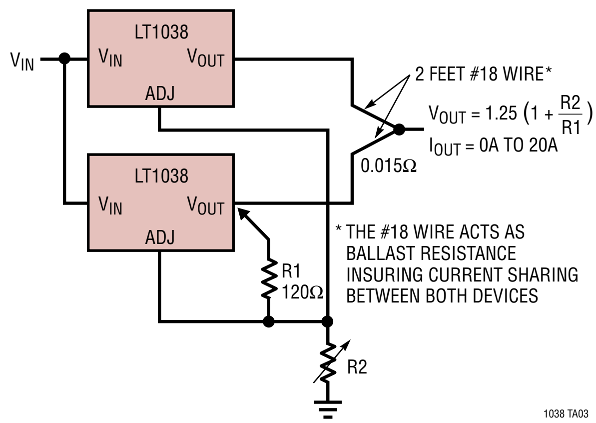


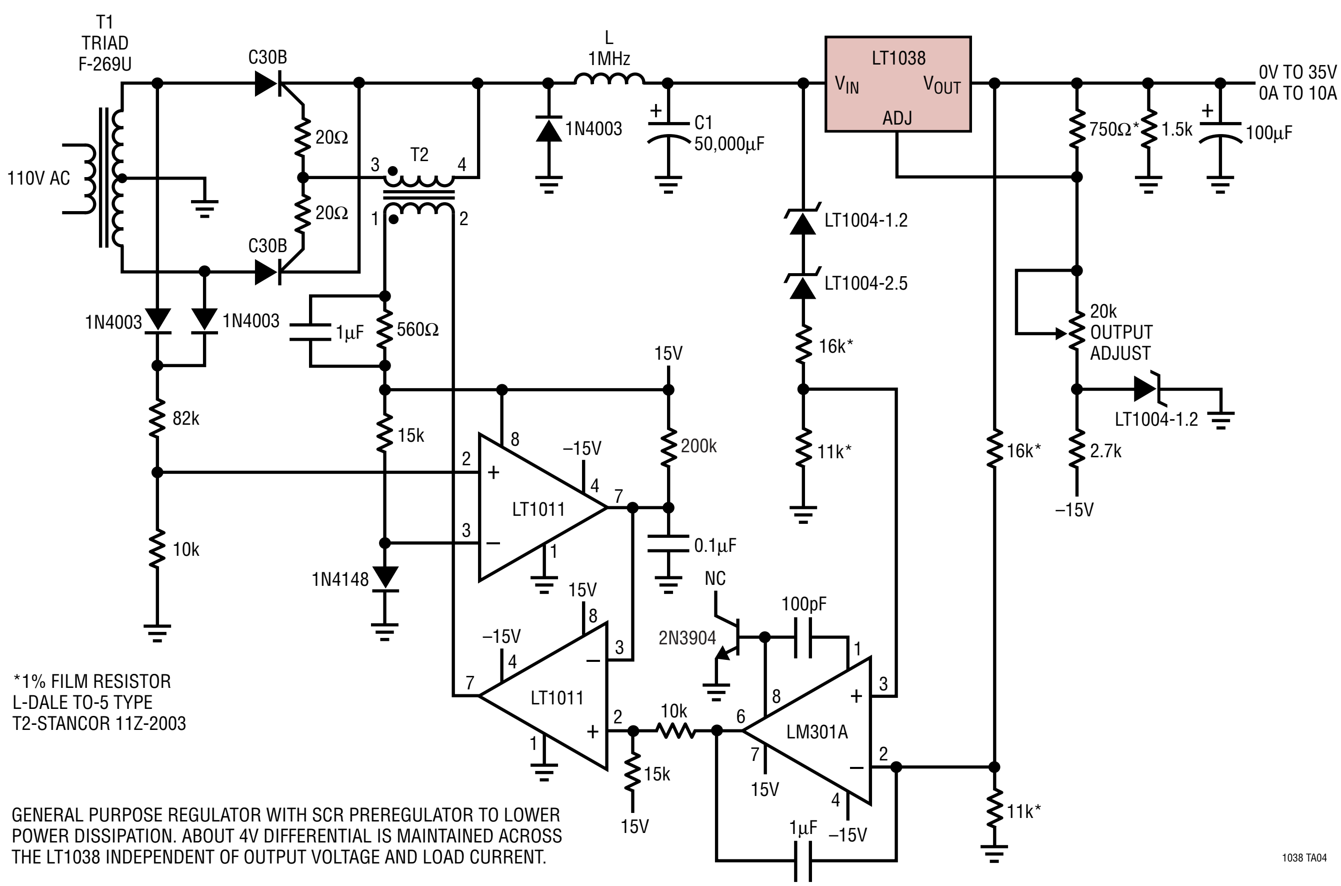
Figure 3. Connections for Best Load Regulation

TYPICAL APPLICATIONS

Paralleling Regulators

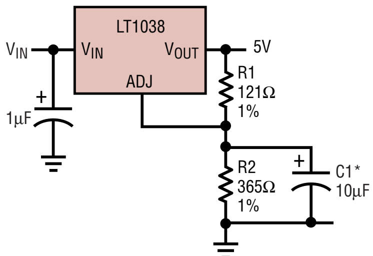


10A Variable Regulator*



TYPICAL APPLICATIONS

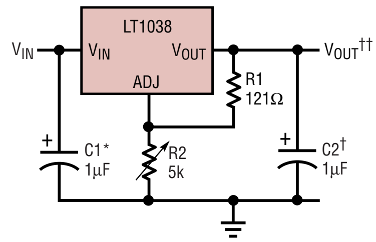
Improving Ripple Rejection



*C1 IMPROVES RIPPLE
REJECTION. X_C SHOULD
BE SMALL COMPARED TO R2.

1038 TA05

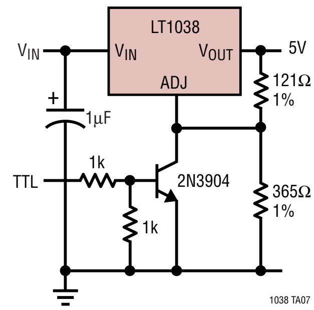
1.2V to 25V Adjustable Regulator



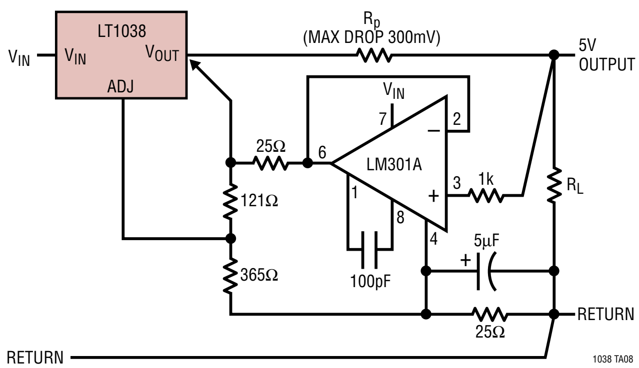
*NEEDED IF DEVICE IS FAR FROM FILTER CAPACITORS
†OPTIONAL—IMPROVES TRANSIENT RESPONSE
††V_{OUT} = 1.25V (1 + R2/R1)

1038 TA06

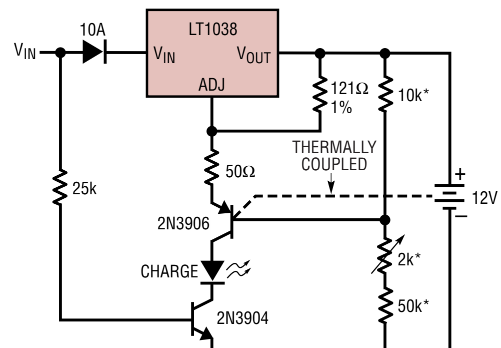
5V Regulator with Shutdown



Remote Sensing



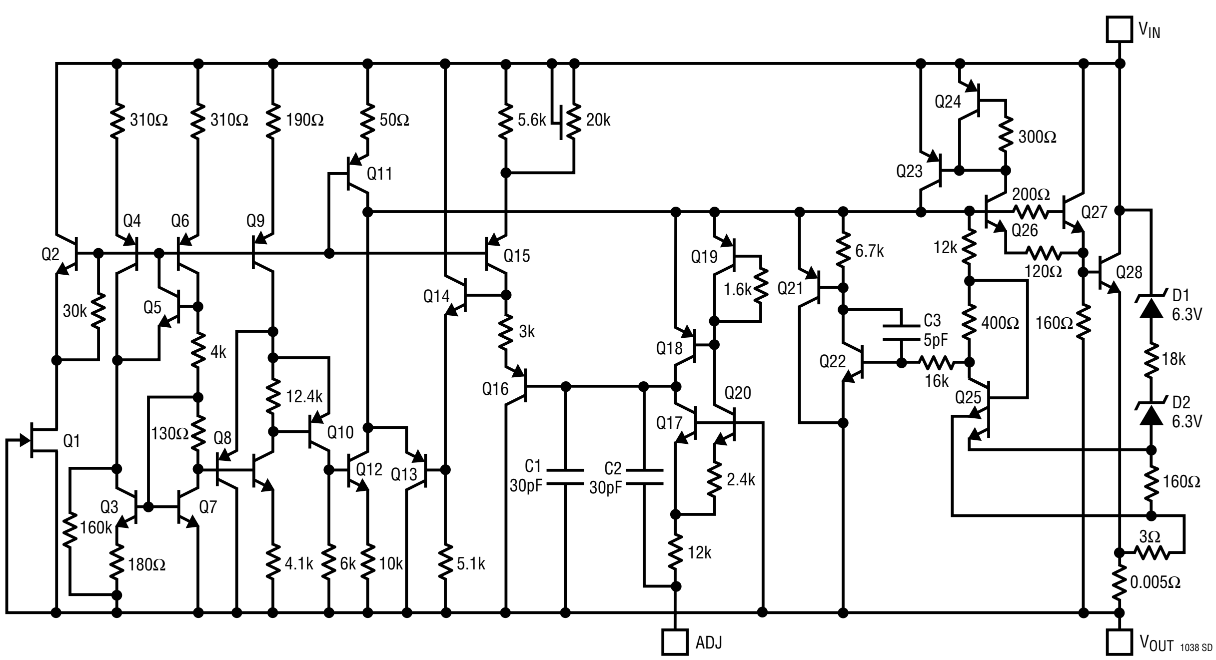
Temperature Compensated Lead Acid Battery Charger



*LOAD ON BATTERY ≈ 200µA
WHEN NOT CHARGING

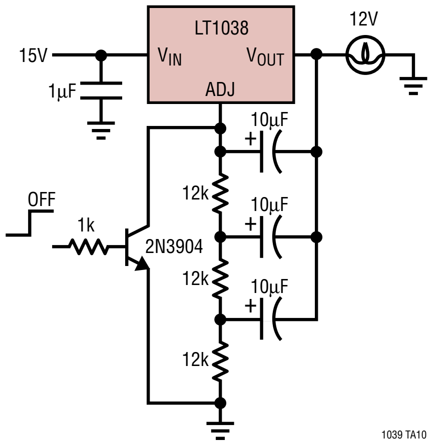
1038 TA09

SCHEMATIC DIAGRAM

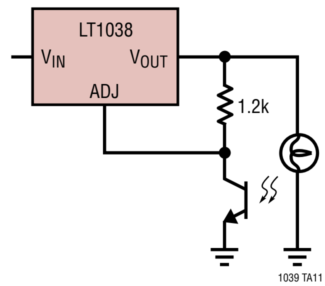


TYPICAL APPLICATIONS

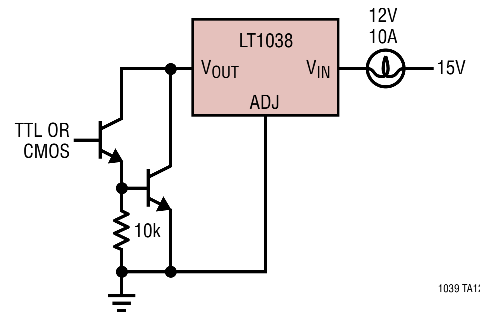
Lamp Flasher



Automatic Light Control



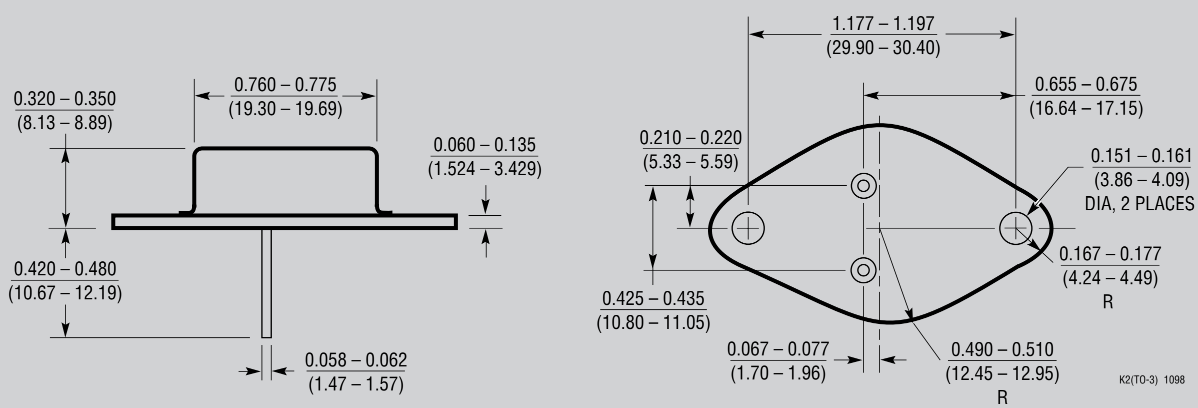
Protected High Current Lamp Driver



PACKAGE DESCRIPTION

Dimensions in inches (millimeters) unless otherwise noted.

K Package
2-Lead TO-3 Metal Can
(60mil Diameter Leads)
(LTC DWG # 05-08-1312)



OBSOLETE PACKAGE

RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LT1084	Low Dropout, 0.01% Load Regulation	7.5A Max Current Output
LT1581	Low Dropout, 430mV at 10A	Best Replacement
LT1584	Low Dropout, 0.05% Load Regulation	7A Max Current Output
LT1585	Low Dropout, 0.05% Load Regulation	5A Max Current Output

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