Logic Controlled Regulator

FEATURES

- Two Regulated Outputs
  - + 12V at 3A
  - + 5V at 75mA
- 2% Output Voltage Tolerance
- 60dB Ripple Rejection
- 0.7% Load Regulation
- TTL and CMOS Compatible Logic Control
- 100% Thermal Burn-In on All Devices

APPLICATIONS

- Power Supply Sequencing
- Remote On/Off Power Control
- Selective System Power during Emergency Power Operation
- Power Supply with Back-Up

DESCRIPTION

The LT1036 features two positive regulators in the same package. The 12V main regulator offers excellent performance while supplying load currents up to 3A, and the 5V auxiliary regulator provides similar performance while supplying lighter loads of 75mA. The main regulator has the additional feature of being under the shutdown control of a logic signal. When the enable pin is taken to a low logic level, the main regulator shuts down and its output voltage goes to near 0V. During this command, the auxiliary output is unaffected by the main regulator's condition and continues to provide a 5V output.

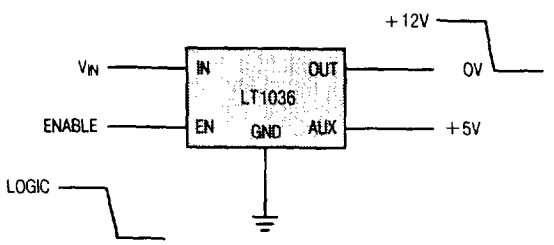
The main output has current and power limiting combined with thermal shutdown to make it virtually blowout proof. The auxiliary output is not affected by the thermal shutdown mechanism or the state of the main output, allowing it to be used as a back-up in case of overloads or shorts on the main supply.

The logic input of the LT1036 (enable pin) has a 1.6V threshold and can be driven from a high source impedance. This allows it to be driven by most logic families, including TTL and CMOS.

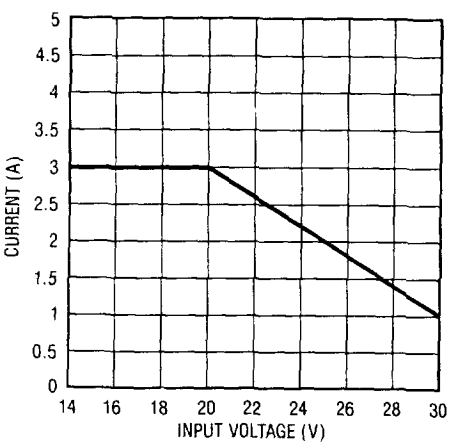
For a dual 5V version of the LT1036, please see the LT1035 data sheet.

4

Functional Diagram



Guaranteed Load Current, 12V Output



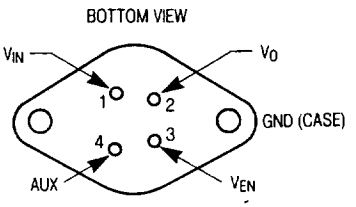
ABSOLUTE MAXIMUM RATINGS

Power Dissipation—Continuous (Note 6) 24W
Power Dissipation—Fault Conditions .. Internally Limited
Input Voltage (V_{IN}) 30V
Enable Voltage (V_{EN}) 30V
Operating Junction Temperature
LT1036M ..... −55°C to 150°C
LT1036C ..... 0°C to 125°C
Storage ..... −65°C to 150°C
Lead Temperature (Soldering, 10 sec.) ..... 300°C

PRECONDITIONING

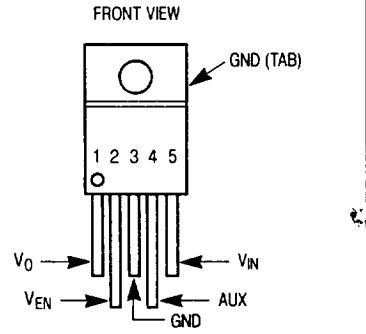
100% Burn-In in Thermal Limit

PACKAGE/ORDER INFORMATION



4 LEAD TO-3

ORDER PART NUMBER
LT1036MK LT1036CK



5 LEAD TO-220

ORDER PART NUMBER
LT1036CT

ELECTRICAL CHARACTERISTICS

Main Regulator (See Note 1) V_{IN} = 15V unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS		LT1036M/C MIN	LT1036M/C TYP	LT1036M/C MAX	UNITS
V_O	Output Voltage	T_j = 25°C		11.76	12	12.24	V
	High	15V ≤ V_{IN} ≤ 30V $I_{OUT} \le I_{MAX}$ (Note 6)	●	11.52		12.48	V
	Low	7V ≤ V_{IN} ≤ 30V	●		0.1	0.3	V
$\frac{\Delta V_O}{\Delta I_O}$	Load Regulation (Note 6)	V_{IN} = 16V 0 ≤ I_O ≤ 3A (Note 2)	●		10	80	mV
$\frac{\Delta V_O}{\Delta V_{IN}}$	Line Regulation	15V ≤ V_{IN} ≤ 30V (Note 2)			1	4	mV/V
	Ripple Rejection	50Hz ≤ f ≤ 500Hz (Note 8)		50	60		dB
	Thermal Regulation	ΔP_D = 20W (Note 4)			0.003	0.012	%/W
I_O	Available Load Current (Note 6)	15V ≤ V_{IN} ≤ 20V V_{IN} = 25V	● ●	3 2	4 2.7		A A
I_{SC}	Short Circuit Current	V_{IN} = 15V V_{IN} = 25V			2.3 1	4 2	A A
V_{IN}	Input Voltage to Maintain Regulation (Dropout Voltage)	(Note 5) I_O = 1A I_O = 3A	 ● ●		 13.8 14.4	 14.5 15	 V V
I_Q	Quiescent Current	Output High Output Low			4 3	5.5 4.5	mA mA
θ_{jC}	Thermal Resistance, Junction to Case	TO-3 TO-220			1.5 2	2.5 3	°C/W °C/W

ELECTRICAL CHARACTERISTICS Auxiliary Regulator (See Note 1)

SYMBOL	PARAMETER	CONDITIONS		LT1036M/C MIN	TYP	MAX	UNITS
V_O	Output Voltage	$T_j = 25°C$		4.9	5.0	5.1	V
		$7.2V \le V_{IN} \le 30V$ $0mA \le I_O \le 75mA$	●	4.8	5.0	5.2	V
$\frac{\Delta V_O}{\Delta I_O}$	Load Regulation	$7.2V \le V_{IN} \le 30V$ $0mA \le I_O \le 75mA$ (Note 2)	●		5	15	mV
$\frac{\Delta V_O}{\Delta V_{IN}}$	Line Regulation	$7.2V \le V_{IN} \le 30V$ (Note 2)	 ●		0.2	1 2	mV/V mV/V
	Ripple Rejection	$50Hz \le f \le 500Hz$			74		dB
I_{SC}	Short Circuit Current (Note 7)	$7.0V \le V_{IN} = 30V$			140	250	mA
V_{IN}	Input Voltage to Maintain Regulation (Dropout Voltage)	(Note 5) $I_O \le 10mA$ $I_O = 75mA$	 ● ●		 6.2 6.8	 6.5 7.2	 V V

ELECTRICAL CHARACTERISTICS Logic Control (See Note 1)

SYMBOL	PARAMETER	CONDITIONS		LT1036M/C MIN	TYP	MAX	UNITS
V_{EN}	Enable Threshold Voltage	$7.0V \le V_{IN} \le 30V$ $T_j = 25°C$	 ●	1.45 1.3	1.6 1.6	1.7 1.8	V V
	Enable Pin Current	$V_{EN} \le 1V$ (Note 3)	●	0	1.5	12	μA
		$V_{EN} \ge 2.4V$	●		0	6	μA

The ● denotes the specifications which apply over the full operating temperature range.

Note 1: Unless otherwise indicated, these specifications apply for $V_{IN} = 15V$, $I_O = 0mA$, and $T_j = 25°C$.

Note 2: Line and load regulation is measured using a low duty cycle pulse, causing little change in the junction temperature. Effects due to thermal gradients and device heating must be taken into account separately.

Note 3: When the enable pin is at a low logic level, current flows out of the enable pin.

Note 4: Pulse length for this measurement is 20ms.

Note 5: Input voltage is reduced until output drops by 100mV from its initial value.

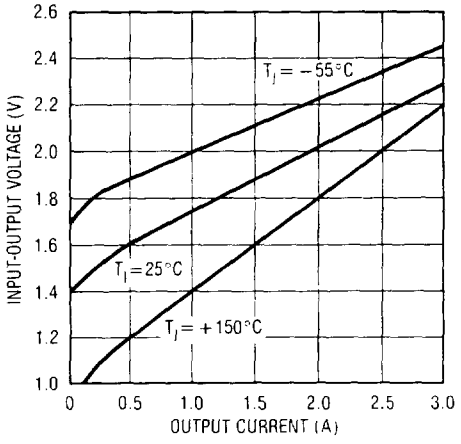
Note 6: See "Guaranteed Load Current" graph.

Note 7: Continuous shorts on the auxiliary output are not allowed unless adequate heat sinking is used to maintain junction temperature below 150°C.

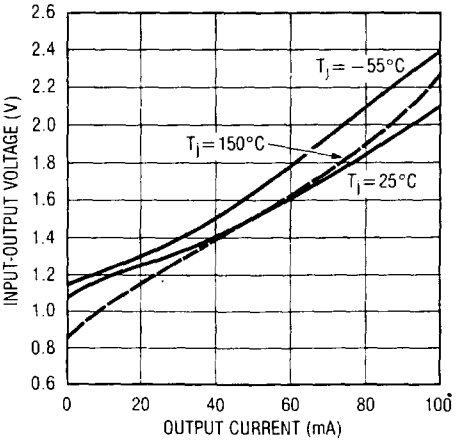
Note 8: Guaranteed but not tested.

TYPICAL PERFORMANCE CHARACTERISTICS

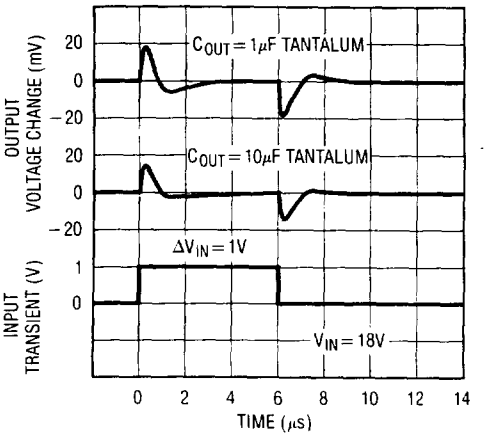
Minimum Input-Output Differential of Main Output



Minimum Input-Output Differential of Auxiliary Output

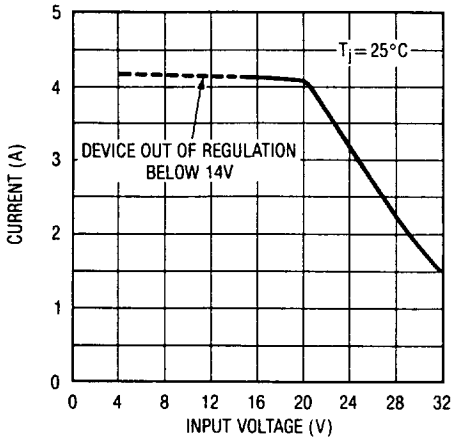


Line Transient Response, 12V Output

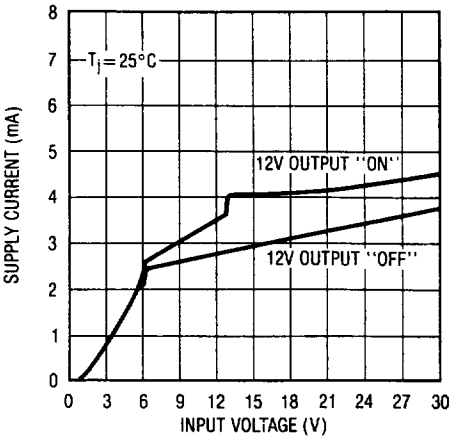


TYPICAL PERFORMANCE CHARACTERISTICS

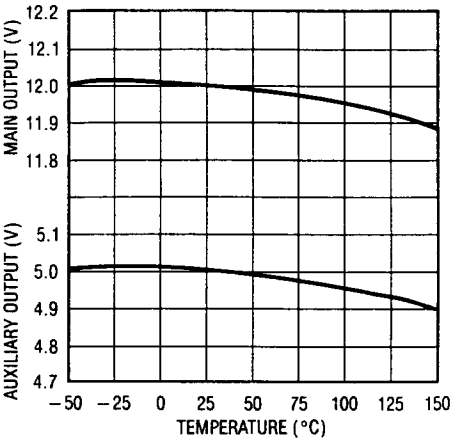
Maximum Available Load Current, 12V Output



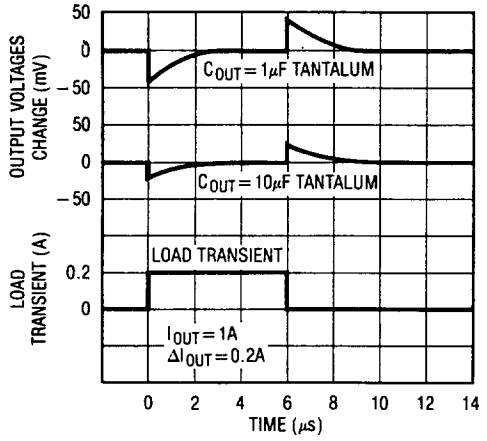
Quiescent Current



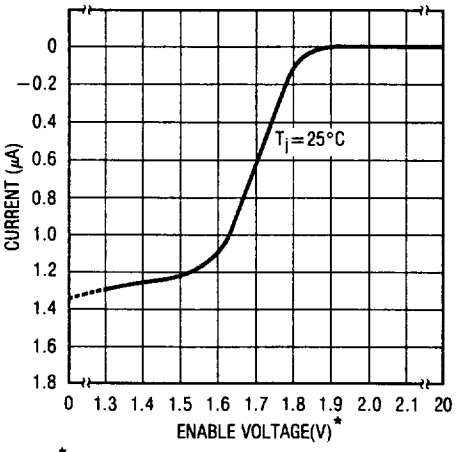
Output Voltage vs Temperature



Load Transient Response, 12V Output

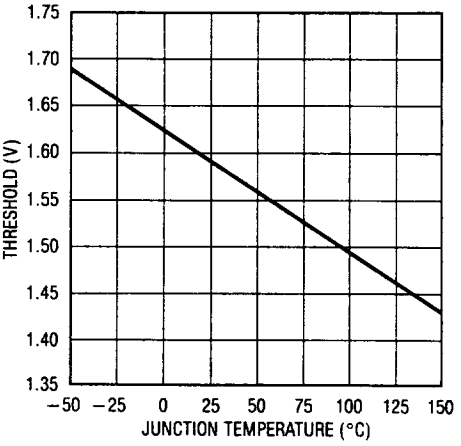


Enable Pin Characteristics

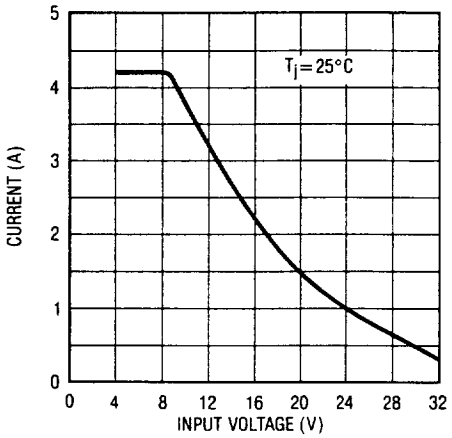


*NOTE SCALE CHANGE

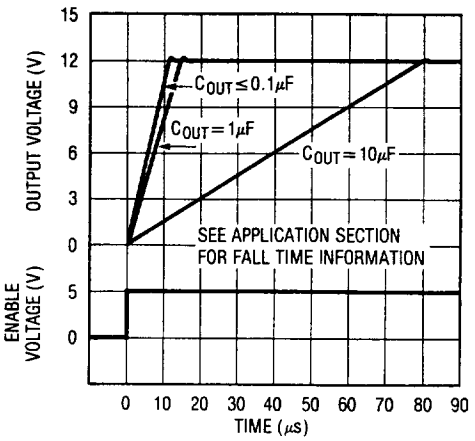
Enable Threshold



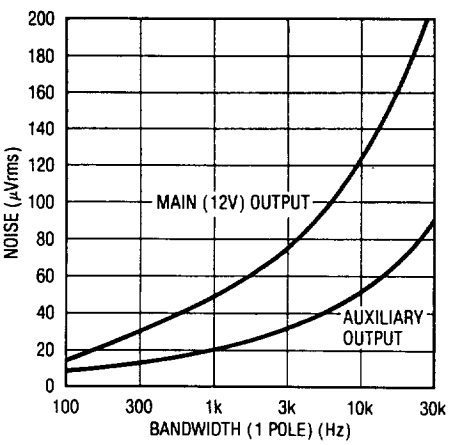
Short Circuit Current, 12V Output



Output Switching Characteristics



Output Voltage Noise



APPLICATIONS INFORMATION

General Information

The LT1036 is a dual output regulator. The main 12V output is capable of delivering up to 3A of load current and can be shut down with a logic signal. The auxiliary 5V output supplies a minimum of 75mA and is unaffected by the logic signal. The outputs are trimmed to ±2% initial tolerance and exhibit excellent line and load regulation.

The logic control feature makes the LT1036 ideal for many system applications where it is desirable to power-up a portion of the system for a period of time, and then power the system down during a standby operation. Applications such as multiple power supply sequencing, elimination of expensive AC and DC power switches, delayed start applications, switching 12V DC loads, and many others are now easily accomplished.

Timing functions, such as delayed power-up or power-down, can also be performed directly at the enable pin.

Because a logic low on the enable pin shuts down the main regulator, feedback from output to enable can be used to generate hysteresis or latching functions.

The low quiescent current drain of the LT1036 makes it useful in battery-powered or battery back-up applications. The enable pin can be used as a "low battery" detector or to shut down major portions of system power, allowing memory portions to continue to operate from the auxiliary output. At low output currents, the auxiliary output will regulate with input voltage typically as low as 6.2V, giving maximum battery life.

Good design practice with all regulators is to bypass the input and output terminals. A 2μF solid tantalum at the input and at both outputs is suggested. For the applications which follow, the bypass capacitors are still recommended, but for simplicity are not shown on the diagram. It is also recommended that for maximum noise immunity the voltage enable pin be tied high if it is unused. It can be tied directly to V_{IN}, as shown in Figure 1, or to the auxiliary output. If the enable pin is left open, it will float to a high logic level of approximately 1.6V and the main output regulator will be at 12V.

The enable pin is fully protected against input voltages up to 30V, even if the power input voltage is zero.

The basic shutdown control circuit uses a direct gate drive or an open collector driver and a pull-up resistor which are tied to V_{AUX}, as shown in Figure 2.

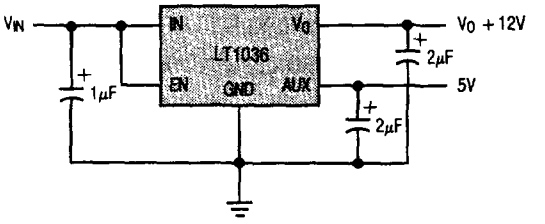


Figure 1

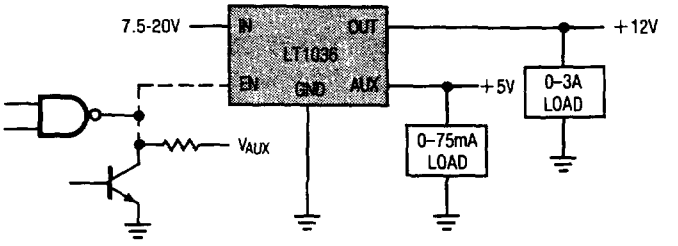


Figure 2

Driving the Enable Pin

The enable pin equivalent schematic is shown in Figure 3. Basically, enable pin current is zero above the threshold and about 1.5μA below the threshold, flowing out of the pin. Standard logic, such as TTL and CMOS, will interface directly to the enable pin, even if the logic output swing is higher than the input voltage (V_{IN}) to the regulator. 15V CMOS can be used to drive the enable pin, even if the regulator is not powered up, without loading the CMOS output.

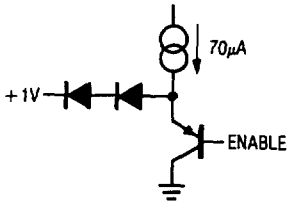


Figure 3

Timing functions, such as delayed power-up or power-down, can be implemented by driving the enable pin with an RC network. The current flowing out of the enable pin should not be used as the timing current in delayed power-up applications as it is temperature sensitive and varies somewhat from device to device. Instead, a resistor tied to the auxiliary output, the input, or to a logic signal

APPLICATIONS INFORMATION

should be used. The timing resistor chosen should provide at least 25μA of current to "swamp out" the effects of the internal current.

Main Output Current/Voltage Characteristics

Following a high to low transition at the enable pin, the main regulator output will begin to drop after a delay of approximately 0.4μs. With no capacitive load, the output will fall to zero in approximately 0.8μs (R_L = 4Ω to 100Ω). With a capacitive load, fall time is limited by the RC product of the load and the output capacitance. For light loads (R_L > 400Ω), the discharge time is controlled by an internal current pull-down of 15mA for output voltages down to 1.5V. Below 1.5V, the pull-down current drops to ≈4mA. The DC output voltage in the shutdown mode is approximately 0.12V due to an internal current path in the regulator. (See Figure 4)

The user should note that the output in the low state can only sink about 3mA. If current is forced into the output, the output voltage will rise to 1V at 5mA and about 1.5V at 10mA. With no output capacitor, the rise time of the main output is about 12μs. With an output capacitor, rise time is limited by the short circuit current of the LT1036 and the load capacitance. A 10μF output capacitor slows the output rise time to approximately 80μs.

Output Current

The main output current limits at about 4A for input voltages below 20V. Internal foldback, or "power limiting", circuitry detects the input-output voltage differential and reduces current limit for input to output voltages exceeding 8V. With 25V input, for instance, short circuit current is reduced to ≈0.9A.

An additional feature of the LT1036 is that the auxiliary supply does not incorporate, nor is it affected by, thermal shutdown. Any fault condition of the main regulator will not affect the auxiliary output voltage.

The following applications circuits will serve to indicate the versatility of the LT1036.

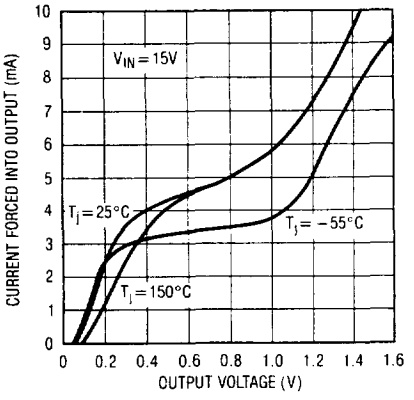
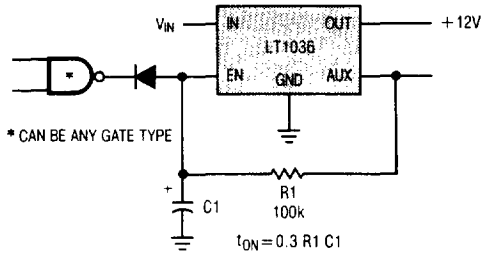


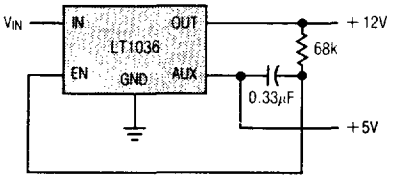
Figure 4

TYPICAL APPLICATIONS

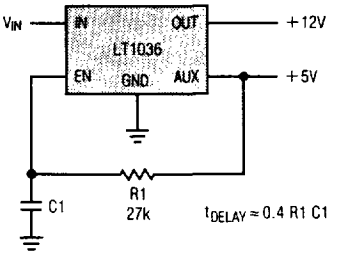
Fast Turn-Off, Delayed Turn-On



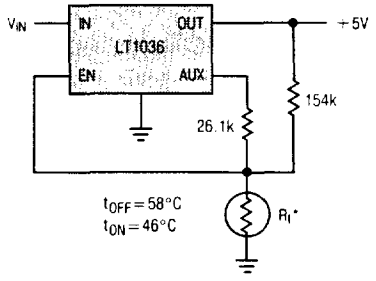
Latch-Off with Output Short



Delayed Power-Up

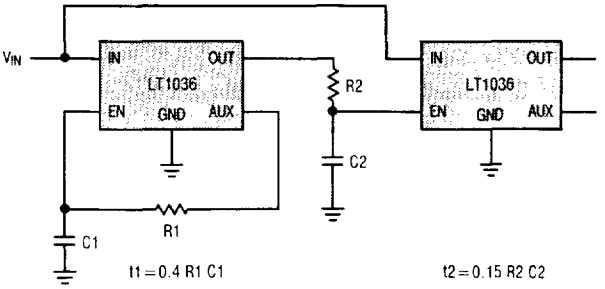


Thermal Cutoff at High Ambient Temperature



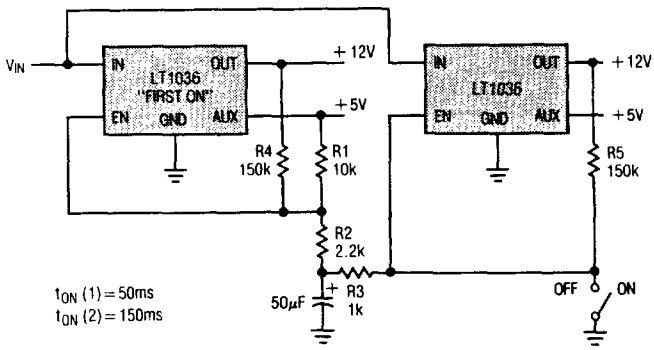
*YELLOW SPRINGS #44008, 30kΩ @ 25°C

Power Supply Turn-On Sequencing

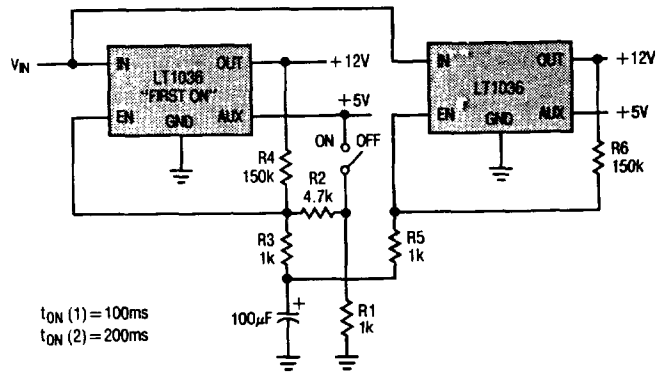


TYPICAL APPLICATIONS

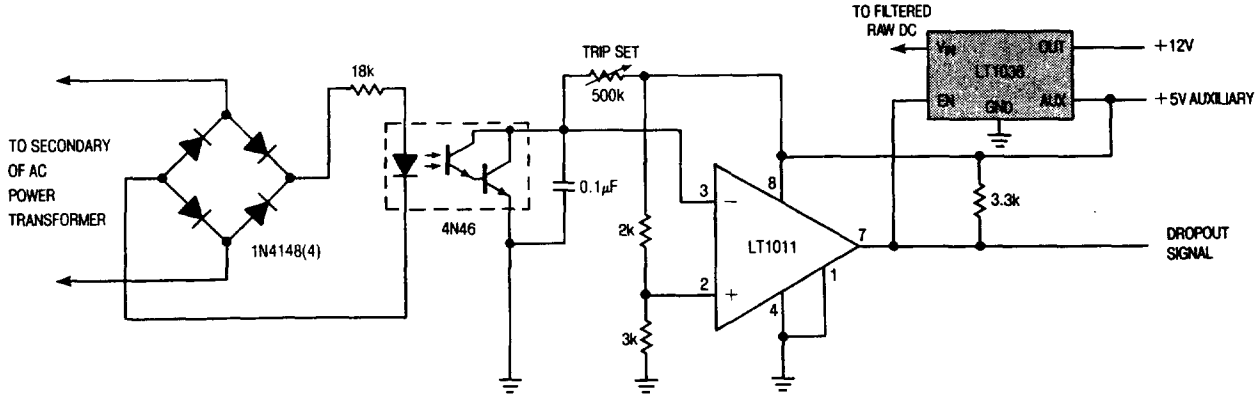
First-On, Last-Off Sequencing



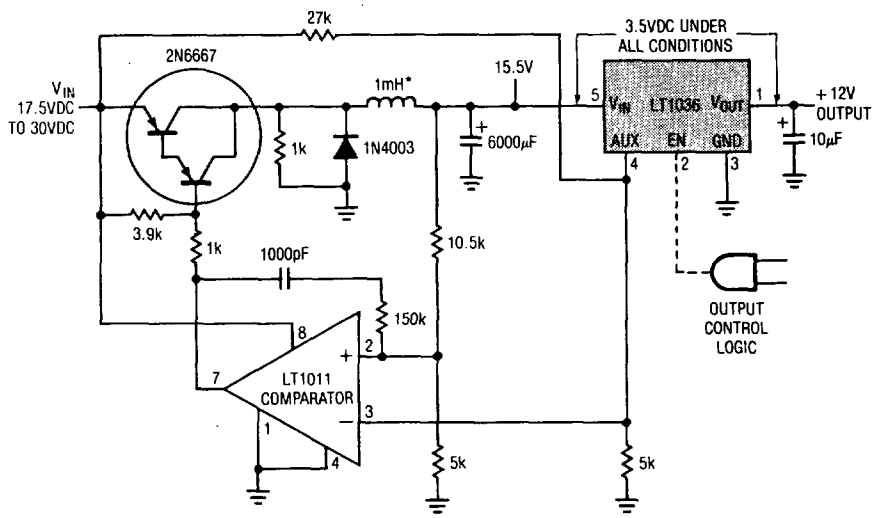
First-On, First-Off Sequencing



Line Dropout Detector

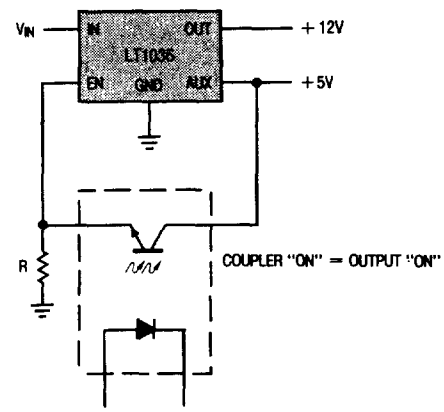


Low Dissipation Regulator



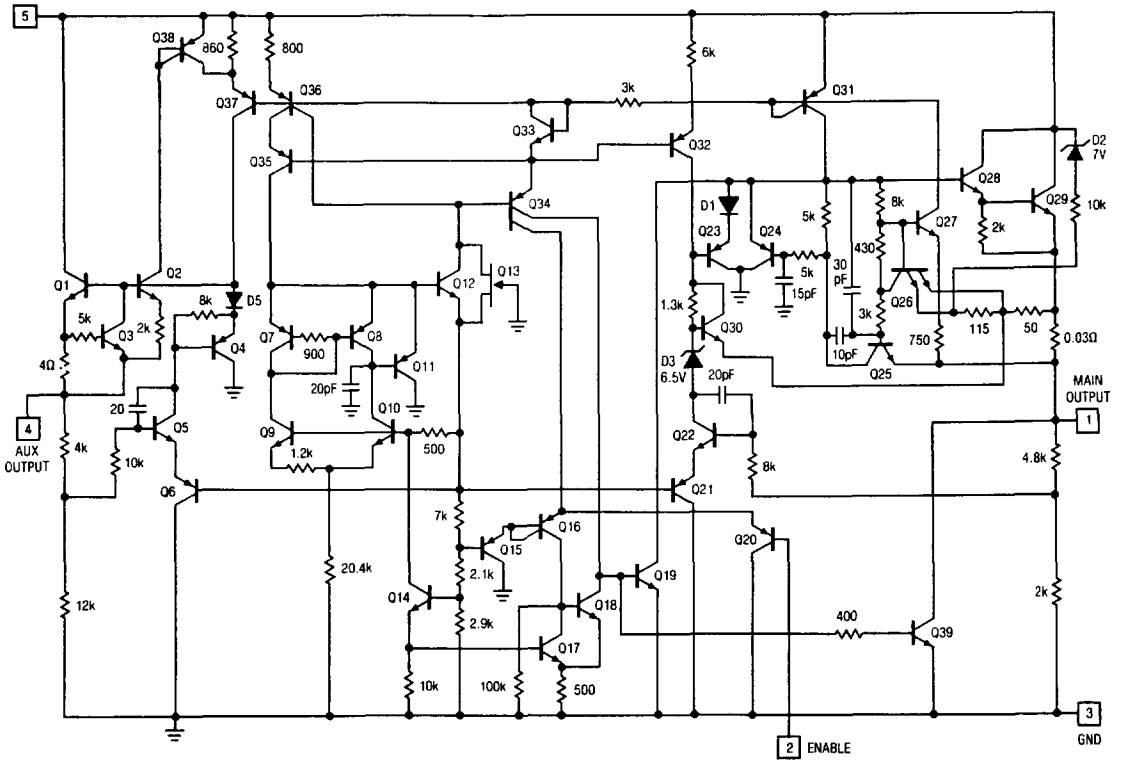
*DALE TD-5
THIS CIRCUIT IS DESIGNED TO REDUCE POWER DISSIPATION IN THE LT1036 OVER A 90VAC–140VAC INPUT RANGE.

Opto-Coupled Output Control



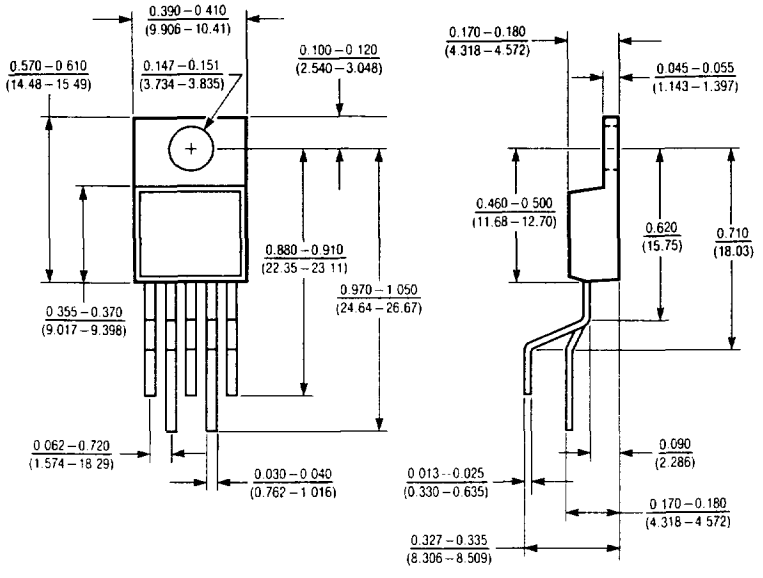
SELECT R DEPENDING UPON THE ON-RESISTANCE OF THE OPTO COUPLER

SCHEMATIC DIAGRAM



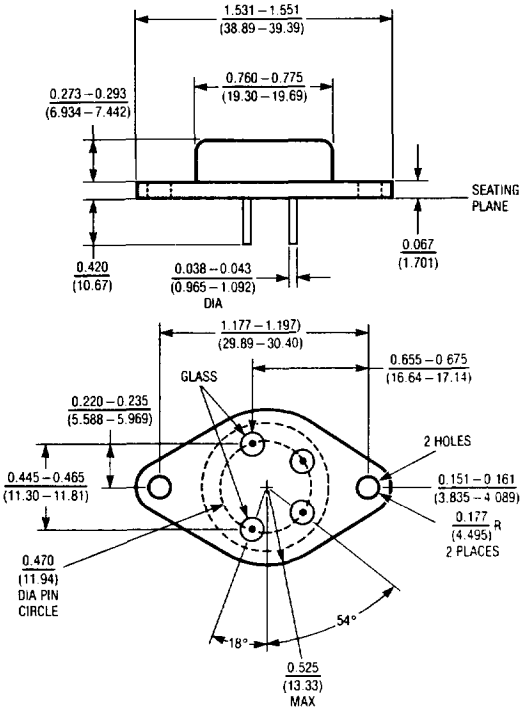
PACKAGE DESCRIPTION Dimensions in inches (millimeters) unless otherwise noted.

TO-220 Package (5 Lead)



	T_{jMAX}	θ_{jC}
LT1036C	125°C	3°C/W

4-Pin Metal Package Similar to JEDEC TO-3



	T_{jMAX}	θ_{jC}
LT1036M	150°C	2.5°C/W
LT1036C	125°C	2.5°C/W