

### FEATURES

- Adjustable Output . . . . . Down To 1.2V
- Fixed Output Voltages . . . . . 1.5, 2.5, 3.3, 5.0V
- Output Current . . . . . 1.5A
- Low Dropout Voltage . . . . . 1.1V Typ.
- Extremely Tight Load And Line Regulation
- Current & Thermal Limiting
- Standard 3-Terminal Low Cost TO-220, TO-263 & TO-252
- Similar To Industry Standard LT1086/LT1586

### APPLICATIONS

- Powering VGA & Sound Card
- Power PC™ Supplies
- SMPS Post-Regulator
- High Efficiency "Green" Computer Systems
- High Efficiency Linear Power Supplies
- Portable Instrumentation
- Constant Current Regulators
- Adjustable Power Supplies
- Battery charger

### PRODUCT DESCRIPTION

Calogic's CLM2815 is a low power 1.5A adjustable and fixed voltage regulator. The device requires 2 external resistors to set the output for the adjustable version. The CLM2815 has been designed for low voltage applications that require lower dropout and faster transient responses. The device is well suited to power a low voltage microprocessor that requires a low dropout and a fast transient response to regulate from +2.85V to 3.8V. The device is adjustable to 1.2 volts.

The product family offers full protection against over-current faults, reversed input polarity, reversed load insertion, and positive and negative transient voltage. On-chip trimming adjusts the reference voltage to 1% while delivering 1.5A output current.

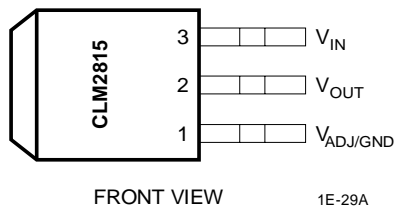
Encapsulated in a 3-pin TO-220, TO-263 & TO-252 packages.

### ORDERING INFORMATION

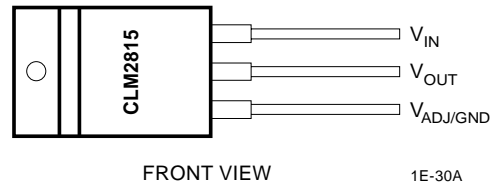
Part	Package	Temperature Range
CLM2815AU	TO-220	-45 to +125°C
CLM2815AAU	TO-220	-45 to +125°C
CLM2815AU-X	TO-220	-45 to +125°C
CLM2815AAU-X	TO-220	-45 to +125°C
CLM2815AT	TO-263 (DD)	-45 to +125°C
CLM2815AAT	TO-263 (DD)	-45 to +125°C
CLM2815AT-X	TO-263 (DD)	-45 to +125°C
CLM2815AAT-X	TO-263 (DD)	-45 to +125°C

### PIN CONNECTIONS

#### PLASTIC TO-263 PACKAGE



#### PLASTIC TO-220 PACKAGE



## ABSOLUTE MAXIMUM RATINGS

Lead Temp. (Soldering, 10 Seconds) . . . . .	300°C	Input Voltage . . . . .	10V
Storage Temperature Range . . . . .	-65°C to +150°C	Input to Output Voltage Differential . . . . .	10V
Operating Junction Temperature Range		Maximum Output Current . . . . .	2A
CLM2815 Control Section . . . . .	-45°C +125°C		
CLM2815 Power Transistor . . . . .	-45°C +150°C		

## ELECTRICAL CHARACTERISTICS (Note 1) at I<sub>OUT</sub> = 10mA, T<sub>A</sub> = 25°C, unless otherwise specified.

PARAMETER	TYP	CLM2815A		CLM2815		UNITS	CONDITIONS
		MIN	MAX	MIN	MAX		
<b>1.5V VERSION</b>							
Output Voltage (Note 2)	1.5 <b>1.5</b>	1.485 <b>1.470</b>	1.515 <b>1.530</b>	1.470 <b>1.455</b>	1.530 <b>1.545</b>	V	CLM2815-1.5V, 0 ≤ I <sub>OUT</sub> ≤ 1.5A, 2.75V ≤ V <sub>IN</sub> ≤ 7V
<b>2.5V VERSION</b>							
Output Voltage (Note 2)	2.5 <b>2.5</b>	2.475 <b>2.450</b>	2.525 <b>2.550</b>	2.450 <b>2.425</b>	2.550 <b>2.575</b>	V	CLM2815-2.5V, 0 ≤ I <sub>OUT</sub> ≤ 1.5A, 3.5V ≤ V <sub>IN</sub> ≤ 7V
<b>3.3V VERSION</b>							
Output Voltage (Note 2)	3.3 <b>3.3</b>	3.270 <b>3.240</b>	3.330 <b>3.360</b>	3.230 <b>3.201</b>	3.370 <b>3.399</b>	V	CLM2815-3.3V, 0 ≤ I <sub>OUT</sub> ≤ 1.5A, 4.75V ≤ V <sub>IN</sub> ≤ 7V
<b>5.0V VERSION</b>							
Output Voltage (Note 2)	5.0 <b>5.0</b>	4.95 <b>4.90</b>	5.05 <b>5.10</b>	4.900 <b>4.850</b>	5.100 <b>5.150</b>	V	CLM2815-5.0V, 0 ≤ I <sub>OUT</sub> ≤ 1.5A, 5.5V ≤ V <sub>IN</sub> ≤ 7V
<b>ALL VOLTAGE OPTIONS</b>							
Reference Voltage (V <sub>REF</sub> )	<b>1.250</b>	<b>1.225</b>	<b>1.270</b>	<b>1.225</b>	<b>1.270</b>	V	V <sub>IN</sub> ≤ 7V, P ≤ P <sub>MAX</sub> 1.5V ≤ (V <sub>IN</sub> - V <sub>OUT</sub> ) ≤ 5.75V, 10mA ≤ I <sub>OUT</sub> ≤ I <sub>OUT</sub> ≤ 5.75
Min. Load Current (Note 3)	<b>5</b>		<b>10</b>		<b>10</b>	mA	1.5V ≤ (V <sub>IN</sub> - V <sub>OUT</sub> ) ≤ 5.75V
Line Regulation (ΔV <sub>REF</sub> (I <sub>IN</sub> ))	0.005		0.2		0.2	%	2.75V ≤ V <sub>IN</sub> ≤ 7V, I <sub>OUT</sub> = 10mA, T <sub>J</sub> = 125°C (Note 3)
	0.005		0.2		0.2		V <sub>IN</sub> ≤ 7V, I <sub>OUT</sub> = 0mA, T <sub>J</sub> = 125°C (Note 2)
Load Regulation (ΔV <sub>REF</sub> (I <sub>OUT</sub> ))	0.05		0.3		0.3	%	10mA ≤ I <sub>OUT</sub> ≤ 1.5A, (V <sub>IN</sub> - V <sub>OUT</sub> ) = 3V, T <sub>J</sub> = 25°C
	0.05		0.3		0.3		0 ≤ I <sub>OUT</sub> ≤ 1.5A, V <sub>IN</sub> = 7V, T <sub>J</sub> = 125°C (Note 2)
Dropout Voltage	<b>1.1</b>		<b>1.2</b>		1.2	V	ΔV <sub>REF</sub> = 1%, I <sub>OUT</sub> = 1.5A (Note 3), I <sub>OUT</sub> ≤ 1.5A (Note 2)
Current Limit (I <sub>OUT</sub> (MAX))	<b>2.5</b>	<b>1.7</b>		1.7		A	V <sub>IN</sub> = 7V ≤ 1.5A 1.4V ≤ (V <sub>IN</sub> - V <sub>OUT</sub> ) (Note 3)
Long Term Stability	0.3 (Note 2)		1		1	%	T <sub>A</sub> = 125°C, 1000 Hrs.
Thermal Regulation (ΔV <sub>OUT</sub> (PWR))	0.01		0.020		0.020	%/W	T <sub>A</sub> = 25°C, 20ms pulse
Temperature Stability (ΔV <sub>OUT</sub> (T))	0.25					%	
Output Noise, RMS	0.003					%V <sub>O</sub>	10Hz to 10kHz, T <sub>A</sub> = 25°C
Thermal Resistance	3.0		3.0		3.0	°C/W	TO-220 Junction to Tab
	60		60		60		Junction to Ambient
	3.0		3.0		3.0		DD Package Junction to Tab
	60		60		60		Junction to Ambient

The **Bold** specifications apply to the over full operating temperature range.

Note 1: Changes in output voltage due to heating effects are covered under the specification for thermal regulation.

Note 2: Fixed version only.

Note 3: Adjustable version only.

## APPLICATION HINTS

The Calogic Semiconductor CLM2815 incorporates protection against over-current faults, reversed load insertion, over temperature operation, and positive and negative transient voltage. However, the use of an output capacitor is required in order to insure the stability and the performances.

### Stability

The output capacitor is part of the regulator's frequency compensation system. Either a 220 $\mu$ F aluminum electrolytic capacitor or a 47 $\mu$ F solid tantalum capacitor between the output terminal and ground guarantees stable operation for all operating conditions.

However, in order to minimize overshoot and undershoot, and therefore optimize the design, please refer to the section 'Ripple Rejection'.

### Ripple Rejection

Ripple rejection can be improved by adding a capacitor between the ADJ pin and ground. When ADJ pin bypassing is used, the value of the output capacitor required increases to its maximum (220 $\mu$ F for an aluminum electrolytic capacitor, or 47 $\mu$ F for a solid tantalum capacitor). If the ADJ pin is not bypass, the value of the output capacitor can be lowered to 100 $\mu$ F for an electrolytic aluminum capacitor or 15 $\mu$ F for a solid tantalum capacitor.

However the value of the ADJ-bypass capacitor should be chosen with respect to the following equation:

$$C = 1 / ( 6.28 \cdot F_R \cdot R_1 )$$

Where C = value of the capacitor in Farads (select an equal or larger standard value),

$F_R$  = ripple frequency in Hz,

$R_1$  = value of resistor  $R_1$  in Ohms.

If an ADJ-bypass capacitor is used, the amplitude of the output ripple will be independent of the output voltage. If an ADJ-bypass capacitor is not used, the output ripple will be proportional to the ratio of the output voltage to the reference voltage:

$$M = V_{OUT} / V_{REF}$$

Where M = multiplier for the ripple seen when the ADJ pin is optimally bypassed.

$V_{REF}$  = Reference Voltage

### Reducing parasitic resistance and inductance

One solution to minimize parasitic resistance and inductance is to connect in parallel capacitors. This arrangement will improve the transient response of the power supply if your system requires rapidly changing current load condition.

### Thermal Consideration

Although the CLM2815 offers some limiting circuitry for overload conditions, it is necessary not to exceed the maximum junction temperature, and therefore to be careful about thermal resistance. The heat flow will follow the lowest resistance path, which is the Junction-to-case thermal resistance. In order to insure the best thermal flow of the component, a proper mounting is required. Note that the case of the device is electrically connected to the output. In case the case has to be electrically isolated, a thermally conductive spacer can be used. However do not forget to consider its contribution to thermal resistance.

Assuming:

$V_{IN} = 10V$ ,  $V_{OUT} = 5V$ ,  $I_{OUT} = 1.5A$ ,  $T_A = 90^\circ C$ ,  $\Theta_{CASE} = 1^\circ C/W$  (no external heat sink, no wind)

Power dissipation under these conditions

$$P_D = (V_{IN} - V_{OUT}) \cdot I_{OUT} = 7.5W$$

Junction Temperature

$$T_J = T_A + P_D \cdot (\Theta_{CASE} + \Theta_{JC})$$

For the Control Section

$$T_J = 90^\circ C + 7.5W \cdot (1^\circ C/W + 0.6^\circ C/W) = 102^\circ C$$

114 $^\circ C$   $T_{JUNCTION\ MAX}$  for the control section.

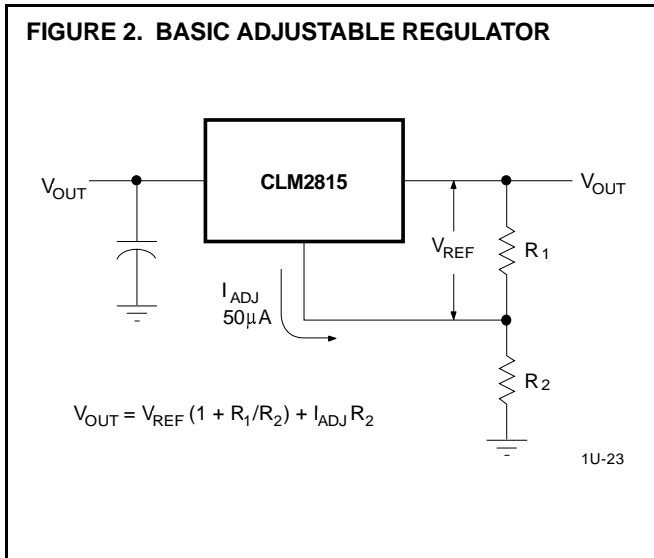
For the Power Section

$$T_J = 90^\circ C + 7.5W \cdot (1^\circ C/W + 1.6^\circ C/W) = 104.5^\circ C$$

109.5 $^\circ C$   $T_{JUNCTION\ MAX}$  for the power transistor.

In both cases reliable operation is insured by adequate junction temperature.

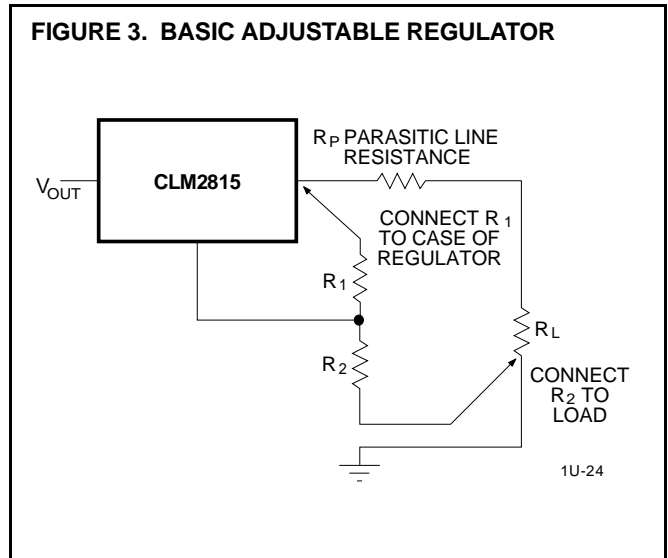
**FIGURE 2. BASIC ADJUSTABLE REGULATOR**



**Output Voltage**

Consider Figure 2. The resistance  $R_1$  generates a constant current flow, normally the specified load current of 10mA. This current will go through the resistance  $R_2$  to set the overall output voltage. The current  $I_{ADJ}$  is very small and constant. Therefore its contribution to the overall output voltage is very small and can generally be ignored.

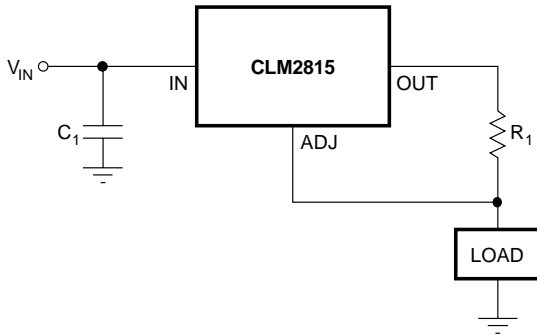
**FIGURE 3. BASIC ADJUSTABLE REGULATOR**



**Load Regulation**

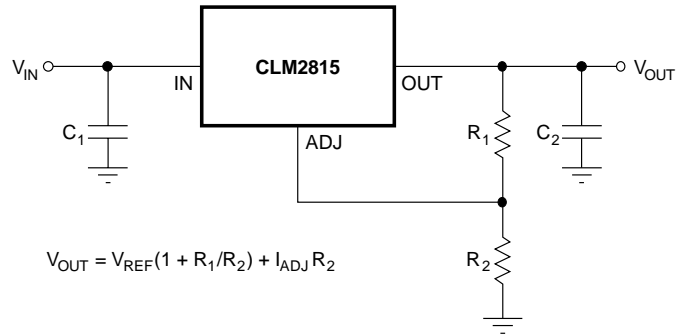
Parasitic line resistance can degrade load regulation. In order not to affect the behavior of the regulator, it is best to connect directly the  $R_1$  resistance from the resistor divider to the case, and not to the load. For the same reason, it is best to connect the resistor  $R_2$  to the Negative side of the load.

**TYPICAL APPLICATIONS**



**1.5A CURRENT OUTPUT REGULATOR**

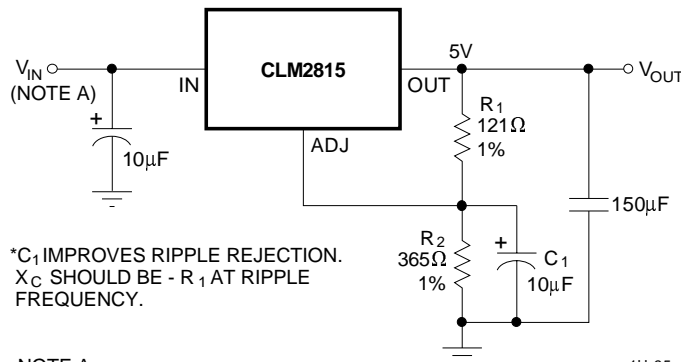
1E-37



$$V_{OUT} = V_{REF}(1 + R_1/R_2) + I_{ADJ}R_2$$

**TYPICAL ADJUSTABLE REGULATOR**

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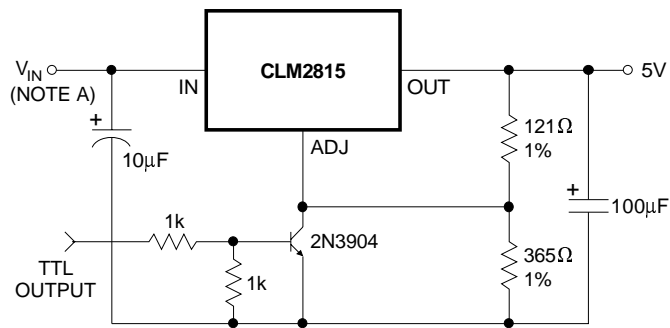


\*C<sub>1</sub> IMPROVES RIPPLE REJECTION.  
X<sub>C</sub> SHOULD BE - R<sub>1</sub> AT RIPPLE  
FREQUENCY.

NOTE A:  
 $V_{IN(MIN)} = (INTENDED V_{OUT}) + (V_{DROPOUT(MAX)})$

1U-25

**IMPROVING RIPPLE REJECTION**

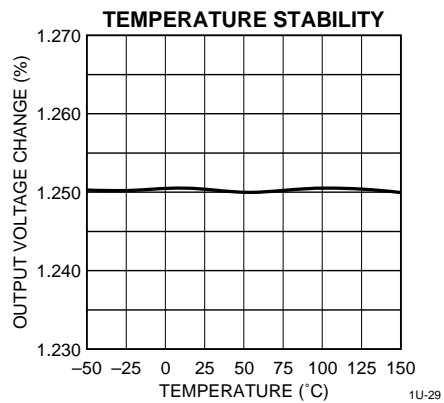
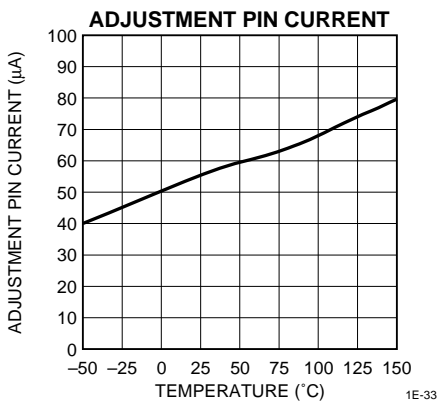
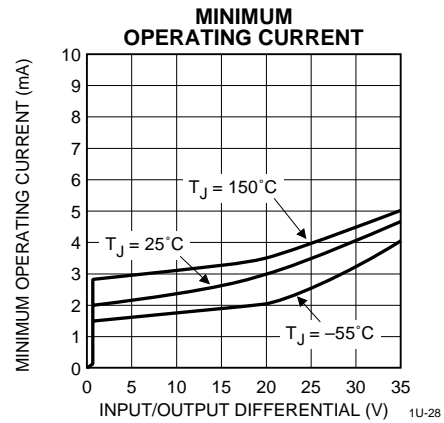
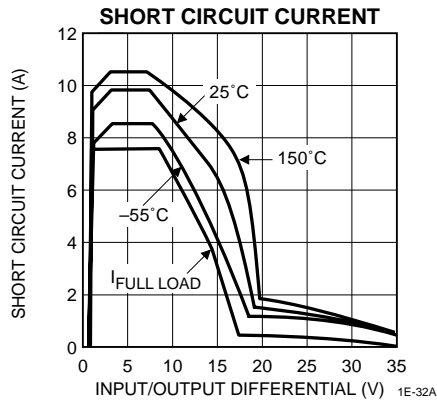
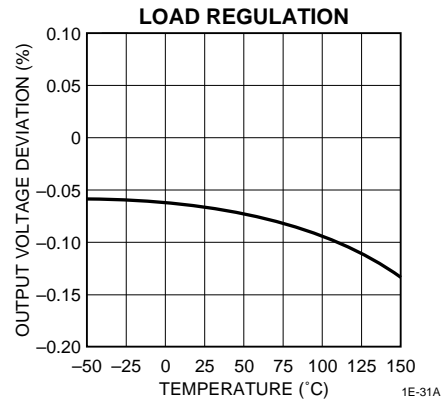
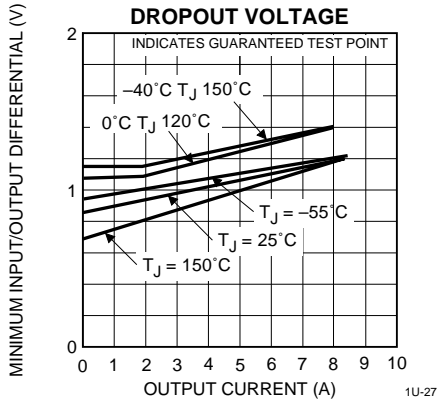


NOTE A:  $V_{IN(MIN)} = (INTENDED V_{OUT}) + (V_{DROPOUT(MAX)})$

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**5V REGULATOR WITH SHUTDOWN**

TYPICAL PERFORMANCE CHARACTERISTICS



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