Calogic CORPORATION

1.5A Low Dropout Voltage Regulator Adjustable & Fixed Output Fast Response

CLM2815

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

CLM2815

3 V_{IN}
2 V_{OUT}
1 $V_{ADJ/GND}$
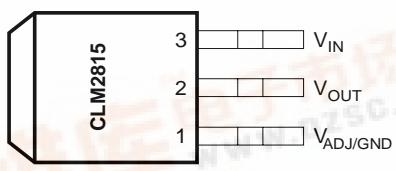
FRONT VIEW   1E-29A

PLASTIC TO-220 PACKAGE

CLM2815

V_{IN}
V_{OUT}
$V_{ADJ/GND}$

FRONT VIEW   1E-30A

CLM2815

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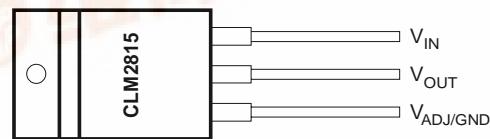
ABSOLUTE MAXIMUM RATINGS

Lead Temp. (Soldering, 10 Seconds) . . . . 300°C
Storage Temperature Range . . . . -65°C to +150°C
Operating Junction Temperature Range
  CLM2815 Control Section . . . . -45°C +125°C
  CLM2815 Power Transistor . . . . -45°C +150°C

Input Voltage 10V
Input to Output Voltage Differential 10V
Maximum Output Current 2A

ELECTRICAL CHARACTERISTICS (Note 1) at I_{OUT} = 10mA, T_A = 25°C, unless otherwise specified.

PARAMETER	TYP	CLM2815A		CLM2815		UNITS	CONDITIONS
		MIN	MAX	MIN	MAX		
1.5V VERSION							
Output Voltage (Note 2)	1.5 **1.5**	1.485 **1.470**	1.515 **1.530**	1.470 **1.455**	1.530 **1.545**	V	CLM2815-1.5V, $0 \le I_{OUT} \le 1.5A$, $2.75V \le V_{IN} \le 7V$
2.5V VERSION							
Output Voltage (Note 2)	2.5 **2.5**	2.475 **2.450**	2.525 **2.550**	2.450 **2.425**	2.550 **2.575**	V	CLM2815-2.5V, $0 \le I_{OUT} \le 1.5A$, $3.5V \le V_{IN} \le 7V$
3.3V VERSION							
Output Voltage (Note 2)	3.3 **3.3**	3.270 **3.240**	3.330 **3.360**	3.230 **3.201**	3.370 **3.399**	V	CLM2815-3.3V, $0 \le I_{OUT} \le 1.5A$, $4.75V \le V_{IN} \le 7V$
5.0V VERSION							
Output Voltage (Note 2)	5.0 **5.0**	4.95 **4.90**	5.05 **5.10**	4.900 **4.850**	5.100 **5.15**0	V	CLM2815-5.0V, $0 \le I_{OUT} \le 1.5A$, $5.5V \le V_{IN} \le 7V$
ALL VOLTAGE OPTIONS							
Reference Voltage (V_{REF})	**1.250**	**1.225**	**1.270**	**1.225**	**1.270**	V	$V_{IN} \le 7V$, $P \le P_{MAX}$ $1.5V \le (V_{IN} - V_{OUT}) \le 5.75V$, $10mA \le I_{OUT} \le I_{OUT} \le 5.75$
Min. Load Current (Note 3)	**5**		**10**		**10**	mA	$1.5V \le (V_{IN} - V_{OUT}) \le 5.75V$
Line Regulation (ΔV_{REF} (I_{IN}))	0.005		0.2		0.2	%	$2.75V \le V_{IN} \le 7V$, I_{OUT} = 10mA, T_J = 125°C (Note 3)
	0.005		0.2		0.2		$V_{IN} \le 7V$, I_{OUT} = 0mA, T_J = 125°C (Note 2)
Load Regulation (ΔV_{REF} (I_{OUT}))	0.05		0.3		0.3	%	$10mA \le I_{OUT} \le 1.5A$, $(V_{IN} - V_{OUT})$ = 3V, T_J = 25°C
	0.05		0.3		0.3		$0 \le I_{OUT} \le 1.5A$, V_{IN} = 7V, T_J = 125°C (Note 2)
Dropout Voltage	**1.1**		**1.2**		1.2	V	ΔV_{REF} = 1%, I_{OUT} = 1.5A (Note 3), $I_{OUT} \le 1.5A$ (Note 2)
Current Limit ($I_{OUT(MAX)}$)	**2.5**	**1.7**		1.7		A	V_{IN} = 7V $\le 1.5A$ $1.4V \le (V_{IN} - V_{OUT})$ (Note 3)
Long Term Stability	0.3 (Note 2)		1		1	%	T_A = 125°C, 1000 Hrs.
Thermal Regulation (ΔV_{OUT} (PWR))	0.01		0.020		0.020	%/W	T_A = 25°C, 20ms pulse
Temperature Stability (ΔV_{OUT} (T))	0.25					%	
Output Noise, RMS	0.003					%V_O	10Hz to 10kHz, T_A = 25°C

Thermal Resistance	3.0
	60
	3.0
	60
			3.0
			60
			3.0
			60
					3.0
					60
					3.0
					60
						°C/W	TO-220 Junction to Tab
							                  Junction to Ambient
							DD Package Junction to Tab
							                  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: Adustable 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 220μF aluminum electrolytic capacitor or a 47μF 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 (220μF for an aluminum electrolytic capacitor, or 47μF for a solid tantalum capacitor). If the ADJ pin is not bypass, the value of the output capacitor can be lowered to 100μF for an electrolytic aluminum capacitor or 15μF 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°C, Θ_{CASE} = 1°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
$T_J = 90^oC + 7.5W \cdot (1^oC/W + 0.6^oC/W) = 102^oC$
114°C $T_{JUNCTION\ MAX}$ for the control section.

For the Power Section
$T_J = 90^oC + 7.5W \cdot (1^oC/W + 1.6^oC/W) = 104.5^oC$
109.5^{o}C $T_{JUNCTION\ MAX}$ for the power transistor.

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

FIGURE 2. BASIC ADJUSTABLE REGULATOR

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

1U-23
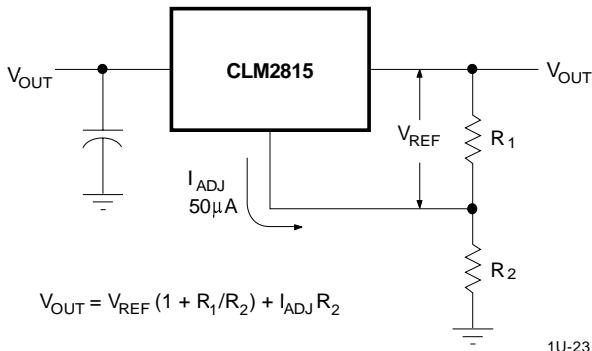
FIGURE 3. BASIC ADJUSTABLE REGULATOR

R_P PARASITIC LINE RESISTANCE

CONNECT R $_1$ TO CASE OF REGULATOR

CONNECT R$_2$ TO LOAD

1U-24
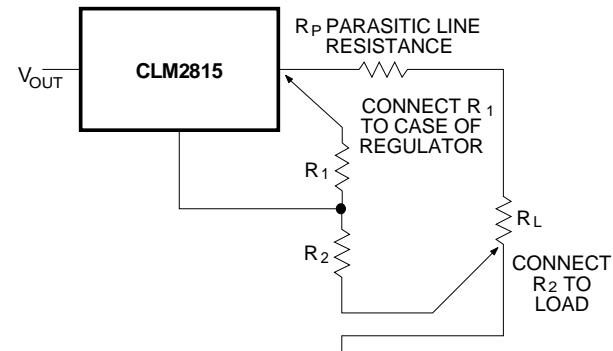
Output Voltage

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.

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.

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TYPICAL APPLICATIONS
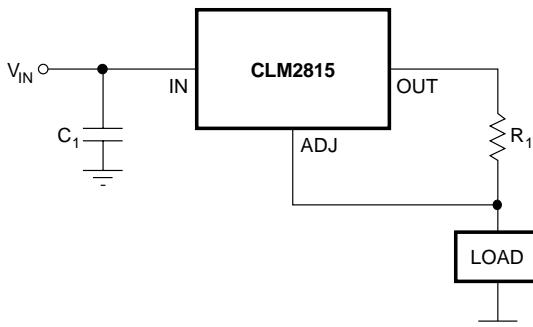
1.5A CURRENT OUTPUT REGULATOR   1E-37
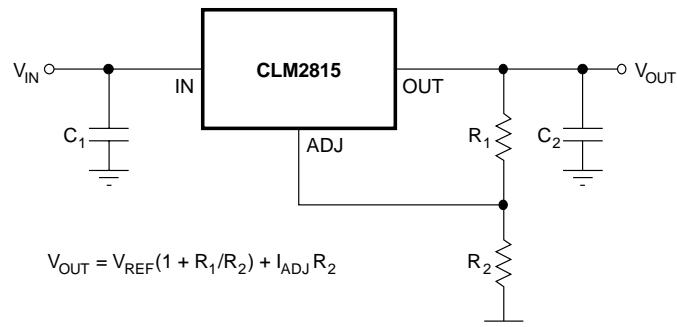
TYPICAL ADJUSTABLE REGULATOR   1E-38

$$V_{OUT} = V_{REF}(1 + R_1/R_2) + I_{ADJ} R_2$$
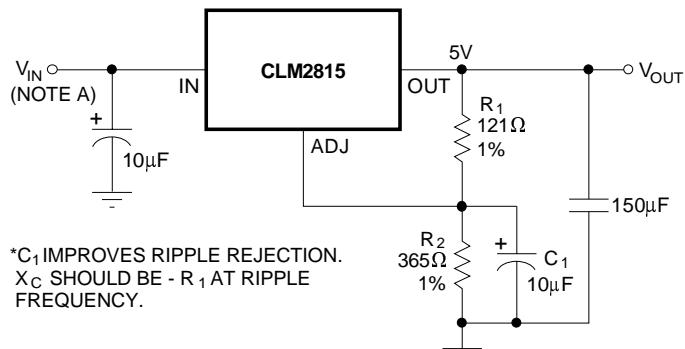
*C_1 IMPROVES RIPPLE REJECTION.
X_C SHOULD BE - R_1 AT RIPPLE
FREQUENCY.

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

1U-25

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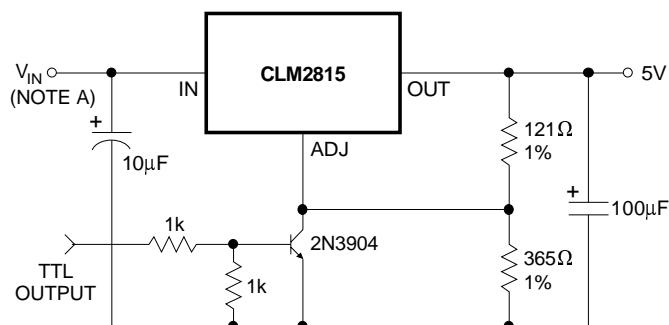
NOTE A: $V_{IN (MIN)} = $ (INTENDED V_{OUT}) + ($V_{DROPOUT (MAX)}$)

1U-26

5V REGULATOR WITH SHUTDOWN

CLM2815

TYPICAL PERFORMANCE CHARACTERISTICS

DROPOUT VOLTAGE

INDICATES GUARANTEED TEST POINT

−40˚C T$_J$ 150˚C

0˚C T$_J$ 120˚C

T$_J$ = −55˚C

T$_J$ = 25˚C

T$_J$ = 150˚C

MINIMUM INPUT/OUTPUT DIFFERENTIAL (V)

OUTPUT CURRENT (A)

1U-27

LOAD REGULATION

OUTPUT VOLTAGE DEVIATION (%)

TEMPERATURE (˚C)

1E-31A

SHORT CIRCUIT CURRENT

25˚C

150˚C

−55˚C

I$_{FULL\ LOAD}$

SHORT CIRCUIT CURRENT (A)

INPUT/OUTPUT DIFFERENTIAL (V)

1E-32A

MINIMUM OPERATING CURRENT

T$_J$ = 150˚C

T$_J$ = 25˚C

T$_J$ = −55˚C

MINIMUM OPERATING CURRENT (mA)

INPUT/OUTPUT DIFFERENTIAL (V)

1U-28

ADJUSTMENT PIN CURRENT

ADJUSTMENT PIN CURRENT (µA)

TEMPERATURE (˚C)

1E-33

TEMPERATURE STABILITY

OUTPUT VOLTAGE CHANGE (%)

TEMPERATURE (˚C)

1U-29