

ALPHA
SEMICONDUCTOR

Excellence in Analog Power Products

AS2820

2.0A Low Dropout Voltage Regulator Adjustable & Fixed Output, Fast Response

FEATURES

- Adjustable Output Down To 1.2V
- Fixed Output Voltages 1.5, 2.5, 3.3, 5.0V
- Output Current Of 2.0A
- 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 LT1085/LT1585

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

The ALPHA Semiconductor AS2820 are low power 2.0A adjustable and fixed voltage regulators that are very easy to use. It requires only 2 external resistors to set the output voltage for adjustable version. The AS2820 are designed for low voltage applications that offers lower dropout voltage and faster transient response. This device is an excellent choice for use in powering low voltage microprocessor that require a lower dropout, faster transient response to regulate from +2.5V to 3.8V supplies and as a post regulator for switching supplies applications. The AS2820 features low dropout of a maximum 1.2 volts.

The AS2820 offers over current limit and full protection against reversed input polarity, reversed load insertion, and positive and negative transient voltage. The I_Q of this device flows into the load, which increases efficiency.

The AS2820 are offered in a 3-pin TO-220, TO-263 & TO-252 packages compatible with other 3 terminal regulators. For a 3A low dropout regulator refer to the AS2830 data sheet.

ORDERING INFORMATION

TO-220 3-PIN	DD PLASTIC 3-PIN	TO-252 DPAK	OPERATING JUNCTION TEMP RANGE
AS2820YU-X	AS2820YT-X	AS2820YR-X	-45 to +125°C

X = Output Voltage (i.e. 1.5 for 1.5V, 2.5 for 2.5V etc.)

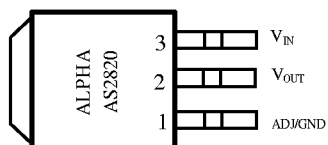
Y = Output Tolerance, Y = A for 1%

Blank for 2%

Consult with factory for other fixed voltages.

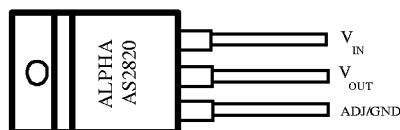
PIN CONNECTIONS

Plastic TO-263 Package



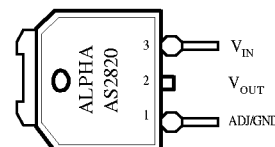
Top View

Plastic TO-220 Package



Front View

TO-252 Package



Front View

ABSOLUTE MAXIMUM RATINGS

Lead Temp. (Soldering, 10 Seconds) 300°C
 Storage Temperature Range -65° to +150°C
 Operating Junction Temperature Range.....
 AS2820 Control Section..... -45°C +125°C
 AS2820 Power Transistor..... -45°C +150°C

Minimum Input Voltage..... 10V
 Input to Output Voltage Differential Max..... 8.8V

ELECTRICAL CHARACTERISTICS (NOTE 1) at $I_{OUT} = 10\text{mA}$, $T_A = 25^\circ\text{C}$, unless otherwise specified.

PARAMETER	CONDITIONS	Typ	AS2820A		AS2820		Units
			Min	Max	Min	Max	
1.5V Version							
Output Voltage (Note 2)	AS2820-1.5V, $0 \leq I_{OUT} \leq 2.0\text{A}$, $2.75\text{V} \leq V_{IN} \leq 10\text{V}$	1.5 1.5	1.485 1.470	1.515 1.530	1.470 1.455	1.530 1.545	V
2.5V Version							
Output Voltage (Note 2)	AS2820-2.5V, $0 \leq I_{OUT} \leq 2.0\text{A}$, $3.5\text{V} \leq V_{IN} \leq 10\text{V}$	2.5 2.5	2.475 2.450	2.525 2.550	2.450 2.425	2.550 2.575	V
3.3V Version							
Output Voltage (Note 2)	AS2820-3.3V, $0 \leq I_{OUT} \leq 2.0\text{A}$, $4.75\text{V} \leq V_{IN} \leq 10\text{V}$	3.3 3.3	3.270 3.240	3.330 3.360	3.230 3.201	3.370 3.399	V
5.0V Version							
Output Voltage (Note 2)	AS2820-5.0V, $0 \leq I_{OUT} \leq 2.0\text{A}$, $5.5\text{V} \leq V_{IN} \leq 10\text{V}$	5.0 5.0	4.95 4.90	5.05 5.10	4.900 4.850	5.100 5.150	V
All Voltage Options							
Reference Voltage (V_{REF})	$V_{IN} \leq 7\text{V}$, $P \leq P_{MAX}$ $1.5\text{V} \leq (V_{IN} - V_{OUT}) \leq (V_{IN} - V_{OUT})_{MAX}$, $10\text{mA} \leq I_{OUT} \leq 2.0\text{A}$	1.250	1.238 1.225	1.263 1.270	1.225 1.212	1.270 1.288	V
Min. Load Current (Note 3)	$1.5\text{V} \leq (V_{IN} - V_{OUT}) \leq (V_{IN} - V_{OUT})_{MAX}$	5		10		10	mA
Line Regulation ($\Delta V_{REF}(V_{IN})$)	$2.75\text{V} \leq V_{IN} \leq 7\text{V}$, $I_{OUT} = 10\text{mA}$, $T_J = 25^\circ\text{C}$ (Note 3)	0.005		0.2		0.2	%
	$V_{IN} \leq 7\text{V}$, $I_{OUT} = 0\text{mA}$, $T_J = 25^\circ\text{C}$ (Note 2)	0.005		0.2		0.2	%
Load Regulation ($\Delta V_{REF}(I_{OUT})$)	$10\text{mA} \leq I_{OUT} \leq 2.0\text{A}$, $(V_{IN} - V_{OUT}) = 3\text{V}$, $T_J = 25^\circ\text{C}$ (Note 3)	0.05		0.3		0.3	%
	$0 \leq I_{OUT} \leq 2.0\text{A}$, $V_{IN} = 7\text{V}$, $T_J = 25^\circ\text{C}$ (Note 2)	0.05		0.3		0.3	%
Dropout Voltage	$\Delta V_{REF} = 1\%$ $I_{OUT} = 2.0\text{A}$ $I_{OUT} \leq 2.0\text{A}$	1.1		1.2		1.2	V
Current Limit $I_{OUT(MAX)}$	$V_{IN} = 7\text{V}$ $1.4\text{V} \leq (V_{IN} - V_{OUT})$ (Note 3)	4.0	3.2		3.2		A
Long Term Stability	$T_A = 125^\circ\text{C}$, 1000 Hrs.	0.3 (Note 2)		1		1	%
Thermal Regulation ($\Delta V_{OUT}(P_{WR})$)	$T_A = 25^\circ\text{C}$, 20 ms pulse	0.01		0.020		0.020	%/W
Temperature Stability ($\Delta V_{OUT}(T)$)		0.25					%
Output Noise, RMS	10Hz to 10kHz $T_A = 25^\circ\text{C}$	0.003					% V_O
Thermal Resistance	TO-220 Junction to Tab	3.0		3.0		3.0	$^\circ\text{C}/\text{W}$
	Junction to Ambient	60		60		60	
	DD Package Junction to Tab	3.0		3.0		3.0	$^\circ\text{C}/\text{W}$
	Junction to Ambient	60		60		60	

The Bold specifications apply to the 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 ALPHA Semiconductor AS2820 incorporates protection against over-current faults, reversed load insertion, over temperature operation, and positive and negative transient voltage. Also AS2820 is inherently a very stable device however, the use of an output capacitor is required in order to improve the stability and the performance.

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 as shown in figure 6. 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:

$$C = 1 / (6.28 * F_R * R_1)$$

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 use, 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 AS2820 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:

$V_{IN} = 10V$, $V_{OUT} = 5V$, $I_{OUT} = 2.0A$, $T_A = 90^\circ C$, $\theta_{CASE} = 1^\circ C/W$ (no external heat sink, no wind)

Power dissipation under these conditions

$$P_D = (V_{IN} - V_{OUT}) * I_{OUT} = 15W$$

Junction Temperature

$$T_J = T_A + P_D * (\theta_{CASE} + \theta_{JC})$$

For the Control Section

$$T_J = 90^\circ C + 15W * (1^\circ C/W + 0.6^\circ C/W) = 114^\circ C$$

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

For the Power Section

$$T_J = 90^\circ C + 15W * (1^\circ C/W + 1.6^\circ C/W) = 129^\circ C$$

$129^\circ C < T_{JUNCTION\ MAX}$ for the power transistor.

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

Basic Adjustable Regulator

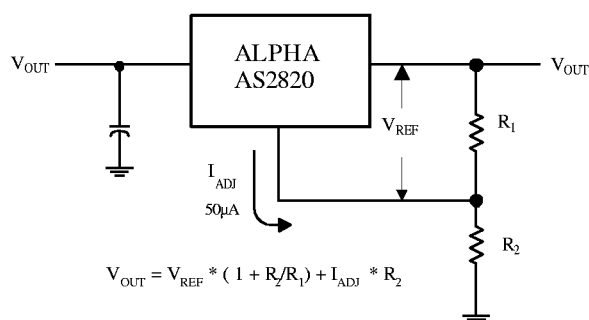


Fig.2 Basic Adjustable Regulator

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.

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.

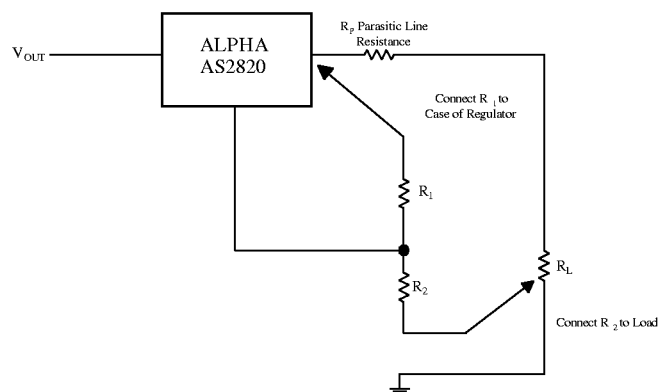
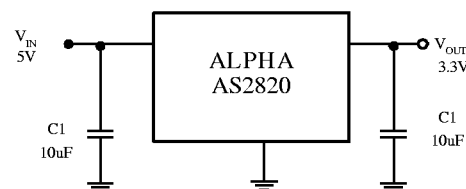


Fig.3 Basic Adjustable Regulator



Basic Fixed Regulator

Output Voltage

The fixed voltage LDO voltage regulators are simple to use regulators since the V_{OUT} is preset to the specifications. It is important however, to provide the proper output capacitance for stability and improvement. For most operating conditions a capacitance of 22µF tantalum or 100µF electrolytic will ensure stability and prevent oscillation.

TYPICAL APPLICATIONS

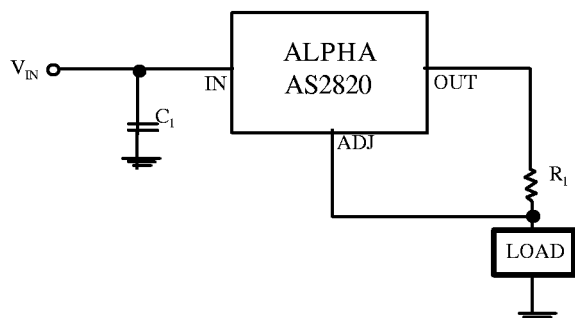
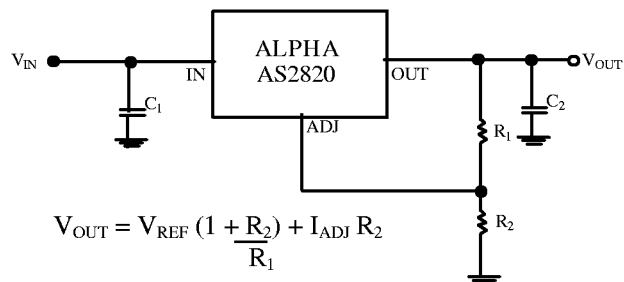
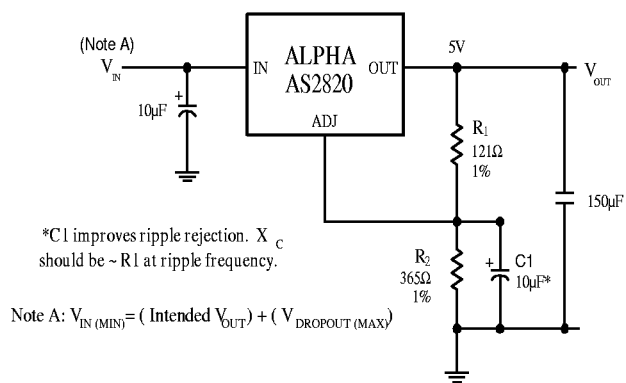


Fig.4 3A Current Output Regulator



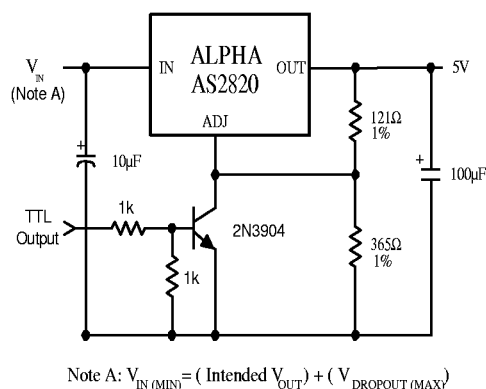
$$V_{OUT} = V_{REF} \left(1 + \frac{R_2}{R_1}\right) + I_{ADJ} R_2$$

Fig 5. Typical Adjustable Regulator



Note A: $V_{IN(MIN)} = (\text{Intended } V_{OUT}) + (V_{DROPOUT(MAX)})$

Fig. 6 Improving Ripple Rejection

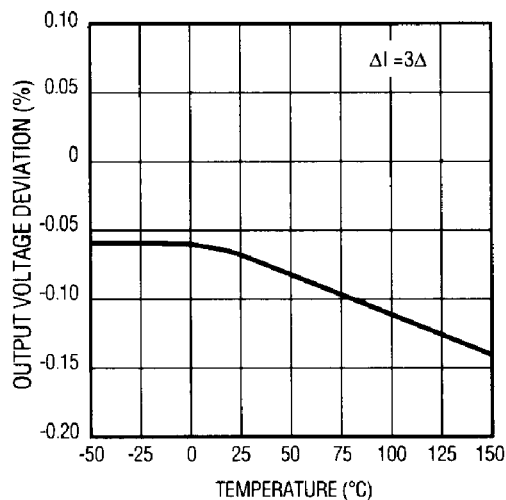


Note A: $V_{IN(MIN)} = (\text{Intended } V_{OUT}) + (V_{DROPOUT(MAX)})$

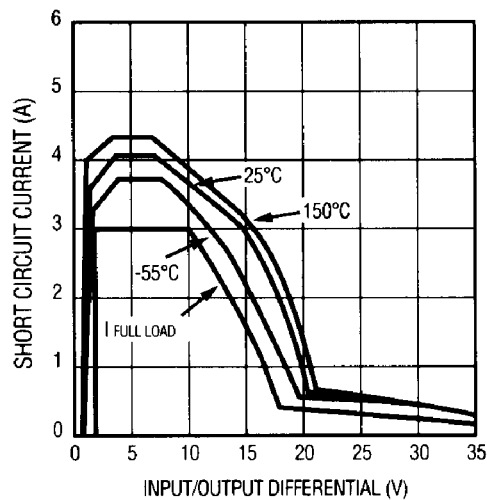
Fig.7 5V Regulator with Shutdown

TYPICAL CHARACTERISTICS

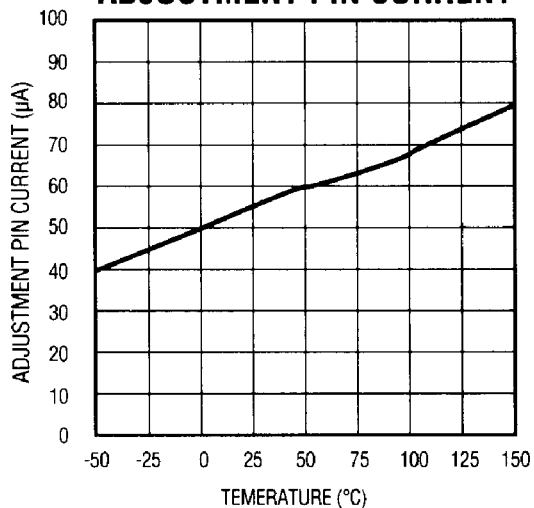
LOAD REGULATION



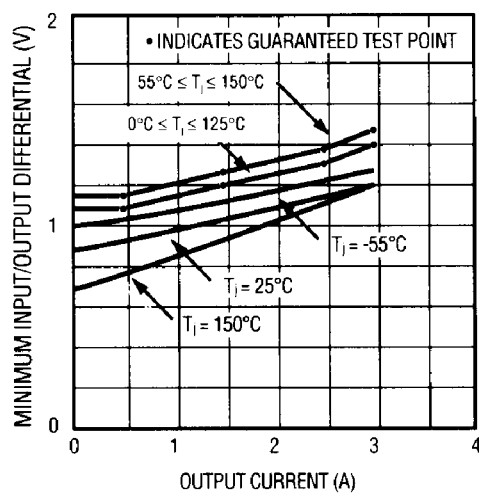
SHORT CIRCUIT CURRENT



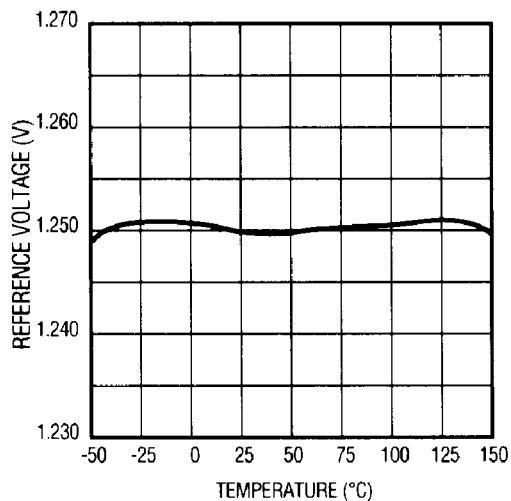
ADJUSTMENT PIN CURRENT



DROPOUT VOLTAGE



TEMPERATURE STABILITY



MINIMUM OPERATING CURRENT

