ALPHA
SEMICONDUCTOR
Excellence in Analog Power Products

AS1581

5A Ultra Low Dropout Voltage Regulator
Fast Response, Adjustable & Fixed

FEATURES
- Low Dropout Voltage 500mV at 5A Full Load Current
- Adjustable Output Down to 1.2V from ATX Power Supply
- Fixed Output Voltages of 3.3V, 2.8V & 2.5V
- Extremely Tight Voltage and Line Regulation
- Standard 5-Terminal Low Cost TO-220 & TO-263

APPLICATIONS
- 3.3V to 2.8V ATX Power Supplies
- 3.3V to 2.9V for Portable PENTIUM™ Processor
- 5V to 3.5V VRE Supply
- High Efficiency "Green" Computer Systems

PRODUCT DESCRIPTION
The Alpha Semiconductor AS1581 is a 5A Low Dropout Regulator with extremely low dropout voltage. The adjustable version requires only two external resistors to set the output voltage. The fixed version has a preset output of 3.3V, 2.8V or 2.5V and does not require any external resistors. The AS1581 features a low dropout of less than 400mV(typ.) and offers fast transient response. This device is suitable for Pentium applications requiring 2.8V or 2.5V from 3.3V ATX power supplies, where a low current input voltage 1V greater than the output voltage is needed. With an external sense pin the load regulation is less than 1mV. This device is an excellent choice for the use in powering low voltage microprocessors that require a lower dropout, fast transient response to regulate from 3.3V and 5V supplies. The AS1581 is also an excellent choice as a post regulator for switching supplies applications.

The AS1581 offers full protection against over-current faults, reversed input polarity, over temperature operation and positive and negative transient voltage.

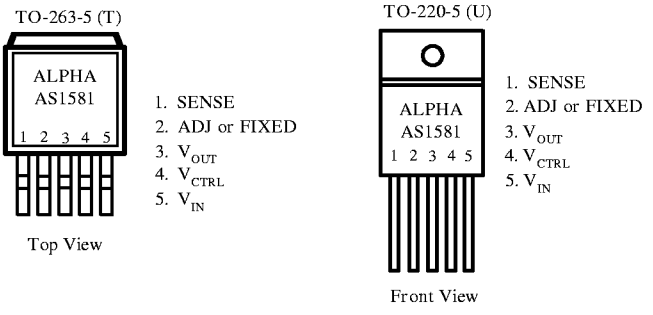
The AS1581 is offered in a 5 pin TO-220 and TO-263 compatible with industry standard 5-terminal regulators. For 7A, 3A and 1.5A ultra low dropout versions refer to AS1580, AS1582 and AS1583 data sheets respectively.

ORDERING INFORMATION

TO-22O 5-PIN	TO-263 5-PIN	OUTPUT
AS1581U	AS1581T	Adjustable
AS1581U-X	AS1581T-X	Fixed

Consult with factory for other fixed output voltages.
X= Output Voltage (3.3V, 2.8V & 2.5V)

PIN CONNECTIONS



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Rev.8/27/99

ABSOLUTE MAXIMUM RATINGS

Power Dissipation ..... Internally Limited
Lead Temp (soldering, 10 seconds) ..... 300°C
Storage Temperature Range ..... -65°C to +150°C
Operating Junction Temperature Range
AS1581 Control Section ..... 0°C to +125°C
AS1581 Power Transistor ..... 0°C to +150°C

Input Supply Voltage 6V
V_{CTRL} Input Voltage 13V

ELECTRICAL CHARACTERISTICS at V_S =14V, Ta=25°C, Io=10mA, C2=100µF, unless otherwise specified. (Note 1)

(Boldface applies over full temperature range).

Parameters	Conditions		AS1581 Min	AS1581 Typ	AS1581 Max	Units
2.5V Version						
Output Voltage	V_{CTRL}=6.0V to 12V, V_{IN}=3.0V to 5.0V, I_O=10mA I_O=10mA to 5A		2.450 2.400	2.500	2.550 2.600	V
2.8V Version						
Output Voltage	V_{CTRL}=6.3V to 12V, V_{IN}=3.3V to 12V, I_O=10mA I_O=10mA to 5A		2.744 2.688	2.800	2.856 2.912	V
3.3V Version						
Output Voltage	V_{CTRL}=6.3V to 12V, V_{IN}=3.3V to 12V, I_O=10mA I_O=10mA to 5A		3.234 3.168	3.300	3.366 3.462	V
All Voltage Options						
Reference Voltage	V_{CTRL}=2.75V, V_{IN}=2.00V, I_O=10mA V_{CTRL}=2.7V to 12V, V_{IN}=2.05V to 5.5V, I_O=10mA to 5A		1.238	1.250	1.263	V
Line Regulation	V_{CTRL}=2.5V to 12V, V_{IN}=1.75V to 5.5V, I_O=10mA V_{ADJ}=0V			1.0	3.0	mV
Load Regulation (Note1)	V_{CTRL}=2.75V, V_{IN}=2.1V, I_O=10mA to 5A,V_{ADJ}=0V			1.0	5.0	mV
Dropout Voltage Minimum V_{CTRL}(Note2) (V_{CTRL} – V_{OUT})	V_{ADJ}=0V V_{IN}=2.05V, I_O=1A			1.10	1.25	V
Dropout Voltage Minimum V_{IN}(Note2) (V_{IN} - V_{OUT})	V_{ADJ}=0V V_{IN}=2.75V, I_O=5A			0.40	0.50	V
Current Limit	V_{CTRL}=2.75V, V_{IN}=2.05V,dV_O=100mV,V_{ADJ}=0V		5.1			A
Minimum Load Current	V_{CTRL}=5V, V_{IN}=3.3V,V_{ADJ}=0V			5	10	mA
Thermal Regulation	30ms Pulse			0.002	0.02	%W
Ripple Rejection	V_{CTRL}=3.75V V_{IN}=3.75V, I_O=2.5A,V_{ADJ}=0V T_J=25, V_{RIPPLE}=1Vpp at 120Hz		60	80		dB
Control Pin Current	V_{ADJ}=0V V_{CTRL} =2.75V, V_{IN}=2.05V, I_O=5A			60	120	mA
Adjustable Pin Current	V_{CTRL}=2.75V, V_{IN}=2.05V,V_{ADJ}=0V I_O=10mA			50	120	µA
Thermal Resistance	TO-220-5	Junction to Case (θ_{JC})			3	°C/W
		Junction to Ambient (θ_{JA})			50	°C/W
	TO-263-5	Junction to Case (θ_{JC})			3	°C/W
		Junction to Ambient (θ_{JA})			60	°C/W

The Bold specifications applying to the over full operating temperature range.

Note 1: Low duty cycle pulse testing with Kelvin connections are required to order to maintain accurate data.

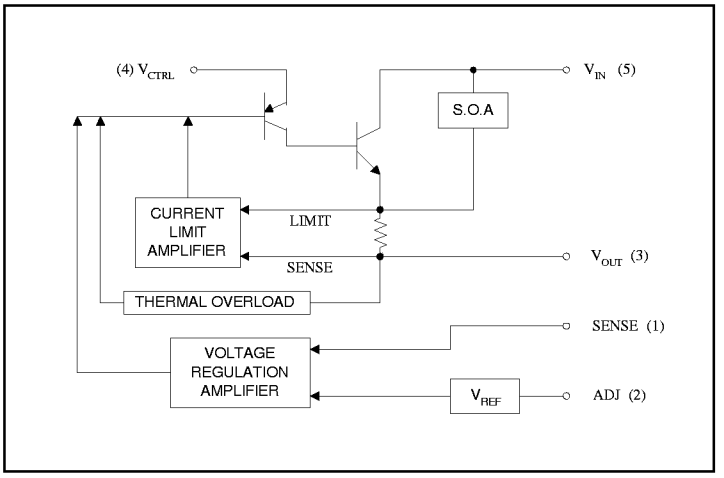
Note 2: Dropout voltage is defined as the minimum differential between V_{IN} and V_{OUT} or V_{CTRL} and V_{OUT} required to maintain regulation at V_{OUT} 99% Nominal V_{OUT}.

Note 3: V_{REF} is measured across the Adjust pin to Sense pin.

PIN DESCRIPTION

1. Sense = Allows Kelvin sense of V_{OUT} at the load. (Positive side of the reference voltage of the device).
1. ADJ = Negative side of the reference voltage for the device. Adding a small bypass capacitor from the ADJ pin to ground will improve the transient response.
1. V_{OUT} = Power output of the device.
4. V_{CTRL} = Supply pin for the control circuitry of the device. The current flow into this pin will be about 1% of the output current. V_{CTRL} must be between 1.0V and 1.3V greater than the output voltage for the device to regulate.
4. V_{IN} = Output load current is supplied through this pin. V_{IN} must be between 0.1V and 0.8V greater than the output voltage for the device to regulate.

BLOCK DIAGRAM



APPLICATIONS NOTES

The AS1581 is designed as a high performance and low cost solution for application requiring a lower dropout than traditional NPN regulators.

The AS1581 uses a separate input voltage V_{CTRL} ($V_{CTRL} \geq V_{OUT}$+ 1.3V) to minimize the dropout voltage. This allows the 2.5V power for the load to come from a 3.3V system supply. As added benefit this will reduce the heat dissipation, and lower heatsink and cooling fan cost. A typical application would use 5V for Vin and 3.3V for V_{CTRL} from a motherboard power supply to provide a nominal 2.5V output. Using the sense pin allows to Kelvin measure the output, reducing resistive-associated errors.

The AS1581 can power the 2.5V core voltage for microprocessors such as Pentium™, P55C™, AMD5k86™ and K6™ and the IBM PowerPC™ 603EV and 604EV processors.

*The reduction of heat dissipation is a result of the increase of the regulator efficiency (efficiency = V_{OUT} / V_{IN}).

Adjustable Regulator Design

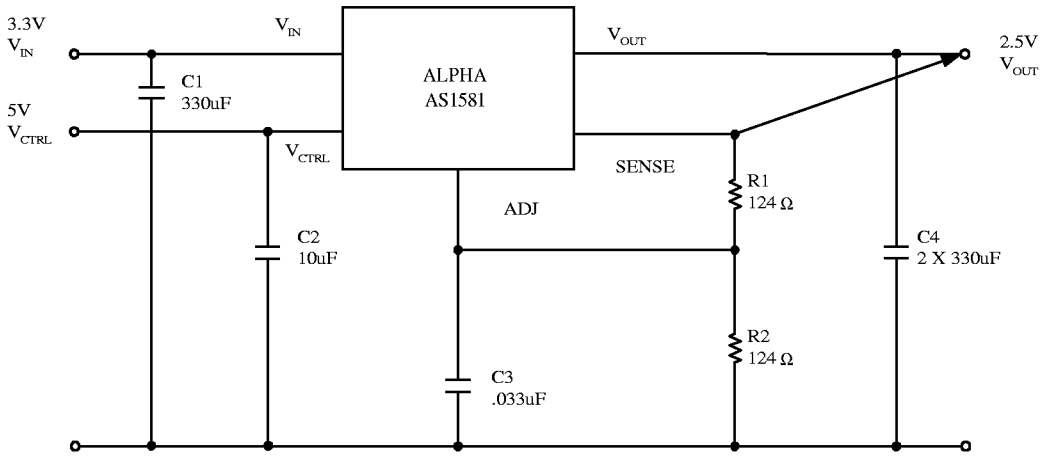
1.25V reference voltage is being developed between the SENSE pin and the ADJ pin of the AS1581. Adding two external resistors (see fig 1.) will allow setting the output voltage from 1.25V to 6V. R_1 is chosen so that this current is specified minimum load current of 10mA. R_2 is given by the formula: $V_{OUT} = V_{REF} (1+ R_2/R_1) + I_{ADJ} (R_2)$. The current flowing from the ADJ pin is typically 50µA. This ADJ pin contributes to the final VOUT but is usually neglected. Connecting the sense pin to the top of the resistor divider will improve load regulation.

Lowering Noise

Using the SENSE pin to Kelvin the load will increase accuracy of the output voltage during load regulation. For the fixed voltage devices, adding a capacitor at the GND pin will improve transient response. This capacitor is chosen in the range of 1µF to 0.1µF and will depend on the amount of output capacitance in the system.

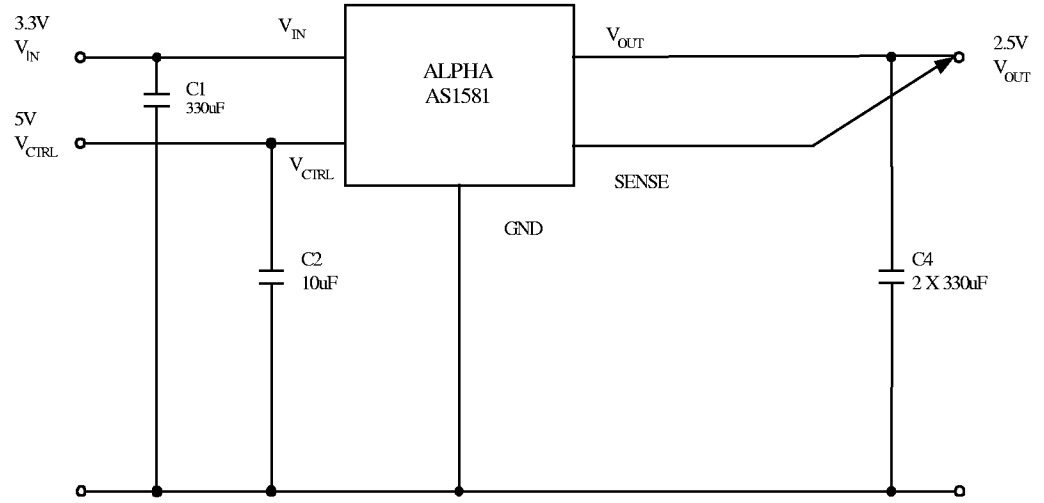
TYPICAL APPLICATION

Fig. 1 Adjustable Regulator



(1) V_{CTRL} needed when $V_{IN} < 5V$.
(2) $V_{OUT} = V_{REF}(1 + R2/R1) + I_{ADJ}R2$.
(3) V_{REF} is measured across adjust to sense.

Fig.2 Typical Fixed Regulator



(1) V_{CTRL} is needed when $V_{IN} < 5V$.