Micro Power 300mA, High PSRR Linear Regulator

General Description

The ASD2303 is a high performance linear regulator with very low dropout voltage and excellent transient response. It is designed to operate with wide input voltage range of 2.2 – 5.5. The device is capable of supplying 300mA of output current with a typical dropout Voltage of 350mV. The product is available in either fixed or adjustable output Voltage.

The linear regulator has been optimized for noise sensitive applications. Connecting a small capacitor from C_{BYP} to ground reduces output self-noise and increases power supply ripple rejection. In addition, the device includes an enable pin for electrical on/off of the regulator. Forcing the enable pin to logic low shuts down the LDO and reduces the supply current to 1µA.

The regulator offers complete short-circuit and thermal protection. The combination of these two internal protection circuits gives the device a comprehensive safety system to safe guard against extreme adverse operating conditions.

The ASD2303 is available in SOT23-5, and it is rated for -40°C to +125°C temperature range.

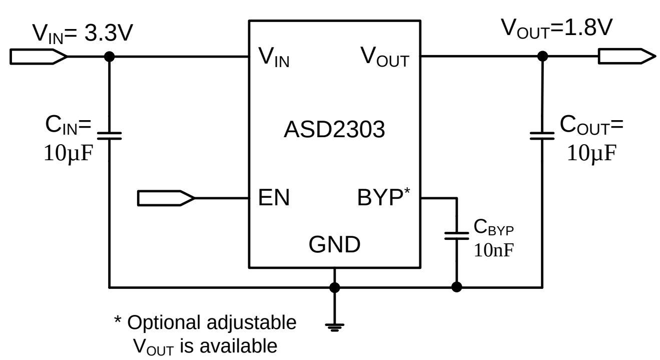
Features

- V_{IN} range: 2.2 – 5.5V
- Adjustable V_{OUT} as low as 0.9V
- 300mA maximum output current
- Low self noise
- 50µA of typical supply current
- 360mV typical dropout voltage @ full load
- Enable (EN) pin for LDO on/off
- Optional Bypass for low high PSRR and output noise
- Stable with Electrolytic, Tantalum or Ceramic capacitors
- Short circuit protection
- Thermal shutdown protection
- -40°C to +125°C temperature range
- Available in SOT23-5 package
- RoHS & WEEE compliant

Applications

- Wireless Communication Equipment
- Car Navigation System
- Power Meters
- PCMIC cards
- Cordless Phones

Typical Application

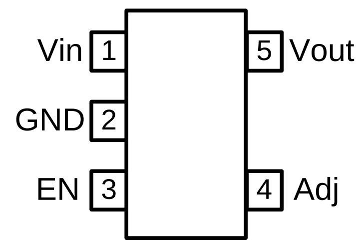


Pin Description

Pin #	Symbol	Description
1	V_{IN}	Input supply pin. Connect a 10μF capacitor between this pin and ground.
2	GND	Ground connection.
3	EN	Enable pin. It controls the electrical on/off of the device. When connected to logic low, the device shuts off and consumes 1μA of current. A logic high will resume normal operation
4	Adj	Feedback Voltage. A resistor network of two resistors is used to set-up the output voltage connected between V_{out} and GND. The center tap of the two resistors is connected to Adj pin.
	BYP	Bypass pin. Connect an external capacitor from BYP to ground to bypass the noise generated by the internal bandgap. This improves power supply rejection ratio and output noise.
5	V_{OUT}	Regulated output Voltage. Connect a 10μF capacitor from this pin to ground.

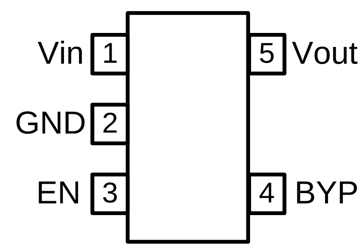
Pin Configuration (Adjustable Option)

SOT23-5 (Top View)



Pin Configuration (Bypass Option)

SOT23-5 (Top View)



Absolute Maximum Ratings [1]

Maximum Input Supply Voltage .... -0.3V to 8.0V
Enable Voltage .... -0.3V to 8.0V
Feedback Voltage (FB) .... GND-0.3V to V_{IN}+0.3V

Recommended Operating Conditions

Input Voltage .... 2.2 to 5.5V
Ambient Operating Temperature .... -40°C to +125°C

Thermal Information [2]

SOT23-5 θ_{JA} .... 300˚C/W
Storage Temperature Range .... -65 to 150˚C
Lead Temperature (soldering 10s) .... 300˚C
Junction Temperature .... -40°C to +125°C

Electrical Characteristics

UNLESS OTHERWISE NOTED:

V_{IN}=5V; V_{OUT}=3.3V; C_{IN}=10µF; C_{OUT}=10µF; C_{FF}=100pF; -40˚C≤T_A=T_J≤85˚C; $T_{J(MAX.)}$= 125°C; TYPICAL VALUES ARE T_A= 25°C

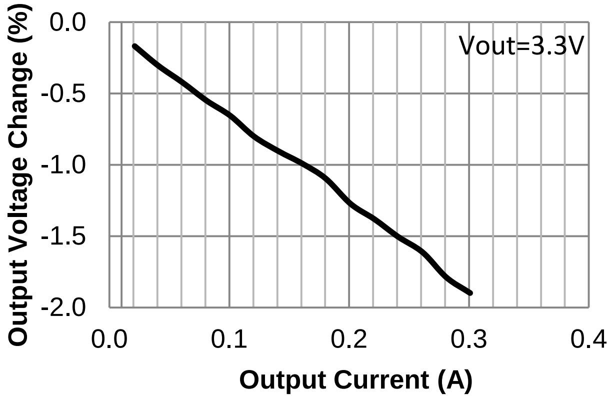
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Output Voltage Range	V_O	Adjustable only	0.9		V_{IN} - V_{DO}	V
Maximum Output Current	I_O		300			mA
Load Regulation[3]		I_{OUT}= 1mA – 200mA		0.5	1.7	%
Line Regulation		V_{IN} = 3.0 – 5.5V; I_{OUT}=10mA	-1.0	0.05	1.0	%
Supply Current	I_Q			50	350	µA
Shutdown current	I_{SHD}	V_{EN}=GND			1.0	µA
Current Limit	I_{LIM}		0.45	0.70		A
Dropout Voltage[3]	V_{DO}	V_{OUT}> 2.8V; I_{OUT}=300mA		300	500	mV
		2.0V<V_{OUT}≤ 2.8V; I_{OUT}= 300mA		450	650	
		V_{OUT}≤ 1.5V; I_{OUT}= 300mA		1300	1600	
Enable startup time	T_{SS}	C_{BYP}=Open; C_{OUT}=10µF; I_{OUT}= 0.03A		60		µs
Feedback Voltage	V_{FB}	I_{OUT}= 1.0 – 200mA	0.873	0.9	0.918	V
Enable Threshold Low	$V_{EN(L)}$				0.4	V
Enable Threshold High	$V_{EN(H)}$		1.6			V
Input Enable Low Current	$I_{EN(L)}$	V_{EN} = 0V		0.1	1.0	µA
Input Enable High Current	$I_{EN(H)}$	V_{EN} =Vin		0.3	1.0	µA
Ripple Rejection Ratio	PSRR	F=100Hz, I_O=0.1A ; C_{BYP}= open		55		dB
Output Noise	e_n	BW= 20 – 100KHz ; Io=10mA ; C_{BYP}= Open		12		µVrms
Thermal Shutdown	T_{SD}			155		˚C
Thermal Shutdown Hysteresis	T_{SD_HYS}			10		˚C

Notes:

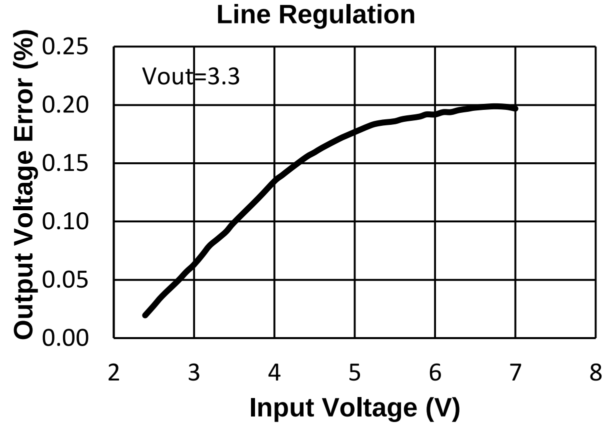
1. Stresses above those listed in Absolute Maximum Ratings may cause permanent damage to the device.
2. Measured on approximately 1" square of 1oz copper
3. The ASD2303 is guaranteed to meet performance specifications over the -40°C to +125°C operating temperature range and is assured by design, characterization, and correlation with statistical process control.
4. Load regulation is measured using pulse techniques with duty cycle <5%.

Typical Characteristics

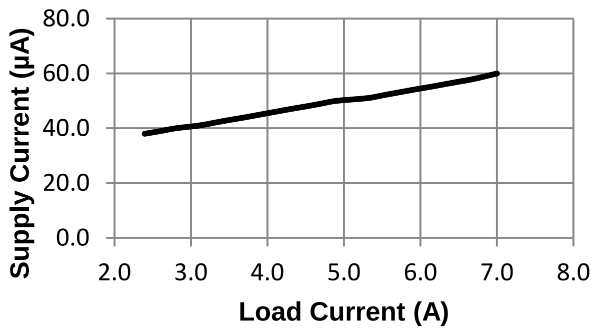
Load Regulation



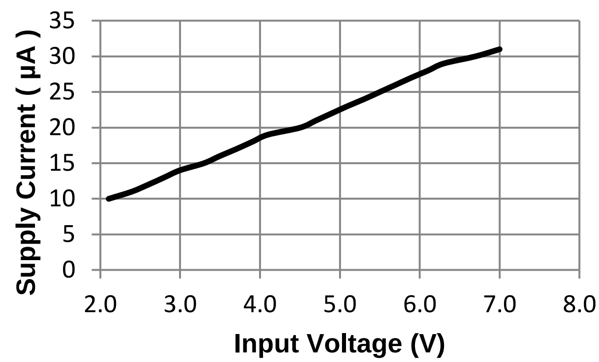
Line Regulation



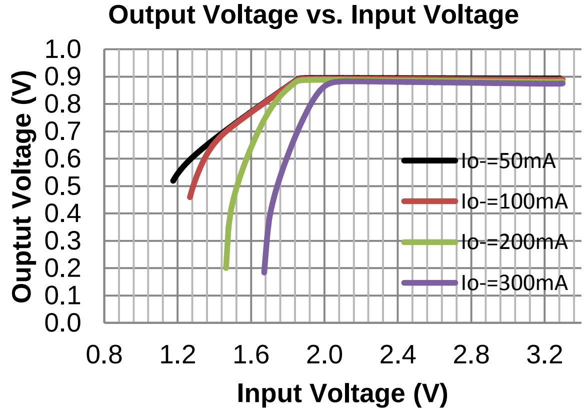
Supply Current vs. Load Current
Vo=Vfb



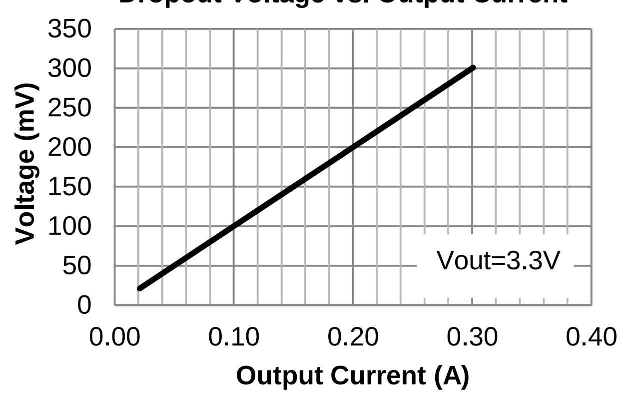
Shutdown Current vs. Input Voltage



Output Voltage vs. Input Voltage

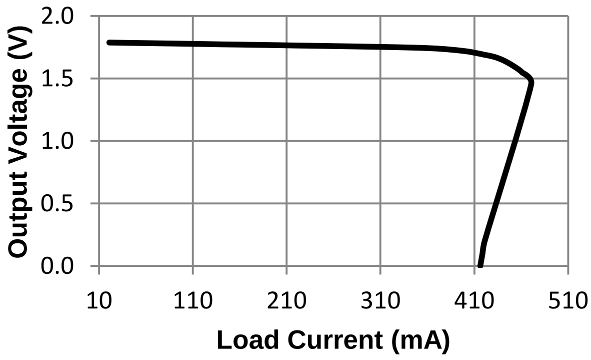


Dropout Voltage vs. Output Current

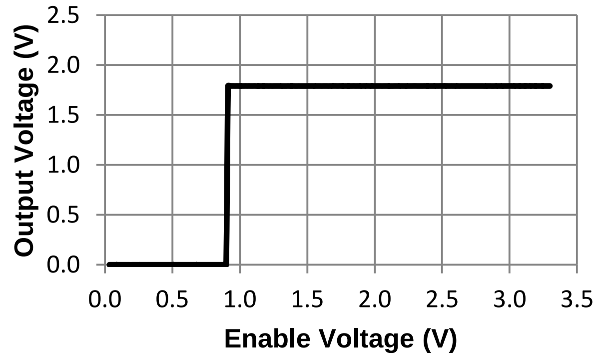


Typical Characteristics

Output Voltage vs. Load Current

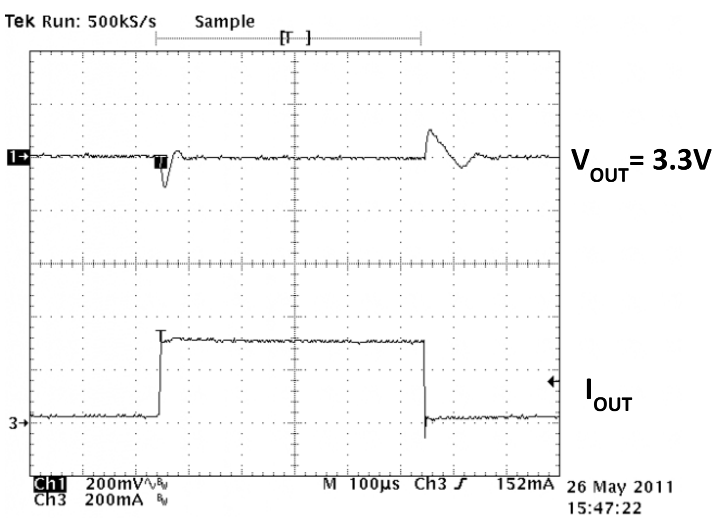


Output Voltage vs. Enable Voltage



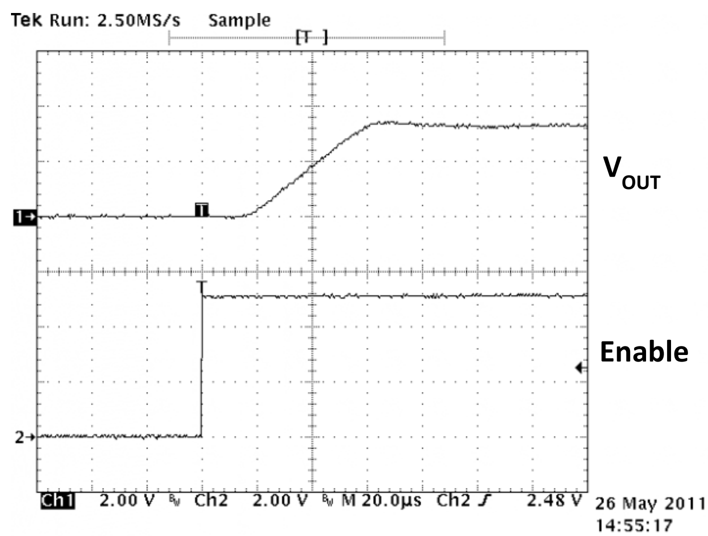
Transient Response

V_{IN}=5V; V_{OUT}=3.3V (adj); Load Step= 0.27A; C_{IN}=10μF; C_{OUT}=20μF;C_{FF}=300pF; C_{BYP}=N/A

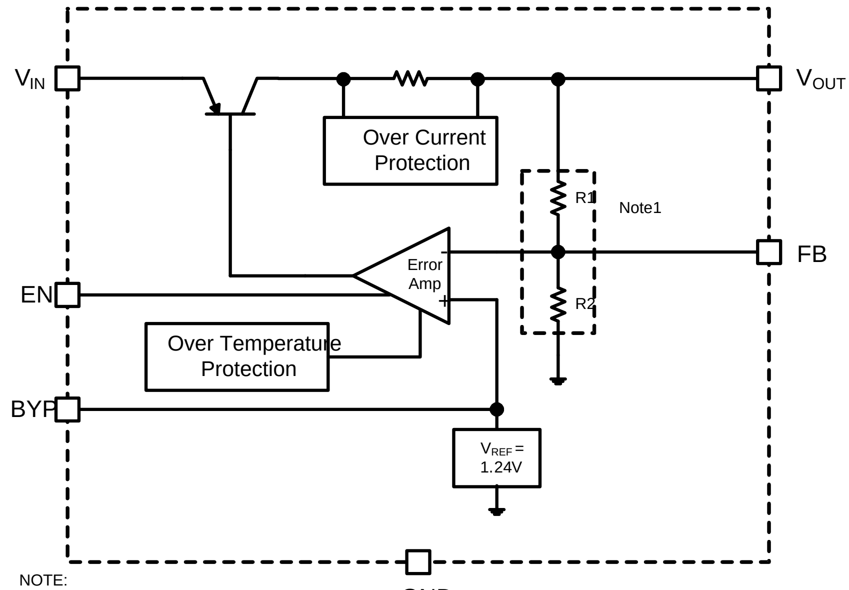


Enable Startup

V_{IN}=5V; V_{OUT}=3.3V (adj); Load Step= 30mA; C_{IN}=10μF; C_{OUT}=10μF;C_{FF}=100pF; C_{BYP}=N/A



Functional Block Diagram



NOTE:
1. For fixed Voltage option, R_1 & R_2 are integrated.

Application Hints

Input Capacitor (C_{IN})

An Input capacitor may be required when the device is not near the source power supply or when supplied by a battery. This capacitor will reduce the circuit's sensitivity when powered from complex source impedance and significantly enhance the output transient response. The input bypass should be mounted with the short possible track directly across the regulator's input and ground terminals. A 10µF ceramic capacitor should be adequate for most applications.

Output Capacitor (C_{OUT})

The output capacitor provides not only stability to the regulator, but also, enhances the load transient response. A minimum capacitance of 10µF is required. When selecting a ceramic capacitor, only X5R and X7R dielectric types should be used. Other types such as Z5U and Y5F have such severe loss of capacitance due to effects of temperature variation and applied voltage, they may provide as little as 20% of rated capacitance in many typical applications.

Always consult capacitor manufacturer's data curves before selecting a capacitor. High-quality ceramic capacitors can be obtained from Taiyo-Yuden, AVX, and Murata. Higher values of the output capacitance can be used to enhance loop stability and transient response.

The value of the output capacitor can be increased without limit. Higher capacitance values help to improve transient response and ripple rejection and reduce output noise.

Output Voltage

The adjustable output voltage option allows the user to select an output voltage by using an external resistor divider. ASD2303 uses a 0.9V reference voltage at the positive terminal of the error amplifier. To set the output voltage a programming resistor from the adjust pin (ADJ) to ground must be selected. A 10kΩ resistor is a good selection for a programming resistor R2. A higher value may result in an excessively sensitive feedback node while a lower value will draw more current and degrade the light load efficiency. The equation for selecting the voltage specific resistor is:

$$V_O = \left(1 + \frac{R1}{R2}\right) * V_{FB}$$

For the fixed output devices, R1 and R2 are included within the device.

Enable

The enable (EN) pin is active high and is compatible with standard digital signaling levels. When V_{EN} below 0.4V, it turns the regulator off while V_{EN} above 1.6V turns the regulator on. If not used, EN can be connected to the input Voltage. If EN is connected to V_{IN}, it should be connected as close as possible to the largest capacitance on the input to prevent voltage droops on that line from triggering the enable circuit.

Bypass

Connecting a capacitor between the BYP pin and ground can significantly reduce output noise. Values can range from 0pF to 10nF, depending on the sensitivity to output noise in the application. The start up speed of the ASD2303 is inversely proportional to the size of the bypass capacitor. Applications requiring a slow ramp-up of output voltage should consider larger values of bypass capacitance. Likewise, if rapid turn on is necessary, consider omitting C_{BYP}.

Thermal Consideration

The ASD2303 is designed to provide 300mA of continuous current in a very small package. Maximum power dissipation can be calculated based on the output current and the voltage drop across the part. To determine the maximum power dissipation of the package, use the junction-to-ambient thermal resistance of the device and the following basic equation:

$$P_{D(\max)} = \left(\frac{T_{J(\max)} - T_A}{\theta_{JA}} \right)$$

Where TJ(max) is the maximum junction temperature of the die, TA is the ambient operating temperature, and θJA is layout dependent. The actual power dissipation of the regulator circuit can be determined using the equation:

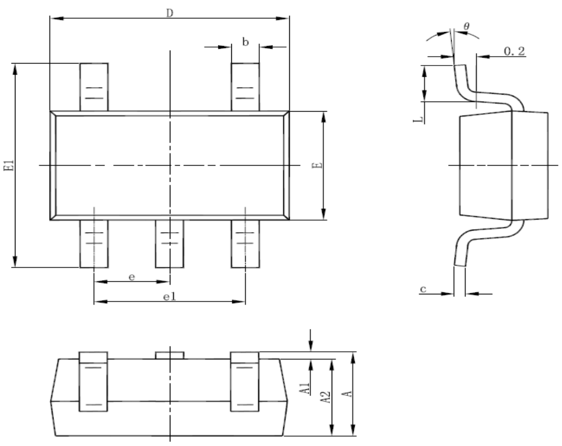
$$P_D = (V_{IN} - V_{OUT}) * I_{OUT} + V_{IN} * I_{SUP}$$

Substituting PD(max) for PD and solving for the operating conditions that are critical to the application will give the maximum operating conditions for the regulator circuit.

Ordering Information

Device	Package	Output Voltage	Packing Method & Quantity
ASD2303M5	SOT23-5L	Adjustable	2500 Tape & Reel
ASD2303M5-1.8V	SOT23-5L	1.8V	2500 Tape & Reel
ASD2303M5-3.3V	SOT23-5L	3.3V	2500 Tape & Reel

Outline Drawing and Landing Pattern – SOT23-5



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°