PS22924

12V, 2A Fast Transient Response Linear Regulator
Preliminary

Data Sheet 292205 issue 1

Features

- V_{IN} Range 1.7 – 12V
- Fixed and adjustable output voltage
- 2A maximum output current
- 350mV typical dropout voltage
- Bypass output for low PSRR and output noise
- Power Good pin with 500µs delay
- Low self noise
- Shutdown mode for longer battery life
- High PSRR typically 60dB at 100Hz
- Stable with a wide range of Ceramic, Tantalum or Electrolytic capacitors
- Current limit protection
- Thermal Shutdown
- -40℃ to 125℃ temperature range
- Available in SOIC-8 package

Applications

- Set Top Boxes
- Digital Audio systems
- DSP
- POL regulators
- SMPS post regulator

Description

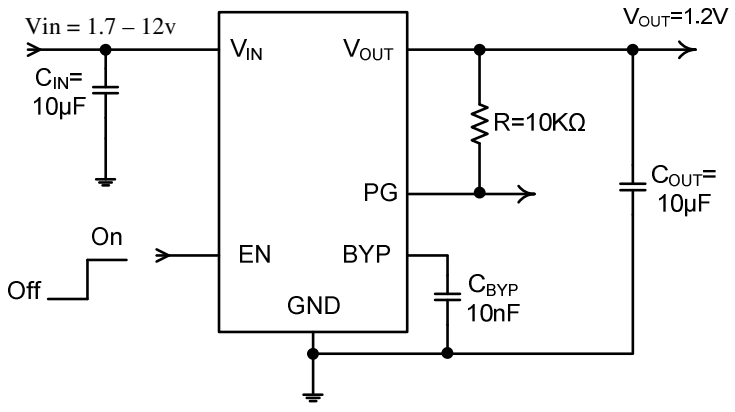
The PS22924 is a high performance, precision linear regulator with very low dropout voltage and excellent transient response. It is designed to operate with wide input voltage range of 1.7 – 12 Volts making it ideal for two step conversion. The device is capable of supplying 2A of output current with a typical dropout voltage of 350mV. The output Voltage is available in either fixed or adjustable options. For fixed option, the internal resistor network can be set in 100mV increment ranging from 0.5 to 5.0 volts.

The product 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 below 1µA. The PS22924 features fast transient response and low self output noise. Connecting a capacitor form ByPass to GND further enhances the PSRR and the output noise.

An open collector power good flag with 500µs delay is available for systems requiring supply monitoring and sequencing of other supplies. The regulator features the full suite of protection with a combination of current limit and thermal overload protection.

The PS22924 is available in a thermally enhanced SOIC-8 EDP packages, and it is rated for -40℃ to +125℃ junction temperature range.

Typical Application



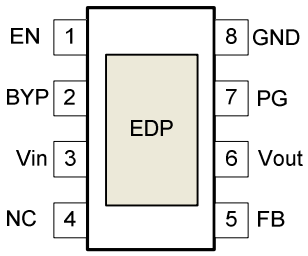
Pin Description

Symbol	Pin Number	Description
EN	1	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. Logic high will resume normal operation.
ByPass	2	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. A minimum capacitor of 220pF is recommended.
V_{IN}	3	Input supply pin. Connect a 10µF capacitor between this pin and ground.
NC	4	No connect.
FB	5	Feedback Voltage. For preset Vout devices an on-chip resistor network of two resistors is used to set-up the output voltage. In this case FB needs to be connected externally to Vout. For adjustable Vout devices the centre of an external resistive chain needs to be connected to this FB pin.
V_{OUT}	6	Regulated output Voltage. Connect a 10µF capacitor from this pin to ground.
PG	7	Power good. It is an open collector, active high output that indicates the status of the output voltage. When output voltage (V_{OUT}) exceeds the PG trip threshold, the PG pin goes in to a high impedance state. When the device is out of regulation or shutdown, the PG pin is pulled low. A 10KΩ to 1MΩ resistor should be connected from PG to V_{OUT}.
GND	8	Ground connection.
	EDP	Expose pad. Connected to PCB ground plane for good thermal dissipation.

NB: N/A = Not available in the shown package type

Pin Configuration

SOIC-8 (Top View)



Absolute Maximum Ratings (1)

Maximum Input Supply Voltage…….....…… -0.8 to 15V
Enable Voltage……..... -0.8 to 15V
Power Good……..... -0.8 to 15V
Feedback Voltage……..... -0.8 to 5V
ByPass Voltage……. -0.8 to 5V

Recommended Operating Conditions

Input Voltage…….…….. 1.7 to 12V
Enable input Voltage…….…….. 0V to V_{IN}
Junction Operating Temperature……..…… -40˚C to 125˚C

Thermal Information (2)

SOIC-8[1] θ_{JA}.....36˚C/W
Storage Temperature Range……..... -65 to 150˚C
Lead Temperature……..…….…… 260˚C
Junction Temperature…….…….... -40 to 125˚C

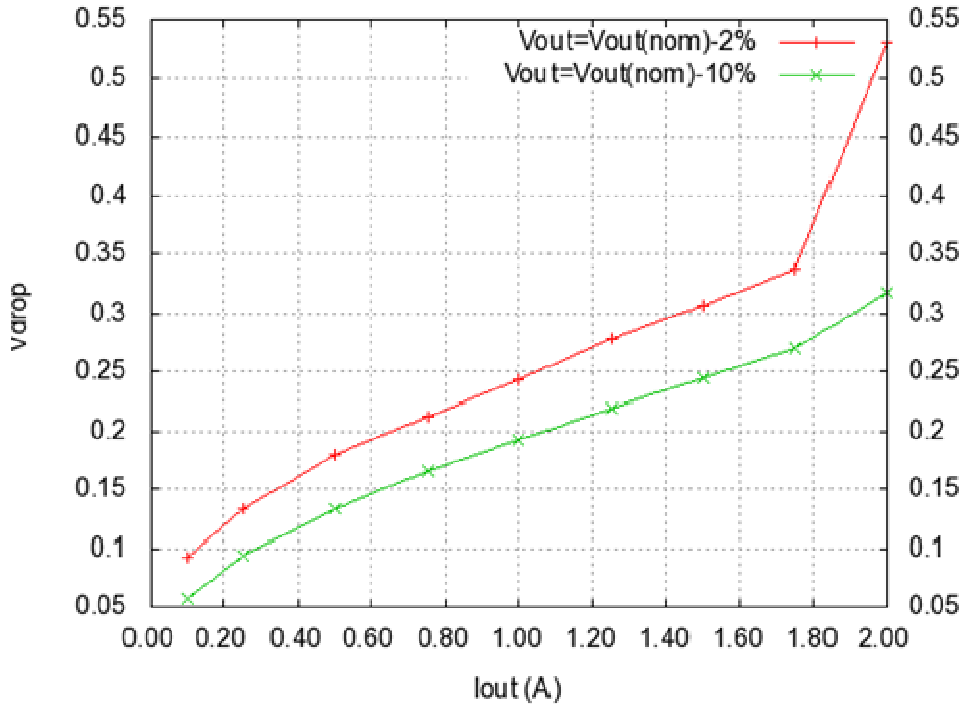
ELECTRICAL CHARACTERISTICS

Unless otherwise noted: V_{IN}=5.0V; V_O=3.3V; C_{IN}=C_{OUT}=22µF; -40˚C to $T_{J(MAX.)}$= 125°C; Typical values are T_A= 25°C

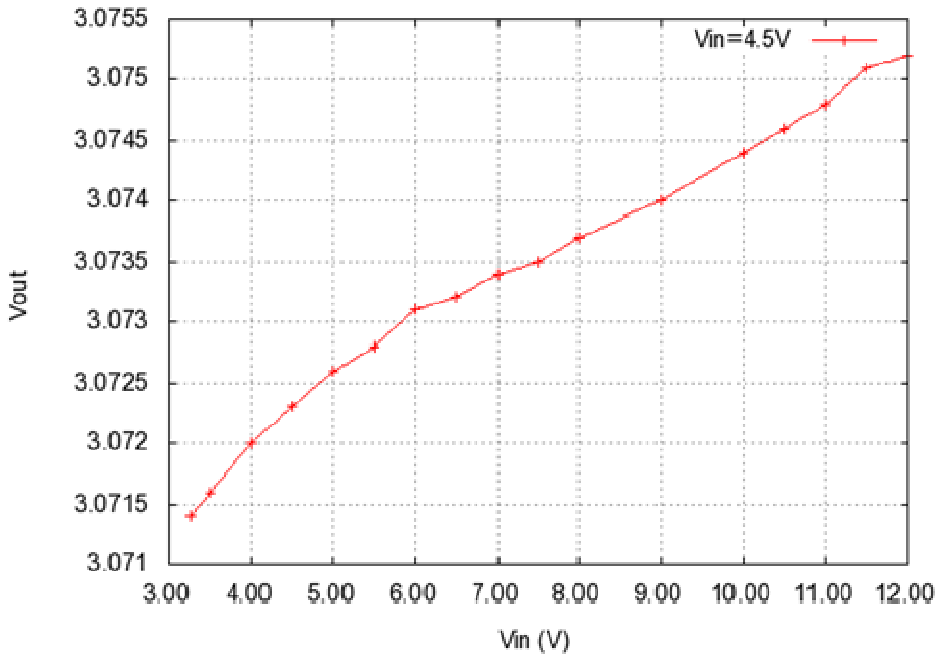
Parameter	Symbol	Conditions		Min.	Typ.	Max.	Units
Output Voltage Range	V_O	Fixed option; 100mV increment		0.5		5.0	V
		Adjustable		0.5		V_O+V_{DO}	
Output Voltage Tolerance					TBD		%
Feedback Voltage	V_{FB}			0.494	0.50	0.506	V
Maximum Output Current	I_O			2			A
Shutdown current	I_{SHD}	V_{EN}=GND			0.1	1.0	µA
Current Limit	I_{LIM}			2.2		3.2	A
Supply Current	I_Q	I_{OUT}= 2A				TBD	mA
Load Regulation[3]		I_{OUT}= 0.1mA – 2A		-1.0		1.0	%
Line Regulation		V_{IN}= Vo+1V to 12V; I_{OUT}=10mA		-0.5		0.5	%
Dropout Voltage	V_{DO}	I_{OUT}= 1A				TBD	mV
		I_{OUT}= 1.5A				TBD	
		I_{OUT}= 2A				TBD	
Enable Threshold Low	$V_{EN(L)}$					0.8	V
Enable Threshold High	$V_{EN(H)}$			1.4			V
Input Enable Low Current	$I_{EN(L)}$	V_{EN} = 0V			0.01	2.0	µA
Input Enable High Current	$I_{EN(H)}$	V_{EN} =2V			5.0	8.0	µA
Ripple Rejection Ratio	PSRR	I_O=50mA	Freq=100Hz		62		dB
			Freq=10KHz		60		
Output Noise	e_n	BW; 10Hz – 100KHz Io=100mA C_{OUT}= 10µF	C_{BYP}= Open		TBD		nV/√Hz
			C_{BYP}=100nF		TBD		
Power good low threshold	V_{OL_PG}	I_{PG}=200µA				400	mV
Power good delay	V_{PG_delay}				500		µs
Thermal Shutdown	T_{SD}				140		˚C
Thermal Shutdown Hys.	T_{SD_HYS}				15		˚C

Notes:

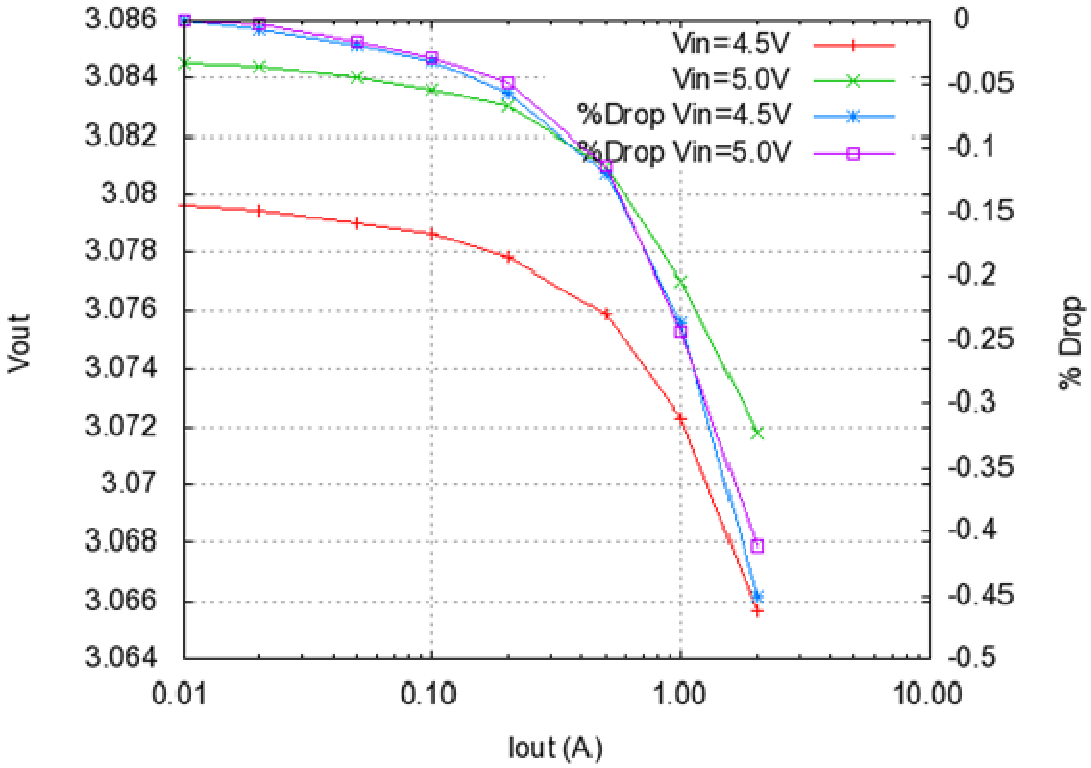
1. Stresses above those listed in Absolute Maximum Ratings may cause permanent damage to the device. Measured on approximately 1” square of 1oz copper.
2. The PS22924 is guaranteed to meet performance specifications over the -40°C to +125°C junction operating temperature range and is assured by design, characterization, and correlation with statistical process control.
3. Load regulation is measured using pulse techniques with duty cycle <5%.



Typical Dropout voltage vs Iout(A)

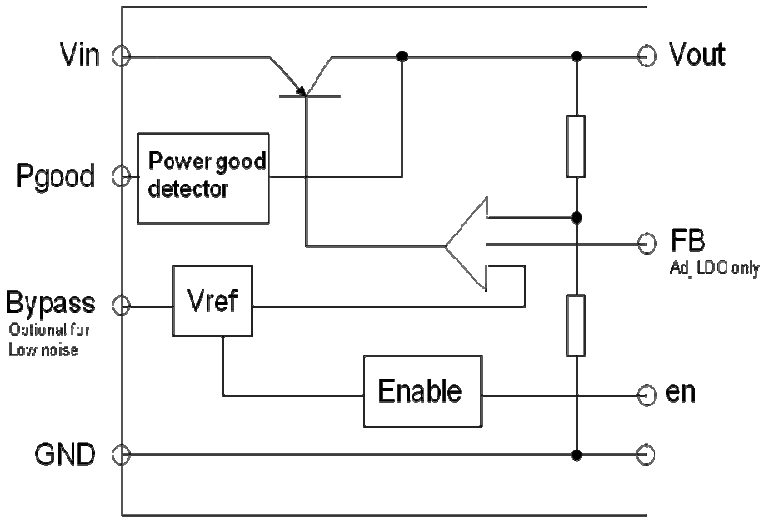


Typical Line regulation vs Vin (V)



Typical Load regulation vs Iout(A)

FUNCTIONAL BLOCK DIAGRAM



APPLICATION HINT

Input Capacitor (C_{IN})

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.

Output Voltage

The adjustable output voltage option allows the user to select an output voltage by using an external resistor divider. PS22924 uses a 0.5V reference voltage at the positive terminal of the error amplifier. To set the output voltage a programming resistor from the feedback pin (FB) 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.

ByPass Capacitor

Connecting a capacitor between the BYP pin and ground can significantly reduce output noise. Values can range from 0pF to 100nF, depending on the sensitivity to output noise in the application. The start up speed of the PS22294 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}.

Enable/Shutdown

The enable (EN) pin is active high and is compatible with standard digital signalling levels. When V_{EN} below 0.8V, it turns the regulator off while V_{EN} above 1.4V 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.

Thermal consideration

The PS22294 is designed to provide 2A 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 $T_{J(max)}$ is the maximum junction temperature of the die, T_A is the ambient operating temperature, and θ_{JA} 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.

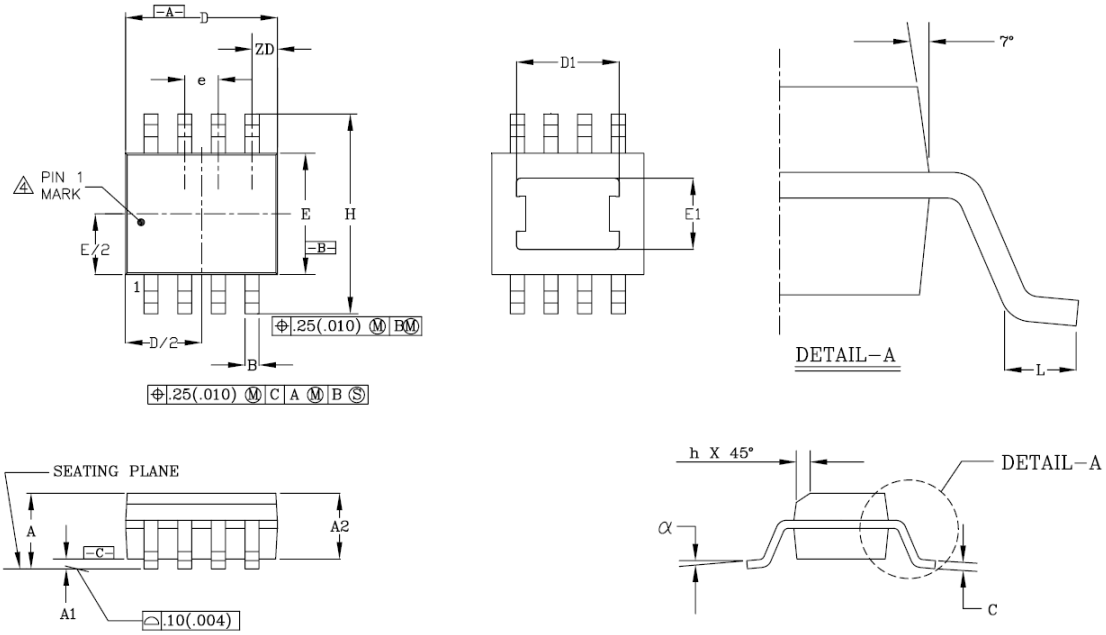
The thermal resistance of the SO8-EDP is 36 (°C/W) junction to Ambient, and 5.5 (°C/W) junction to case.

Ordering Information

Device	Operating Junction Temp.	Package	Output voltage
PS22924C1S4A3	-40°C to +125°C	SOIC-8	Adjustable
PS22924TMS4A3	-40°C to +125°C	SOIC-8	2.5v
PS22924TUS4A3	-40°C to +125°C	SOIC-8	3.3v

N.B For other values of output voltage please contact your local Plessey Semiconductors sales representative

Outline Drawing and Landing Pattern (SOIC-8)



SYMBOL	SOIC-8LD	
	MILLIMETERS	
	MIN	MAX
A1	0.10	0.25
B	0.36	0.46
C	0.19	0.25
D	4.80	4.98
D1	3.20	3.40
E	3.81	3.99
E1	2.19	2.39
e	1.27 BSC	
H	5.80	6.20
h	0.25	0.50
L	0.41	1.27
A	1.52	1.72
α	0°	8°
ZD	0.53 REF	
A2	1.37	1.57

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