



TS9004

300mA CMOS LDO Adjustable Voltage with Enable & Power Good

SOT-26



Pin assignment

- | | |
|-----------|---------------|
| 1. Input | 6. Output |
| 2. Ground | 5. Feedback |
| 3. Enable | 4. Power Good |

Low Drop Out Voltage 0.4V
Adjustable Voltage
Enable Shutdown
Power Good

General Description

The TS9004 is a positive voltage linear regulator developed utilizing CMOS technology featured low quiescent current (30uA typ.), low dropout voltage, and high output voltage accuracy, making them ideal for battery applications. The Chip Enable (CE) includes a CMOS or TTL compatible input allows the output to be turned off to prolong battery life. The TS9004 is included a precision voltage reference, current fold-back, error correction circuit, a current limited output driver, over temperature shutdown, and a "Power Good" detector, which pulls low when the output is out of regulation. This series are offered in 6-pin SOT-26 package.

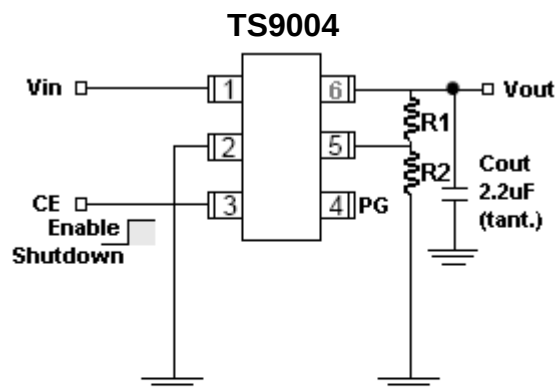
Features

- ✧ Dropout voltage typically 0.4V@Io=300mA (Vo>2.5V)
- ✧ Low power consumption: 30uA (typ.)
- ✧ Output voltage +/-2.5%
- ✧ Internal current limit and thermal shutdown
- ✧ Short circuit current fold-back
- ✧ Power saving shutdown mode
- ✧ Power good output function
- ✧ Adjustable output voltage

Applications

- ✧ Palmtops
- ✧ Video recorders
- ✧ Battery powered equipment
- ✧ PC peripherals
- ✧ High-efficiency linear power supplies
- ✧ Digital signal camera

Typical Application Circuit



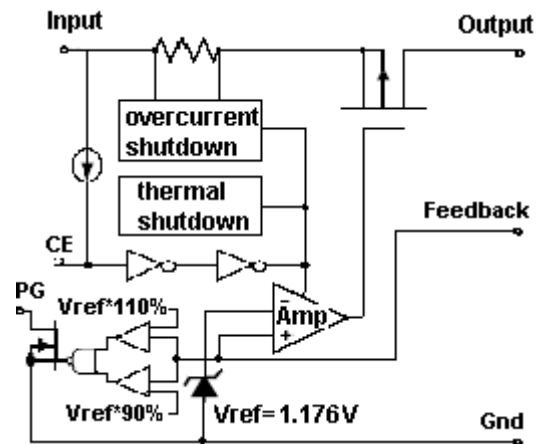
Note: suggest to add a small Cap 100pF between output and connection of R1 and R2 to get less output ripple

$$V_{out} = V_{ref} * (1 + R1 / R2); V_{ref} = 1.176V$$

Ordering Information

Part No.	Operating Temp. (Ambient)	Package
TS9004CX6	-40 ~ +85 °C	SOT-26

Block Diagram



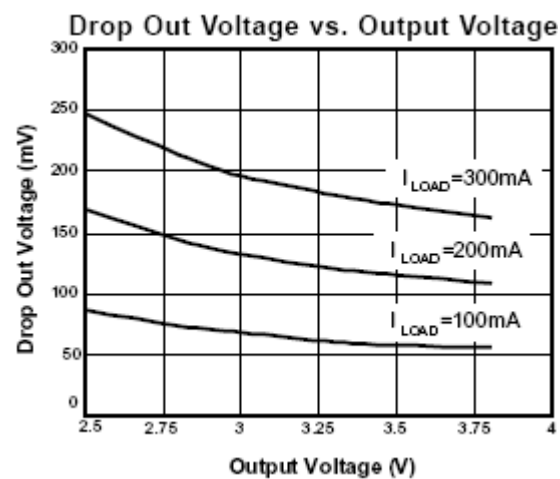
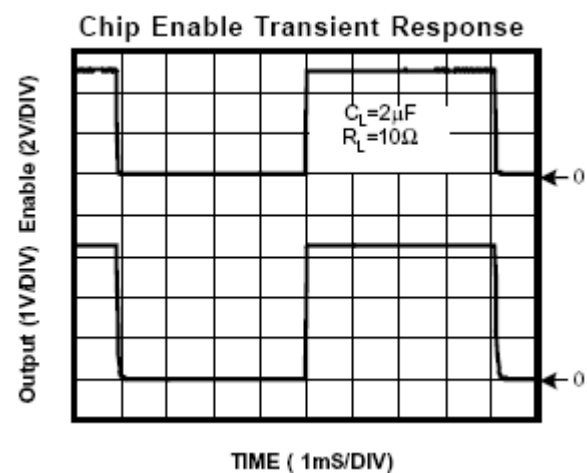
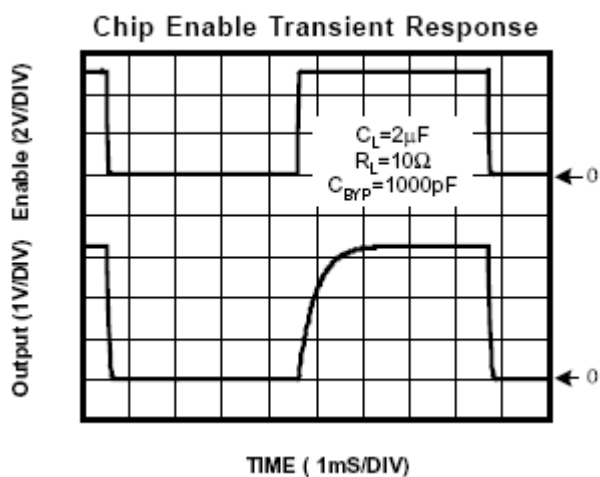
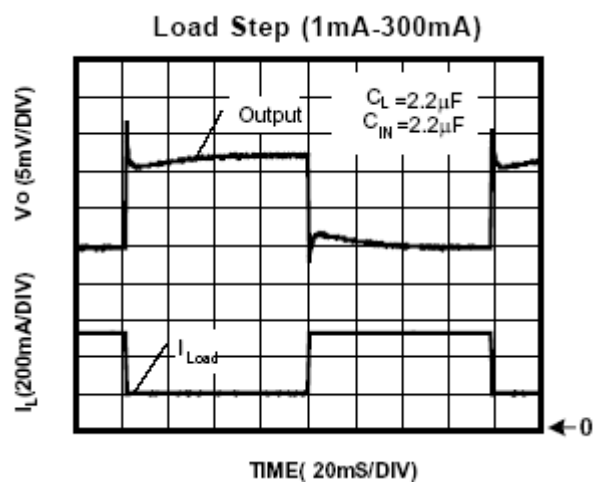
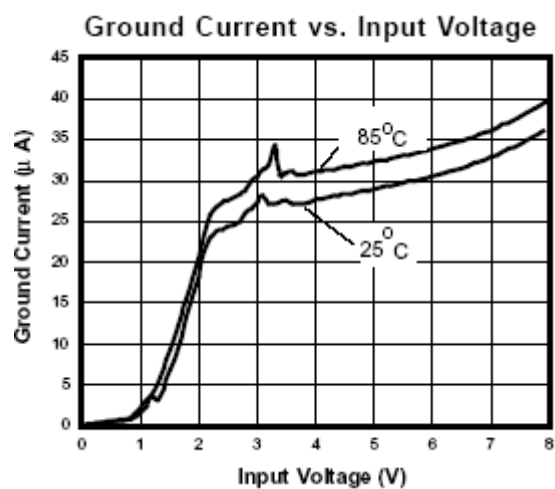


Absolute Maximum Rating							
Input Supply Voltage	Vin		+7		V		
Enable Input Voltage	Vce		Gnd-0.3 ~ Vin+0.3		V		
Output Current	Io		Pd / (Vin – Vout)				
Power Dissipation	PD		Internal Limited (note)				
Thermal Resistance	Θja		260		°C/W		
Operating Ambient Temperature Range	Ta		-40 ~ +85		°C		
Operating Junction Temperature Range	Tj		-40 ~ +125		°C		
Storage Temperature Range	TSTG		-65 ~ +150		°C		
Lead Soldering Temperature (260 °C)			10		S		
ESD Classification	HBM		2k		V		
Caution: Stress above the listed absolute rating may cause permanent damage to the device.							
Note: Pd(max) = [Tj(max) – Ta] / Θja, where Θja depends on the printed circuit layout							
Electrical Characteristics (Ta = 25 °C, Vin= Vin(min), Vce≥2V, unless otherwise specified.)							
Parameter		Conditions		Min	Typ	Max	Unit
Input Voltage				Note 1	--	7	V
Bandgap Reference		Voo= VBG, Io= 10mA		0.99 Vo	1.176	1.01 Vo	V
Vout Temperature Coefficient				--	25	--	ppm/ °C
Maximum Output Current		Vin=Vo+1V,		300	--	--	mA
Output Current Limit		Vout=0V		--	800	--	mA
Short Circuit Current (note 3)		Vout< 0.8V		--	150	--	mA
Line Regulation		Vo+1V ≤Vin≤ Vo+2V, Io= 1mA	Vout≥2.0V	--	--	0.3	%
			Vout<2.0V	--	--	0.1	
Load Regulation		1mA≤IL≤300mA		--	0.2	1.0	%
Dropout Voltage		Io=300mA, Vout=Vo - 2%	Vout≥2.0V	--	300	400	mV
			Vout<2.0V	--	800	1300	
Quiescent Current		Vin≤0.4V (shutdown)		--	2	--	uA
Quiescent Current		Vout≥0.4V, Io=0mA		--	30	35	uA
Ground Pin Current		Io= 1mA ~ 300mA		--	30	35	uA
Power Supply Rejection Ratio		Io=100mA,	At f=1kHz,	--	60	--	dB
			At f=10kHz,	--	50	--	
Over Temperature Shutdown				--	150	--	°C
Output Noise		Io=10mA, f=10Hz~100kHz, Co=2.2uF		--	30	--	uVrms
Enable Input							
Enable Input Logic-High Voltage		Vin= 2.7V to 7V		--	Vin/2+0.8V	Vin	V
Enable Input Logic-Low Voltage		Vin= 2.7V to 7V		0	Vin/2-0.8V	--	V
Enable Input Current		Ven≤ 0.4V		--	--	3	uA
		Ven= Vin		--	--	0.1	

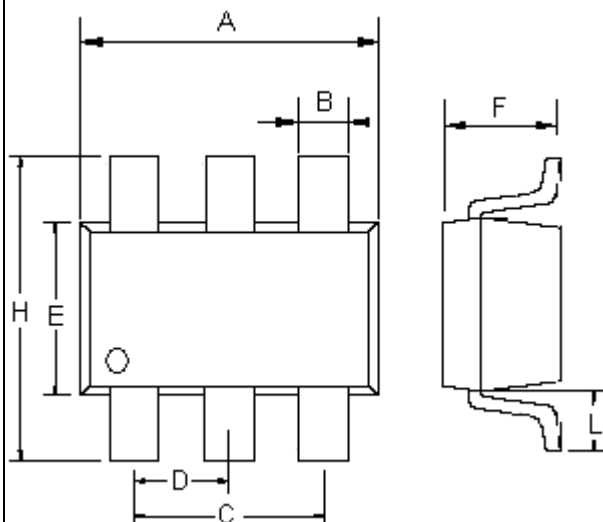


Electrical Characteristics (Ta = 25 °C, Vin= Vin(min), Vce≥2V, unless otherwise specified.)					
Power Good					
PG Low Threshold	% of Vo (PG ON)	89.5	--	85	%
PG High Threshold	% of Vo (PG OFF)	--	--	96.5	
PG leakage current	V _{PG} = 7V	--	--	1	uA
PG voltage rating	Vo in regulation	--	--	7	V
PG voltage low	Isink = 0.4mA	--	--	0.4	V
Delay Time to PG (note 2)	Vin= 5V	--	8	--	mS
	Vin= 3V	--	4	--	
Note 1: Vin(min) = Vout + Vdropout					
Note 2: Guaranteed by design, not 100% tested.					
Note 3: Short circuit current and current limit value will be increased as input voltage is larger than Vin(min)					
Detail Description					
Description					
The TS9004 series of CMOS regulators contain a P-MOS pass transistor, voltage reference, error amplifier, over current protection, thermal shutdown and power good function.					
The TS9004 series switches from voltage mode to current mode when the load exceeds the rated output current. This prevents over stress. The TS9004 also incorporates current fold-back to reduce power dissipation when the output is short circuit. This feature becomes active when the output drops below 0.8V, and reduces the current flow by 65%. Full current is restored when the voltage exceeds 0.8V.					
The internal P-channel pass transistor receives data from the error amplifier, over current shutdown, short output protection and thermal protection circuits. During normal operation, the error amplifier compares the output voltage to a precision reference. Over current and thermal shutdown circuits become active when the junction temperature exceeds 150 °C, or the current exceeds 300mA. During thermal shutdown, the output voltage remains low. Normal operation is restored when the junction temperature drops below 120 °C.					
Enable					
The Chip Enable pin normally floats high. When actively, pulled low, the PMOS pass transistor shut off, and all internal circuits are powered down. In this state, the quiescent current is less than 1uA. This pin behaves much like an electronic switch.					
External Capacitor					
The TS9004 series is stable with an output capacitor to ground of 2.2uF or greater. It can keep stable even with higher or poor ESR capacitors. A second capacitor is recommended between the input and ground to stabilize Vin. The input capacitor should be larger than 0.1uF to have a beneficial effect. All capacitors should be placed in close proximity to the pins. A “quiet” ground termination is desirable.					
Power Good					
The TS9002 includes the Power Good feature. When the output is not within = +/-15% of the specified voltage, it pulls low. This can occur on other condition:					
– Input voltage too low					
– Temperature during over					
– Current during over					

Typical Electrical Characteristics



SOT-26 Mechanical Drawing



SOT-26 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.70	3.00	0.106	0.118
B	0.25	0.50	0.010	0.020
C	1.90(typ)		0.075(typ)	
D	0.95(typ)		0.037(typ)	
E	1.50	1.70	0.059	0.067
F	1.05	1.35	0.041	0.053
H	2.60	3.00	0.102	0.118
L	0.60(typ)		0.024(typ)	