TS5215

300mA Low Noise LDO Voltage Regulator with Enable

SOT-25

SOT-89-5L

SOP-8

Low Power Consumption
Low Drop Out Voltage 0.35V
Fixed and Adjustable Output
Enable Shutdown

General Description

The TS5215 series is an efficient linear voltage regulator with ultra low noise output, very low dropout voltage (typically 17mV at light loads and 350mV at 300mA), and very low power consumption (125uA at 100uA), providing high output current even when the application requires very low dropout voltage. The Chip Enable (CE) includes a CMOS or TTL compatible input allows the output to be turned off to prolong battery life. When shutdown, power consumption drops nearly to zero.

The TS5215 series is included a precision voltage reference, error correction circuit, a current limited output driver, over temperature shutdown, revered battery protection and a reference bypass pin to improve its already excellent low-noise performance.

The TS5215 series is available in fixed and adjustable output voltage version in SOT-25, SOT-89-5L and SOP-8 package.

Features

- ✧ Ultra low noise output.
- ✧ Low dropout voltage
- ✧ Low power consumption
- ✧ "Zero" off-mode current
- ✧ Logic controlled electronic enable
- ✧ Internal current limit and Thermal shutdown protection

Applications

- ✧ Cellular telephones
- ✧ Palmtops, notebook computers
- ✧ Battery powered equipment
- ✧ Consumer and personal electronics
- ✧ SMPS post regulator and DC to DC modules
- ✧ High-efficiency linear power supplies

Ordering Information

Part No.	Operating Temp.	Package
TS5215CS**xx**	-40 ~ +125 °C	SOP-8
TS5215CY5**xx**		SOT-89-5L
TS5215CX5**xx**		SOT-25

Note: Where **xx** denotes voltage option, available are
50= 5.0V
33= 3.3V
30= 3.0V
25= 2.5V.
Leave blank for adjustable version.
Contact factory for additional voltage options.

Pin Assignment

SOT-25	SOT-89-5L	SOP-8	Pin Configuration	Pin Description
3	**3**	**1**	Enable	TTL/COMS compatible input. Logic high is enable; logic low or open is shutdown
1	**4**	**2**	Input	Unregulated input: +16V maximum supply
2	**2**	**5,6,7,8**	Ground	Ground: Ground pin and TAB/heatsink are internally connected.
5	**5**	**3**	Output	Regulator output
4	**1**	**4**	By Pass **(fixed voltage)**	A 470uF capacitor (Cbypass) connected from Bypass to Ground quiets this reference
			Feed Back **(adjustable)**	Adjustment input: Feedback input. Connect to resistive voltage-divider network. **(Vout<8V)**

Absolute Maximum Rating (Note 1)

Input Supply Voltage		Vin	-20~ +20	V
Enable Input Voltage		Vce	-20~ +20	V
Output Current		Io	500	mA
Power Dissipation (Note 2)		P_D	Internal limited	
Thermal Resistance	SOT-23	Θja	220	°C/W
	SOT-89-5L		110	
	SOP-8		55	
Operating Junction Temperature Range		Tj	-40 ~ +125	°C
Storage Temperature Range		T_{STG}	-65 ~ +150	°C
Lead Soldering Temperature (260 °C)			5	S

Recommend Operating Rating (Note 3)

Input Supply Voltage	Vin	+2.5 ~ +16	V
Enable Input Voltage	Vce	0 ~ Vin	V

Electrical Characteristics

Vin=Vo+1V, Io=1mA, Cout=1uF, Vce≥2V, Tj = 25 °C, unless otherwise specified.

Parameter	Conditions		Min	Typ	Max	Unit
Output Voltage	Vin=Vo + 1V		0.98|Vo|	Vout	1.02|Vo|	V
Output Voltage Temp. Coefficient	(Note 4)		--	40	--	ppm/ °C
Line Regulation	Vo+1V ≤ Vin ≤ 16V		--	0.005	0.05	%/V
Load Regulation (Note 5)	1mA ≤ Io ≤ 300mA		--	0.02	0.2	%/V
Dropout Voltage (Note 6)	Io=100uA		--	17	50	mV
	Io=150mA		--	200	300	
	Io=300mA		--	350	600	
Quiescent Current	Vin≤0.4V (shutdown)		--	0.01	1	uA
	Vin≤0.18V (shutdown)		--	--	5	
Ground Pin Current (Note 7)	Vce≥2V	Io=100uA	--	80	125	uA
		Io=150mA	--	600	1500	
		Io=300mA	--	1900	2500	
Output Current Limit	Vout=0V		--	550	600	mA
Power Supply Rejection Ratio	At f=100Hz, Io=100uA,		--	75	--	dB
Thermal Regulation (Note 8)			--	0.05	--	%/W
Output Noise	Io=50mA, Co=2.2uF, 470pF from bypass to Ground		--	260	--	nV√Hz
Enable function						
Enable Input Logic-Low Voltage	Regulation shutdown		--	--	0.4	V
Enable Input Logic-High Voltage	Regulation enable		2.0	--	--	V
Enable Input Current	V_{IL}≤ 0.4V		--	0.01	-1	uA
	V_{IH}≥ 2.0V		--	5	20	

Electrical Characteristics (continued)

Note 1: Exceeding the absolute maximum rating may damage the device.

Note 2: The maximum allowable power dissipation at any Ta is Pd(max) = [Tj(max) - Ta] + Θja. Exceeding the maximum allowable power dissipation will result in excessive die temperature, and the regulator will go into thermal shutdown.

Note 3: The device is not guaranteed to function outside its operating rating.

Note 4: Output voltage temperature coefficient is defined as the worst case voltage change divided by the total temperature range.

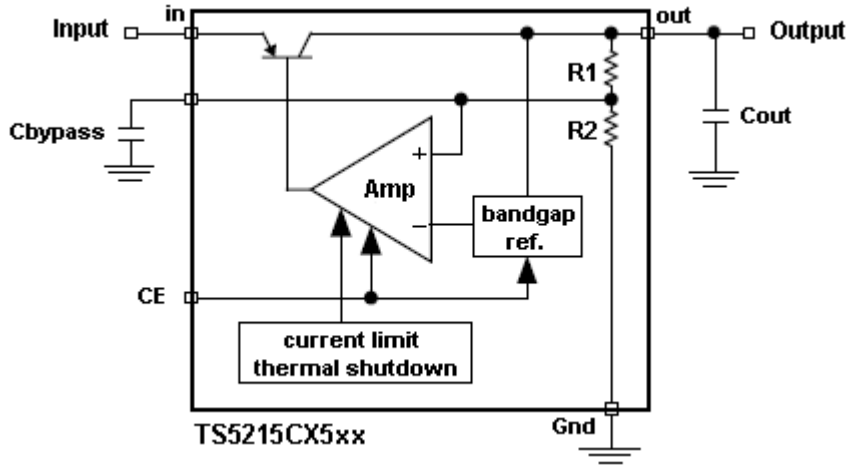
Note 5: Regulation is measured at constant junction temperature using low duty cycle pulse testing. Parts are tested for load regulation in the load range from 1mA to 300mA. Changes in output voltage due to heating effects are covered by the thermal regulation specification.

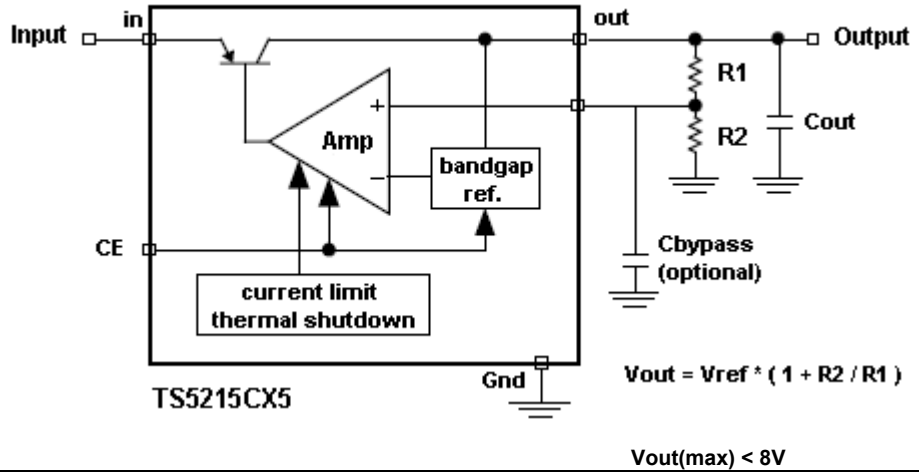
Note 6: Dropout voltage is defined as the input to output differential at which the output voltage drops 2% below its nominal value measured at 1V differential.

Note 7: Ground pin current is the regulator quiescent current plus pass transistor base current. The total current drawn from the supply is the sum of the load current plus the ground pin current.

Note 8: Thermal regulation is defined as the change in output voltage at a time “t” after a change in power dissipation is applied, excluding load or line regulation effects. Specifications are for a 300mA load pulse at Vin=16V for t=10mS.

Block Diagrams





Application Information

Enable Input

TS5215 series feature an active-high (>2V) enable (EN) input that allows ON/OFF control of the regulator. Current drain reduces to “zero” when the device is shutdown, with only micro-amperes of leakage current. The EN is compatible with CMOS logic interfacing. EN may be directly tied to Vin and pulled up to the maximum supply voltage.

Input Capacitor Requirement

An input capacitor of 1uF or greater is recommended when the device is more than 10” away from the bulk AC supply capacitance or when the supply is a battery.

Reference Bypass Capacitor

Bypass is connected to the internal voltage reference. A 470uF capacitor (Cbypass) connected from Bypass to Ground quiets this reference, providing a significant reduction in output noise. Cbypass reduces the regulator phase margin; when using Cbypass, output capacitors of 2.2uF or greater are generally required to maintain stability.

The star up speed of the TS5215 is inversely proportional to the size of the reference bypass capacitor. Applications requiring a slow ramp up of output voltage should consider larger values of Cbypass. Likewise, if rapid turn on is necessary, consider omitting Cbypass. If output noise is not a major concern, omitted Cbypass and leave Bypass open.

Output Capacitor Requirement

The TS5215 series requires an output capacitor to maintain stability and improve transient response is necessary. The value of this capacitor is dependent upon whether a reference bypass capacitor is used. 1uF minimum is recommended when Cbypass is not used. 2.2uF minimum is recommended when Cbypass is 470uF. Larger values improve the regulator’s transient response. The output capacitor value may be increased without limit.

The output capacitor should have an ESR (effective series resistance) less than 5Ω and a resonant frequency above 1MHz. Ultra low ESR capacitors can cause a low amplitude oscillation on the output and/or under damped transient response.

Most of tantalum or aluminum electrolytic capacitors are adequate; film types will work. Since many aluminum electrolytic have electrolytes that freeze at about –30°C, solid tantalums are recommended for operation below –25°C. At lower values of output current, less output capacitance is required for output stability. The capacitor can be reduced to 0.47uF for current below 10mA or 0.33uF for currents below 1mA.

No Load Stability

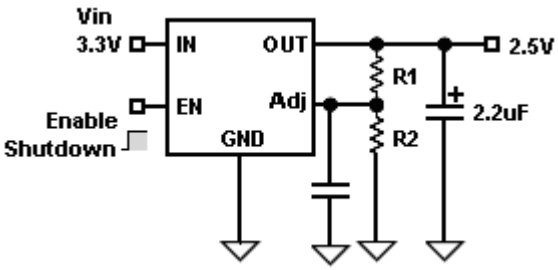
The TS5215 series will remain stable and in regulation with no load, unlike many other voltage regulators. This is especially important in CMOS RAM keep alive applications.

Adjustable Regulator Design

The adjustable regulator versions can be adjusted to a specific output voltage by using two external resistors to programming the output voltage anywhere between 1.25 and the 8V maximum operating rating of the family.

Two resistors are used. Resistors can be quite large up to 470kΩ, because of the very high input impedance and low bias current of the sense comparator, the resistor values are calculated by:

Vout = 1.23V * (R2 / R1 + 1)



A capacitor from Adj to Ground provides greatly improved noise performance.

Dual Supply Operation

When used in dual supply systems where the regulator load is returned to a negative supply, the output voltage must be diode clamped to ground.

Application Information (continues)

Thermal Characteristics

TS5215 series 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-ambient thermal resistance of the device and the following basic equation:

Pd(max) = [Tj(max) – Ta] /Θja

Tj(max) is the maximum junction temperature of the die(125°C), and Ta is the ambient operating temperature. Θja is layout dependent, the actual power dissipation of the regulator circuit can be determined using the equation:

Pd = (Vin – Vout) * Iout + Vin * Ignd

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. For example, when operating the TS5215CX533 at room temperature with a minimum footprint layout, the maximum input voltage for a set output current can be determined as follows:

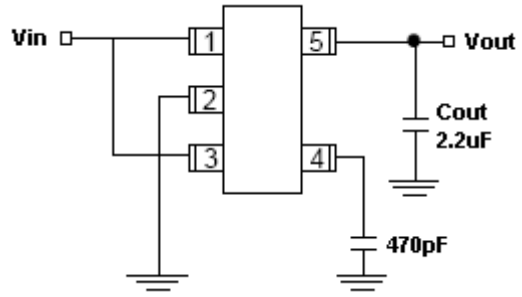
Pd(max) = (125°C – 25°C) / 220°C/W
Pd(max) = 455mW

The junction to ambient thermal resistance for the minimum footprint is 220°C/W, the maximum power dissipation must not be exceeded for proper operation. Using the output voltage of 3.3V and an output current of 300mA, the maximum input voltage can be determined. Form the electrical characteristics table, the maximum ground current for 300mA output current is 2.5mA.

445mW = (Vin – 3.3V) * 300mA + Vin * 2.5mA
445mW = Vin * 300mA – 3.3 * 300mA + Vin * 2.5mA
445mW = Vin * 300mA – 990mW + Vin * 2.5mA
1435mW = Vin * 302.5mA
Vin(max) = 4.74v

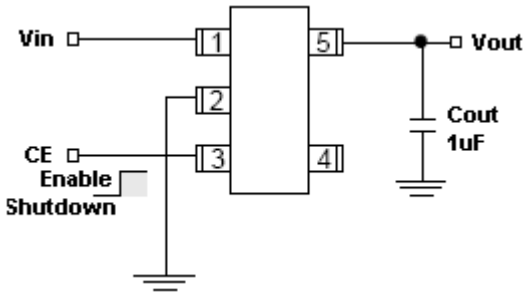
Therefore, a 3.3V application at 300mA of output current can accept a maximum input voltage of 4.74V in a SOT-25 package.

Fixed Output Regulator Application



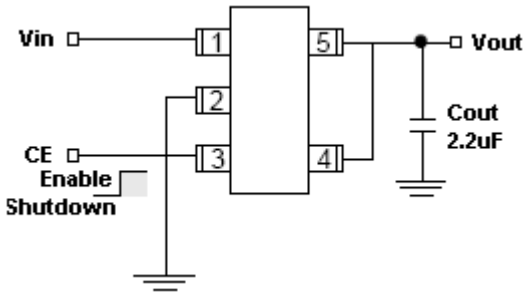
Ultra Low Noise Fixed Voltage Application

Includes a 470uF capacitor for low noise operation and shows EN connected to IN for an application where enable/shutdown is not required. Cout= 2.2uF minimum.



Low Noise Fixed Voltage Application

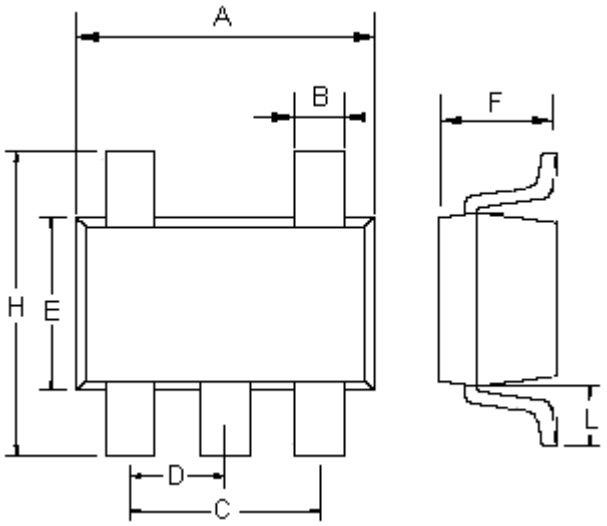
An example of a low noise configuration where Cbypass is not required. Cout= 1uF minimum



Reference Voltage Output Application

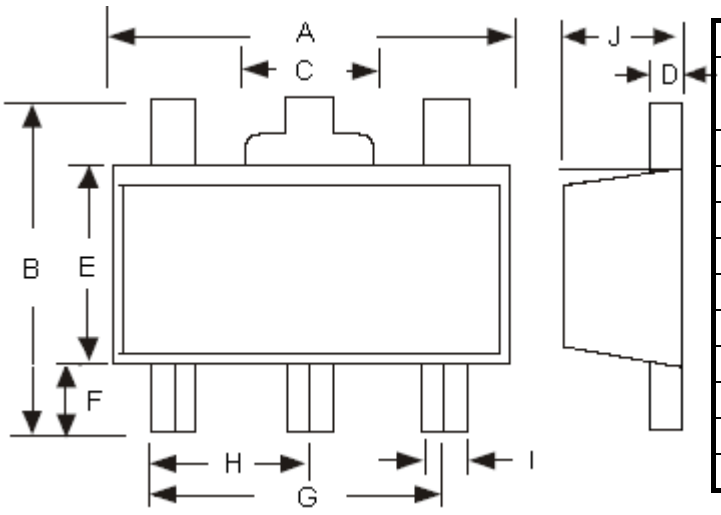
An example of reference voltage (1.23V) as the output voltage when adjustable pin connect to output.

SOT-25 Mechanical Drawing



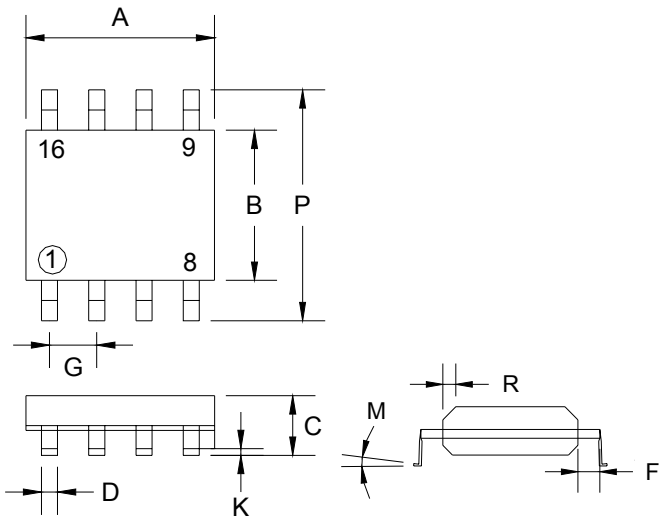
SOT-25 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.70	3.00	0.106	0.118
B	0.25	0.50	0.010	0.020
C	1.90(typ)		0.075(typ)	
D	0.95(typ)		0.037(typ)	
E	1.50	1.70	0.059	0.067
F	1.05	1.35	0.041	0.053
H	2.60	3.00	0.102	0.118
L	0.60(typ)		0.024(typ)	

SOT-89-5L Mechanical Drawing



SOT-89-5L DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.40	4.60	0.17	0.18
B	4.05	4.25	0.16	0.17
C	1.50	1.70	0.06	0.07
D	0.35	0.41	0.01	0.02
E	2.40	2.60	0.09	0.10
F	0.80	--	0.03	--
G	3.00(typ)		0.12(typ)	
H	1.50(typ)		0.06(typ)	
I	0.40	0.52	0.01	0.02
J	1.40	1.60	0.05	0.06

SOP-8 Mechanical Drawing



SOP-8 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.196
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 (typ)		0.05 (typ)	
K	0.10	0.25	0.004	0.009
M	0^o	7^o	0^o	7^o
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019