TAIWAN SEMICONDUCTOR

RoHS COMPLIANCE

TS5213

80mA Low Noise LDO Voltage Regulator with Enable Function

SOT-25

Pin Definition:
1. Input
2. Ground
3. Enable
4. N/C
5. Output

SOT-353

Pin Definition:
1. Enable
2. N/C or Ground
3. Ground
4. Output
5. Input

General Description

TS5213 is an efficient linear voltage regulator with ultra low noise output, very low dropout voltage (typically 50mV at light loads and 320mV at 80mA), and very low ground current (225uA at 20mA), providing high output current even when the application requires very low dropout voltage. The Chip Enable (EN) 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. TS5213 is included a precision voltage reference, error correction circuit, a current limited output driver, over temperature shutdown and revered battery protection.

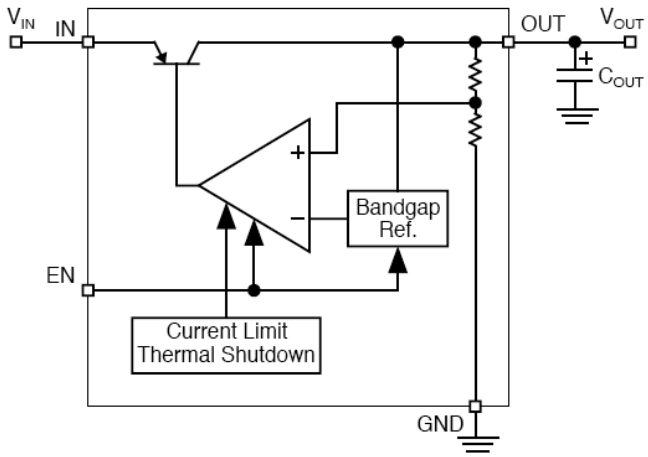
Features

- Ultra Low Noise Output
- Output Current up to 80mA
- Low Power Consumption
- "Zero" Off-mode Consumption
- Logic Controlled Electronic Enable
- Current Limit & Thermal Shutdown Protection

Application

- Cellular Telephones
- Palmtops, Notebook Computers
- Battery Powered Equipment
- SMPS Post Regulator and DC to DC Modules
- High-efficiency Linear Power Supplies
- Portable Application

Block Diagram

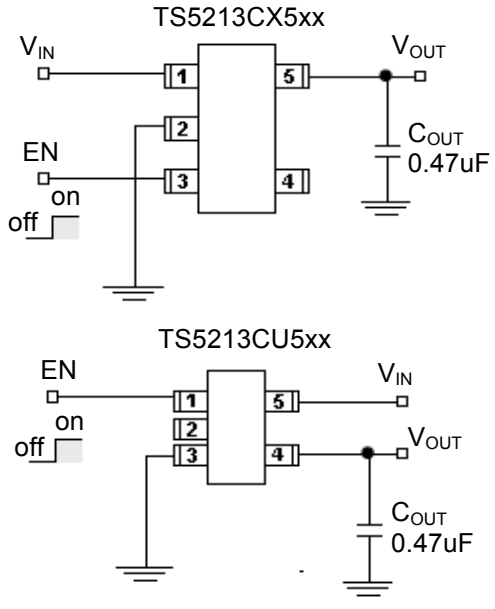


Ordering Information

Part No.	Package	Packing
TS5213CX5**xx** RF	SOT-25	3Kpcs / 7" Reel
TS5213CU5**xx** RF	SOT-353	3Kpcs / 7" Reel

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

Typical Application Circuit



EN may be connected to V_{IN} pin to regulation ON
C_{IN} > 0.1uF in basic operating
C_{OUT} >0.47uF in low noise operating

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Absolute Maximum Rating (Note 1)

Parameter		Symbol	Limit	Unit
Input Supply Voltage		V_{IN}	-20~ +20	V
Enable Input Voltage		V_{CE}	-20~ +20	V
Power Dissipation (Note 2)		P_D	Internal limited	
Thermal Resistance	SOT-25	Θ_{JA}	220	°C/W
	SOT-353		450	
Operating Junction Temperature Range		T_J	-40 ~ +125	°C
Storage Temperature Range		T_{STG}	-65 ~ +150	°C
Lead Soldering Temperature (260°C)			5	S

Recommend Operating Rating (Note 2)

Parameter	Symbol	Limit	Unit
Input Supply Voltage	V_{IN}	+2.5 ~ +16	V
Enable Input Voltage	V_{CE}	0 ~ V_{IN}	V

Electrical Specification (V_{IN}=Vo+1V, Io=1mA, C_{OU}T=0.47uF, V_{EN}≥2V, T_J = 25°C, unless otherwise specified.)

Parameter	Conditions		Min	Typ	Max	Unit
Output Voltage	V_{IN}=Vo + 1V		-3	--	3	%
	-40ºC ≤ T_J ≤ +125ºC		-4	--	4	
Output Voltage Temp. Coefficient	(Note 5)		--	50	200	ppm/°C
Line Regulation	Vo+1V ≤ V_{IN} ≤ 16V		--	0.008	0.3	%
Load Regulation (Note 6)	0.1mA ≤ Io ≤ 80mA		--	0.08	0.3	%
Dropout Voltage (Note 7)	Io=100uA		--	50	--	mV
	Io=20mA		--	230	300	
	Io=50mA		--	280	370	
	Io=80mA		--	320	420	
Quiescent Current	V_{EN} ≤0.4V (shutdown)		--	0.01	10	uA
Ground Pin Current (Note 8)	V_{EN}≥2V (active)	Io=100uA	--	80	--	uA
		Io=20mA	--	225	750	
		Io=50mA	--	850	--	
		Io=80mA	--	1800	3000	
Output Current Limit	V_{OUT} =0V		--	250	--	mA
Power Supply Rejection Ratio	At f=100Hz, Io=100uA,		--	65	--	dB
Thermal Regulation (Note 9)			--	0.05	--	%/W
Enable function						
Enable Input Logic-Low Voltage	Regulation shutdown		--	--	0.6	V
Enable Input Logic-High Voltage	Regulation enable		2.0	--	--	V
Enable Input Current	V_{IL}≤ 0.6V		--	0.01	1	uA
	V_{IH}≥ 2.0V		--	15	50	

Electrical Specification (Continue)

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

Note 2: The maximum allowable power dissipation at any Ta is Pd(max) = [$T_{J(MAX)}$ - Ta] + Θ_{JA}. Exceeding the maximum allowable power dissipation will result in excessive die temperature, and the regulator will go into thermal shutdown.

Note 3: Devices are ESD sensitive. Handling precautions recommended.

Note 4: The device is not guaranteed to function outside its operating rating.

Note 5: Output voltage temperature coefficient is defined as the worst case voltage change divided by the total temperature range.

Note 6: 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 80mA. Changes in output voltage due to heating effects are covered by the thermal regulation specification.

Note 7: 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 8: 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 9: 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 80mA load pulse at V_{IH} =16V for t=10mS.

Application Information

Enable Input

TS5213 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 V_{IH} and pulled up to the maximum supply voltage.

Input Capacitor Requirement

An input capacitor of 0.17uF 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.

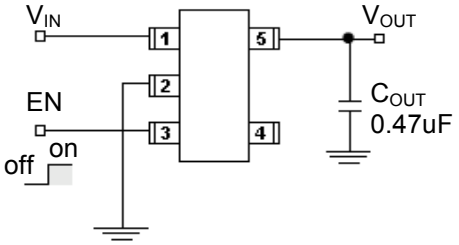
Output Capacitor Requirement

The TS5213 series requires an output capacitor to maintain stability and improve transient response is necessary. The TS5213 is ultra stable, requiring only 0.47uF of output capacitance for stability. It is stable with all type of capacitors, including the tiny, low-ESR ceramic chip capacitors. The output capacitor value may be increased without limit.

No Load Stability

The TS5213 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.

Fixed Output Regulator Application



Low Noise Fixed Voltage Application

TS5213 series is offered a smaller system solution, it is only required a small multilayer ceramic capacitor for stability.

Application Information (Continue)

Thermal Characteristics

TS5213 series is designed to provide 80mA 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:

$$P_{D(MAX)} = [T_{J(MAX)} – T_A] / \Theta_{JA}$$

$T_{J(MAX)}$ is the maximum junction temperature of the die(125°C), and Ta is the ambient operating temperature. Θ_{JA} is layout dependent, the actual power dissipation of the regulator circuit can be determined using the equation:

$$P_D = (V_{IN} – V_{OUT}) * I_{OUT} + V_{IN} * I_{GND}$$

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 TS5213CX550 at room temperature with a minimum footprint layout, the maximum input voltage for a set output current can be determined as follows:

$$P_{D(MAX)} = (125^oC – 25^oC) / 220^oC/W$$
$$P_{D(MAX)} = 455mW$$

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 5.0V and an output current of 80mA, the maximum input voltage can be determined. Form the electrical characteristics table, the maximum ground current for 80mA output current is 1mA.

$$445mW = (V_{IN} – 5.0V) * 80mA + V_{IN} * 1.8mA$$
$$445mW = V_{IN} * 80mA – 5.0 * 80mA + V_{IN} * 1.8mA$$
$$445mW = V_{IN} * 80mA – 400mW + V_{IN} * 1.8mA$$
$$845mW = V_{IN} * 81.8mA$$
$$V_{IN} (max) = 10.33V$$

Therefore, a 5.0V application at 80mA of output current can accept a maximum input voltage of 10.33V in a SOT-25 package.

Electrical Characteristics Curve

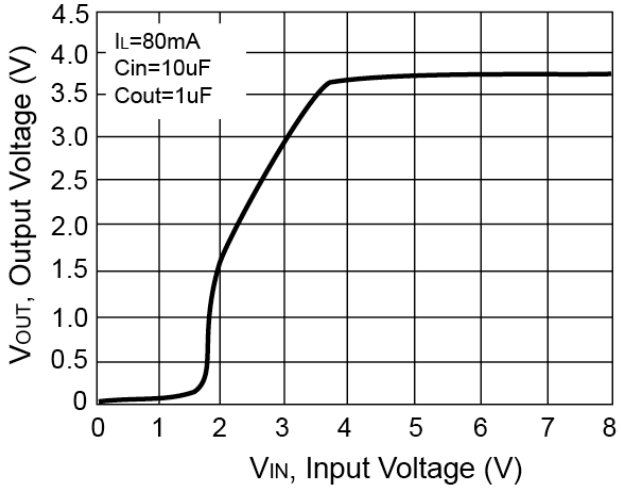


Figure 1. Output Voltage vs. Input Voltage

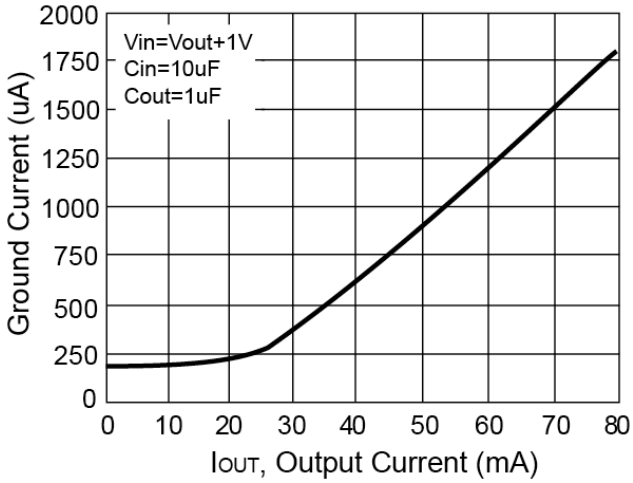


Figure 2. Ground Current vs. Output Current

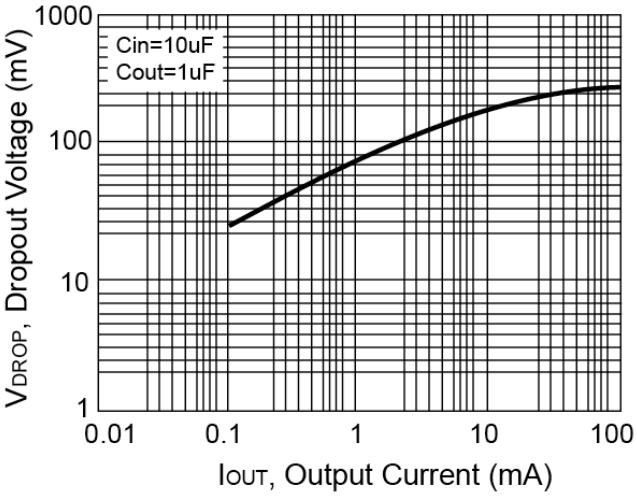


Figure 3. Dropout Voltage vs. Output Current

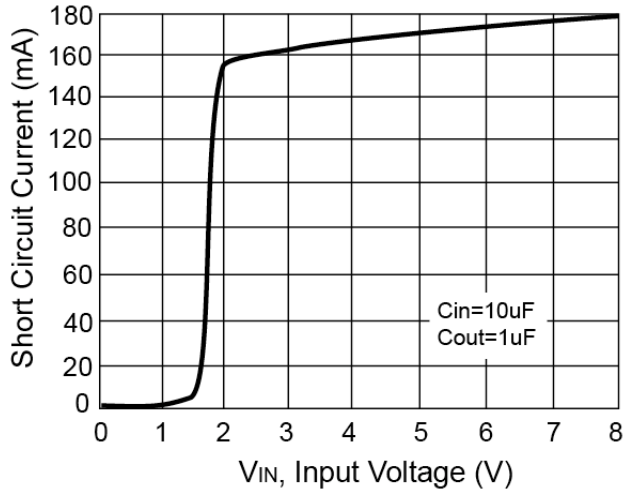


Figure 4. Short Circuit Current vs. Input Voltage

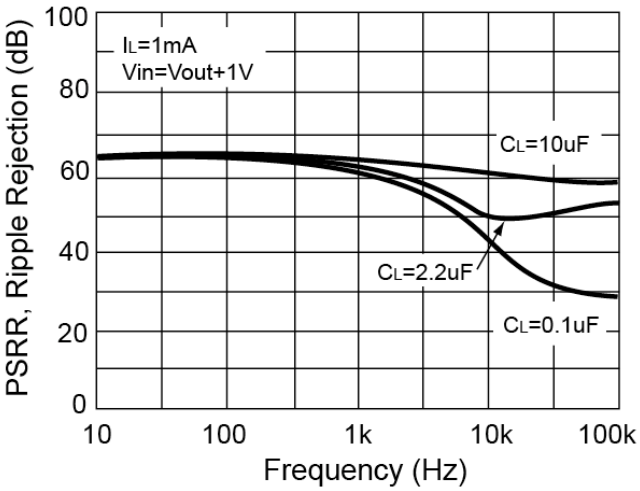


Figure 5. Ripple Rejection vs. Frequency

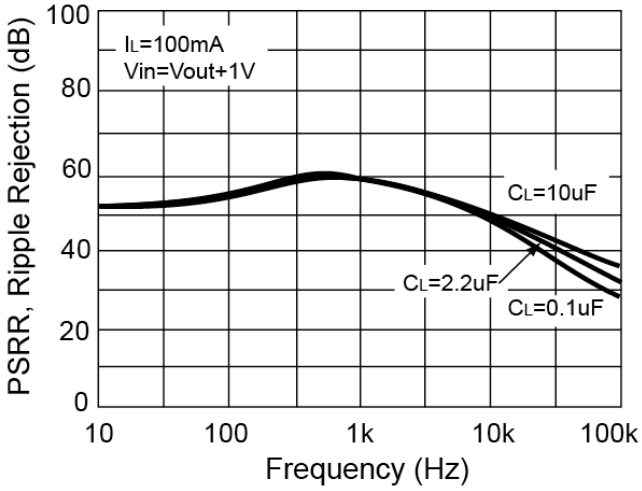


Figure 6. Ripple Rejection vs. Frequency

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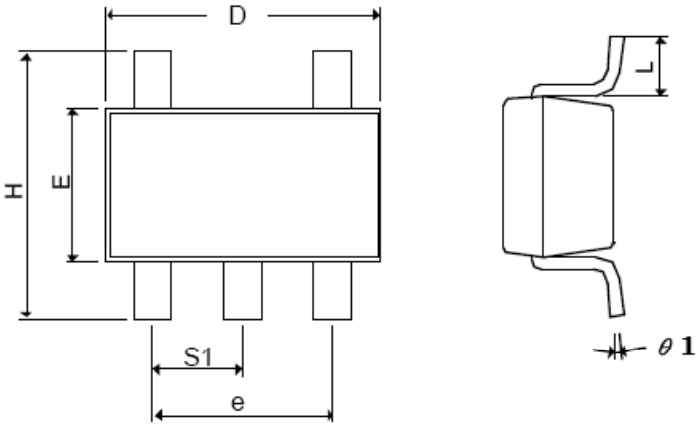
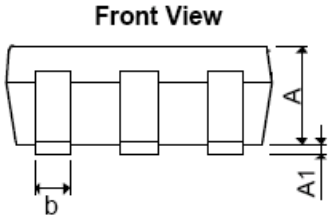
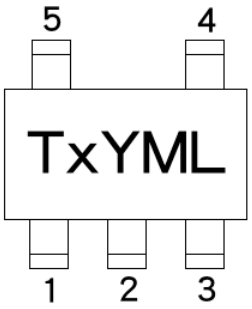
SOT-25 Mechanical Drawing





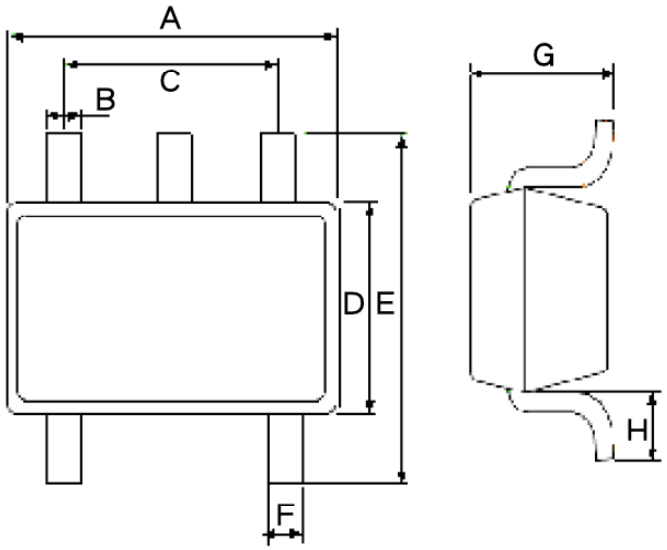
SOT-25 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX.
A+A1	0.09	1.25	0.0354	0.0492
B	0.30	0.50	0.0118	0.0197
C	0.09	0.25	0.0035	0.0098
D	2.70	3.10	0.1063	0.1220
E	1.40	1.80	0.0551	0.0709
E	1.90 BSC		0.0748 BSC	
H	2.40	3.00	0.09449	0.1181
L	0.35 BSC		0.0138 BSC	
Θ1	0°	10°	0°	10°
S1	0.95 BSC		0.0374 BSC	

Marking Diagram



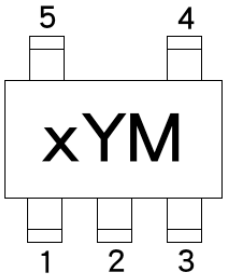
T = Device Code
X = Voltage Code
(**5** = 5.0V, **S** = 3.3V, **P** = 3.0V, **K** = 2.5V)
Y = Year Code
M = Month Code
(**A**=Jan, **B**=Feb, **C**=Mar, **D**=Apl, **E**=May, **F**=Jun, **G**=Jul, **H**=Aug, **I**=Sep, **J**=Oct, **K**=Nov, **L**=Dec)
L = Lot Code

SOT-353 Mechanical Drawing



SOT-353 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.80	2.20	0.0709	0.0866
B	0.25	0.40	0.0098	0.0157
C	1.30(typ)		0.0512(typ)	
D	1.15	1.35	0.0453	0.0531
E	1.80	2.40	0.0709	0.0945
F	0.35	0.50	0.0137	0.0197
G	0.80	1.10	0.0315	0.0433
H	0.10	0.45	0.0039	0.0177

Marking Diagram



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