1A, PWM Step-Down DC/DC Converter

◆ DESCRIPTION

The MT5201 is a step-down, current mode, DC-DC converter. At heavy load, the constant-frequency PWM control performs excellent stability and transient response. To ensure the longest battery life in portable applications, the MT5201 have a power-saving Pulse-skipping Modulation (PSM) mode and reduce the quiescent current under light load operation to save power.

The MT5201 is supported with a range of input voltages form 2.5V to 5.5V allowing the use of a single Li+/Li-polymer cell, multiple Alkaline/NiMH cell, USB, and other standard power sources. The output voltage is adjustable from 0.6V to the input voltage, while the suffix part numbers MT5201-X.X indicate pre-set voltage ranges of 3.3V, 1.8V, 1.5V or 1.2V. All versions Include internal power switch and synchronous rectifier for minimal external part count and high efficiency. During the shutdown, the input is disconnected form the output and the shutdown current is less than 0.1uA. Other key features include under-voltage lockout to prevent deep-battery discharge.

◆ FEATURES

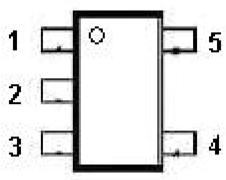
- Efficiency up to 96%
- Only 40uA(TYP.) Quiescent Current
- Up to 1A
- Internal Synchronous Rectifier
- 1.5MHz Switching Frequency
- Under-Voltage Lockout
- Short Circuit Protection
- 5-pin Small SOT-23-5 Package
- Pb-Free Package

◆ APPLICATIONS

- Cellular phone
- Portable electronics
- Wireless Devices
- Cordless phone
- Computer peripherals
- Battery Powered Widgets
- Electronic scales

◆ PIN CONFIGURATIONS

SOT-23-5 (Top View)



MT5201-X.XN

PIN CONFIGURATION

Pin Number	Name	Function
1	EN	Enable(active high)
2	GND	Ground
3	SW	Switch
4	VIN	Input
5	VOUT/FB	Output/Feedback

ORDERING INFORMATION

Device	Package		V_{OUT} Volts	T_A (°C)
MT5201-X.XN	N	SOT-23-5L	X.X_ 3.3/ 1.8/ 1.5/ 1.2/ ADJ	0-85

POWER DISSIPATION TABLE

Package	θ_{JA} (°C /W)	$T_A \leq 25$°C Power rating(mW)	T_A=70°C Power rating(mW)	T_A= 85°C Power rating (mW)
N	250	400	220	160

Note :

1. Exceeding the maximum allowable power dissipation will result in excessive die temperature, and the regulator will go into thermal shutdown.
2. T_J: Junction Temperature Calculation:
   $T_J = T_A + (P_D \times \theta_{JA})$
   The θ_{JA} numbers are guidelines for the thermal performance of the device/PC-board system. All of the above assume no ambient airflow.
3. θ_{JA}: Thermal Resistance-Junction to Ambient.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Maximum	Unit
Input Voltage	V_{IN}	6.6	V
EN, FB Pin Voltage	V_{EN}	-0.3 to V_{IN}	V
SW Pin Voltage	V_{SW}	-0.3 to (V_{IN} +0.3)	V
Junction Temperature	T_J	125	°C
Storage Temperature Range	T_{STG}	- 65 to 150	°C
Soldering Temperature Range	T_{OPR}	300/5sec	°C

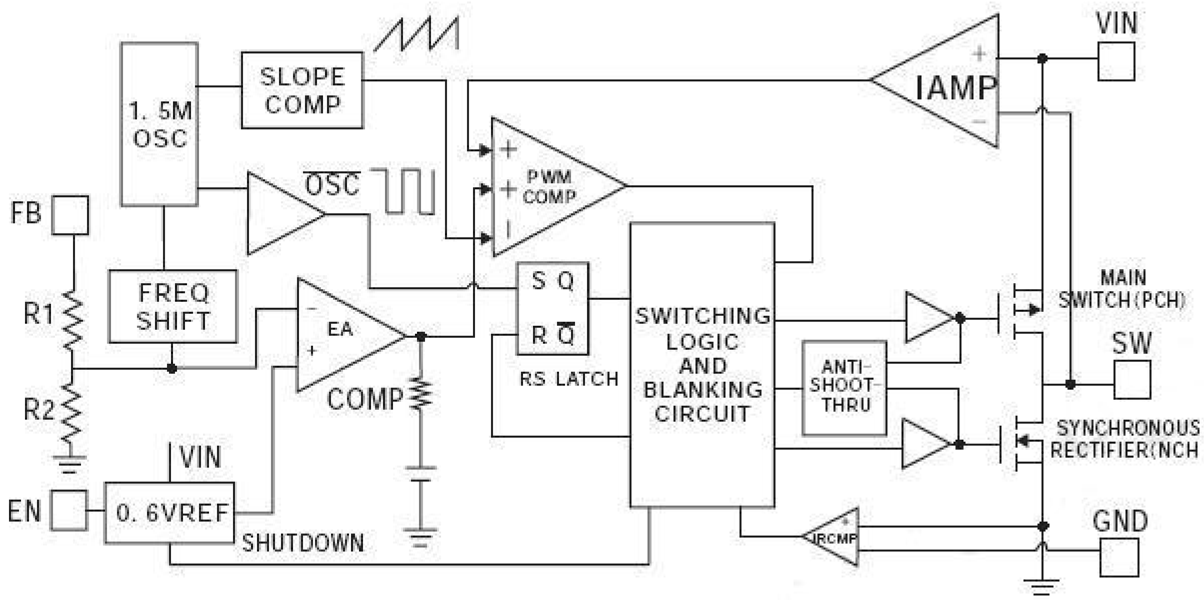
Note :

These are stress ratings only and functional operation is not implied. Exposure to absolute maximum ratings for prolonged time periods may affect device reliability. All voltages are with respect to ground.

◆ RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Max	Unit
Supply Voltage	V_{CC}	5.5	V
Supply Voltage(for Max.duration of 30 Min.)	V_{CC}	6.0	V
Operating Temperature	T_{OPR}	85	^{o}C

◆ BLOCK DIAGRAM

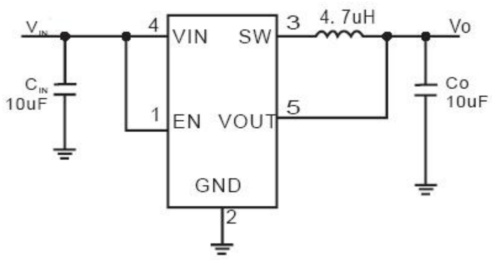


◆ ELECTRICAL CHARACTERISTICS

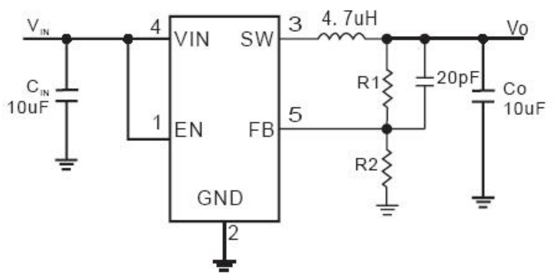
T_A=25℃, V_{IN}=5V, V_O=1.8V, C_{IN}=10uF, C_O=10uF, L=4.7uH, unless otherwise noted.

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Input Voltage Range	V_{IN}			2.5	-	5.5	V
Regulated Feedback Voltage	V_{FB}			0.588	0.6	0.612	V
Reference Voltage Line Regulation	V_{FB}			-	0.3	-	%/V
Regulated Output Voltage Accuary	V_O	I_O=100mA		-3	-	+3	%
Peak Inductor Current	I_{PK}	V_{IN}=3V, V_{FB}=0.5V or V_O=90%		-	1.4	-	A
Output Voltage Line Regulation	LNR	V_{IN}=2.5V to 5.5V,I_O=10mA		-	0.2	-	%/V
Output Voltage Load Regulation	LDR	I_O=1mA to 1A		-	0.5	-	%
Quiescent Current	I_Q	No load		-	40	70	uA
Shutdown Current	I_{SD}	V_{EN}=0V		-	0.01	1	uA
Oscillator Frequency	F_{OSC}	V_O=100%		1.2	1.5	1.8	Mhz
		V_{FB}=0V or V_O=0V		-	500	-	KHz
Drain-Source On-State Resistance	$R_{DS(ON)}$	I_{DS}=100mA	P MOSFET	-	0.45	-	Ω
			N MOSFET	-	0.4	-	Ω
SW Leakage Current	I_{LSW}			-	±0.01	1	uA
High Efficiency	η			-	96	-	%
EN Threshold High	V_{EH}			1.3	-	-	V
EN Threshold Low	V_{EL}			-	-	0.4	V
EN Leakage Current	I_{EN}			-	±0.01	-	uA

◆ TYPICAL APPLICATIONS



Fixed Output Voltage



Adjustable Output Voltage

$$Vo = 0.6 \times \left(1 + \frac{R1}{R2}\right)$$

◆ APPLICATION INFORMATION

The basic MT5201 application circuit is shown in Page4. External component selection is driven by the load requirement and begins with the selection of L followed by C_{IN} and $C_{OUT.}$

Inductor Selection

For most applications, the value of the inductor will fall in the range of 1μH to 4.7μH. Its value is chosen based on the desired ripple current. Large value inductors lower ripple current and small value inductors result in higher ripple currents. Higher V_{IN} or V_{OUT} also increases the ripple current as shown in equation1. A reasonable starting point for setting ripple current is ΔI_L=240mA(40% of 600mA).

$$V_{IL}=\frac{1}{(f)(L)}Vout\left(1-\frac{Vout}{V_{IN}}\right) \quad ....(1)$$

The DC current rating of the inductor should be at least equal to the maximum load current plus half the ripple current to prevent core saturation. Thus, a 720mA rated inductor should be enough for most applications (600mA+120mA). For better efficiency, choose a low DC-resistance inductor.

C_{IN} and C_{OUT} Selection

In continuous mode, the source current of the top MOSFET is a square wave of duty cycle V_{OUT}/V_{IN}. To prevent large voltage transients, a low ESR input capacitor sized for the maximum RMS current must be used. The maximum RMS capacitor current is given by:

$$I_{RMS} \cong I_{OMAX}\frac{\left[Vout\,(Vin-Vout)\right]^{1/2}}{V_{IN}}$$

This formula has a maximum at V_{IN}=2Vout, where I_{RMS}=Iout/2. This simple worst-case condition is commonly used for design because even significant deviations do not offer much relief. Note that the capacitor manufacturer's ripple current ratings are often based on 2000 hours of life. This makes it advisable to further derate the capacitor, or choose a capacitor rated at a higher temperature than required. Consult the manufacturer if there is any question.

The selection of C_{OUT} is driven by the required effective series resistance (ESR)

◆ APPLICATION INFORMATION (Cont.)

Typically, once the ESR requirement for C_{OUT} has been met, the RMS current rating generally far exceeds the I_{RIPRLE} (P-P) requirement. The output ripple $\triangle V_{OUT}$ is determined by:

$$\triangle Vout \cong \triangle I_L \left(ESR + \frac{1}{8fCout} \right)$$

Where f=operating frequency, C_{OUT}=output capacitance and $\triangle I_L$= ripple current in the inductor. For a fixed output voltage, the output ripple is highest at maximum input voltage since $\triangle I_L$ increases with input voltage.

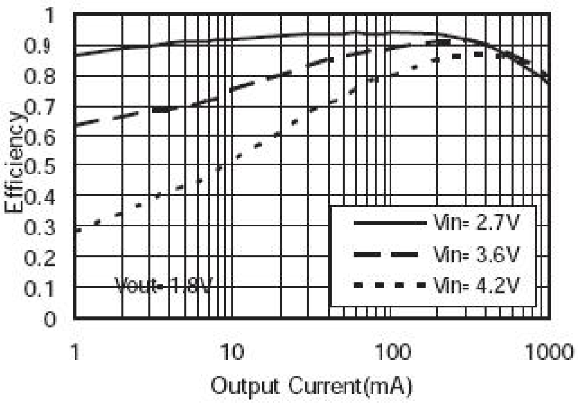
Using Ceramic Input ad Output Capacitors

Higher values, lower cost ceramic capacitors are now becoming available in smaller case sizes. Their high ripple current, high voltage rating and low ESR make them ideal for switching regulator applications. Using ceramic capacitors can achieve very low output ripple and small circuit size.

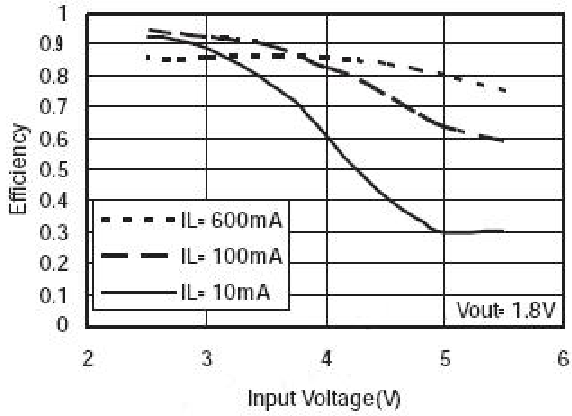
When choosing the input and output ceramic capacitors, choose the X5R or X7R dielectric formulations. These dielectrics have the best temperature and voltage characteristics of all the ceramics for a given value and size.

◆ TYPICAL PERFORMANCE CHARACTERISTICS

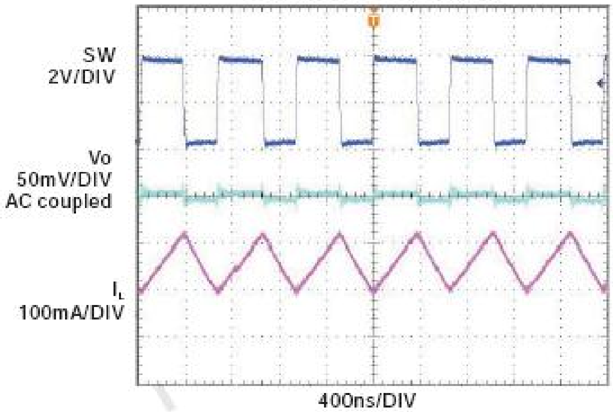
Efficiency vs Output Current



Efficiency vs Input Voltage

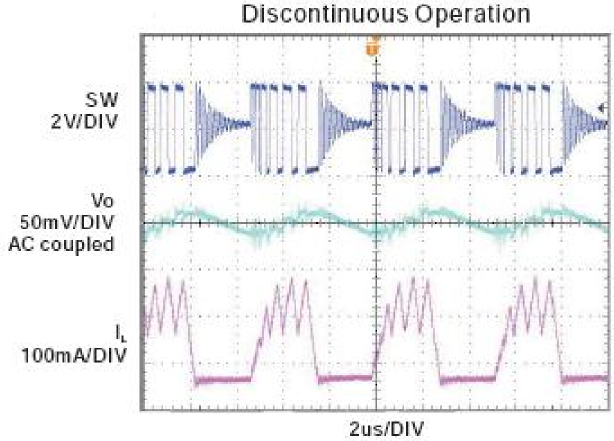


Continuous Operation



Vin= 3.6V,Vout= 1.8V,Io= 200mA

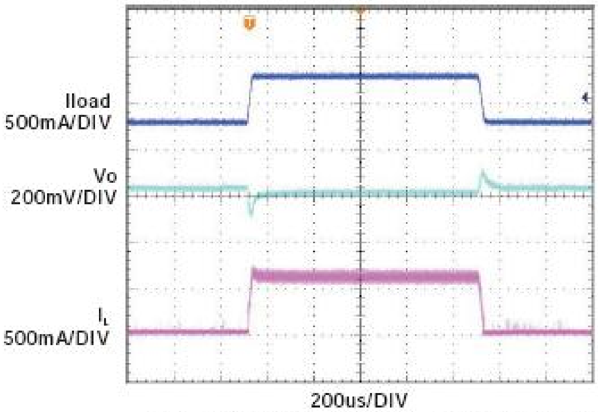
Discontinuous Operation



Vin= 3.6V,Vout= 1.8V,Io= 70mA

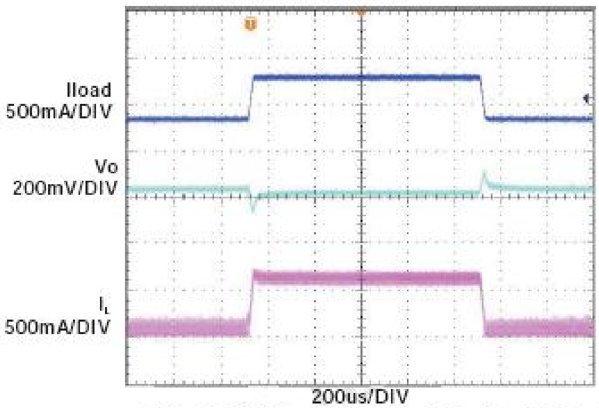
◆ TYPICAL PERFORMANCE CHARACTERISTICS

Load Regulation



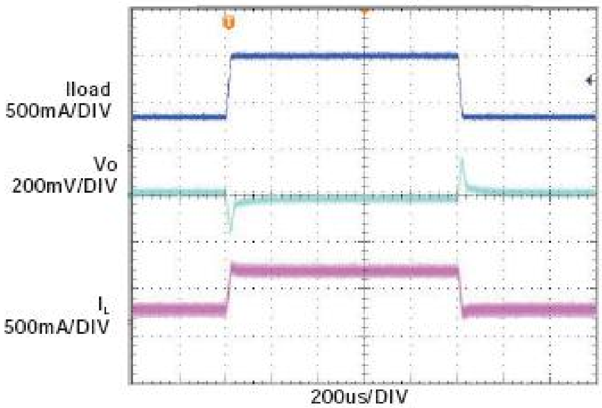
Vin= 3.6V,Vout= 1.8V,Io= 0mA to 600mA

Load Regulation



Vin= 3.6V,Vout= 1.8V,Io= 50mA to 600mA

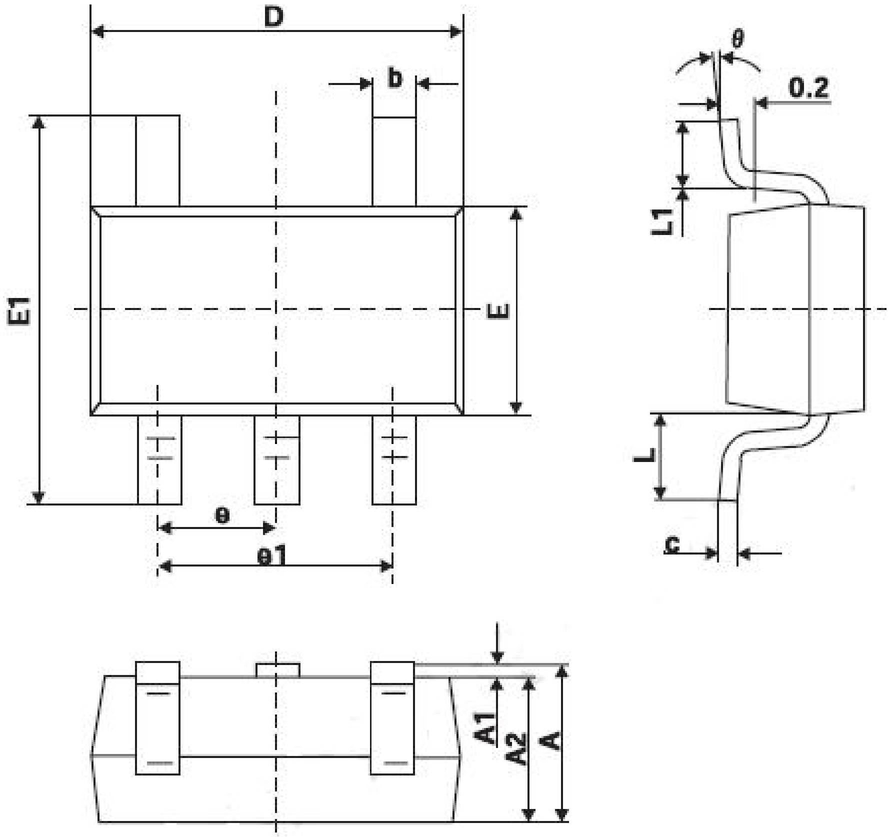
Load Regulation



Vin= 3.6V,Vout= 1.8V,Io= 200mA to 600mA

◆ PHYSICAL DIMENSIONS:

SOT-23-5L



Symbol	A	A1	A2	b	c	D	E
Spec	1.15±0.1	0.05±0.05	1.10±0.05	0.35±0.05	0.15±0.05	2.9 2±0.1	1.6±0.1
Symbol	E1	e	e 1	L	L1		
Spec	2.8±0.15	0.9 50TYP	1.9 0±0.1	0.70REF	0.45±0.15	4°±4°	