

Ultra-Low Quiescent Synchronous Boost Converter

FEATURES

- Up to 92% Efficiency
- Generates 3.3V at 150mA from a Single AA Cell
- Low Start-up Voltage: 0.85V
- Internal Synchronous Rectifier
- 2.2V to 5.0V Output Range
- Low Device Quiescent Current: 20 μ A
- Shutdown Current:<1 μ A
- Available in SOT23 and SOT23-5L Package

APPLICATIONS

- One, Two and Three Cell Alkaline and NiMH/NiCd
- Portable Products
- Single-Cell Li-Ion Powered Devices
- Personal Medical Products
- Wireless Handsets
- Handheld Instruments
- Bluetooth Handsets
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GENERAL DESCRIPTION

The TMI5120 is a compact, high-efficiency, synchronous step DC-DC Converter. It provides an easy-to-use power by either single-cell, two-cell, or three-cell alkaline, NiCd, NiMH, and single-cell Li-Ion or Li-Polymer batteries.

The boost converter is based on a PFM mode controller topology using synchronous rectification to obtain maximum efficiency at minimal quiescent currents.

For standby applications, the TMI5120 consumes only 20 μ A while operating at no load, and the devices feature low shutdown current of under 1 μ A .

The Device is offered in the low profile 3-pin SOT23 package and 5-pin SOT23-5L.

TYPICAL APPILICATION

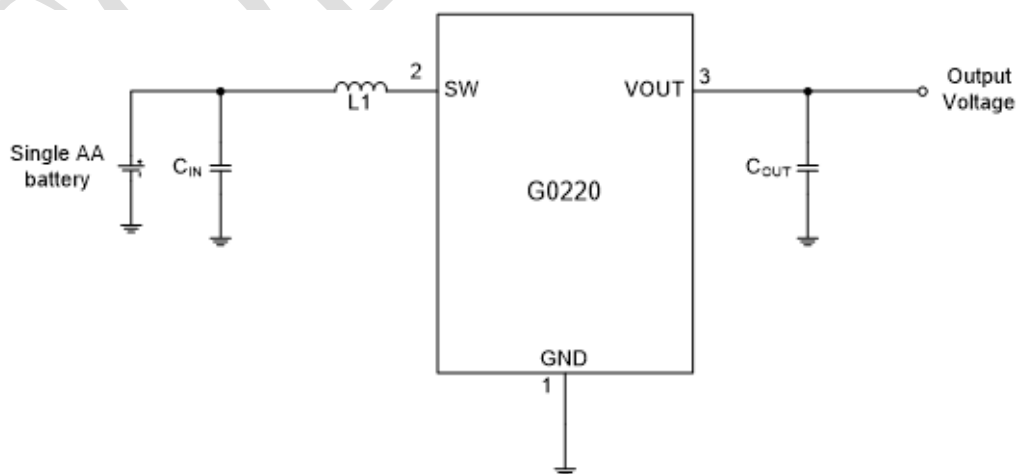
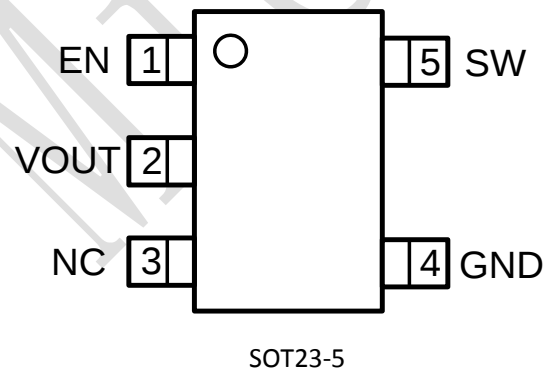
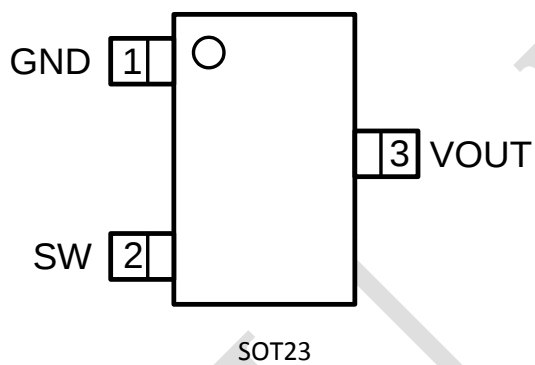


Figure 1. Basic Application Circuit

ABSOLUTE MAXIMUM RATINGS (Note 1)

Parameter	Value	Unit
SW Voltage Range	-0.3~5.5	V
VOUT Voltage Range	-0.3~5.5	V
EN Voltage Range	-0.3~5.5	V
Junction Temperature	155	°C
Lead Temperature(Soldering,10Sec)	260	°C
Power Dissipation	500	mW

PACKAGE/ORDER INFORMATION



Top Mark: T31XXX (T31: Device Code, XXX: Inside Code)

Part Number	Package	Top mark	Quantity/ Reel
TMI5120	SOT23/SOT23-5	T31XXX	3000

PIN FUNCTIONS

Pin		Name	Function
SOT23-5	SOT23		
1		EN	The Enable Device Pin. This pin is a logic-level input used to enable or disable device switching and low shutdown current while disabled. A logic high will enable the converter output. A logic low will ensure that the converter is disabled.
2	3	VOUT	The Output Voltage Power Pin Connects the Output Voltage to the Switch Node. Bias is derived from VOUT. PCB trace length from VOUT to the output filter capacitor(s) should be as short and wide as possible. VOUT is held at VIN-0.6V in shutdown due to the body diode of the internal PMOS.
3		NC	No Connection. No internal connection.
4	1	GND	Signal and Power Ground. Provide a short direct PCB path between GND and the (-) side of the output capacitor(s).
5	2	SW	Switch Pin. Connect the inductor from input voltage to the SW pin. The SW pin carries inductor current. The integrated N-Channel switch drain and integrated P-Channel drain possible to reduce EMI and voltage overshoot.

ESD RATING

Items	Description	Value	Unit
V _{ESD}	Human Body Model for all pins	±2000	V

JEDEC specification JS-001

RECOMMENDED OPERATING CONDITIONS

Items	Description	Min	Max	Unit
TA	Operating Temperature Range	-40	85	°C

ELECTRICAL CHARACTERISTICS (Note 3)

($C_{IN}=4.7\mu F$, $C_{OUT}=10\mu F$, $L=4.7\mu H$, $T_A = 25^\circ C$, unless otherwise noted.)

Parameter	Test Conditions	Min	Typ	Max	Unit
Minimum Start-Up Voltage	$V_{OUT}=3.3V$, $I_{OUT}=1mA$		0.85	1	V
Minimum Operating Voltage	(Note 4)		0.5	0.65	V
Output Voltage Adjust Range		2.2		5.0	V
Maximum Output Current	$V_{IN}=1.5V$, $V_{OUT}=3.3V$		150		mA
	$V_{IN}=0.9V$, $V_{OUT}=3.3V$		70		mA
Line Regulation	$(\Delta V_{OUT}/V_{OUT})/\Delta V_{IN}$	-1	0.01	1	%
Load Regulation	$\Delta V_{OUT}/V_{OUT}$, $I_{OUT}=25mA$ to $100mA$, $V_{IN}=1.5V$	-1	0.01	1	%
Quiescent Current (No Load)	$V_{IN}=1.5V$, $V_{OUT}=3.3V$		20	30	μA
NMOS Switch Leakage	$V_{SW}=5V$		0.1	5	μA
PMOS Switch Leakage	$V_{SW}=0V$		0.1	5	μA
NMOS Switch On Resistance	$V_{OUT} = 3.3V$		0.45		Ω
PMOS Switch On Resistance	$V_{OUT} = 3.3V$		0.65		Ω
NMOS Current Limit		0.6	0.85		A
Duty Cycle		74	90		%
Switching Frequency			300		kHz
SHDN Input High		1			V
SHDN Input Low				0.3	V

Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

Note 2: T_J is calculated from the ambient temperature T_A and power dissipation P_D according to the following formula: $T_J = T_A + (P_D) \times (250^\circ C/W)$.

Note 3: 100% production test at $+25^\circ C$. Specifications over the temperature range are guaranteed by design and characterization.

Note 4: Minimum V_{IN} operation after start-up is only limited by the battery's ability to provide the necessary power as it enters a deeply discharged state.

OPERATION

The TMI5120 is a high performance, high efficient switching boost converter. To achieve high efficiency, the power stage is realized as a synchronous-boost topology. The device is capable of low start-up voltage and delivers high efficiency over a wide load range for single-cell, two-cell, or three-cell alkaline, NiCd, NiMH and single-cell Li-Ion battery inputs. For the power switching, two actively-controlled low- $R_{DS(on)}$ power MOSFETs are implemented. A high level of integration lowers total system cost, eases implementation and reduces board area.

The device features low start-up voltage, PFM mode operation, low I_Q , integrated synchronous switch. The operation of the TMI5120 can be understood by referring to the block diagram of Figure 2. The TMI5120 operates in a PFM mode with peak current control scheme. The converter monitors the output voltage through the feedback network which is connected to the error comparator. As soon as the feedback voltage falls below the internal reference voltage, the internal power NMOSFET turns on and the inductor current ramps up. The power NMOSFET turns off as soon as the inductor current reaches the setting peak current limit. As the power NMOSFET turns off, the internal power PMOSFET turns on and delivers the inductor current to the output. After the inductor current drops to zero, the TMI5120 compares the feedback voltage with the reference voltage. Once the feedback voltage falls below the reference voltage, the switch power MOSFETs turn on again. In this way, the TMI5120 regulates the output voltage at the target value.

Using this PFM peak current control scheme, the converter operates in discontinuous conduction mode (DCM) where the switch frequency depends on the output current. This regulation scheme is inherently stable, allowing a wide selection range for the inductor and output capacitor.

APPLICATION INFORMATION

Inductor Selection

The TMI5120 is designed to be used with small surface-mount inductors, the inductance value of 4.7 μ H is recommended to achieve a good balance between inductor size, converter load transient response and minimized noise.

The selected inductor should have a saturation current that is larger than the maximum peak current of the converter. Use the minimal value of selected current limit for this calculation.

Another important inductor parameter is the dc resistance. The lower the dc resistance, the higher the efficiency of the converter.

To minimize radiated noise, use a shielded bobbin inductor.

Capacitor Selection

Low ESR (equivalent series resistance) capacitors should be used to minimize the output voltage ripple. Multilayer ceramic capacitors are an excellent choice as they have extremely low ESR and are available in small footprints. A 10 μ F to 22 μ F output capacitor is sufficient for most applications. Larger values may be used to obtain lower output ripple and improve

transient response. X5R and X7R dielectric material are preferred for their ability to maintain capacitance over wide voltage and temperature ranges.

Low ESR input capacitors reduce input switching noise and reduce the peak current drawn from the battery. It follows that ceramic capacitors are also a good choice for input decoupling and should be located as close as possible to the device. A 4.7 μ F to 10 μ F input capacitor is sufficient for most application. Larger values may be used without limitations.

Layout Consideration

For best performance of the TMI5120, the following guidelines must be strictly followed.

- Input and Output capacitors should be placed close to the IC and connected to ground plane to reduce noise coupling.
- The GND should be connected to a strong ground plane for heat sinking and noise protection.
- Keep the main current traces as possible as short and wide.
- SW node of the converter is with high frequency voltage swing. It should be kept at a small area.

FUNCTION BLOCK DIAGRAM

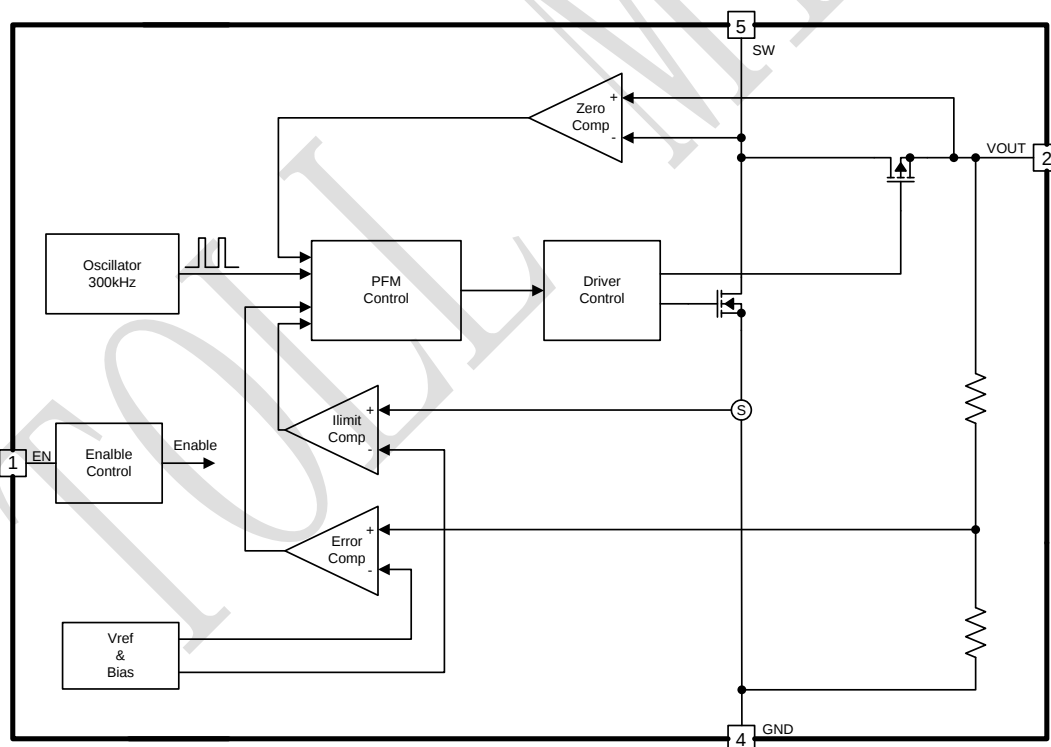
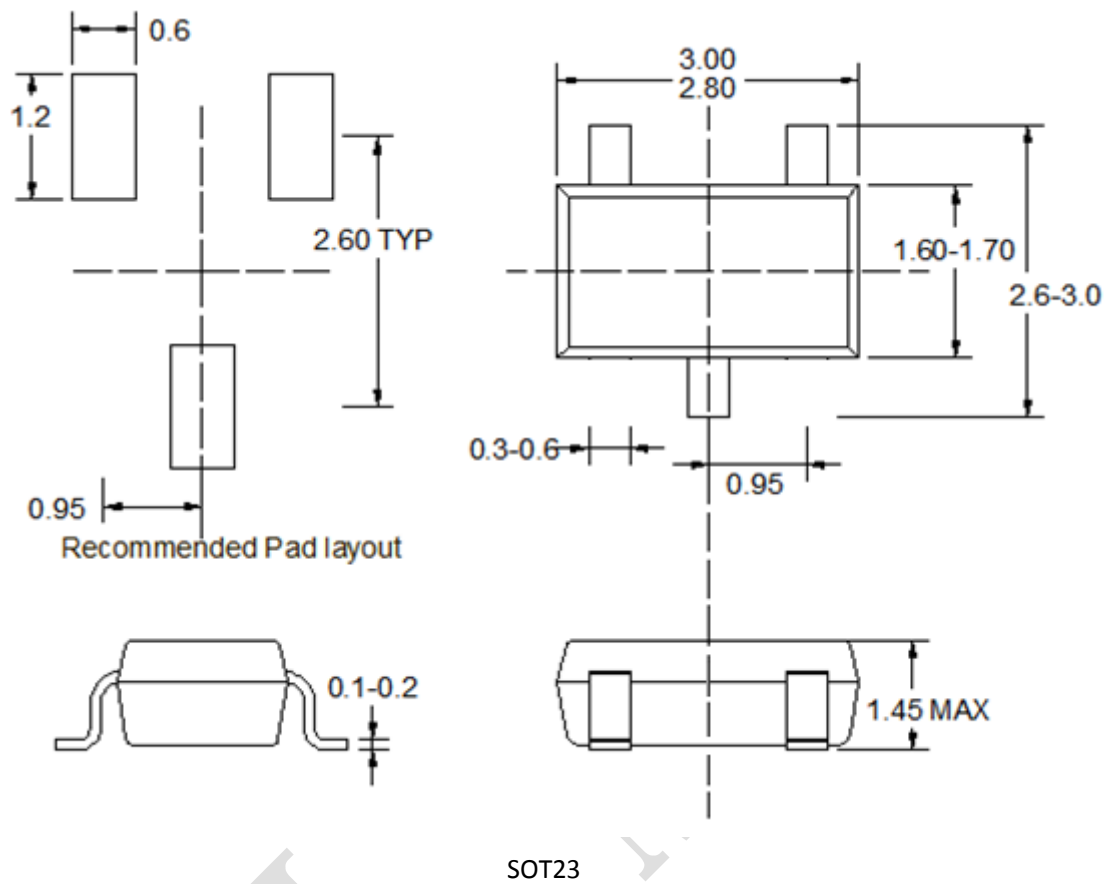
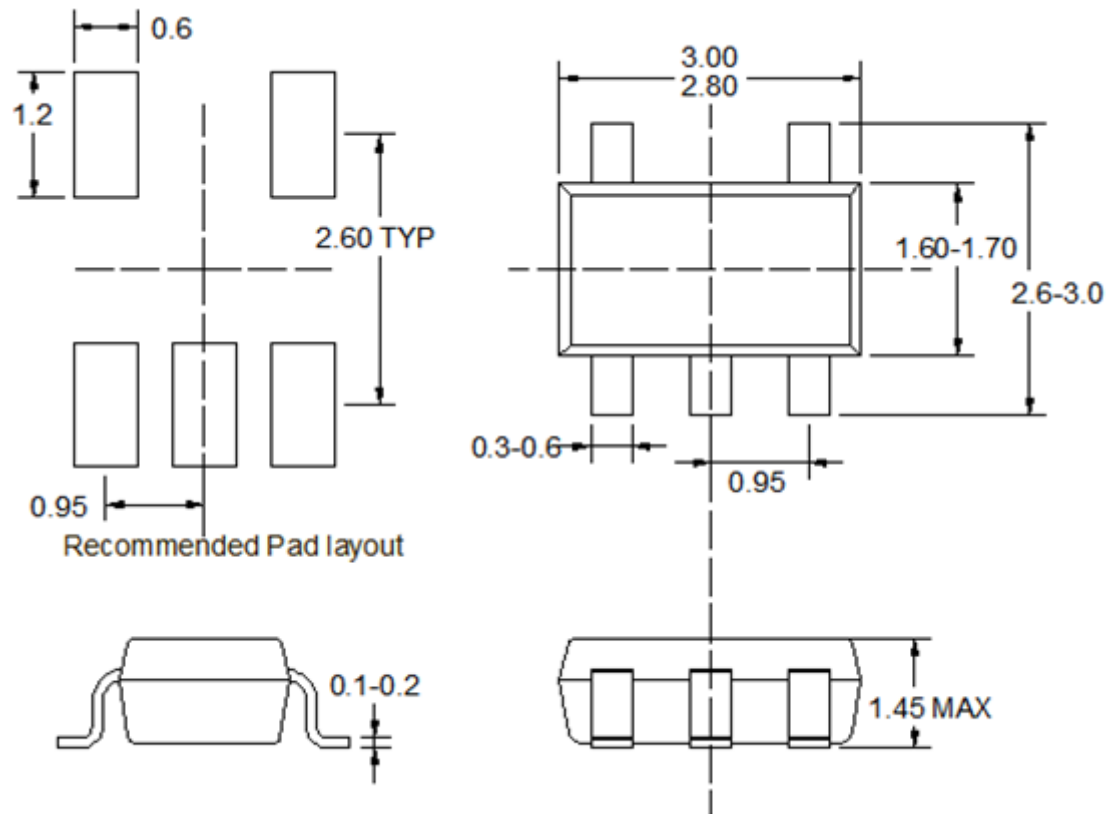


Figure 2.TMI5120 Block Diagram

PACKAGE INFORMATION





SOT23-5