FEATURES

- High Efficiency: Up to 96%
- 1.5MHz Constant Frequency Operation
- 1.0A Output Current
- No Schottky Diode Required
- 2.5V to 6V Input Voltage Range
- Output Voltage as Low as 0.6V
- PFM Mode for High Efficiency in Light Load
- 100% Duty Cycle in Dropout Operation
- Low Quiescent Current: 40μA
- Short Circuit Protection
- Thermal Fault Protection
- Inrush Current Limit and Soft Start
- SOT23-5 package

APPLICATIONS

- Cellular and Smart Phones
- Microprocessors and DSP Core Supplies
- Wireless and DSL Modems
- PDA
- MP3 Player
- Digital Still and Video Cameras
- Portable Instruments

GENERAL DESCRIPTION

The MST8010 are high-efficiency, high frequency synchronous step-down DC-DC regulator ICs capable of delivering up to 1.5A output currents. The MST8010 can operate over a wide input voltage range from 2.5V to 6.0V and integrate main switch and synchronous switch with very low RDS(ON) to minimize the conduction loss.

It is ideal for powering portable equipment that runs from a single cell Lithium-Ion (Li+) battery. The output voltage can be regulated as low as 0.6V. The MST8010 can also run at 100% duty cycle for low dropout operation, extending battery life in portable system. This device offers two operation modes, PWM control and PFM Mode switching control, which allows a high efficiency over the wider range of the load.

The MST8010 is offered in a low profile (1mm) 5-pin, thin SOT package, and is available in an adjustable version.

TYPICAL APPLICATION

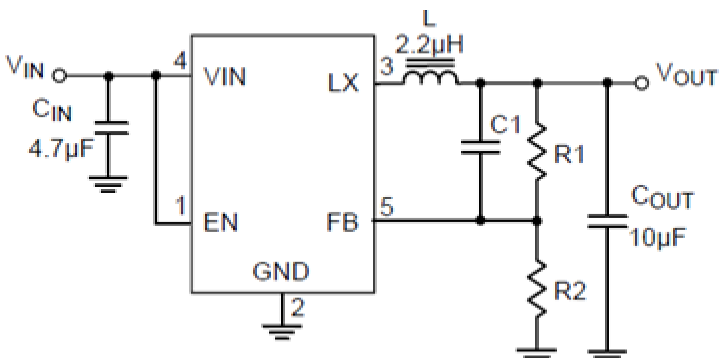
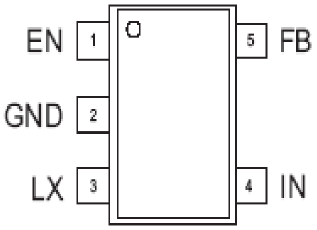


Figure 1: High Efficiency Step-down Converter

Package/Order Information



Order Part Number
Part marking

Note 4: Data Code

Pin Description

PIN	NAME	FUNCTION
1	EN	Regulator Enable control input. Drive RUN above 1.5V to turn on the part. Drive RUN below 0.3V to turn it off. In shutdown, all functions are disabled drawing <1µA supply current. Do not leave RUN floating.
2	GND	Ground
3	LX	Power Switch Output. It is the Switch note connection to Inductor. This pin connects to the drains of the internal P-CH and N-CH MOSFET switches.
4	IN	Supply Input Pin. Must be closely decoupled to GND, Pin 2, with a 2.2µF or greater ceramic capacitor.
5	FB	Feedback Input Pin. Connect FB to the center point of the external resistor divider. The feedback threshold voltage is 0.6V.

Functional Block Diagram

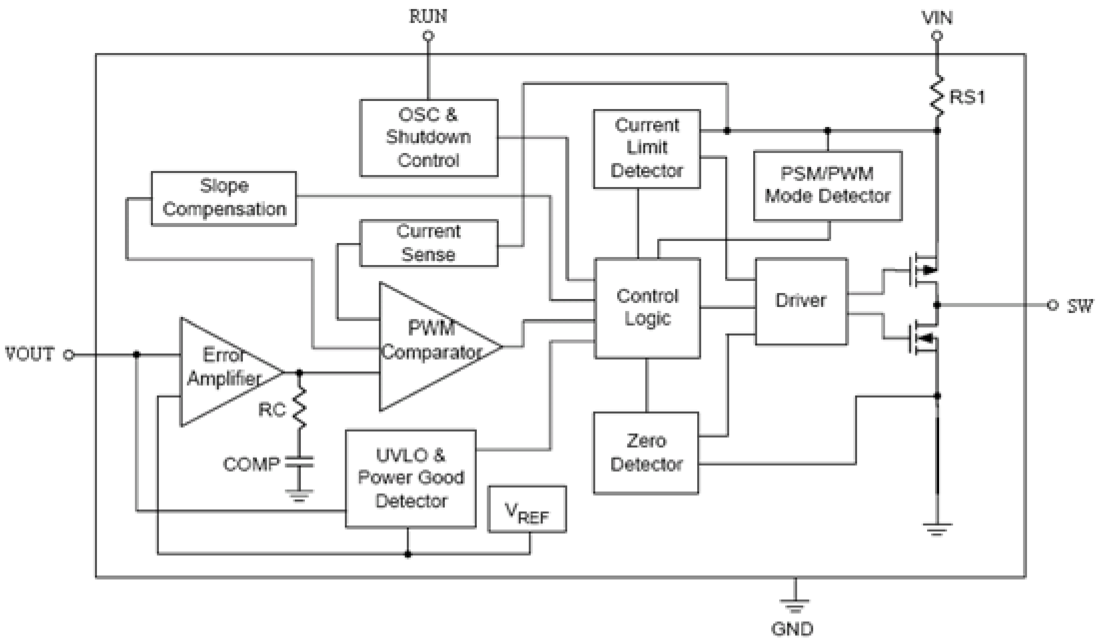


Figure 2. MST8010 Block Diagram

Absolute Maximum Rating (Note 1)

Input Supply Voltage……………..…-0.3V to +6V
RUN, V_{FB} Voltages -0.3V to V_{IN}+0.3V
SW, Vout Voltages -0.3V to V_{IN}+0.3V
Peak SW Sink and Source Current 2.5A

Operating Temperature Range -40°C to +85°C
Junction Temperature (Note 2) +125°C
Storage Temperature Range -65°C to +150°C
Lead Temperature (Soldering, 10S) +300°C

Electrical Characteristics (Note 3)

(V_{IN}=V_{RUN}=3.6V, V_{OUT}=1.8V, T_A = 25°C, unless otherwise noted.)

Parameter	Conditions	MIN	TYP	MAX	unit
Input Voltage Range		2.5		6.0	V
UVLO Threshold			2.4		V
Input DC Supply Current					µA
PWM Mode	Vout = 90%, Iload=0mA		150	300	µA
PFM Mode	Vout = 105%, Iload=0mA		40	70	µA
Shutdown Mode	V_{RUN} = 0V, V_{IN}=4.2V		0.1	1.0	µA
Regulated Feedback Voltage	T_A = 25°C	0.588	0.600	0.612	V
Reference Voltage Line Regulation	Vin=2.5V to 6.0V		0.04	0.40	%/V
Output Voltage Line Regulation	V_{IN} = 2.5V to 6.0V		0.04	0.4	%
Output Voltage Load Regulation			0.5		%
Oscillation Frequency			1.5		MHz
On Resistance of PMOS	I_{SW}=100mA		0.3		Ω
ON Resistance of NMOS	I_{SW}=-100mA		0.2		Ω
Peak Current Limit	V_{IN}= 3V, Vout=90%	1.5			A
RUN Threshold		0.30	1.0	1.50	V
RUN Leakage Current			±0.01	±1.0	µA
SW Leakage Current	V_{RUN}=0V,V_{IN}=Vsw=5V		±0.01	±1.0	µA
Thermal Shutdown			160		℃

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:

$T_J = T_A + (P_D) \times (250°C/W)$.

Note3: 100% production test at +25°C. Specifications over the temperature range are guaranteed by design and characterization.

FUNCTIONAL DESCRIPTION

MST8010 is a synchronous buck regulator IC that integrates the PWM/PFM control, top and bottom switches on the same die to minimize the switching transition loss and conduction loss. With ultra-low RDS(ON) power switches and proprietary PWM control, this regulator IC can achieve the highest efficiency and the highest switch frequency simultaneously to minimize the external inductor and capacitor size, and thus achieving the minimum solution footprint.

The MST8010 requires only three external power components (Cin, Cout and L). The adjustable version can be programmed with external feedback to any voltage, ranging from 0.6V to the input voltage. At dropout, the converter duty cycle increases to 100% and the output voltage tracks the input voltage minus the Rdson drop of the high-side MOSFET.

The internal error amplifier and compensation provides excellent transient response, load, and line regulation. Soft start function prevents input inrush current and output overshoot during start up.

APPLICATIONS INFORMATION

Setting the Output Voltage

The external resistor divider is used to set the output voltage (see Typical Application on page 1). The feedback resistor R1 also sets the feedback loop bandwidth with the internal compensation capacitor. Choose R1 to be around 100kΩ for optimal transient response. R2 is then given by:

$$R_2 = \frac{R_1}{V_{out}/V_{FB} - 1}$$

Inductor Selection

For most designs, the MST8010 operates with inductors of 1µH to 4.7µH. Low inductance values are physically smaller but require faster switching, which results in some efficiency loss. The inductor value can be derived from the following equation:

$$L = \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times \Delta I_L \times f_{OSC}}$$

Where ΔI_L is inductor Ripple Current. Large value inductors result in lower ripple current and small value inductors result in high ripple current. For optimum voltage-positioning load transients, choose an inductor with DC series resistance in the 50mΩ to 150mΩ range.

Input Capacitor Selection

With the maximum load current at 1.5A, the maximum ripple current through input capacitor is about 0.6Arms. A typical X7R or better grade ceramic capacitor with 6V rating and greater than 10uF capacitance can handle this ripple current well. To minimize the potential noise problem, place this ceramic capacitor really close to the VIN and GND pins. Care should be taken to minimize the loop area formed by CIN, and IN/GND pins.

Output Capacitor Selection

The output capacitor is required to keep the output voltage ripple small and to ensure regulation loop stability. The output capacitor must have low impedance at the switching frequency. Ceramic capacitors with X5R or X7R dielectrics are recommended due to their low ESR and high ripple current ratings. The output ripple V_{OUT} is determined by:

$$\Delta V_{OUT} \le \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times f_{OSC} \times L} \times \left(ESR + \frac{1}{8 \times f_{osc} \times C3} \right)$$

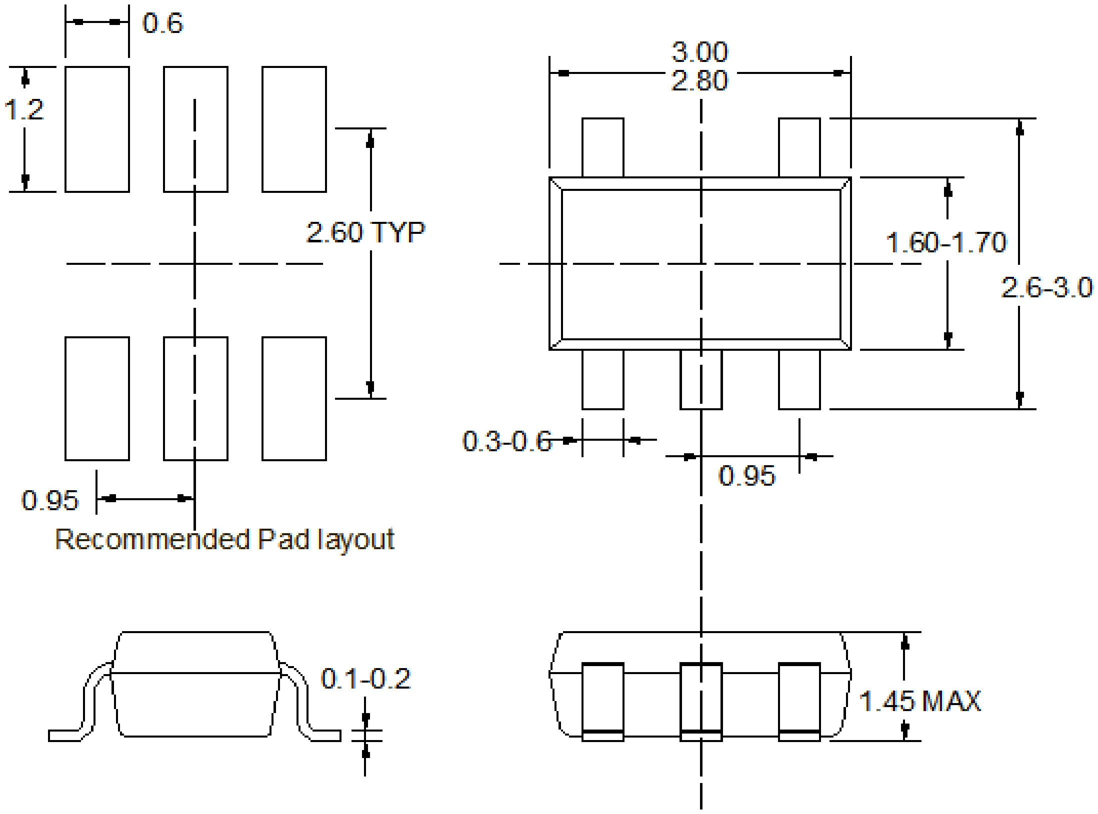
A 10µF ceramic can satisfy most applications.

PC Board Layout Checklist

When laying out the printed circuit board, the following checking should be used to ensure proper operation of the MST8010. Check the following in your layout:

1. The power traces, consisting of the GND trace, the SW trace and the VIN trace should be kept short, direct and wide.
2. Does the (+) plates of Cin connect to VIN as closely as possible? This capacitor provides the AC current to the internal power MOSFETs.
3. Keep the switching node, SW, away from the sensitive VOUT node.
4. Keep the (-) plates of Cin and Cout as close as possible.

PACKAGE DESCRIPTION



Note:
1) All dimensions are in millimeters.
2) Package length does not include mold flash, protrusion or gate burr.
3) Package width does not include interlead flash or protrusion.
4) Lead coplanarity (bottom of leads after forming) shall be 0.10 millimeters max.
5) Pin 1 is lower left pin when reading top mark from left to right,