1.2A, 24V Synchronous Step-Down Converter

DESCRIPTION

The KA9886 is a current mode monolithic buck switching regulator. Operating with an input range of 4.5V~24V, the KA9886 delivers 1.2A of continuous output current with two integrated N-Channel MOSFETs. The internal synchronous power switches provide high efficiency without the use of an external Schottky diode. At light loads, regulators operate in low frequency to maintain high efficiency and low output ripple. Current mode control provides tight load transient response and cycle-by-cycle current limit.

The KA9886 guarantees robustness with over current protection and hiccup, thermal protection, start-up current run-away protection, and input under voltage lockout.

The KA9886 is available in 6-pin SOT23-6 package, which provides a compact solution with minimal external components.

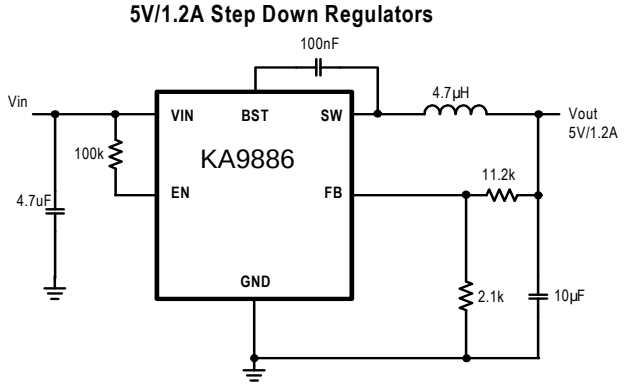
FEATURES

- 4.5 V to 24 V operating input range 1.2A output current
- Up to 93% efficiency
- High efficiency (>78%) at light load
- Internal Soft-Start
- Fixed 1.2MHz Switching frequency
- Available in SOT23-6 package
- Input under voltage lockout
- Start-up current run-away protection
- Over current protection and Hiccup
- Thermal protection

APPLICATIONS

- Distributed Power Systems
- Automotive Systems
- High Voltage Power Conversion
- Industrial Power Systems
- Battery Powered Systems

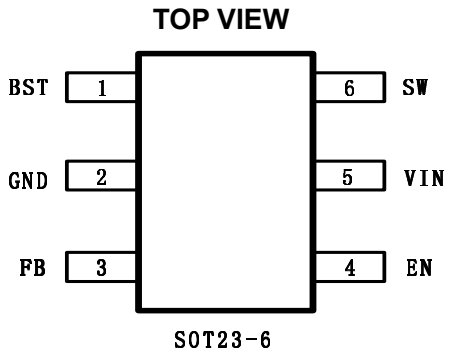
TYPICAL APPLICATION



ORDER INFORMATION

LEAD FREE FINISH	TAPE AND REEL	PACKAGE	TOP MARKING
KA9886SSOTB#	TRPBF	SOT23-6	BV

PIN CONFIGURATION



ABSOLUTE MAXIMUM RATING[1)]

VIN, EN, SW Pin ..... -0.3V to 26V
BST Pin ..... SW-0.3V to SW+5V
All other Pins ..... -0.3V to 6V
Junction Temperature[2) 3)] 150ºC
Lead Temperature 260ºC
Storage Temperature ..... -65ºC to +150ºC

RECOMMENDED OPERATING CONDITIONS

Input Voltage VIN .....4.5V to 24V
Output Voltage Vout.....0.8V to 21V
Operating Junction Temperature .....-40ºC to 125ºC

THERMAL PERFORMANCE[4)]

	θ_{JA}	θ_{Jc}
SOT23-6	220	...130ºC/W

Note:

1) Exceeding these ratings may damage the device.

2) The KA9886 guarantees robust performance from -40° C to 150°C junction temperature. The junction temperature range specification is assured by design, characterization and correlation with statistical process controls.

3) The KA9886 includes thermal protection that is int ended to protect the device in overload conditions. Thermal protection is active when junction temperature exceeds the maximum operating junction temperature. Continuous operation over the specified absolute maximum operating junction temperature may damage the device.

4) Measured on JESD51-7, 4-layer PCB.

ELECTRICAL CHARACTERISTICS

V_{IN} = 12V, T_A = 25°C, unless otherwise stated.						
Item	**Symbol**	**Condition**	**Min.**	**Typ.**	**Max.**	**Units**
V_{IN} Undervoltage Lockout Threshold	V_{IN_MIN}	V_{IN} falling		4.3		V
V_{IN} Undervoltage Lockout Hysteresis	$V_{IN\_MIN\_HYST}$	V_{IN} rising		250		mV
Shutdown Supply Current	I_{SD}	V_{EN}=0V		0.1	1	μA
Supply Current	I_Q	V_{EN}=5V, V_{FB}=1.2V		40	60	μA
Feedback Voltage	V_{FB}	4.5V<V_{VIN}<24V	776	800	824	mV
Top Switch Resistance[5)]	$R_{DS(ON)T}$			300		mΩ
Bottom Switch Resistance[5)]	$R_{DS(ON)B}$			150		mΩ
Top Switch Leakage Current	I_{LEAK_TOP}	V_{IN}=24V, V_{EN}=0V, V_{SW}=0V			1	uA
Bottom Switch Leakage Current	I_{LEAK_BOT}	V_{IN}= V_{SW} = 24V, V_{EN}=0V			1	uA
Top Switch Current Limit[5)]	I_{LIM_TOP}	Minimum Duty Cycle		2		A
Switch Frequency	f_{SW}			1.2		MHz
Minimum On Time[5)]	T_{ON_MIN}			120		ns
Minimum Off Time[5)]	T_{OFF_MIN}	V_{FB}=0.6V		120		ns
EN Shutdown Threshold	V_{EN_TH}	V_{EN} falling, FB=0V	1.08	1.2	1.32	V
EN Shutdown Hysteresis	V_{EN_HYST}	V_{EN} rising, FB=0V		100		mV
Thermal Shutdown[5)]	T_{TSD}			140		°C
Thermal Shutdown hysteresis[5)]	T_{TSD_HYST}			15		°C

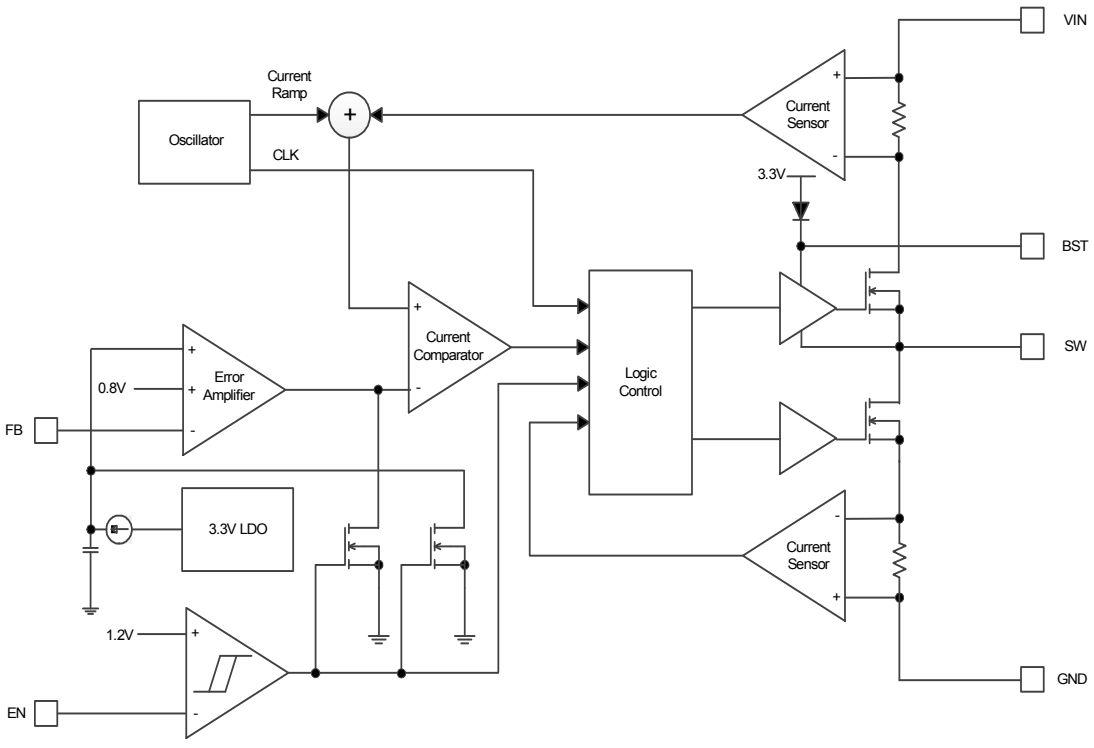
Note：

5) Guaranteed by design.

PIN DESCRIPTION

SOT23-6 Pin	Name	Description
1	BST	Bootstrap pin for top switch. A 0.1uF or larger capacitor should be connected between this pin and the SW pin to supply current to the top switch and top switch driver.
2	GND	Ground.
3	FB	Output feedback pin. FB senses the output voltage and is regulated by the control loop to 800mV. Connect a resistive divider at FB.
4	EN	Drive EN pin high to turn on the regulator and low to turn off the regulator.
7	VIN	Input voltage pin. VIN supplies power to the IC. Connect a 4.5V to 24V supply to VIN and bypass VIN to GND with a suitably large capacitor to eliminate noise on the input to the IC.
8	SW	SW is the switching node that supplies power to the output. Connect the output LC filter from SW to the output load.

BLOCK DIAGRAM



FUNCTIONAL DESCRIPTION

The KA9886 is a synchronous, current-mode, step-down regulator. It regulates input voltage from 4.5V to 24V down to an output voltage as low as 0.8V, and is capable of supplying up to 1.2A of load current.

Current-Mode Control

The KA9886 utilizes current-mode control to regulate the output voltage. The output voltage is measured at the FB pin through a resistive voltage divider and the error is amplified by the internal transconductance error amplifier.
Output of the internal error amplifier is compared with the switch current measured internally to control the output current limit.

PFM Mode

The KA9886 operates in PFM mode at light load. In PFM mode, switch frequency is continuously controlled in proportion to the load current, i.e. switch frequency is decreased when load current drops to boost power efficiency at light load by reducing switch-loss, while switch frequency is increased when load current rises, minimizing both load current and output voltage ripples.

Shut-Down Mode

The KA9886 operates in shut-down mode when voltage at EN pin is driven below 0.3V. In shut-down mode, the entire regulator is off and the supply current consumed by the KA9886 drops below 0.1uA.

Power Switch

N-Channel MOSFET switches are integrated on the KA9886 to down convert the input voltage to the regulated output voltage. Since the top MOSFET needs a gate voltage greater than the input voltage, a boost capacitor connected between BST and SW pins is required to drive the gate of the top switch. The boost capacitor is charged by the internal 3.3V rail when SW is low.

Vin Under-Voltage Protection

A resistive divider can be connected between Vin and ground, with the central tap connected to EN, so that when Vin drops to the pre-set value, EN drops below 1.2V to trigger input under voltage lockout protection.

Output Current Run-Away Protection

At start-up, due to the high voltage at input and low voltage at output, current inertia of the output inductance can be easily built up, resulting in a large start-up output current. A valley current limit is designed in the KA9886 so that only when output current drops below the valley current limit can the bottom power switch be turned off. By such control mechanism, the output current at start-up is well controlled.

Over Current Protection and Hiccup

KA9886 has a cycle-by-cycle current limit.
When the inductor current triggers current limit, KA9886 enters hiccup mode and periodically restart the chip. KA9886 will exit hiccup mode while not triggering current limit.

Thermal Protection

When the temperature of the KA9886 rises above 140°C, it is forced into thermal shut-down. Only when core temperature drops below 125°C can the regulator becomes active again.

PCB Layout Note

1. Place the input decoupling capacitor as close to KA9886 (VIN pin and PGND) as possible to eliminate noise at the input pin.
2. Put the feedback trace as far away from the inductor and noisy power traces as possible.
3. To improve thermal conduction, put an array of vias right under the exposed pad. Use small vias (15mil barrel diameter) so that the holes can be filled during the plating process. Very large holes can cause 'solder-wicking' problems during the reflow soldering process. Use a vias pitch (distance between the centers of two adjacent vias) of 40mil.

PACKAGE OUTLINE

SOT23-6 **UNIT: mm**