**24V/2A**
**Sync. Step-Down Converter**

## DESCRIPTION

The KA9887 is a current mode monolithic buck voltage converter. Operating with an input range of 3.7V-24V, the KA9887 delivers 2A of continuous output current with two integrated N-Channel MOSFETs. At light loads, regulators operate in low frequency to maintain high efficiency and low output ripple.

The KA9887 guarantees robustness with short circuit protection, thermal protection, current run-away protection, and input under voltage lockout.

The KA9887 is available in a 6-pin SOT23 package, which provides a compact solution with minimal external components.

## FEATURES

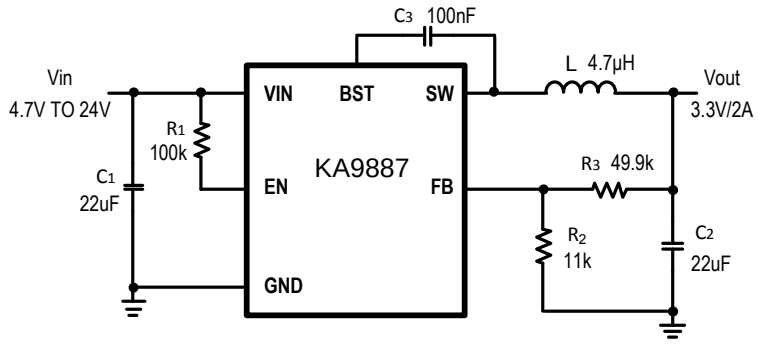
- 3.7V to 24V operating input range
  2A output current
- Up to 95% efficiency
- High efficiency (>80%) at light load
- Fixed 1.4MHz Switching frequency
- Input under voltage lockout
- Start-up current run-away protection
- Over current protection and Hiccup
- Thermal protection
- Available in SOT23-6 package

## APPLICATIONS

- Distributed Power Systems
- Networking Systems
- FPGA, DSP, ASIC Power Supplies
- Green Electronics/ Appliances
- Notebook Computers

## TYPICAL APPLICATION

**3.3V/2A Step Down Regulator**



## ORDER INFORMATION

| DEVICE[1)] | PACKAGE | TOP MARKING[2)] |
|---|---|---|
| SOTB#TRPBF | SOT23-6 | KCX<br>YWLLL |

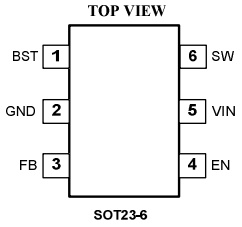
**Notes：**

1) JW□□□# TRPBF
- PB Free
- Tape and Reel(If" TR" is not shown, it means tube)
- Package Code
- Part No.

2) Line1: JWPNA
- Assembly House code
- Product code of JWXXXX
- Joulwatt LOGO

Line2: YWLLL
- Lot number
- Week code
- Year code

## PIN CONFIGURATION




## ABSOLUTE MAXIMUM RATING[1)]

VIN, EN, SW Pin ..... -0.3V to 30V
BST Pin ..... SW-0.3V to SW+5V
All other Pins ..... -0.3V to 6V
Junction Temp. [2) 3)] .....150ºC
Lead Temperature .....260ºC

## RECOMMENDED OPERATING CONDITIONS

Input Voltage VIN ..... 3.7V to 24V
Output Voltage Vout .....0.8V to VIN-3V
Operating Junction Temperature .....-40ºC to 125ºC

## THERMAL PERFORMANCE[4)]

| | $\theta_{JA}$ | $\theta_{Jc}$ |
|---|---|---|
| SOT23-6 ..... | 220 | ...130ºC/W |

**Note：**

**1)** Exceeding these ratings may damage the device.

**2)** The KA9887 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 KA9887 includes thermal protection that is inte nded 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

*VIN=12V, $T_A$=25℃, Unless otherwise stated.*

| Item | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{IN}$ Under Voltage Lock-out Threshold | $V_{IN\_MIN}$ | $V_{IN}$ rising | 3.3 | 3.5 | 3.7 | V |
| $V_{IN}$ Under voltage Lockout Hysteresis | $V_{IN\_MIN\_HYST}$ | | | 300 | | mV |
| Shutdown Supply Current | $I_{SD}$ | $V_{EN}$=0V | | 0.1 | 1 | μA |
| Supply Current | $I_Q$ | $V_{EN}$=5V, $V_{FB}$=1.2V | | 120 | 150 | μA |
| Feedback Voltage | $V_{FB}$ | 3.7V<$V_{VIN}$<24V | 776 | 800 | 824 | mV |
| Top Switch Resistance[5)] | $R_{DS(ON)T}$ | | | 130 | | mΩ |
| Bottom Switch Resistance[5)] | $R_{DS(ON)B}$ | | | 70 | | mΩ |
| Top Switch Leakage Current | $I_{LEAK\_TOP}$ | $V_{IN}$=24V, $V_{EN}$=0V, $V_{SW}$=0V | | 0.1 | 1 | μA |
| Bottom Switch Leakage Current | $I_{LEAK\_BOT}$ | $V_{IN}$=24V, $V_{EN}$=0V, $V_{SW}$=24V | | 0.1 | 1 | μA |
| Top Switch Current Limit[5)] | $I_{LIM\_TOP}$ | Minimum Duty Cycle | | 3.8 | | A |
| Switch Frequency | $F_{SW}$ | | 1000 | 1400 | 1800 | kHz |
| Minimum On Time[5)] | $T_{ON\_MIN}$ | | | 100 | | ns |
| Minimum Off Time[5)] | $T_{OFF\_MIN}$ | $V_{FB}$=0.4V | | 150 | | ns |
| EN Rising threshold voltage | $V_{EN\_TH}$ | $V_{EN}$ rising | 1.9 | 2 | 2.1 | V |
| EN shut down hysteresis[5)] | $V_{EN\_HYST}$ | | 150 | 170 | 200 | mV |
| Thermal Shutdown[5)] | $T_{TSD}$ | | | 160 | | °C |
| Thermal Shutdown hysteresis[5)] | $T_{TSD\_HYST}$ | | | 20 | | °C |

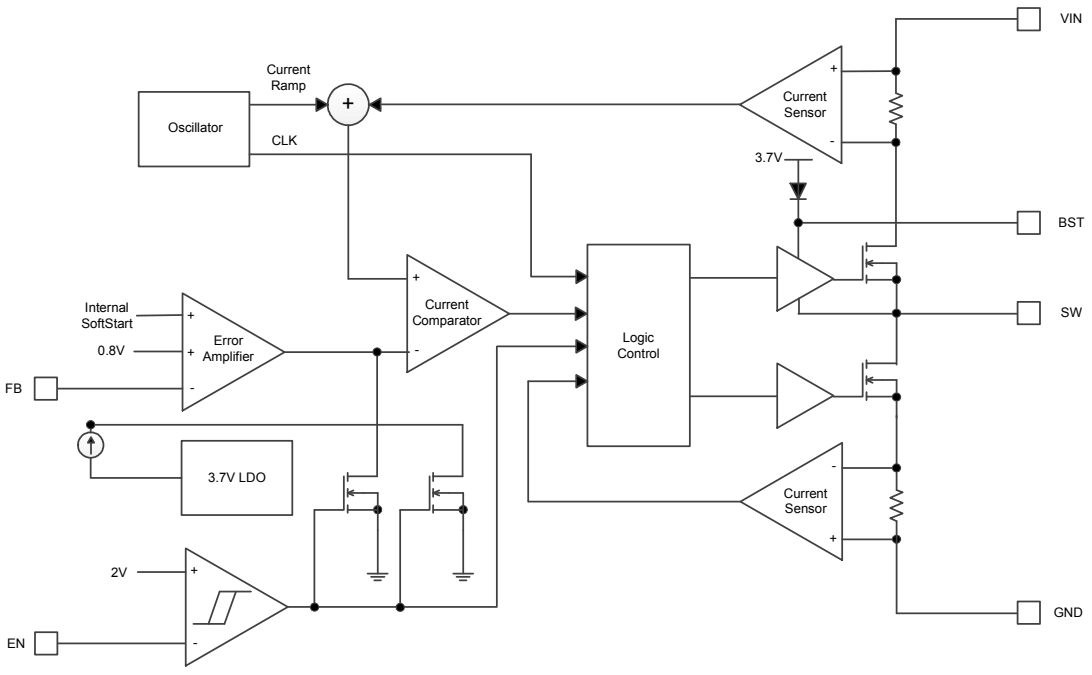
**Note：**

**5)** Guaranteed by design.

## PIN DESCRIPTION

| TSOT23-6 Pin | Name | Description |
|---|---|---|
| 1 | GND | Ground. |
| 2 | SW | SW is the switching node that supplies power to the output. Connect the output LC filter from SW to the output load. |
| 3 | VIN | Input voltage pin. VIN supplies power to the IC. Connect a 3.7V to 24V supply to VIN and bypass VIN to GND with a suitably large capacitor to eliminate noise on the input to the IC. |
| 4 | FB | Output feedback pin. FB senses the output voltage and is regulated by the control loop to 0.8V. Connect a resistive divider at FB. |
| 5 | EN | Drive EN pin high to turn on the regulator and low to turn off the regulator. |
| 6 | 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. |

## BLOCK DIAGRAM



## FUNCTIONAL DESCRIPTION

The KA9887 is a synchronous, current-mode, step-down regulator. It regulates input voltages from 3.7V to 24V down to an output voltage as low as 0.8V, and is capable of supplying up to 2A of load current.

### Current-Mode Control

The KA9887 utilizes current-mode control to regulate the FB voltage. Voltage at the FB pin is regulated at 0.8V so that by connecting an appropriate resistive divider between VOUT and GND, designed output voltage can be achieved.

### PFM Mode

The KA9887 operates in PFM mode at light load. In PFM mode, switch frequency decreases when load current drops to boost power efficiency at light load by reducing switch-loss, while switch frequency increases when load current rises, minimizing output voltage ripples.

### Internal Soft-Start.

Soft-Start makes output voltage rising smoothly follow an internal SS voltage until SS voltage is higher than the internal reference voltage. It can prevent overshoot of output voltage when startup.

### Power Switch

N-Channel MOSFET switches are integrated on the KA9887 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 3.7V rail when SW is low.

### Vin Under-Voltage Protection

A resistive divider can be connected between Vin and GND, with the central tap connected to EN, so that when Vin drops to the pre-set value, EN drops below 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 KA9887 so that only when output current drops below the valley current limit can the top power switch be turned on. By such control mechanism, the output current at start-up is well controlled.

### Over Current Protection and Hiccup

KA9887 has a cycle-by-cycle current limit. When the inductor current triggers current limit, KA9887 enters hiccup mode and periodically restart the chip.

KA9887 will exit hiccup mode while not triggering current limit.

### Thermal Protection

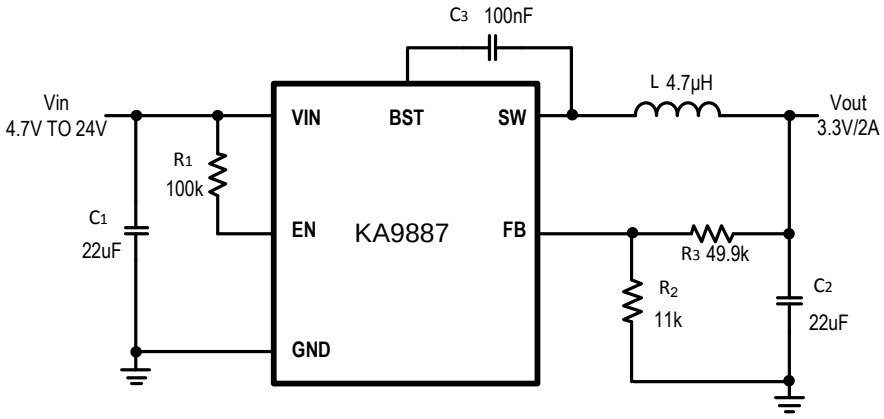
When the temperature of the KA9887 rises above 160°C, it is forced into thermal shut-down.

Only when core temperature drops below 140°C can the regulator becomes active again.

## REFERENCE DESIGN

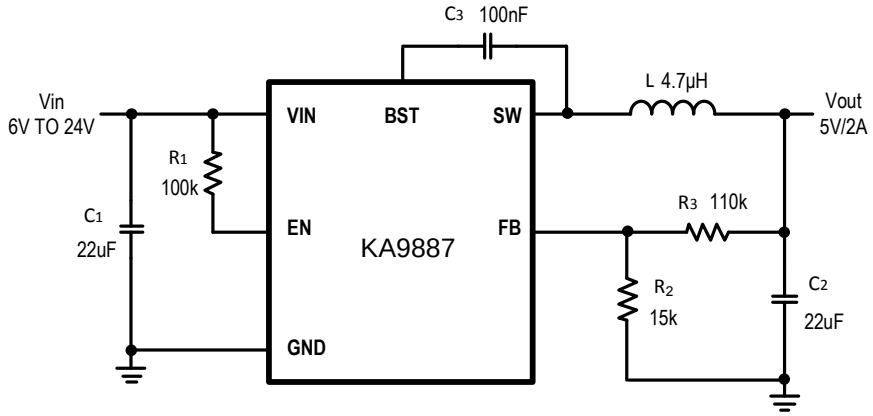
### Reference 1：

$V_{IN}$ ： 4.7V ~ 24V
$V_{OUT}$: 3.3V
$I_{OUT}$ : 0~2A




### Reference 2：

$V_{IN}$ ： 6V ~ 24V
$V_{OUT}$: 5V
$I_{OUT}$ : 0~2A



## PACKAGE OUTLINE

SOT23-6 UNIT: mm