

## General Description

The VS4101 is a step-up DC/DC converter designed for driving up to 8 white LEDs in series from a single cell Lithium Ion battery with constant current. Because it directly regulates output current, the VS4101 is ideal for driving light emitting diodes (LEDs) whose light intensity is proportional to the current passing through them, not the voltage across their terminals. A single external resistor sets LED current between 5mA and 20mA, which can then be easily adjusted using either a DC voltage or a pulse width modulated (PWM) signal. Its low 104mV feedback voltage reduces power loss and improves efficiency. The OV pin monitors the output voltage and turns off the converter if an over-voltage condition is present due to an open circuit condition. The PT4101 is available in SOT23-6 and QFN8 packages.

## Features

- Driver Up to 5 series White LEDs from 2.5V
- Driver Up to 8 series White LEDs from 3.6V
- Up to 87% Efficiency
- Over 1.2MHz Fixed Switching Frequency
- Low 104mV Feedback Voltage
- Open Load Shutdown
- Soft-Start/PWM Dimming
- Internal Current Limit
- SOT23-6 and QFN8 Packages

## Applications

- Cellular Phones
- Digital Cameras
- LCD modules
- PDAs, Handheld Computers

## Typical Application

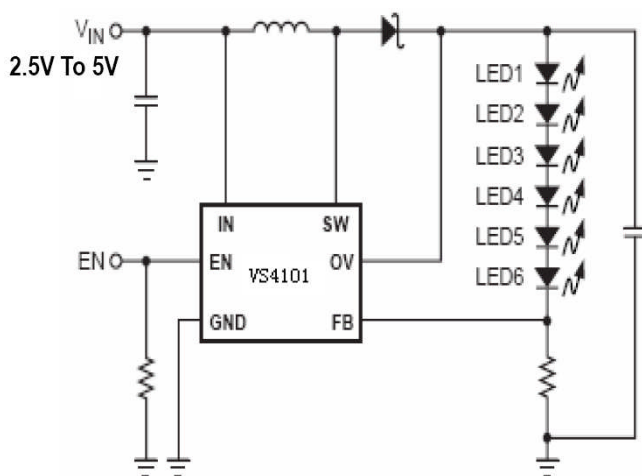


Figure 1. Li-Ion Driver for Six White LEDs

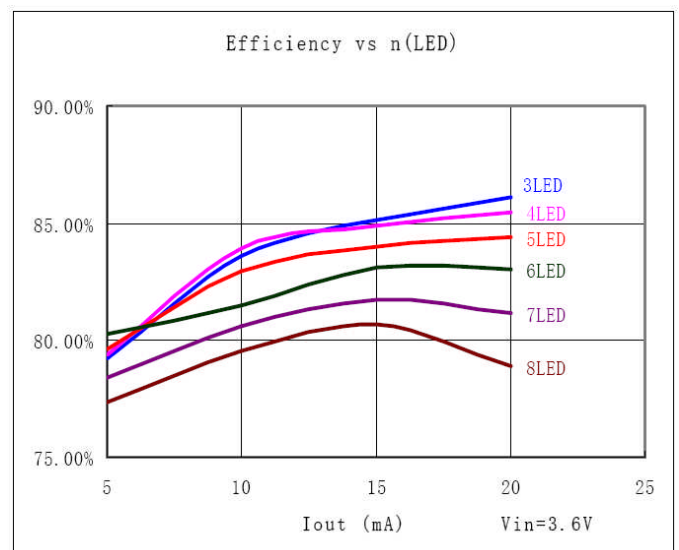


Figure 2. Efficiency vs Number of LEDs

## Ordering Information

### VS4101CPPP

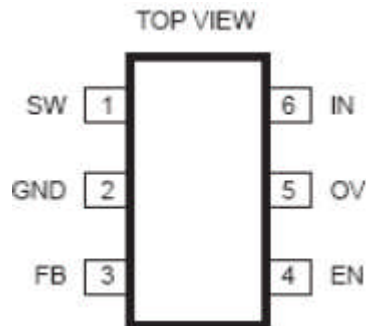
**Package Type**

23F: SOT-23-6

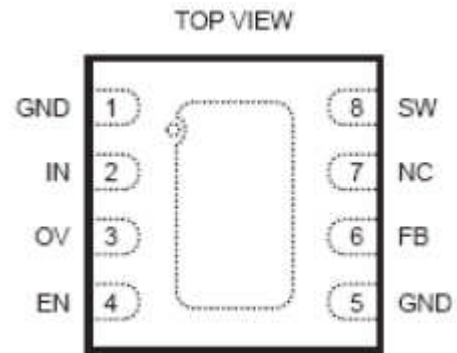
QFN: QFN-8 2x2

E: **Pb Free Package**

## Package Reference



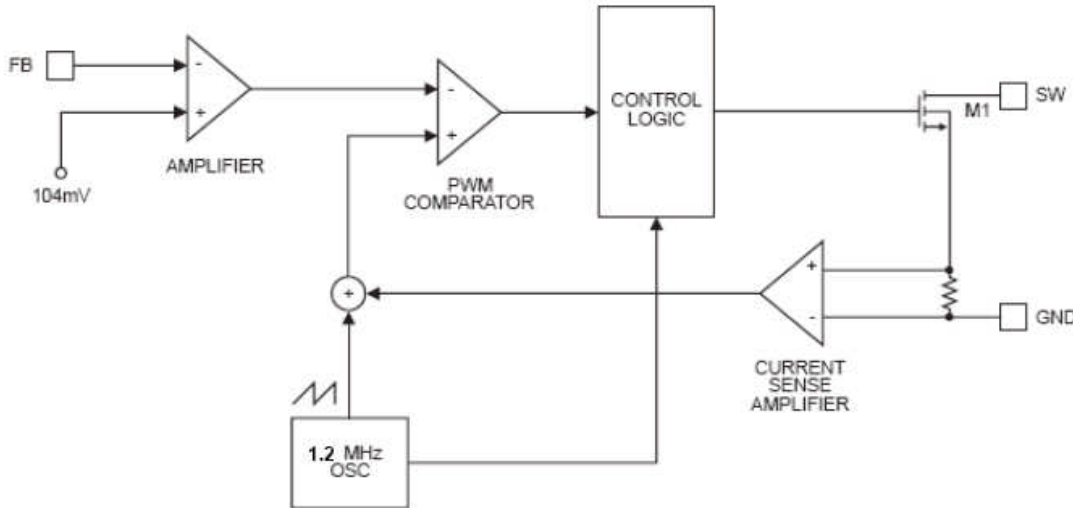
## Package Reference



## Pin Description

| SOT23-6<br>Pin # | QFN8<br>Pin# | Pin Name | Function  |
|------------------|--------------|----------|---|
| 1                | 8            | SW       | Power Switch Output.  |
| 2                | 1,5          | GND      | Ground  |
| 3                | 6            | FB       | Feedback Input.   |
| 4                | 4            | EN       | Regulator On/Off Control Input. A high input at EN turns on the converter, and a low input turns it off. When not used, connect EN to the input source for automatic startup. The EN pin cannot be left floating. |
| 5                | 3            | OV       | Over Voltage Input. OV measures the output voltage for open circuit protection. Connect OV to the output at the top of the LED string.  |
| 6                | 2            | VIN      | Input Supply Pin. Must be locally bypassed.   |

## Functional Block Diagram



## Absolute Maximum Ratings

| Parameter   | Symbol          | Value        | Unit          |
|---|-----------------|--------------|---------------|
| Input Voltage   | $V_{IN}$        | -0.3~6       | V             |
| SW Voltage  | $V_{SW}$        | -0.3~35      | V             |
| FB Voltage  | $V_{FB}$        | -0.3~VDD+0.3 | V             |
| EN Voltage  | $V_{EN}$        | -0.3~VDD+0.3 | V             |
| Thermal Resistance (Junction to Atmosphere, no Heat sink) | $R_{\theta JA}$ | 220          | $^{\circ}C/W$ |
| Operating Junction Temperature                            | $T_J$           | 150          | $^{\circ}C$   |
| Storage Temperature Range                                 | $T_{STG}$       | -55~150      | $^{\circ}C$   |
| Lead Temperature (Soldering, 10sec)                       | $T_{LEAD}$      | 260          | $^{\circ}C$   |

## Recommended Operating Range

| Parameter             | Symbol   | Min      | Max | Unit        |
|-----------------------|----------|----------|-----|-------------|
| Input Voltage         | $V_{IN}$ | 2.5      | 6   | V           |
| Operating Temperature | $T_{OP}$ | -40      | 85  | $^{\circ}C$ |
| Output Voltage        | $V_{SW}$ | $V_{IN}$ | 28  | V           |

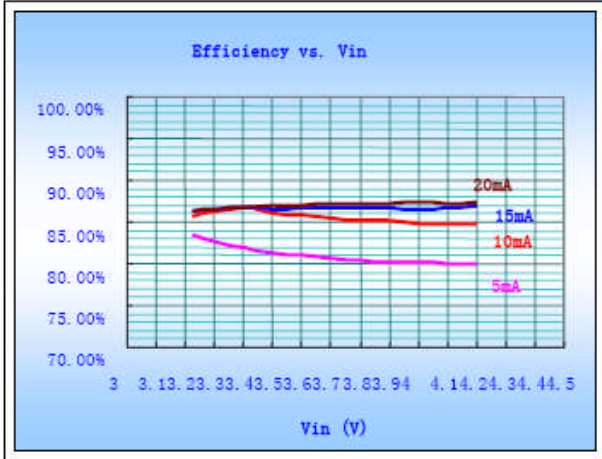
### Electrical Characteristics

(VIN=3V, VCTRL =3V, TA=25°C, unless otherwise specified.)

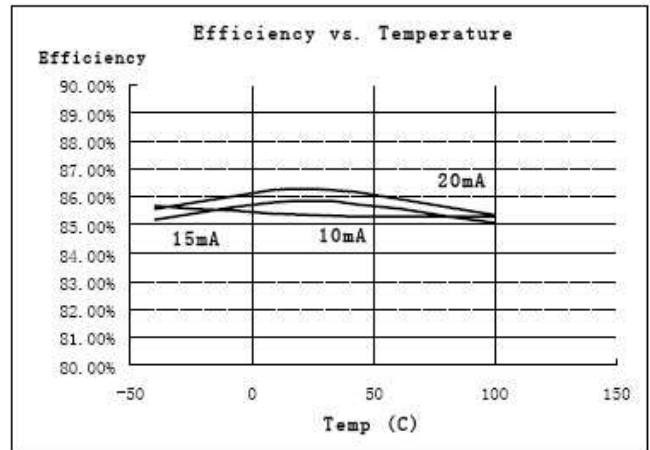
| Parameter                       | Symbol            | Conditions                             | Min | Type | Max | Unit |
|---------------------------------|-------------------|--|-----|------|-----|------|
| Minimum Operating Voltage       | VIN(min)          |  | 2.5 |      |     | V    |
| Maximum Operating Voltage       | VIN(max)          |  |     |      | 6   |      |
| Feedback Voltage                | VFB               | IOUT=15mA, 4 LEDs,<br>TA=-40°C to 85°C | 94  | 104  | 114 | mV   |
| FB Pin Bias Current             | IFB               |  |     | 0.05 | 1   | µA   |
| Supply Current                  | ICC               | VFB=VIN, Not Switching                 |     | 100  | 350 | µA   |
| Supply Current                  | IQ                | VEN=0V                                 |     | 0.1  | 1   | µA   |
| Switching Frequency             | f                 |  | 1.0 | 1.25 | 1.5 | MHz  |
| Maximum Duty Cycle              | DMAX              |  | 85  | 90   |     | %    |
| SW Current Limit                | I <sub>LEAK</sub> |  |     | 400  |     | mA   |
| Switch Leakage Current          |                   | V <sub>SW</sub> =5V                    |     | 0.01 | 1   | µA   |
| EN Pin Voltage                  | VEN               | High                                   | 1.5 |      |     | V    |
|                                 |                   | Low                                    |     |      | 0.4 |      |
| Open Circuit Shutdown Threshold | VOV               | ID=150mA                               |     | 0.7  |     | V    |
| Soft Start Time                 | t                 |  |     | 160  |     | µs   |

**Typical Performance Characteristics**

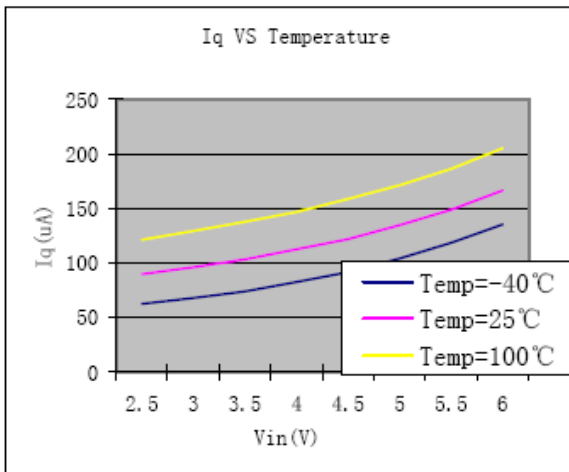
**Efficiency vs Vin and I<sub>LED</sub>**



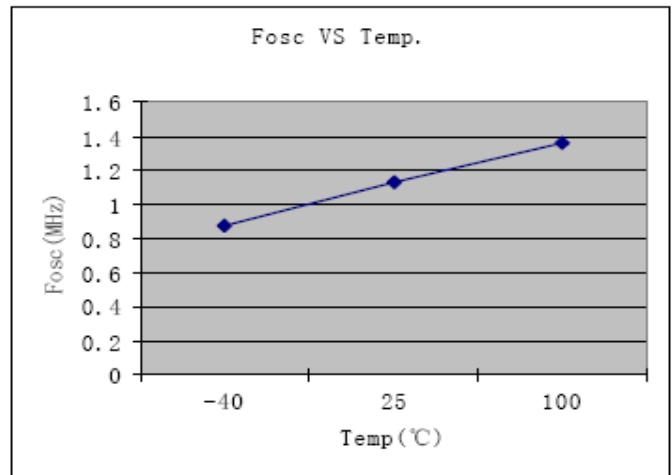
**Efficiency vs Temperature**



**Quiescent Current vs V<sub>IN</sub> and Temperature**



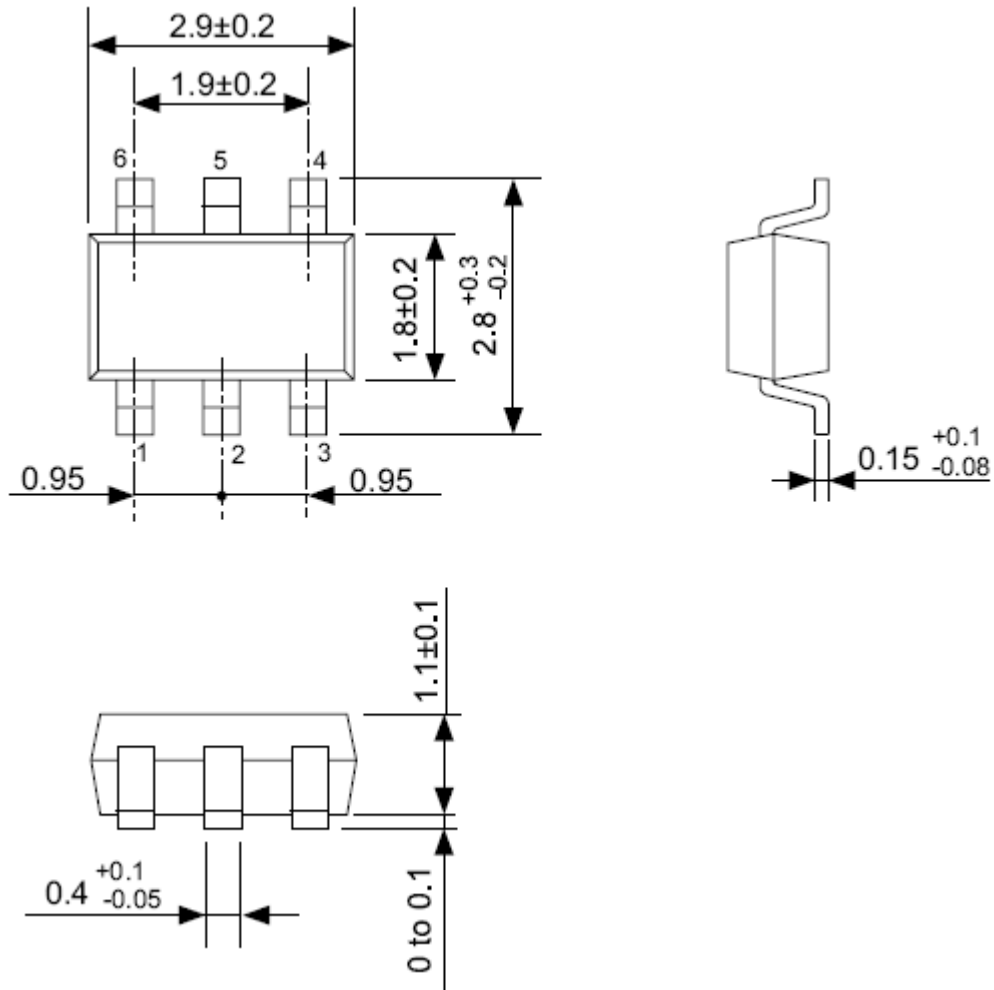
**Switching Frequency vs Temperature**



**Mechanical Dimensions**

SOT-23-6

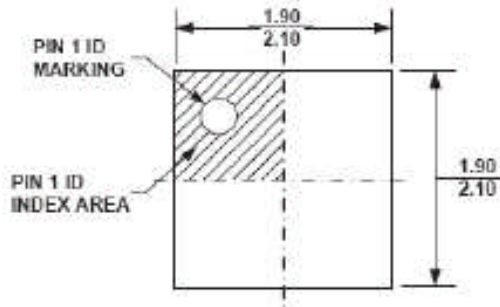
Unit: mm



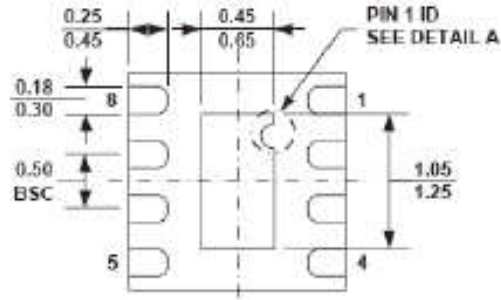
**Mechanical Dimensions**

**QFN8**

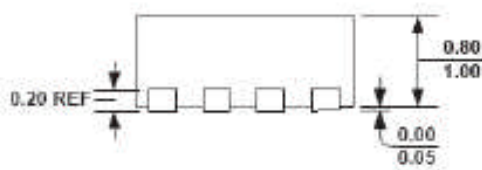
**Unit: mm**



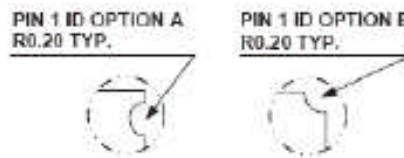
**TOP VIEW**



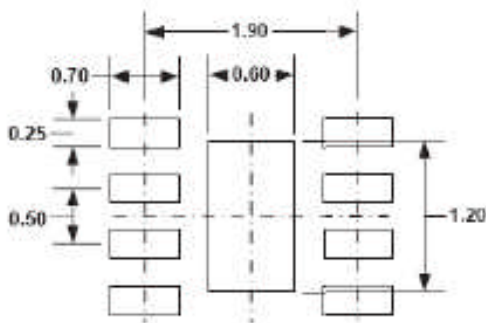
**BOTTOM VIEW**



**SIDE VIEW**



**DETAIL A**



**RECOMMENDED LAND PATTERN**

**NOTE:**

- 1) ALL DIMENSIONS ARE IN MILLIMETERS.
- 2) EXPOSED PADDLE SIZE DOES NOT INCLUDE MOLD FLASH.
- 3) LEAD COPLANARITY SHALL BE 0.10 MILLIMETER MAX.
- 4) DRAWING CONFORMS TO JEDEC MO-229, VARIATION VCCD-3.
- 5) DRAWING IS NOT TO SCALE.