# One Cell Lithium-ion/Polymer Battery Protection IC

## GENERAL DESCRIPTION

JTM9901 is a spacing saving single chip lithium-ion/polymer battery protection IC. Integrating power MOSFET and only two external components makes the protection board highly compact. JTM9901 has full protection including over charging voltage protection, over discharging protection, over current protection, short protection and over temperature protection. The very low standby current drains little current from the cell while in storage. JTM9901 is available in 8 PIN SOP8_EPAD package.

·Integrate low Rdson Power MOSFET
·SOP8_EPAD Package
·Over-temperature Protection
·Two-steps Over current protection
·High-accuracy Voltage Detection
·Low Current Consumption
- Operation Mode: 5.2μA typ.
- Power-down Mode: 3μA typ.

RoHS Compliant and Lead (Pb) Free

## APPLICATIONS

One-Cell Lithium-ion Battery Pack
Lithium-Polymer Battery Pack

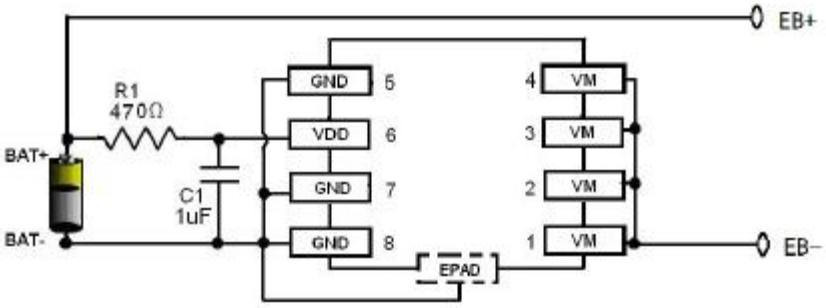



Figure 1. Typical Application Circuit

## PIN DESCRIPTION

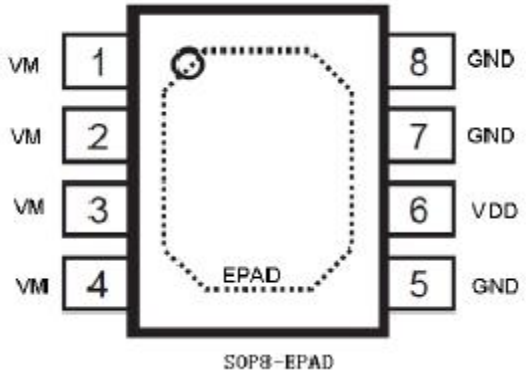



Figure 2. PIN Configuration

## FEATURES

| Number | Name | Description |
|---|---|---|
| 1,2,3,4 | VM | The negative terminal of the battery pack. The internal FET switch connects this terminal to GND |
| 5,7,8,EPAD | GND | Ground, connect the negative terminal of the battery to this pin |
| 6 | VDD | Power Supply |

## ORDERING INFORMATION

| PART NUMBER | Package | Overcharge Detection Voltage [VCU] (V) | Overcharge Release Voltage [VCL] (V) | Overdischarge Detection Voltage [VDL] (V) | Overdischarge Release Voltage [VDR] (V) | Overcurrent Detection Current [IOV1] (A) | Top Mark |
|---|---|---|---|---|---|---|---|
| JTM9901 | ESOP 8 | 4.28 | 4.10 | 2.40 | 3.0 | 8 | 9901xx |

## Function Block Diagram

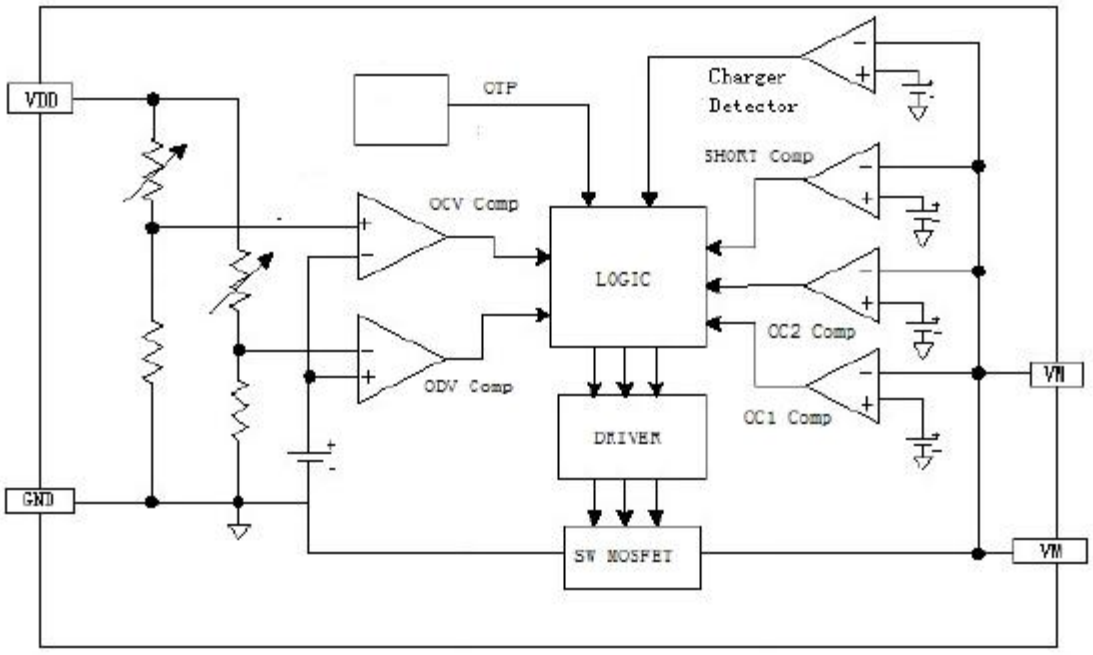



Figure 3. Functional Block Diagram

## ABSOLUTE MAXIMUM RATINGS

(Note: Do not exceed these limits to prevent damage to the device. Exposure to absolute maximum rating conditions for long periods may affect device reliability.)

| PARAMETER | VALUE | UNIT |
|---|---|---|
| VDD input pin voltage | -0.3 to 6 | V |
| VM input pin voltage | -6 to 10 | V |
| Operating Ambient Temperature | -40 to 85 | °C |
| Maximum Junction Temperature | 125 | °C |

| | | |
|---|---|---|
| Storage Temperature | -55 to 150 | °C |
| Lead Temperature ( Soldering, 10 sec) | 300 | °C |
| Power Dissipation at T=25 ℃ | 0.4 | W |
| Package Thermal Resistance (Junction to Ambient) θJA | 250 | °C/W |
| Package Thermal Resistance (Junction to Case) θJC | 130 | °C/W |
| ESD | 2000 | V |

## ABSOLUTE MAXIMUM RATINGS

Typically TA = 27oC, VDD=3.7V unless otherwise specified

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| ***Detection Voltage*** | | | | | | |
| Overcharge Protection Voltage | $V_{OCV}$ | | 4.25 | 4.28 | 4.35 | V |
| Overcharge Protection Release Voltage | $V_{OCR}$ | | 4.04 | 4.10 | 4.16 | V |
| Overdischarge Protection Voltage | $V_{ODV}$ | | 2.3 | 2.4 | 2.5 | V |
| Overdischarge Protection Release Voltage | $V_{ODR}$ | | 2.9 | 3.0 | 3.1 | V |
| Charger Detection Voltage | $V_{CHA}$ | | -0.07 | -0.12 | -0.2 | V |
| ***Detection Current*** | | | | | | |
| Class1 Overdischarge Protection Current | $I_{OCI1}$ | | 6 | 8 | 11 | A |
| Class2 Overdischarge Protection Current | $I_{OCI2}$ | | 10 | 14 | 19 | A |
| Load Short-Circuiting Detection | $I_{SHORT}$ | | 28 | 36 | 45 | A |
| Overcharge Protection Current | $I_{CHA}$ | | 4 | 7 | 10 | A |
| ***Current Consumption*** | | | | | | |
| Current Consumption in Normal Operation | $I_{OPE}$ | $V_{D`D}$=3.9V VM =0V | | 5.2 | 8 | μA |
| Current Consumption in power Down | $I_{PDN}$ | $V_{DD}$=2.0V VM pin floating | | 3 | | μA |
| ***VM Internal Resistance*** | | | | | | |
| Internal Resistance between VM and $V_{DD}$ | $R_{VMD}$ | $V_D$=3.6V VM=1.0V | | 160 | | kΩ |
| Internal Resistance between VM and GND | $R_{VMS}$ | $V_{DD}$=2.0V VM=1.0V | | 50 | | kΩ |
| ***FET on Resistance*** | | | | | | |
| Equivalent FET on Resistance | $R_{DS(ON)}$ | $V_{DD}$=3.6V $I_{VM}$ =1.0A | | 20 | | mΩ |
| ***Over Temperature Protection*** | | | | | | |
| Over Temperature Protection | $T_{SHD+}$ | | | 120 | | oC |

| | | | | | | |
|---|---|---|---|---|---|---|
| Over Temperature Recovery Degree | $T_{SHD-}$ | | | 100 | | $^{o}C$ |
| ***Detection Delay Time*** | | | | | | |
| Overcharge Voltage Detection Delay Time | $t_{OCV}$ | | | 130 | | mS |
| Overdischarge Voltage Detection Delay Time | $t_{ODV}$ | | | 40 | | mS |
| Overdischarge Current1 Delay Time | $t_{IOV1}$ | | | 10 | | mS |
| Overdischarge Current2 Delay Time | $t_{IOV2}$ | | | 3 | | mS |
| Load Short-Circuiting Detection Delay Time | $t_{SHORT}$ | | | 150 | | uS |

# Description of Operation

## Overcharge Protection

When the voltage of the battery cell exceeds the overcharge protection voltage ($V_{OCV}$) beyond the overcharge delay time ($t_{OCV}$) period, charging is inhibited by turning off power MOSFET. The overcharge condition is released in two cases:
1. The voltage of the battery cell becomes lower than the overcharge release voltage ($V_{OCR}$) through self-discharge.
2. The voltage of the battery cell falls below the overcharge protection voltage ($V_{OCV}$) and a load is connected. When the battery voltage is above $V_{OCV}$, the overcharge condition will not release even a load is connected to the pack.

## Overdischarge Protection

When the voltage of the battery cell goes below the overdischarge protection voltage ($V_{ODV}$) beyond the overdischarge delay time ($t_{ODV}$) period, discharging is inhibited. Inhibition of discharging is immediately released when the voltage of the battery cell becomes higher than overdischarge release voltage ($V_{ODR}$).

## Overcurrent Protection

When the discharging current becomes higher than a specified Overdischarge Current and beyond over discharge current delay time period, discharging is inhibited. Inhibition of discharging is immediately released when the load is released or the impedance between EB+ and EB- is larger than 500kΩ. The JTM9901 provides three over current detection levels (8A, 14A and 36A) with three over current delay time ($t_{IOV1}$, $t_{IOV2}$ and $t_{SHORT}$) corresponding to each over current detection level.

## Over Temperature Protection

When IC temperature becomes higher than a specified value, JTM9901 will turn off Power MOSFET whatever in discharging or charging condition. In discharging condition, Inhibition of discharging is released when temperature lower than Over Temperature Recovery Degree (100 °C ) and load also released. In charging condition, Inhibition of charging is released when temperature lower than over temperature recovery degree(100 °C) and charger also removed.

## Over Charging Current Protection

When the charging current becomes higher than discharge protection Current ($I_{CHA}$) and beyond over discharge current delay time period, charging is inhibited. Inhibition of charging is immediately released when the charger is removed.

## Charger detection after Overdischarge

When over discharge occurs, discharging is inhibited. However, charging is still permitted through the parasitic diode of MOSFET. Once the charger is connected to the battery pack, JA9901 detects the voltage between VM and GND is below charge detection threshold voltage ($V_{CHA}$), Power MOSFET will turn on when Battery cell voltage is higher than Overdischarge Protection Voltage.

| | |
|---|---|
| Power Saving after Overdischarge | When overdischarge occurs, the JTM9901 will enter into power-down mode. |

## Timing Diagram

1. Overcharge(OCV) State →Load Discharge State →Normal State

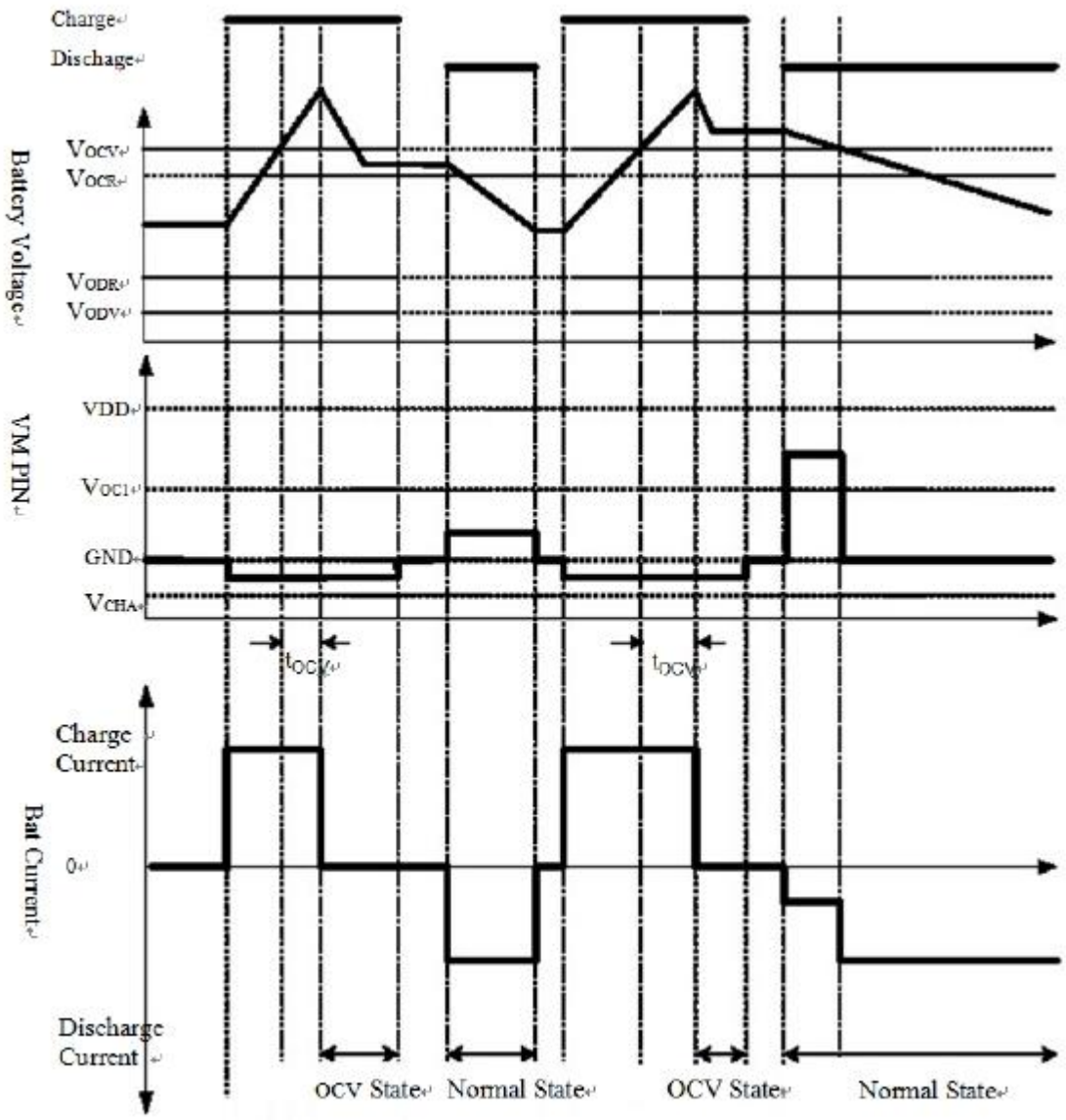



Figure 4. Charge, Discharge and Normal state timing

2. Over Discharge(ODV) State →Charging by a Charger →Normal State

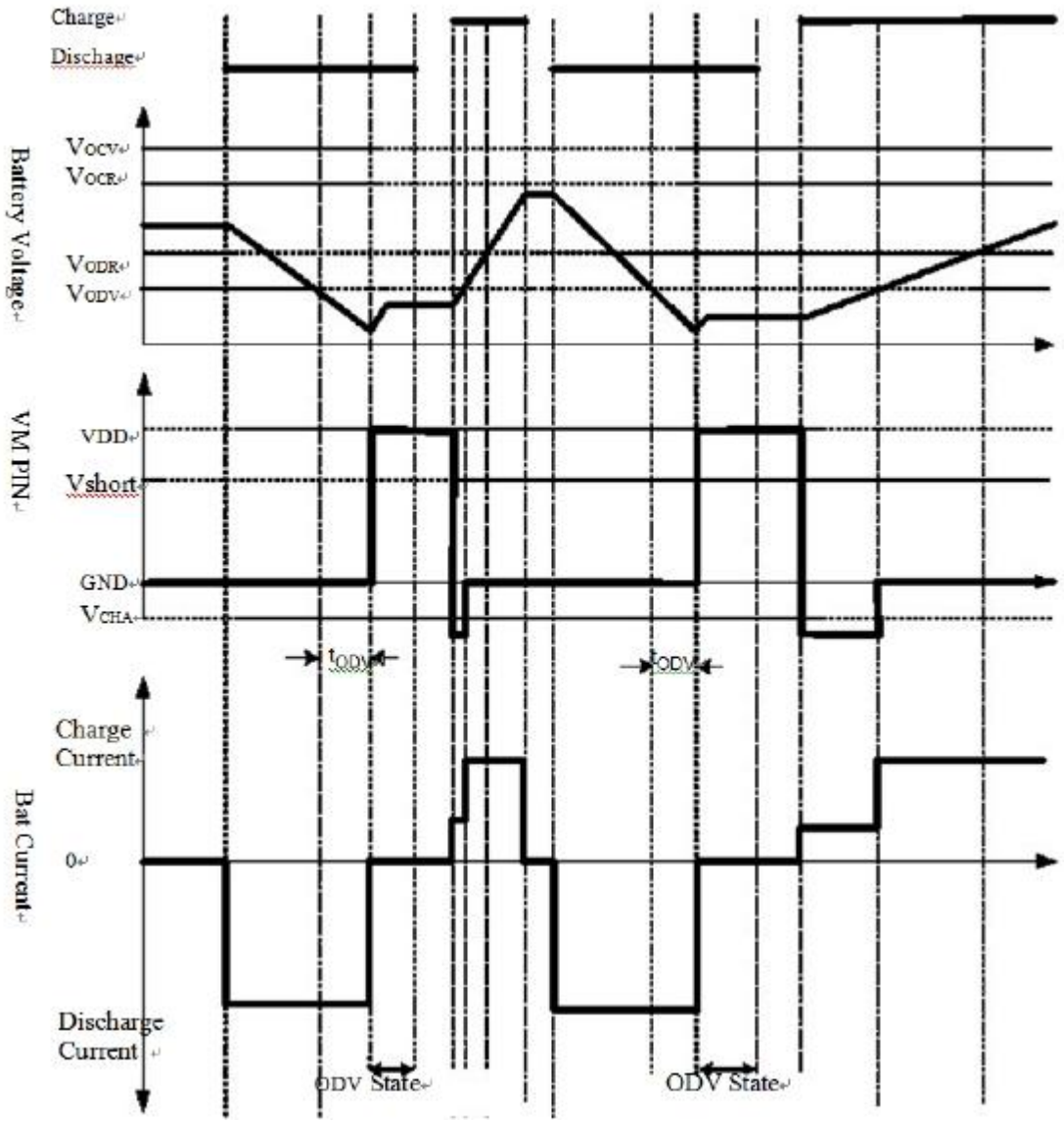



Figure 5. Over Discharge, Charge and Normal state timing

3. Over Discharge Current (ODC)State →Normal State

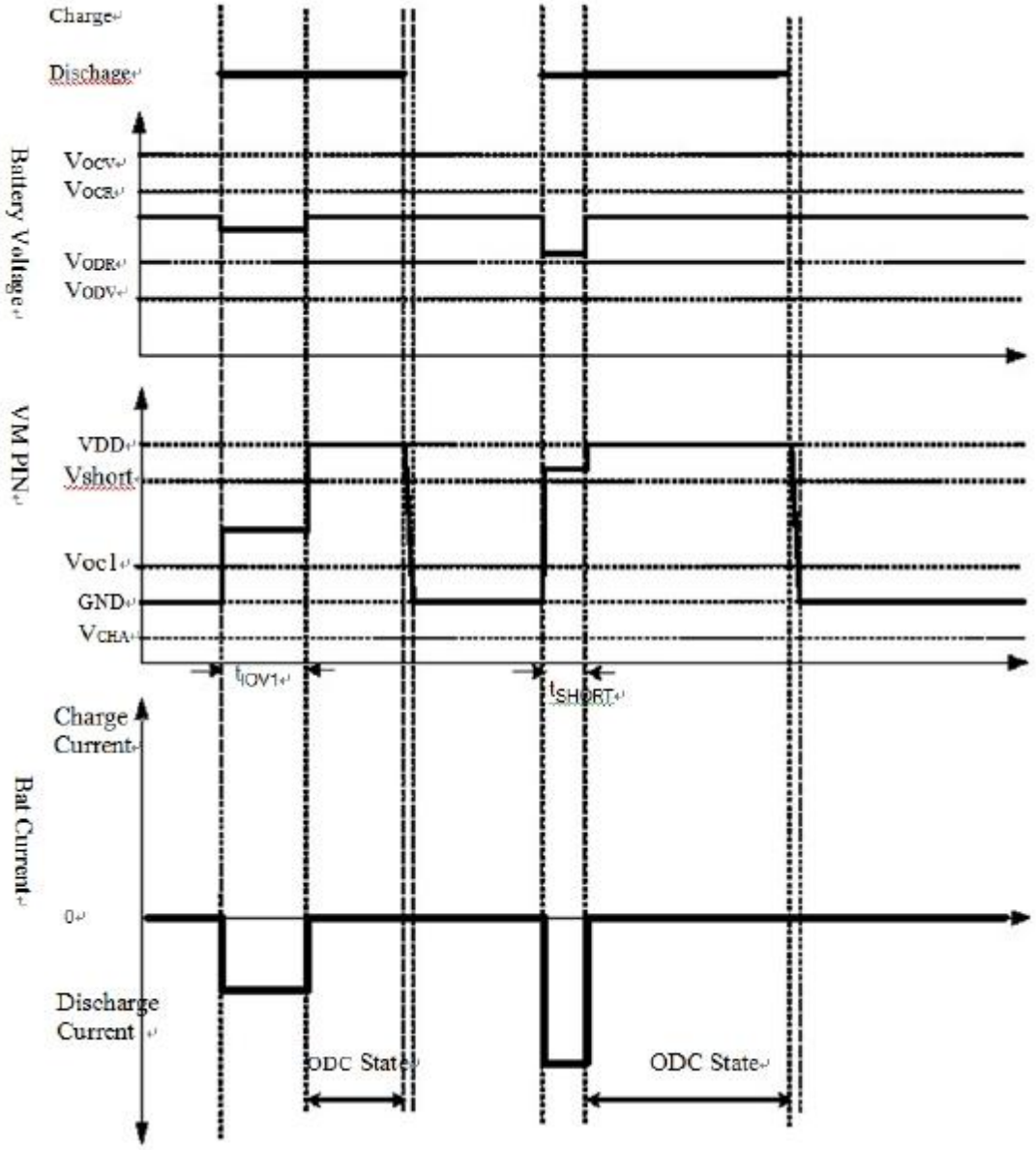



Figure 6. Over Discharge current and Normal state timing

## TYPICAL APPLICATION

As shown in Figure 7, the bold line is the high density current path which must be kept as short as possible. For thermal management, ensure that these trace widths are adequate. C1 is a decoupling capacitor which should be placed as close as possible to JTM9901.

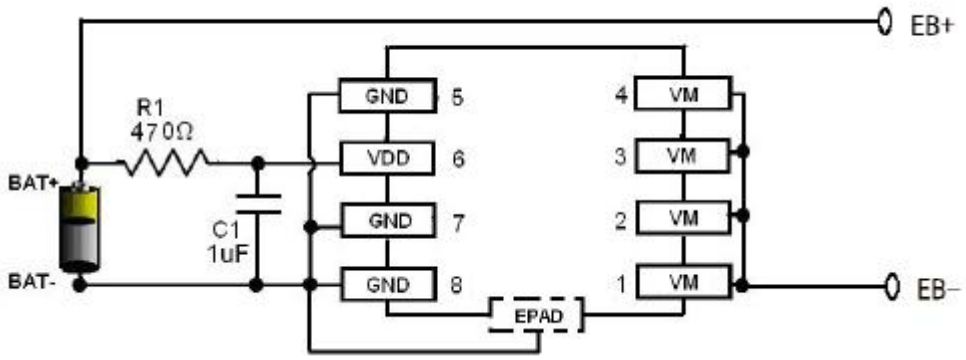



Figure 7. Typical Battery Protection Circuit

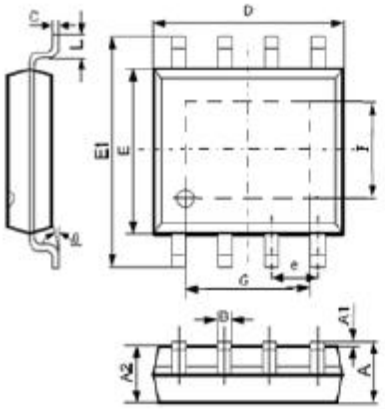
### Precautions

· Pay attention to the operating conditions for input/output voltage and load current so that the power loss in JTM9901 does not exceed the power dissipation of the package.

· Do not apply an electrostatic discharge to this JTM9901 that exceeds the performance ratings of the built-in electrostatic protection circuit.

# PACKAGE OUTLINE

SOP8_EPAD PACKAGE OUTLINE AND DIMENSIONS




| SYMBOL | Dimension in Millimeters | | Dimension in Inches | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 1.35 | 1.75 | 0.053 | 0.069 |
| A1 | 0.100 | 0.250 | 0.004 | 0.010 |
| A2 | 1.350 | 1.550 | 0.053 | 0.061 |
| B | 0.330 | 0.510 | 0.013 | 0.020 |
| C | 0.190 | 0.250 | 0.007 | 0.010 |
| D | 4.700 | 5.100 | 0.185 | 0.201 |
| E | 3.800 | 4.000 | 0.150 | 0.157 |
| E1 | 5.800 | 6.300 | 0.228 | 0.248 |
| e | 1.27 TYP | | 0.050 TYP | |
| L | 0.400 | 1.270 | 0.016 | 0.050 |
| θ | 0° | 8° | 0° | 8° |
| F | 2.26 | 2.56 | 0.089 | 0.101 |
| G | 3.16 | 3.46 | 0.124 | 0.136 |