

## FEATURE

- Protection of Battery Cell Reverse Connection
- Integrate MOSFET
- Over-temperature Protection
- Two-step Overcurrent Detection:
  - Over-discharge Current
  - Load Short Circuiting
- Charger Detection Function
- 0V Battery Charging Function
- High-accuracy Voltage Detection
- Low Current Consumption
- Operation Mode: 4uA typ
- Power-down Mode: 2.0uA typ

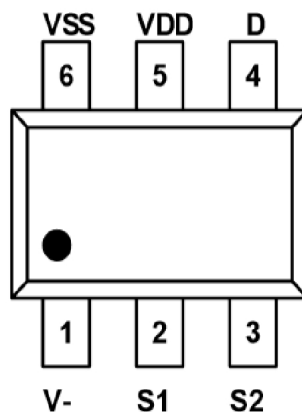
## APPLICATIONS

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

## DESCRIPTION

The HM5406 series product is a high integration solution for lithium-ion/polymer battery protection. HM5406 contains advanced power MOSFET, high-accuracy voltage detection circuits and delay circuits. HM5406 is put into a small package and only one external component makes it an ideal solution in limited space of battery pack. HM5406 has all the protection functions required in the battery application including overcharging, over-discharging, overcurrent and load short circuiting protection etc. The accurate safe and full utilization charging. The low standby current drains little current from the cell while in storage. The device is only targeted for digital cellular phones, but also for any other Li-ion and Li-Poly battery-powered information appliance requiring long-term battery life.

## PIN CONFIGURATION



## PART NUMBER INFORMATION

|        |                               |
|--------|-------------------------------|
| HM5406 | X=Package Code<br>S: SOT23-6L |
|--------|-------------------------------|

## ORDERING INFORMATION

| Part Number | Overcharge<br>Detection<br>Voltage | Overcharge<br>Release<br>Voltage | Overdischarge<br>Detection<br>Voltage | Overdischarge<br>Release<br>Voltage | OverCurrent<br>Detection<br>Current |
|-------------|------------------------------------|----------------------------------|---------------------------------------|-------------------------------------|-------------------------------------|
| HM5406      | 4.3                                | 4.1                              | 2.4                                   | 3.0                                 | 3.2                                 |

## ABSOLUTE MAXIMUM RATINGS ( TA = 25°C Unless otherwise noted )

| Symbol           | Parameter                      | Typica   | Unit |
|------------------|--------------------------------|----------|------|
| V <sub>DD</sub>  | Supply Voltage                 | -0.3~6   | V    |
| V <sub>-</sub>   | Input Pin Voltage              | -6~8     | V    |
| T <sub>J</sub>   | Operation Junction Temperature | 150      | °C   |
| T <sub>STG</sub> | Storage Temperature Range      | -55~+125 | °C   |
| T <sub>OPR</sub> | Operation Temperature          | -40~+80  | °C   |

**Note:** Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress rating only and functional device operation is not implied

## THERMAL DATA

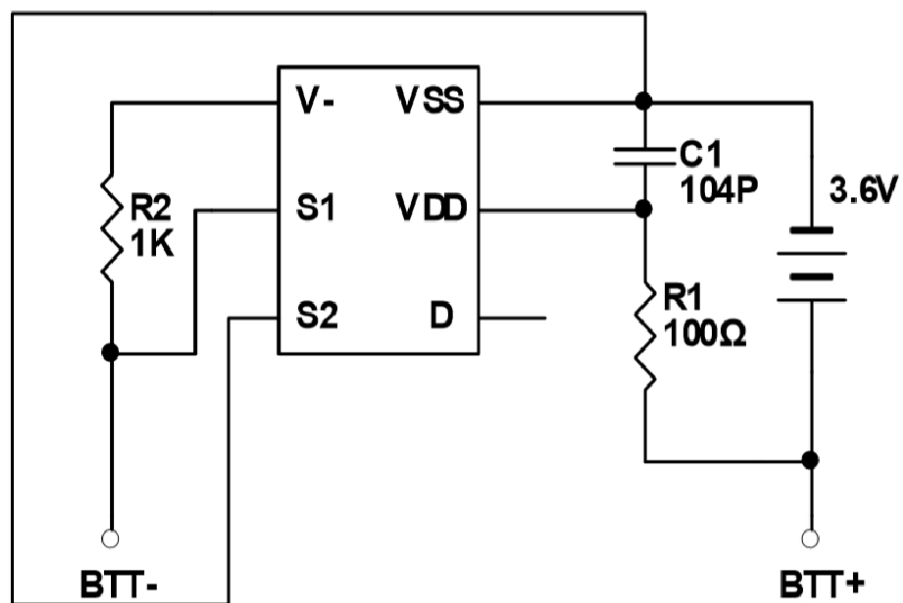
| Symbol           | Parameter                              | Package  | Max | Unit |
|------------------|----------------------------------------|----------|-----|------|
| R <sub>θJA</sub> | Thermal Resistance-Junction to Ambient | SOT23-6L | 200 | °C/W |
| P <sub>D</sub>   | Power Dissipation                      | SOT23-6L | 0.3 | W    |

**ELECTRICAL CHARACTERISTICS(TA=25°C Unless otherwise noted)**

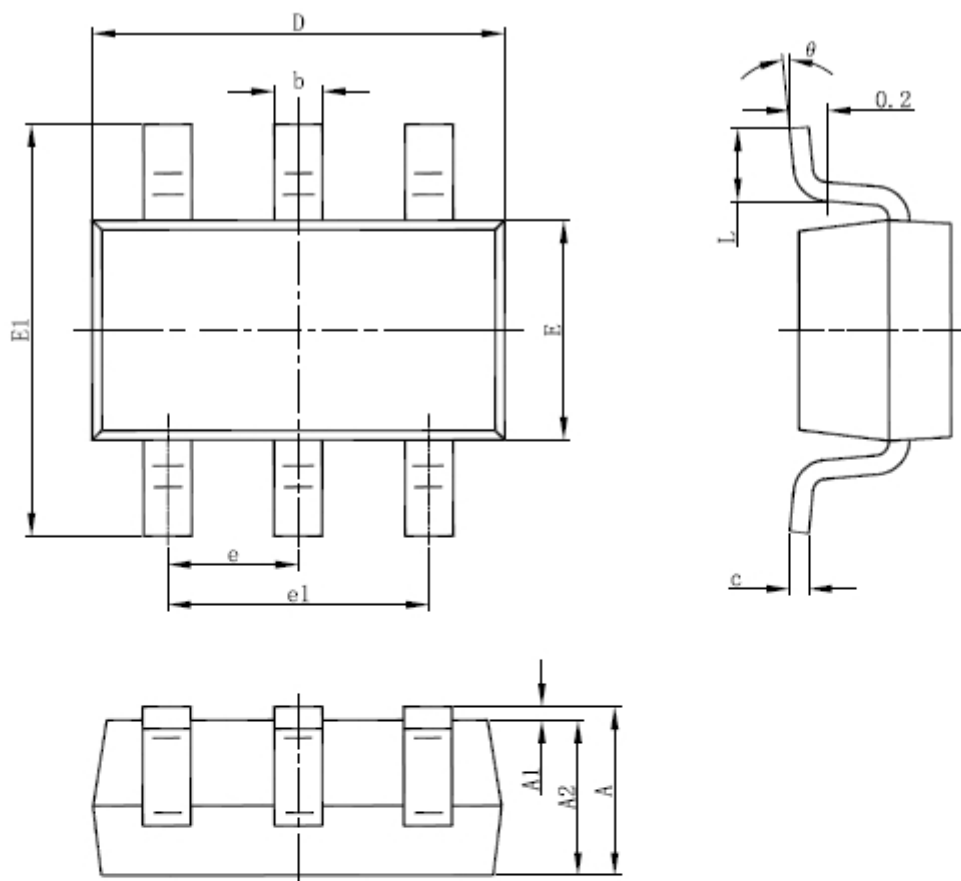
| Symbol                             | Parameter                                  | Condition                                     | Min                   | Typ             | Max                   | Unit |
|------------------------------------|--------------------------------------------|-----------------------------------------------|-----------------------|-----------------|-----------------------|------|
| <b>Detection Voltage</b>           |                                            |                                               |                       |                 |                       |      |
| V <sub>CU</sub>                    | Overcharge Detection Voltage               |                                               | V <sub>CU</sub> -0.05 | V <sub>CU</sub> | V <sub>CU</sub> +0.05 | V    |
| V <sub>CL</sub>                    | Overcharge Release Voltage                 |                                               | V <sub>CL</sub> -0.05 | V <sub>CL</sub> | V <sub>CL</sub> +0.05 | V    |
| V <sub>DL</sub>                    | Overdischarge Detection Voltage            |                                               | V <sub>DL</sub> -0.1  | V <sub>DL</sub> | V <sub>DL</sub> +0.1  | V    |
| V <sub>DR</sub>                    | Overdischarge Release Voltage              |                                               | V <sub>DR</sub> -0.1  | V <sub>DR</sub> | V <sub>DR</sub> +0.1  | V    |
| V <sub>CHA</sub>                   | Charger Detection Voltage                  |                                               |                       | -0.12           |                       | V    |
| <b>Detection Current</b>           |                                            |                                               |                       |                 |                       |      |
| I <sub>IOV</sub>                   | Overdischarge Current Detection            | V <sub>DD</sub> =3.5V                         | 2.1                   | 3               | 3.9                   | A    |
| I <sub>SHORT</sub>                 | Load Short-Circuiting Detection            | V <sub>DD</sub> =3.5V                         | 8                     | 12              | 16                    | A    |
| <b>Current Consumption</b>         |                                            |                                               |                       |                 |                       |      |
| I <sub>OPE</sub>                   | Current Consumption in Normal Operation    | V <sub>DD</sub> =3.5V<br>VM=0V                |                       | 4               | 6                     | uA   |
| I <sub>PON</sub>                   | Current Consumption in Power Down          | V <sub>DD</sub> =2.0V<br>VM pin floating      |                       | 2               | 3.5                   | uA   |
| <b>VM Internal Resistance</b>      |                                            |                                               |                       |                 |                       |      |
| *R <sub>VMD</sub>                  | Internal Resistance Between VM and VDD     | V <sub>DD</sub> =3.5V<br>VM=1.0V              |                       | 320             |                       | kΩ   |
| *R <sub>VMS</sub>                  | Internal Resistance Between VM and GND     | V <sub>DD</sub> =2.0V<br>VM=1.0V              |                       | 100             |                       | kΩ   |
| <b>FET on Resistance</b>           |                                            |                                               |                       |                 |                       |      |
| *R <sub>SS(ON)</sub>               | Equivalent FET on Resistance               | V <sub>DD</sub> =3.6V<br>I <sub>W</sub> =1.0A | 35                    | 45              | 55                    | mΩ   |
| <b>Over Temperature Protection</b> |                                            |                                               |                       |                 |                       |      |
| *T <sub>SHD+</sub>                 | Over Temperature Protection                |                                               |                       | 120             |                       | °C   |
| *T <sub>SHD-</sub>                 | Over Temperature Recovery Degree           |                                               |                       | 100             |                       | °C   |
| <b>Detection Delay Time</b>        |                                            |                                               |                       |                 |                       |      |
| t <sub>CU</sub>                    | Overcharge Voltage Detection Delay Time    |                                               |                       | 140             | 200                   | mS   |
| t <sub>DL</sub>                    | Overdischarge Voltage Detection Delay Time |                                               |                       | 80              | 150                   | mS   |
| *t <sub>IOV</sub>                  | Overdischarge Current Detection Delay Time |                                               |                       | 4               | 10                    | mS   |
| *t <sub>SHORT</sub>                | Load Short-Circuiting Detection Delay Time |                                               |                       | 10              | 20                    | uS   |

Note: \* The parameter is guaranteed by design

TYPICAL APPLICATION



**PACKAGE DIENSIONS**

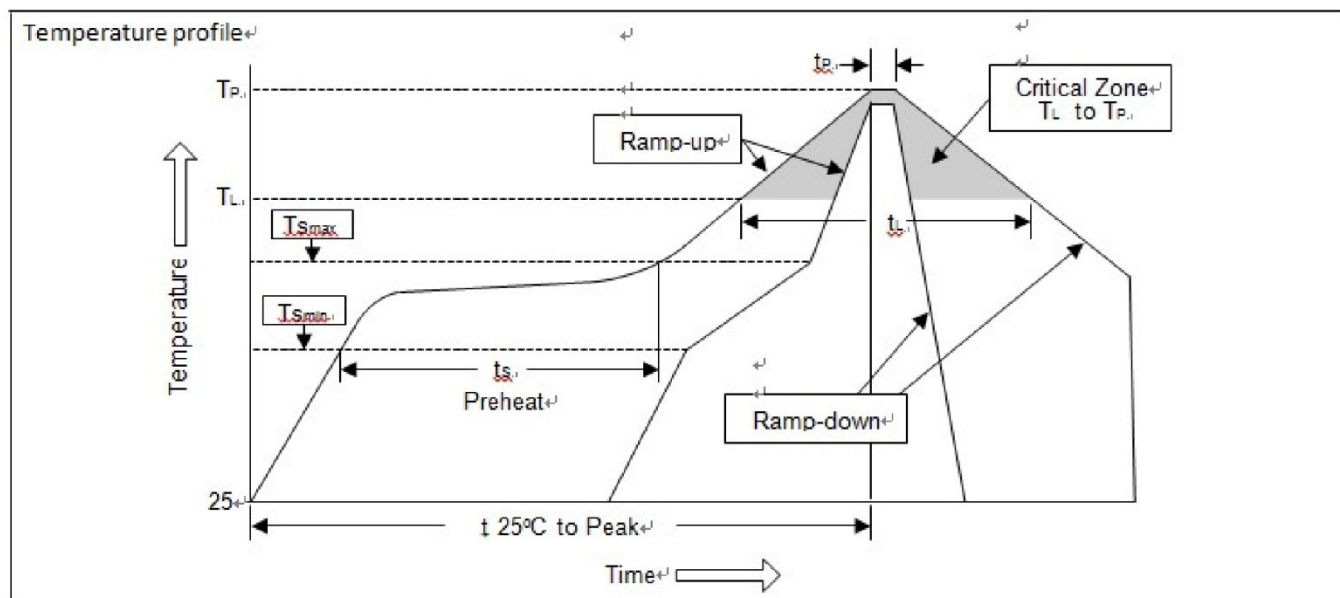


| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | Min                       | Max   | Min                  | Max   |
| A      | 1.050                     | 1.250 | 0.041                | 0.049 |
| A1     | 0.000                     | 0.100 | 0.000                | 0.004 |
| A2     | 1.050                     | 1.150 | 0.041                | 0.045 |
| b      | 0.300                     | 0.500 | 0.012                | 0.020 |
| c      | 0.100                     | 0.200 | 0.004                | 0.008 |
| D      | 2.820                     | 3.020 | 0.111                | 0.119 |
| E      | 1.500                     | 1.700 | 0.059                | 0.067 |
| E1     | 2.650                     | 2.950 | 0.104                | 0.116 |
| e      | 0.950(BSC)                |       | 0.037(BSC)           |       |
| e1     | 1.800                     | 2.000 | 0.071                | 0.079 |
| L      | 0.300                     | 0.600 | 0.012                | 0.024 |
| θ      | 0°                        | 8°    | 0°                   | 8°    |

## SOLDERING METHODS FOR UNIVERCHIP

Storage environment Temperature=10°C~35°C Humidity=65%±15%

Reflow soldering of surface mount device



| Profile Feature                                      | Sn-Pb Eutectic Assembly | Pb free Assembly |
|------------------------------------------------------|-------------------------|------------------|
| Average ramp-up rate ( $T_L$ to $T_P$ )              | <3°C/sec                | <3°C/sec         |
| Preheat                                              |                         |                  |
| -Temperature Min ( $T_{Smin}$ )                      | 100°C                   | 150°C            |
| -Temperature Max ( $T_{Smax}$ )                      | 150°C                   | 200°C            |
| -Time (min to max) ( $t_s$ )                         | 60~120 sec              | 60~180 sec       |
| $T_{Smax}$ to $T_L$                                  |                         |                  |
| -Ramp-up Rate                                        | <3°C/sec                | <3°C/sec         |
| Time maintained above                                |                         |                  |
| -Temperature ( $T_L$ )                               | 183°C                   | 217°C            |
| -Time ( $t_L$ )                                      | 60~150 sec              | 60~150 sec       |
| Peak Temperature ( $T_P$ )                           | 240°C+0/-5°C            | 260°C+0/-5°C     |
| Time within 5°C of actual Peak Temperature ( $t_p$ ) | 10~30 sec               | 20~40 sec        |
| Ramp-down Rate                                       | <6°C/sec                | <6°C/sec         |
| Time 25°C to Peak Temperature                        | <6 minutes              | <6 minutes       |

| Product        | Peak Temperature | Dipping Time |
|----------------|------------------|--------------|
| Pb device      | 245°C±5°C        | 5sec±1sec    |
| Pb-Free device | 260°C+0/-5°C     | 5sec±1sec    |