

Parameters Subject to Change Without Notice

DESCRIPTION

The JW[®]7115/JW7115-1/JW7115-2/JW7111 is a single channel current-limited power switch optimized for Universal Serial Bus (USB) and other hot-swap applications. The rise and fall times are controlled to minimize current overshoot or undershoot during switches on/off.

The device has fast short-circuit response time for improved overall system robustness. It provides a complete protection solution, such as over-current protection, over-temperature protection and short-circuit protection, as well as controlled rise time and under-voltage lockout function. A 7.5ms de-glitch time on the open-drain Flag output prevents false over-current reporting.

JW7115/JW7115-1/JW7115-2 offers SOT23-5 package. JW7111 offers both DFN2X2-6 and SOT23-6 packages.

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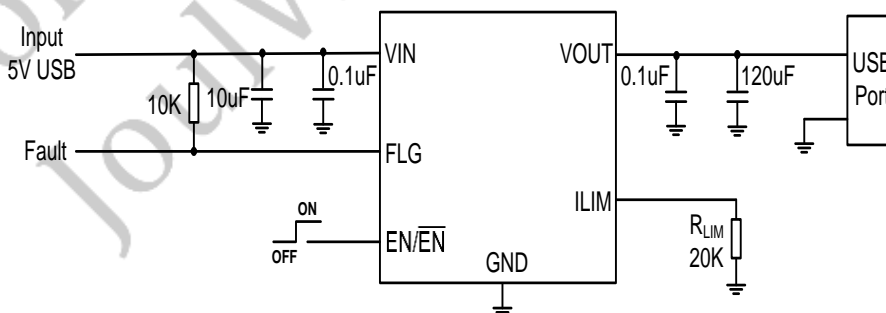
FEATURES

- 50mΩ Integrated N-MOSFET Switch
- Accurate Current Limit
- FLG: active low
- Constant-Current During Over-Current
- Fast Short-Circuit Response Time: 2μs (typ.)
- Operating Range: 2.7V - 5.5V
- Built-in Soft-Start with 3ms Typical Rise Time
- Over-Current, Output Over-Voltage and Thermal Protection
- Fault Report (FAULT) with De-glitch Time
- UL Recognized, File Number E497605
- IEC Recognized, File Number DK-69902-UL
- ESD Protection: 2kV HBM, 500V CDM
- Available in SOT23-5, SOT23-6 and DFN2X2-6 Packages

APPLICATIONS

- Set-Top Boxes
- LCD TVs & Monitors
- Residential Gateways
- Laptops, Desktops, Servers, e-books, Printers, Docking
- Stations, HUBs

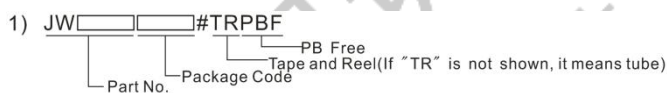
TYPICAL APPLICATION



ORDER INFORMATION

| DEVICE ¹⁾ | PACKAGE | TOP MARKING ²⁾ | ENABLE | CURRENT LIMIT |
|-------------------------|----------|---------------------------|-------------|---------------|
| JW7111DFNB#TRPBF | DFN2X2-6 | JWJ5 XXXX | Active High | RSET |
| JW7111SOTB#TRPBF | SOT23-6 | JWD4 XXXX | Active High | RSET |
| JW7111ADFNB#TRPBF | DFN2X2-6 | JWJ4 XXXX | Active Low | RSET |
| JW7111ASOTB#TRPBF | SOT23-6 | JWJ3 XXXX | Active Low | RSET |
| JW7115SOTA#TRPBF | SOT23-5 | JWG9 XXXX | Active High | 3.2A |
| JW7115-1SOTA#TRPBF | SOT23-5 | JWH8 XXXX | Active High | 1.3A |
| JW7115-2SOTA#TRPBF | SOT23-5 | JWK3 XXXX | Active High | 2.2A |
| JW7115ASOTA#TRPBF | SOT23-5 | JWJ1 XXXX | Active Low | 3.2A |
| JW7115A-1SOTA#TRPBF | SOT23-5 | JWJ2 XXXX | Active Low | 1.3A |
| JW7115A-2 ³⁾ | SOT23-5 | JWK1 XXXX | Active Low | 2.2A |

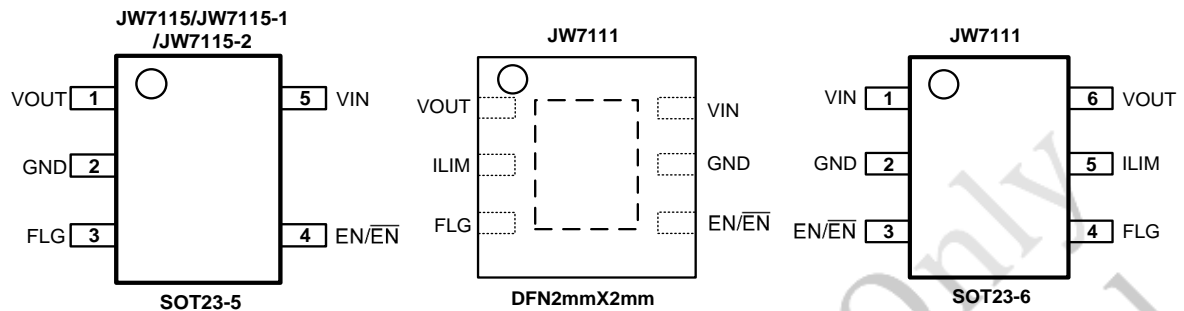
Notes:



- 2) Line 1 of top marking means Part No., and the line 2 of top marking means Date Code.
- 3) JW7115A-2 is equal to JW7115A-2SOTA#TRPBF, and JW7115A-2 offers SOT23-5 package in tape and reel.

PIN CONFIGURATION

TOP VIEW



ABSOLUTE MAXIMUM RATING¹⁾

| | |
|---|-----------------|
| VIN PIN Voltage | -0.3V to 6.5V |
| VOUTPIN Voltage..... | -0.3V to 6.5V |
| Other Pins Voltage..... | -0.3V to 6.5V |
| ILIM Source Current..... | 1mA |
| Junction Temperature ^{2) 3)} | 150°C |
| Lead Temperature | 260°C |
| Storage Temperature | -65°C to +150°C |

RECOMMENDED OPERATING CONDITIONS

| | |
|--|------------------|
| VIN PIN Voltage | 2.7V to 5.5V |
| VOUTPIN Voltage..... | 0V to (VIN+0.2V) |
| EN/ENPIN Voltage..... | 0V to 5.5V |
| High-Level Input Voltage on EN/EN..... | 1.4V to VIN |
| Low-Level Input Voltage on EN/EN..... | 0V to 0.5V |
| Operating Junction Temperature..... | -40°C to 125°C |

THERMAL PERFORMANCE⁴⁾

| | θ_{JA} | θ_{JC} |
|---------------|---------------|---------------|
| SOT23-5..... | 220..... | 130°C/W |
| DFN2X2-6..... | 120..... | 34°C/W |
| SOT23-6..... | 220..... | 130°C/W |

Note:

- 1) Exceeding these ratings may damage the device.
- 2) The JW7115/JW7115-1/JW7115-2/JW7111 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 JW7115/JW7115-1/JW7115-2/JW7111 includes thermal protection that is intended to protect the device in overload conditions.
- 4) Measured on JESD51-7, 4-layer PCB.

ELECTRICAL CHARACTERISTICS

| <i>TA = +25°C, VIN = 2.7V to 5.5V, VEN = 0V or VEN = VIN, unless otherwise stated.</i> | | | | | | | |
|--|---------|--|-----------------------|--------------|-------|-------|-------|
| Item | Symbol | Condition ⁵⁾ | | Min. | Typ. | Max. | Units |
| <i>Supply</i> | | | | | | | |
| Input UVLO | VUVLO | VIN Rising | | | 2.4 | 2.65 | V |
| Input UVLO Hysteresis | ΔVUVLO | VIN Decreasing | | | 25 | | mV |
| Input Shutdown Current | ISHDN | VIN= 5.5V, Disabled, VOUT = Open | | | 0.1 | 1 | uA |
| Input Quiescent Current | Iq | VIN= 5.5V, Enabled, VOUT = Open | | | 80 | 130 | uA |
| <i>Power Switch</i> | | | | | | | |
| Switch On-Resistance | RDS(ON) | SOT2x3-5 | TJ = +25°C, VIN= 5.0V | | 50 | 55 | mΩ |
| | | | -40°C ≤ TA ≤ +85°C | | | 60 | |
| | | SOT23-6 | TJ = +25°C, VIN= 5.0V | | 50 | 55 | |
| | | | -40°C ≤ TA ≤ +85°C | | | 60 | |
| | | DFN2X2-6 | TJ = +25°C, VIN= 5.0V | | 50 | 60 | |
| | | | -40°C ≤ TA ≤ +85°C | | | 75 | |
| Output Turn-On Rise Time | tr | VIN= 5.5V, CL = 1μF, RLOAD = 100Ω. Figure 1. | | | 1.1 | 1.5 | ms |
| | | VIN= 2.7V, CL = 1μF, RLOAD = 100Ω. | | | 0.7 | 1 | |
| Output Turn-Off Fall Time | tf | VIN= 5.5V, CL = 1μF, RLOAD = 100Ω. Figure 1. | | 0.1 | | 0.5 | ms |
| | | VIN= 2.7V, CL = 1μF, RLOAD = 100Ω. | | 0.1 | | 0.5 | |
| <i>Current Limit</i> | | | | | | | |
| Current-Limit Threshold (maximum DC output current), VOUT = VIN -0.5V | ILIMIT | JW7115/ JW7115A | -40°C ≤ TA ≤ +85°C | | 3 | 3.3 | 3.6 |
| | | JW7115-2/ JW7115A-2 | | | 2.0 | 2.2 | 2.4 |
| | | JW7115-1/ JW7115A-1 | | | 1.1 | 1.3 | 1.5 |
| | | JW7111/ JW7111A | RLIM = 10kΩ | -40°C ~+85°C | 2.2 | 2.365 | 2.542 |
| | | | | -40°C ~+85°C | 1.54 | 1.632 | 1.73 |
| | | | RLIM = 20kΩ | TJ = +25°C | 1.18 | 1.251 | 1.326 |
| | | | | -40°C ~+85°C | 1.16 | 1.251 | 1.340 |
| | | | RLIM = 49.9kΩ | TJ = +25°C | 0.5 | 0.530 | 0.562 |
| | | | | -40°C ~+85°C | 0.485 | 0.529 | 0.573 |
| | | | RLIM = 210kΩ | | 0.121 | 0.142 | 0.162 |
| ILIMIT Shorted to VIN | | 0.05 | 0.75 | 0.100 | | | |
| ILIMIT Shorted to GND | | 2.2 | 2.365 | 2.542 | | | |

| | | | | | | | |
|--|-----------------------|--|--|------|------|-----|----|
| Short-Circuit Current Limit, VOUT Connected to GND ⁷⁾ | ISHORT | JW7115/ JW7115A | | | 3.2 | | A |
| | | JW7115-1/ JW7115A-1 | | | 1.3 | | |
| | | JW7115-2/ JW7115A-2 | | | 2.2 | | |
| | JW7111/ JW7111A | RLIM = 10kΩ | | | 2.62 | | A |
| | RLIM = 15kΩ | | | 1.82 | | | |
| | RLIM = 20kΩ | | | 1.38 | | | |
| | RLIM = 49.9kΩ | | | 0.57 | | | |
| Short-Circuit Response Time | tSHORT | VOUT= 0V to IOUT = ILIMIT(VOUT shorted to ground). See Figure 2. | | | 2 | | μs |
| <i>Enable Pin</i> | | | | | | | |
| EN/ $\overline{\text{EN}}$ Input Leakage Current | I _{LEAK-EN} | VIN= 5V, VEN = 0V and 6V | | -0.5 | | 0.5 | uA |
| Turn-On Time | ton | CL = 1μF, RL = 100Ω. See Figure 1. | | | | 3 | ms |
| Turn-Off Time | toff | CL = 1μF, RL = 100Ω. See Figure 1. | | | | 1 | ms |
| <i>Output Discharge</i> | | | | | | | |
| Discharge Resistance ⁶⁾ | R _{DIS} | VIN= 5V, Disabled, IOUT = 1mA | | | | 600 | Ω |
| <i>Fault Flag</i> | | | | | | | |
| FAULT Output Low Voltage | V _{OL} | I _{FAULT} = 1mA | | | | 180 | mV |
| FAULT Off Current | I _{FOH} | V _{FAULT} = 6V | | | | 1 | uA |
| FAULT Blanking and Latch Off Time(Over-Current) | t _{blank_OC} | Assertion or de-assertion due to overcurrent | | 5 | 7.5 | 10 | ms |
| <i>Thermal Shutdown</i> | | | | | | | |
| Thermal Shutdown Threshold ⁷⁾ | T _{SHDN} | Enabled, R _{LOAD} = 1kΩ | | | | 160 | °C |
| Thermal Shutdown Threshold under Current Limit ⁷⁾ | T _{SHDN_OCP} | Enabled, R _{LOAD} = 1kΩ | | | | 140 | °C |
| Thermal Shutdown Hysteresis ⁷⁾ | T _{HYS} | | | | | 20 | °C |

Note:

- 5) Pulse-testing techniques maintain junction temperature close to ambient temperature; thermal effects must be taken into account separately.
- 6) The discharge function is active when the device is disabled (when enable is de-asserted or during power-up power-down when VIN < VUVLO). The discharge function offers a resistive discharge path for the external storage capacitor for limited time.

7) Guaranteed by design

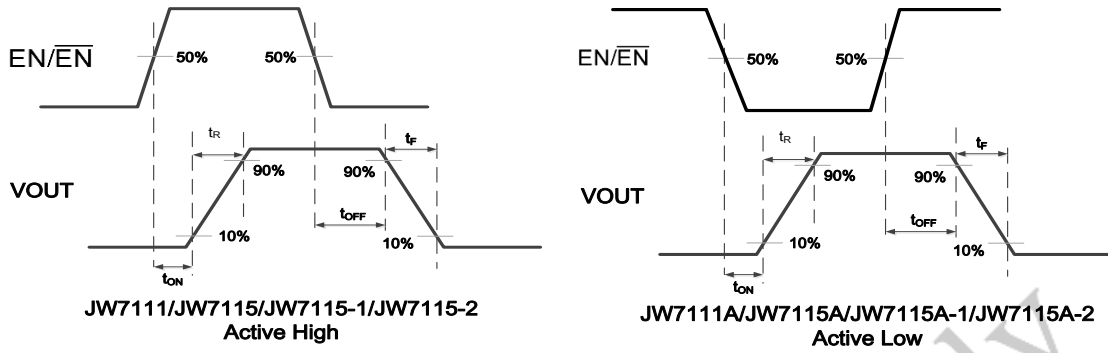


Figure 1 Voltage Waveforms

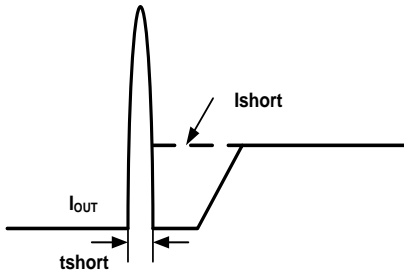


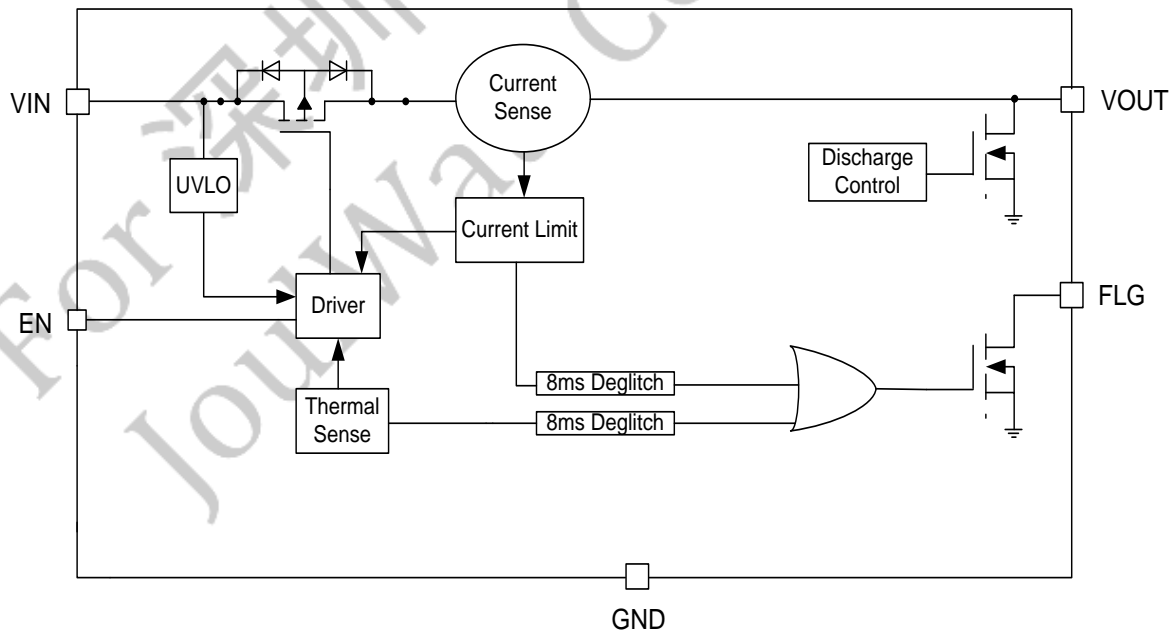
Figure 2 Response Time to Short Circuit Waveform

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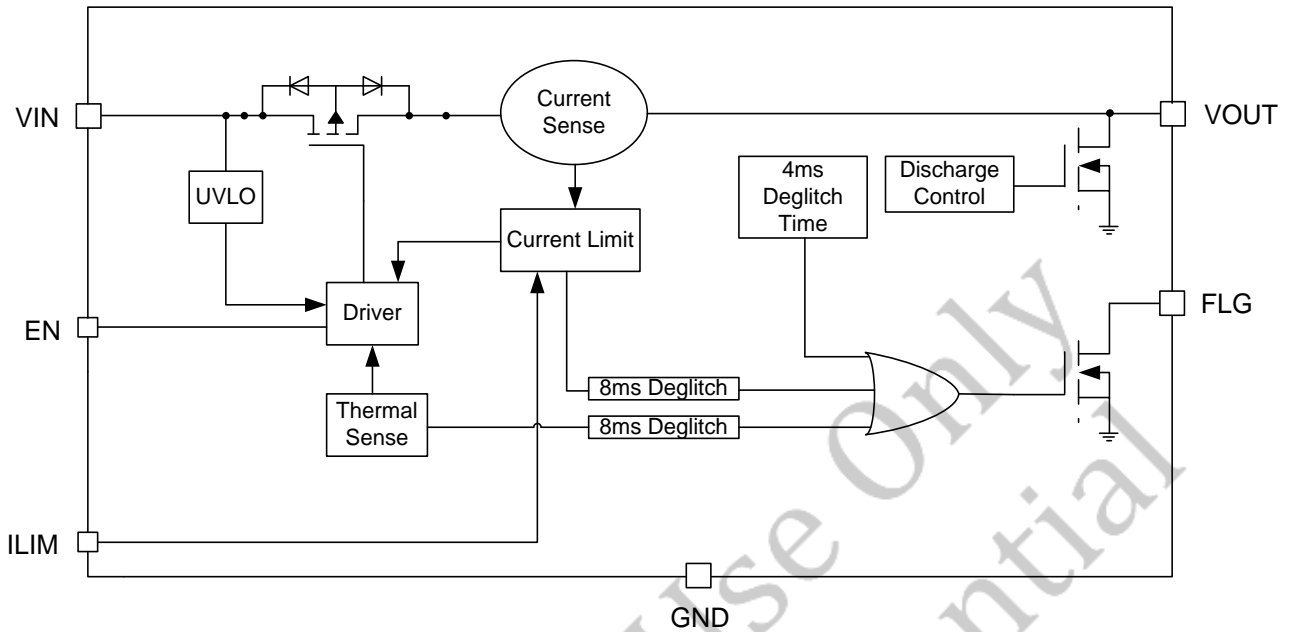
PIN DESCRIPTION

| Pin | | | Name | Description |
|---------|---------|----------|----------------------------|---|
| SOT23-5 | SOT23-6 | DFN2X2-6 | | |
| 1 | 6 | 1 | VOUT | Output voltage |
| 2 | 2 | 5 | GND | Ground(0V) |
| 3 | 4 | 3 | FLG | Active-low open-drain output, asserted during overcurrent, over-temperature. |
| 4 | 3 | 4 | EN/ $\overline{\text{EN}}$ | Enable input |
| | | | | JW7115/JW7115-1/JW7115-2/JW7111: logic high turns on power switch. |
| | | | | JW7115A/JW7115A-1/JW7115A-2/JW7111A: logic low turns on power switch. |
| 5 | 1 | 6 | VIN | Input, connect a 0.1 μ F or greater ceramic capacitor from VIN to GND as close to IC as possible. |
| - | 5 | 2 | ILIM | Use external resistor to set current-limit threshold; Recommended 10k Ω \leq R _{LIM} \leq 232k Ω . |

BLOCK DIAGRAM



JW7115/JW7115-1/JW7115-2/JW7115A/JW7115A-1/JW7115A-2
Block Diagram



JW7111/JW7111A block diagram

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FUNCTIONAL DESCRIPTION

The JW7115/JW7115-1/JW7115-2/JW7111 integrates high-side MOSFET optimized for Universal Serial Bus (USB) that requires protection functions. The MOSFET is driven with controlled gate voltage and slew-rate, which makes this USB device ideal for hot-swap or hot-plug applications.

Discharge Function

When enable is de-asserted, or when the input voltage is under UVLO level, the discharge function is active. The output capacitor is discharged through an internal NMOS in series with a 600Ω resistor. The discharge time is dependent on the RC time constant of the resistance and output capacitance.

FAULT Response

The Fault Flag function is realized by an open-drain circuit. The output goes active low for any of following faults: current limit threshold, short-circuit current limit, or thermal shutdown. In order to avoid the mis-trigger, a 7.5ms deglitch timer is inserted when a fault condition occurs. The FLG output remains low until over-current, short-circuit current limit or over-temperature condition is removed.

Connecting a heavy capacitive load to the output of the device can cause a momentary over-current condition, which does not trigger the FAULT as long as the Fault condition lasts less than 7.5ms deglitch. This deglitch timer is also applied for over-current recovery and over-temperature recovery.

Power Supply Considerations

A 0.01-μF to 0.1-μF X7R or X5R ceramic capacitor between VIN and GND, close to the device, is highly recommended. This limits the input voltage drop during line transients. Placing a high-value electrolytic capacitor on the input (10μF minimum) and output pin (120μF) is recommended when the

output load is heavy.

Additionally, bypassing the device output with a 0.1μF to 4.7μF ceramic capacitor improves the immunity of the device to short-circuit condition.

This capacitor also prevents output from going negative during turn-off due to parasitic inductance. If the negative kick is less than -1V, a schottky diode in parallel with VOUT pin is recommended. Otherwise, the device may go malfunction.

Generic Hot-Plug Applications

In many applications it is common to remove modules or PC boards while the main unit is still operating. These are considered hot-plug applications. Such implementations require the control of current surges. The most effective way to control the current surge is to limit and slowly ramp the current and voltage being applied to the card, similar to the Soft Start in which a power supply normally turns on. Due to the controlled rising and falling times of the switch, these devices can be used to provide a softer start-up to devices being hot-plugged into a powered system.

The UVLO feature also ensures that the switch is off after the card has been removed, and that the switch is off during the next insertion.

Under-Voltage Lockout (UVLO)

Whenever the input voltage falls below UVLO threshold (~2.4V), the power switch is turned off. This facilitates the design of hot-insertion systems where it is not possible to turn off the power switch before input power is removed.

Over-Current and Short-Circuit Protection

An internal sensing FET is employed to sense over-current conditions. Unlike current-sense resistors, sensing FETs do not increase the series resistance of the current path. When an

overcurrent condition is detected, The switch maintains a constant output current and reduces the output voltage accordingly. Complete shutdown occurs only if the fault stays long enough to activate over-temperature protection.

Over-Current FAULT Signal

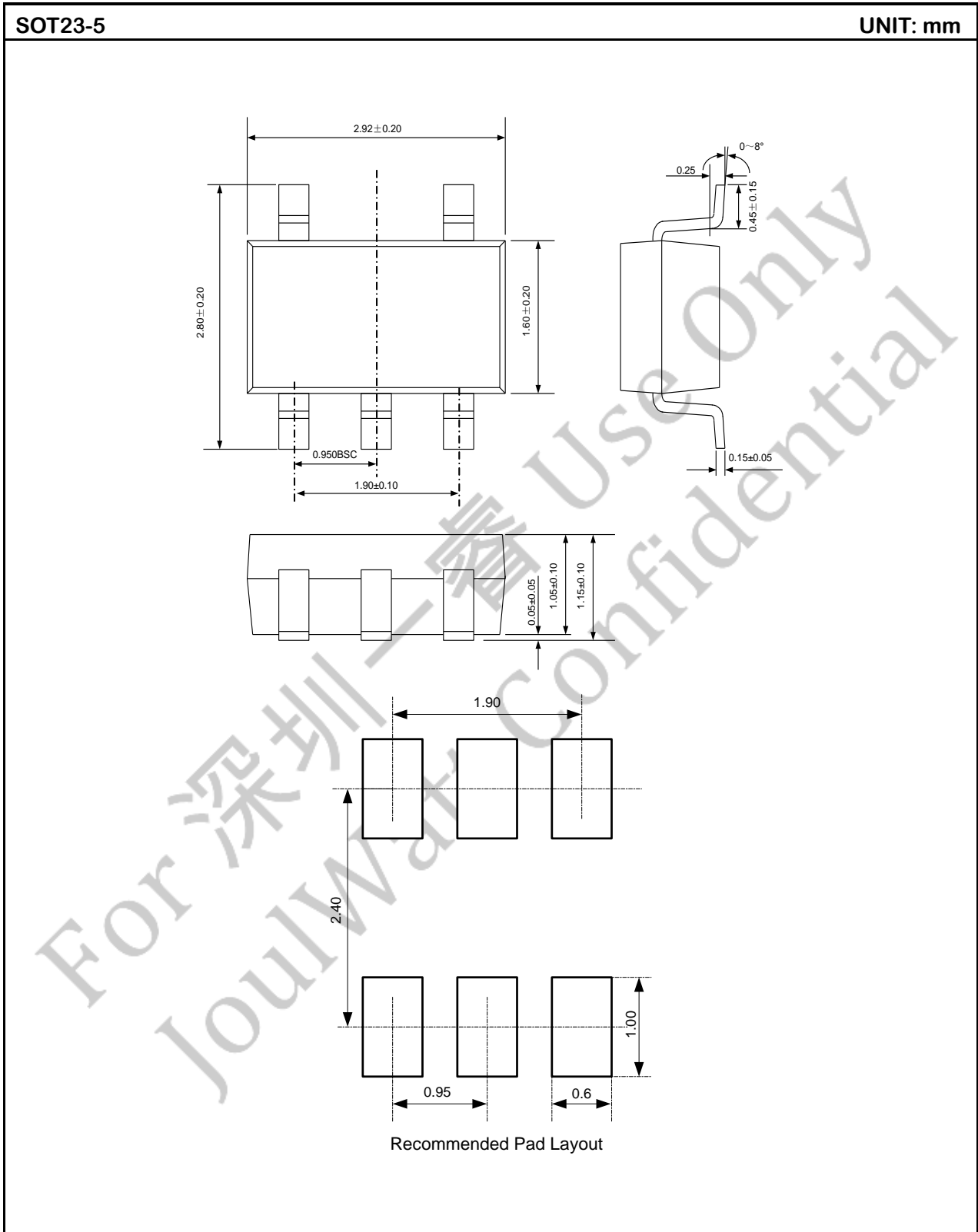
The FAULT signal will be asserted in response to OCP before the device reaches its current limit. The output current upon FAULT signal triggered will be lower than the I_{limit} value. To implement FAULT signal for precision system protection control, it is recommended to leave enough margin from maximum continuous operating current.

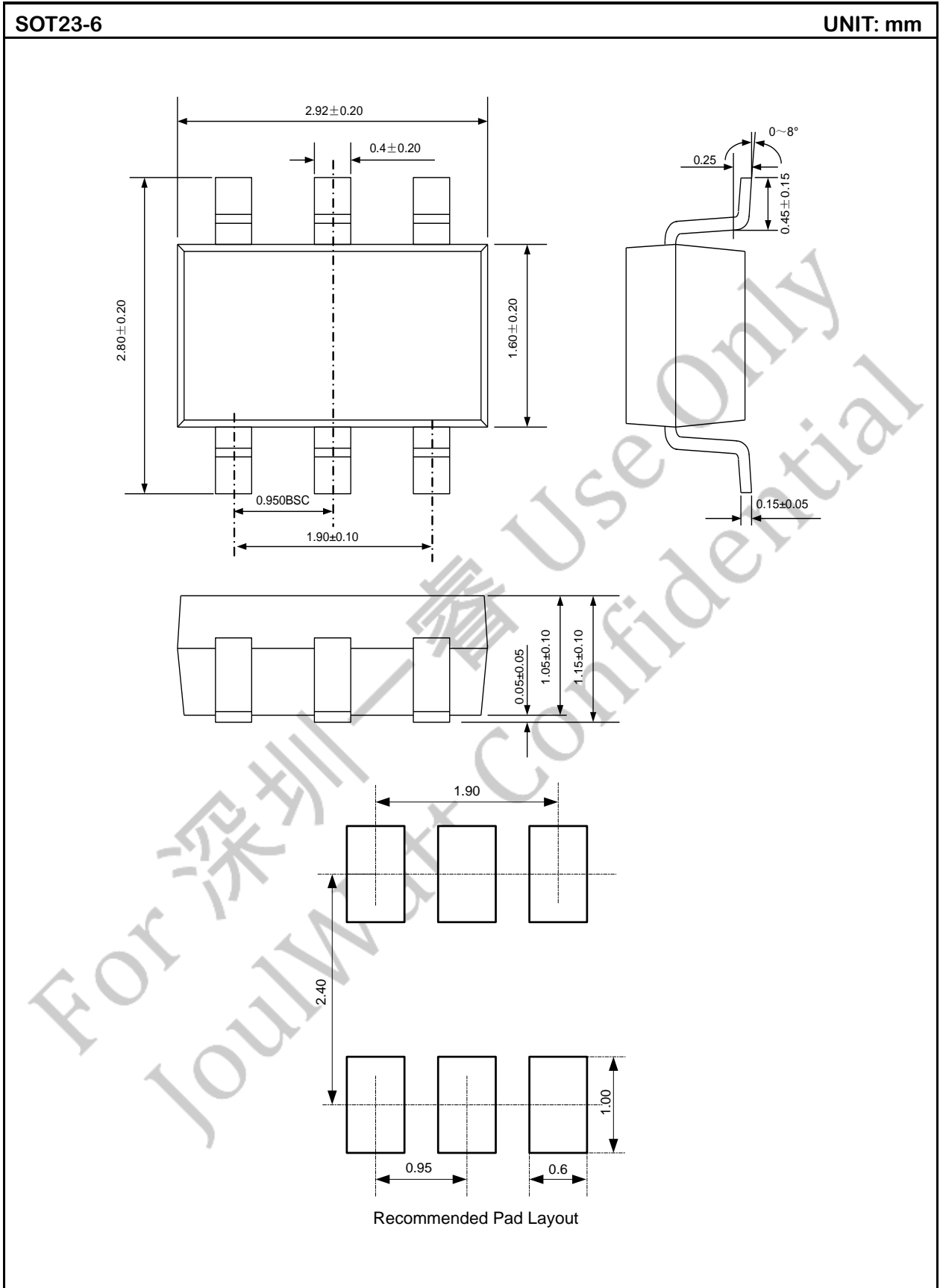
Over-Temperature Protection

Thermal protection prevents the IC from damage when the die temperature exceeds safe margins. This mainly occurs when heavy-overload or short-circuit faults occurs. IC implements a thermal sensing circuit to monitor the operating junction temperature. Once the die temperature rises to approximately $+160^{\circ}\text{C}$ ($+140^{\circ}\text{C}$ in case the part is under current limit), the thermal protection feature activates as follows: The internal thermal sense circuitry turns the power switch off and the FLG output is asserted, thus preventing the power switch from damage. Once the junction temperature drops to 140°C , the MOSFET restart to work.

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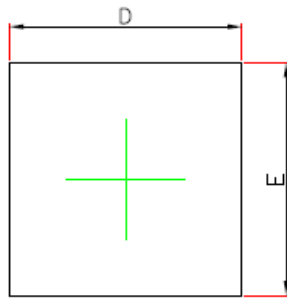
PACKAGE OUTLINE



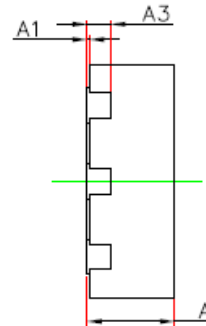


DFN2X2-6

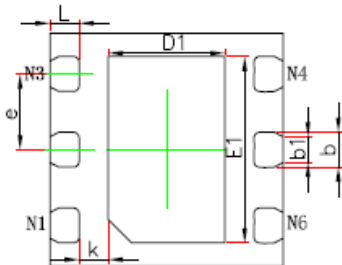
UNIT: mm



TOP VIEW



SIDE VIEW



BOTTOM VIEW

| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|-------|----------------------|-------|
| | Min. | Max. | Min. | Max. |
| A | 0.700 | 0.800 | 0.028 | 0.031 |
| A1 | 0.000 | 0.050 | 0.000 | 0.002 |
| A3 | 0.203REF. | | 0.008REF. | |
| D | 1.900 | 2.100 | 0.075 | 0.083 |
| E | 1.900 | 2.100 | 0.075 | 0.083 |
| D1 | 0.900 | 1.100 | 0.035 | 0.043 |
| E1 | 1.500 | 1.700 | 0.059 | 0.067 |
| k | 0.250 REF. | | 0.010REF. | |
| b | 0.250 | 0.350 | 0.010 | 0.014 |
| b1 | 0.220 REF. | | 0.009 REF. | |
| e | 0.650BSC. | | 0.026BSC. | |
| L | 0.174 | 0.326 | 0.007 | 0.013 |

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