

### Features

- High efficiency
- Using external P channel MOSFET
- Maximum Duty 100%
- Oscillation frequency 600KHz
- Soft Start by an external capacity
- Output voltage accuracy  $\pm 2\%$
- Built-in ON/OFF Function
- Built-in Short-circuit Protection
- Stand-by current max. 10 $\mu$ A
- Quiescent Current 1mA
- Input voltage: 2.5V ~7.0V

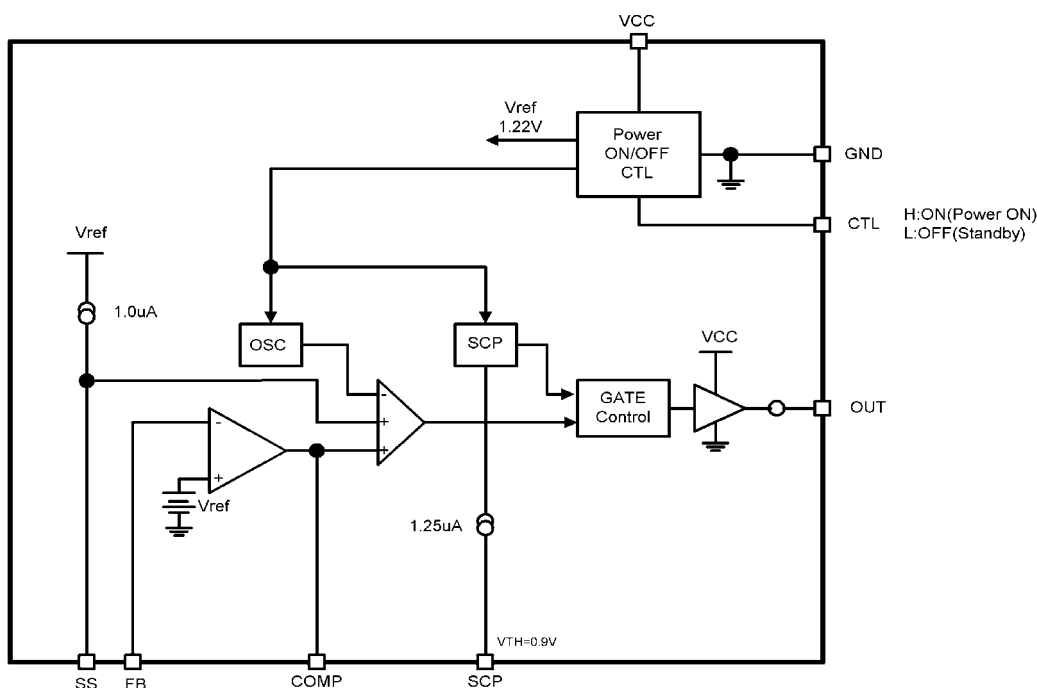
### Applications

- Power Supply for portable devices

### General Description

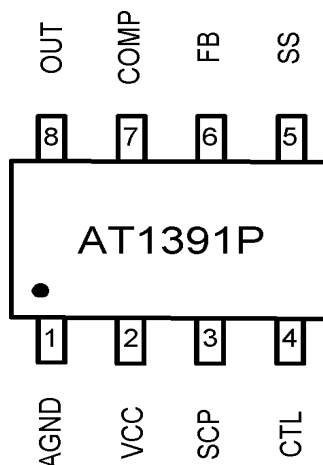
The AT1391 provides complete control and protection for a DC/DC converter optimized for high-performance microprocessor applications. It is designed to drive one P-Channel in a buck topology. The AT1391 integrates all of the control, output adjustment, and protection functions into a single package. The output voltage of the converter can be precisely regulated with a maximum tolerance of  $\pm 2\%$  over temperature and line voltage variations. The AT1391 is a family of low-noise step-down DC/DC converters that is ideally suited for systems powered from a 1-cell Li-ion battery or from a 3-cell to 4-cell NiCd, NiMH, or alkaline battery. It can also be used to USB-Based power system.

### Block Diagram



**Aimtron reserves the right without notice to change this circuitry and specifications.**

## Pin Configuration



## Ordering Information

| Part number | Package | Marking |
|-------------|---------|---------|
| AT1391      | TSSOP8  | AT1391P |

## Pin Description

| Symbol     | Pin No. | Descript                  | Symbol      | Pin No.(A/B) | Descript                        |
|------------|---------|---------------------------|-------------|--------------|---------------------------------|
| <b>GND</b> | 1       | Control blocks ground     | <b>SS</b>   | 5            | Soft-start                      |
| <b>VCC</b> | 2       | Power blocks power supply | <b>FB</b>   | 6            | Error amplifier inverting input |
| <b>SCP</b> | 3       | Short-Circuit protection  | <b>COMP</b> | 7            | Error amplifier output          |
| <b>CTL</b> | 4       | Chip enable, high active  | <b>OUT</b>  | 8            | Output for Pch-MOSFET           |

## Absolute Maximum Ratings

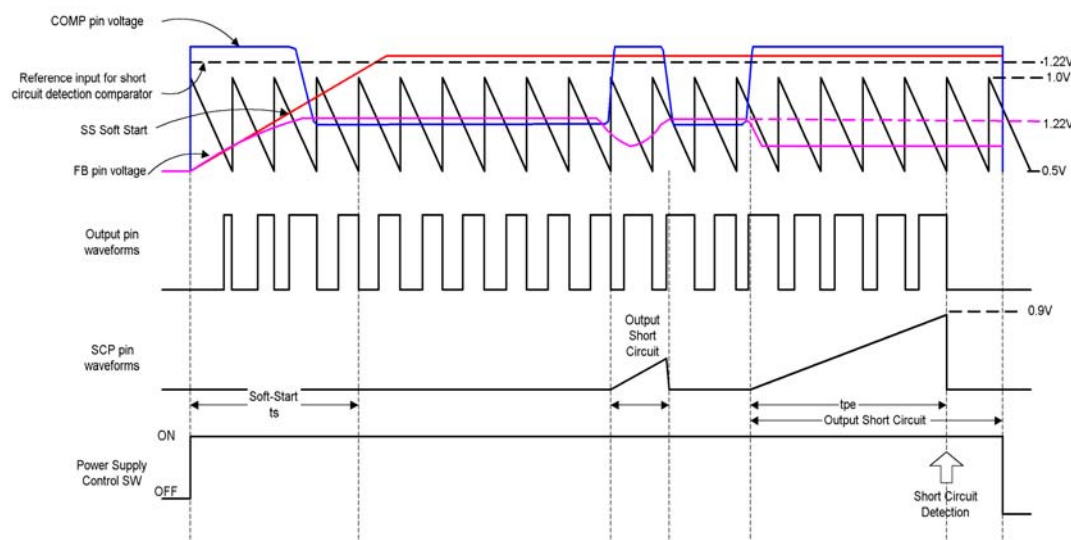
| Parameter                        | Condition                            | Rated Value |      | Unit               |
|----------------------------------|--------------------------------------|-------------|------|--------------------|
|                                  |                                      | Min.        | Max. |                    |
| Power Supply Voltage             | —                                    | -           | +7   | V                  |
| Source Average Current of OUT    | —                                    | -           | -50  | mA                 |
| Sink Average Current of OUT      | —                                    | -           | 50   | mA                 |
| Source Peak Current of OUT       | —                                    | -           | -200 | mA                 |
| Sink Peak Current of OUT         | —                                    | -           | 200  | mA                 |
| Input Voltage to Error Amplifier | —                                    | -           | 6.5  | V                  |
| Continuous power dissipation     | TSSOP8 ( $T_a=+25^{\circ}\text{C}$ ) | -           | 500  | mW                 |
| Operating temperature            | —                                    | -30         | +85  | $^{\circ}\text{C}$ |
| Storage temperature              | —                                    | -55         | +125 | $^{\circ}\text{C}$ |

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## Recommended Operating Conditions

( $T_a=+25^{\circ}\text{C}$ )

| Parameter             | Symbol    | Values |      |      | Unit               |
|-----------------------|-----------|--------|------|------|--------------------|
|                       |           | Min.   | Typ. | Max. |                    |
| Power supply voltage  | $V_{CC}$  | 2.5    | --   | 6    | V                  |
| Control input voltage | $V_{CTL}$ | 0      | --   | 6    | V                  |
| Operating temperature | $T_{OP}$  | -20    | +25  | +85  | $^{\circ}\text{C}$ |



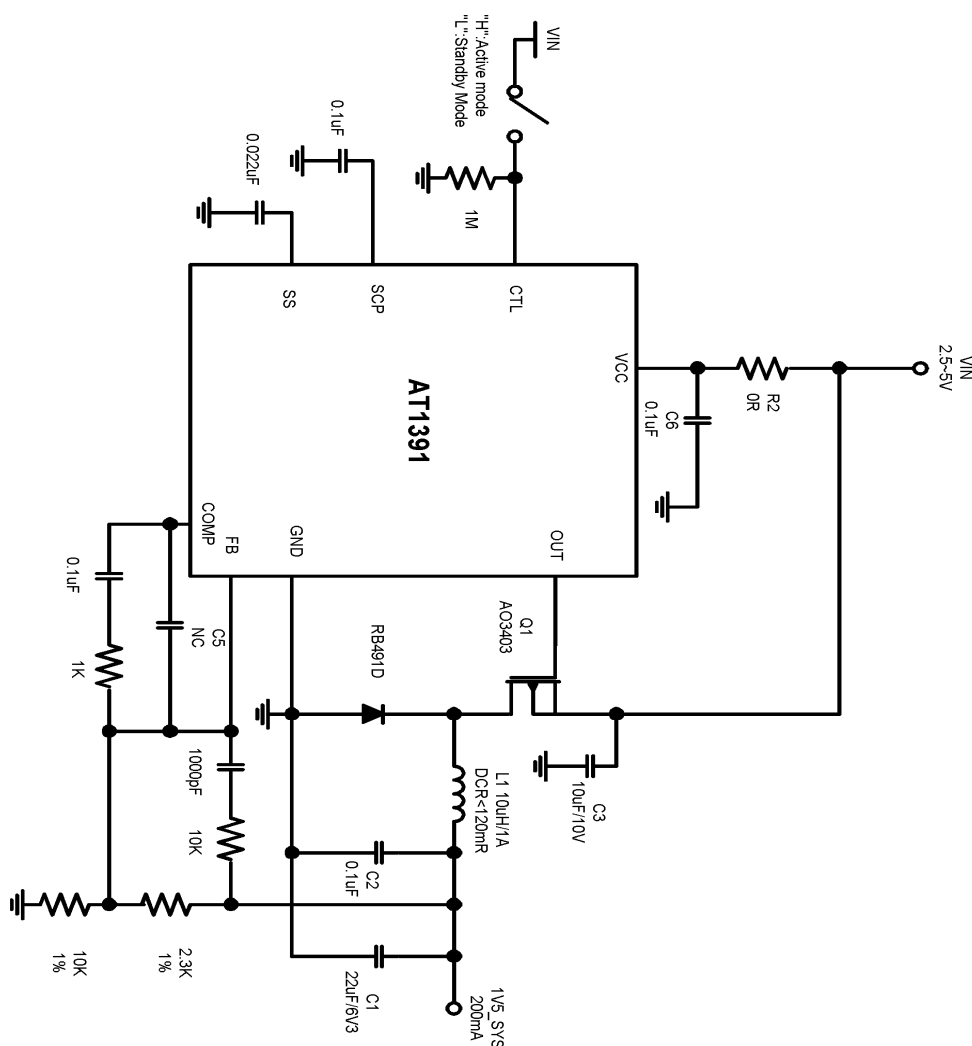
## Electrical Characteristics

(VCC = 5V, T<sub>a</sub> = +25°C , unless otherwise noted. )

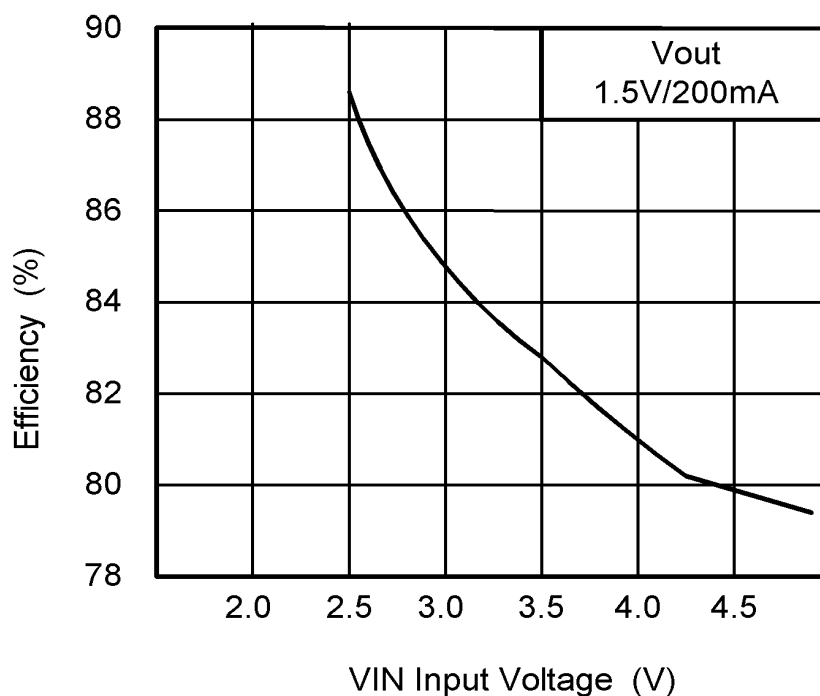
| Parameter                      |                                           | Symbol                | Condition                                                  | Values |       |      | Unit |
|--------------------------------|-------------------------------------------|-----------------------|------------------------------------------------------------|--------|-------|------|------|
|                                |                                           |                       |                                                            | Min.   | Typ.  | Max. |      |
| Entire device                  | Input Supply Range                        | V <sub>CC</sub>       |                                                            | 2.5    | --    | 6.0  | V    |
|                                | Quiescent Current                         | I <sub>CC</sub>       | Duty=50%,<br>f <sub>OSC</sub> =600KHz<br>PDRV/NDRV No Load |        | 1.0   | 1.5  | mA   |
|                                | Current in standby mode                   | I <sub>ST</sub>       | CTL=0V                                                     |        |       | 10   | μA   |
|                                | Reference Voltage                         | V <sub>REF</sub>      | T <sub>a</sub> = -20°C to +85°C                            | 1.20   | 1.22  | 1.24 | V    |
|                                | Reference Voltage line-regulation         | V <sub>REF-Line</sub> | VCC=2.5V to 6.0V                                           |        | 1     | 5    | mV   |
|                                | Reference Variation with Temperature      |                       | T <sub>a</sub> = -20°C to +85°C                            |        | 0.5   | 1.5  | %    |
| Error amplifier                | Input Offset Voltage                      | V <sub>IO</sub>       |                                                            |        |       | 10   | mV   |
|                                | Source Current                            | I <sub>OH</sub>       | V <sub>COMP</sub> = V <sub>REF</sub> -0.5V                 | 1.0    | 1.5   | 2.0  | mA   |
|                                | Sink Current                              | I <sub>OL</sub>       | V <sub>COMP</sub> = 0.5V                                   | -160   | -120  | -80  | μA   |
|                                | Source current Variation with temperature |                       | T <sub>a</sub> = -20°C to +85°C                            |        |       | 20   | %    |
|                                | Sink current Variation with temperature   |                       | T <sub>a</sub> = -20°C to +85°C                            |        |       | 20   | %    |
|                                | Unity Gain Bandwidth                      | f <sub>T</sub>        |                                                            |        | 10.0  |      | MHz  |
|                                | Common Mode Input Voltage Range           | V <sub>COM</sub>      |                                                            | 0.2    |       | 1.5  | V    |
|                                | DC Open Loop Gain                         | A <sub>V</sub>        |                                                            |        | 110   |      | dB   |
| Sawtooth wave oscillator (OSC) | Frequency                                 | f <sub>osc</sub>      |                                                            | 500    | 600   | 700  | KHz  |
|                                | High Level Voltage                        |                       |                                                            |        | 1.0   |      | V    |
|                                | Low Level Voltage                         |                       |                                                            |        | 0.5   |      | V    |
|                                | Variation with Power Supply               |                       | Vcc=2.5V to 6V                                             |        |       | 2    | %    |
|                                | Variation with temperature                |                       | T <sub>a</sub> = -20°C to +85°C                            |        |       | 7    | %    |
| Soft-Start                     | Charge Current of SS                      | I <sub>CSS</sub>      |                                                            |        | -1.0  |      | μA   |
|                                | Invalid threshold voltage of SS           |                       |                                                            |        | 1.0   |      | V    |
| Short-Circuit                  | Charge Current of SS                      | I <sub>CSCP</sub>     |                                                            | -1.5   | -1.25 | -1.0 | μA   |
|                                | Threshold Voltage of SCP                  |                       |                                                            | 0.8    | 0.9   | 1.0  | V    |
| Output Block                   | Output source current                     | I <sub>source</sub>   | Duty≥95% OUT=0V                                            | -      | -130  | -80  | mA   |

|               |                     |                   |                       |     |     |     |               |
|---------------|---------------------|-------------------|-----------------------|-----|-----|-----|---------------|
|               | Output sink current | $I_{\text{sink}}$ | Duty $\leq$ 5% OUT=5V | 65  | 100 |     | mA            |
|               | Output ON resistor  | $R_{\text{OH}}$   | OUT=-15mA             |     | 18  | 30  | $\Omega$      |
|               |                     | $R_{\text{OL}}$   | OUT=15mA              |     | 16  | 25  | $\Omega$      |
|               |                     |                   |                       |     |     |     |               |
| Control Block | CTL input voltage   | $V_{\text{IH}}$   | Active mode           | 2.0 |     | VCC | V             |
|               |                     | $V_{\text{IL}}$   | Standby mode          | 0   |     | 0.5 | V             |
|               | CTL input Current   | $I_{\text{CTL}}$  | CTL=5.0V              |     |     | 20  | $\mu\text{A}$ |

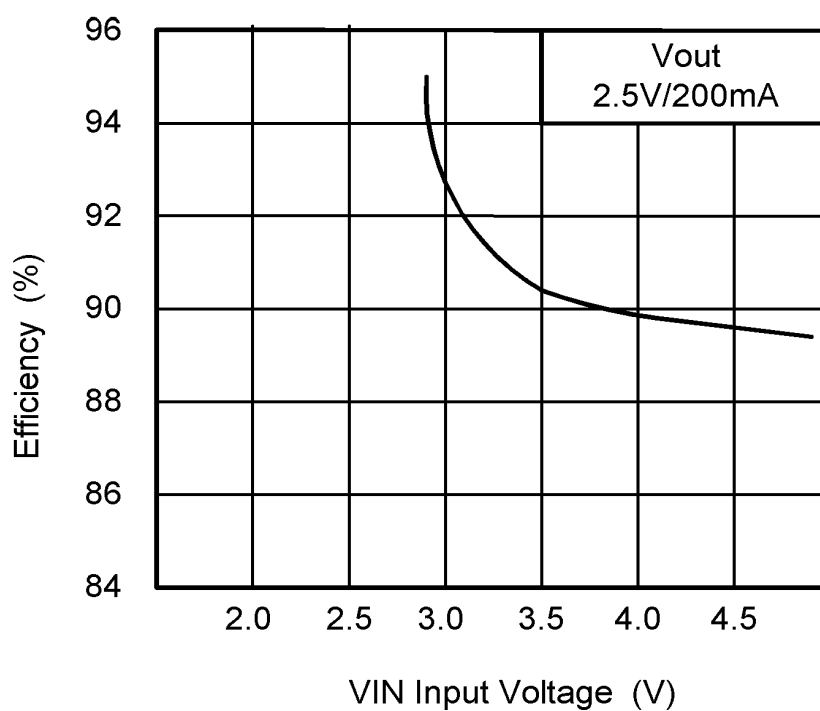
### Application Circuit

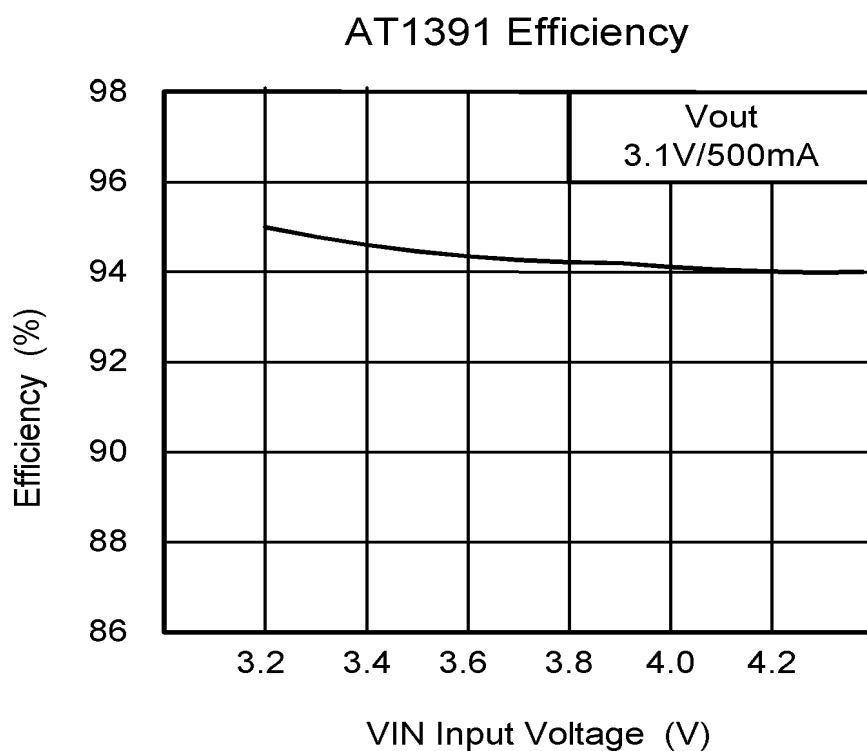


AT1391 Efficiency

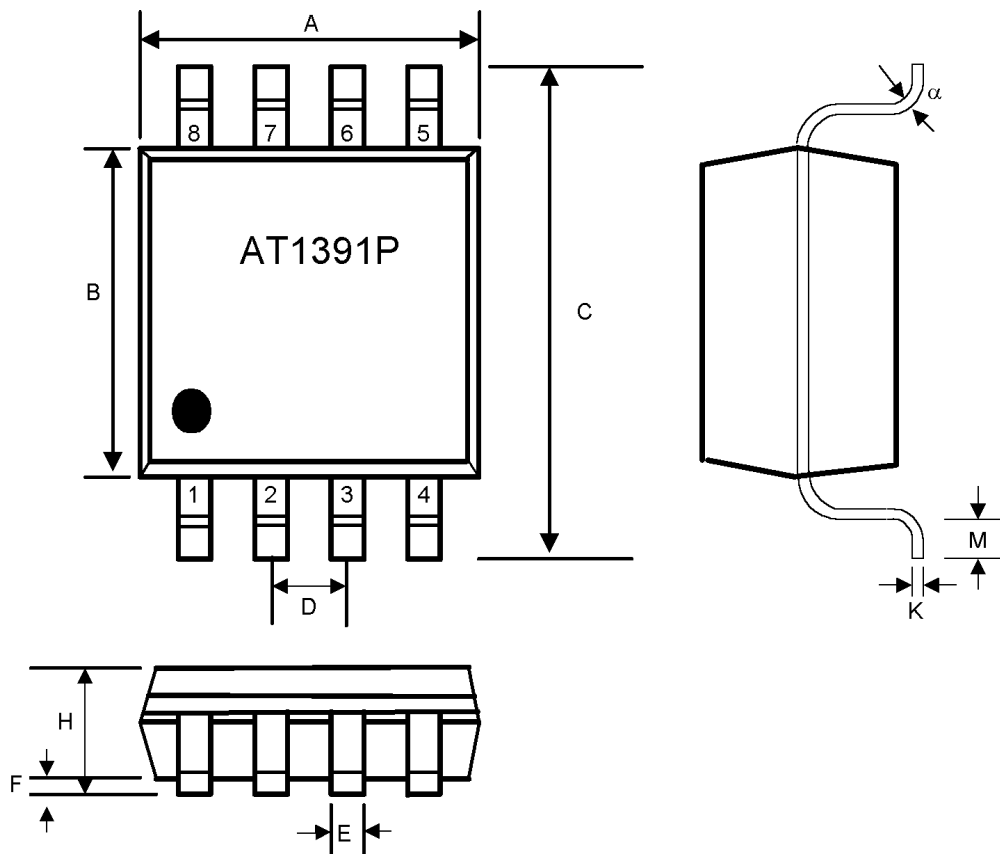


AT1391 Efficiency





**Small Outline 8-pin TSSOP**

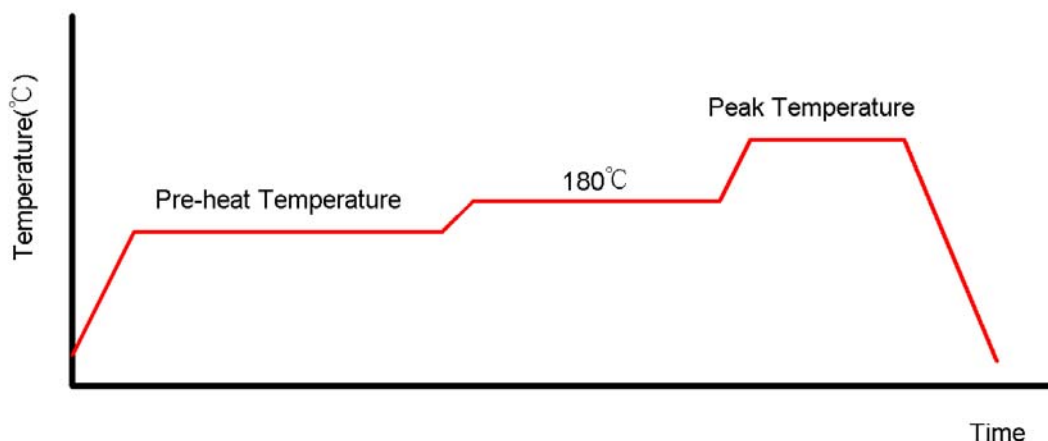


| SYMBOL   | INCHES    |       | MILLIMETERS |      | NOTES |
|----------|-----------|-------|-------------|------|-------|
|          | MIN       | MAX   | MIN         | MAX  |       |
| A        | 0.114     | 0.122 | 2.90        | 3.10 | -     |
| B        | 0.169     | 0.177 | 4.30        | 4.50 | -     |
| C        | 0.244     | 0.260 | 6.20        | 6.60 | -     |
| D        | 0.026 BSC |       | 0.65 BSC    |      | -     |
| E        | 0.010     | 0.012 | 0.25        | 0.30 | -     |
| F        | 0.002     | 0.006 | 0.05        | 0.15 | -     |
| H        | 0.041     | 0.047 | 1.05        | 1.20 | -     |
| K        | 0.005 BSC |       | 0.127 BSC   |      | -     |
| M        | 0.020     | 0.028 | 0.50        | 0.70 | -     |
| $\alpha$ | 0°        | 8°    | 0°          | 8°   | -     |



## Reflow Condition (IR/Convection or VPR Reflow)

Reference JEDEC Standard J-STD-020A



## Classification Reflow Profiles

|                                            | Convection or IR/Convction | VPR                    |
|--------------------------------------------|----------------------------|------------------------|
| Average Heating Rate(180°C to peak)        | 5°C/second max.            | 10°C/second max.       |
| Preheat Temperature(125±20°C)              | 120 seconds max.           |                        |
| Temperature maintained above 180°C         | 10~150 seconds             |                        |
| Time within 5°C of actual Peak Temperature | 10~20 seconds              | 60 seconds             |
| Peak Temperature Range(Note 1)             | 219~225°C or 235~240°C     | 219~225°C or 235~240°C |
| Cooling Rate                               | 6°C /second max.           | 10°C/second max.       |
| Time 25°C to Peak Temperature              | 6 minutes max.             |                        |

\*1 The maximum peak temperatures for IR and VP reflow are depending on package dimensions.

## Package Reflow Conditions

| Pkg. Thickness ≥2.5mm and all bags | Pkg. Thickness <2.5mm and Pkg. Volume ≥350 mm <sup>3</sup> | Pkg. Thickness <2.5mm and Pkg. Volume <350 mm <sup>3</sup> |
|------------------------------------|------------------------------------------------------------|------------------------------------------------------------|
| Convection 219~225°C               |                                                            | Convection 235~240°C                                       |
| VPR 219~225°C                      |                                                            | VPR 235~240°C                                              |
| IR/Convection 219~225°C            |                                                            | IR/Convection 235~240°C                                    |