

Features

- Built-In (Typical 110mΩ at 5.0V) N-Channel MOSFET
- Output can be Forced Higher Than Input (Off-State)
- Low Supply Current
100μA Typical On-State Current
1μA Typical Off-State Current
- 1A minimum Continuous Load Current
- 1.4A Typical Current Limit
- Open-Drain Fault Flag Output
- Hot Plug-In Application (Soft-Start)
- 1.8V to 5.5V Operating Range
- 1.7V Under-Voltage-Lockout (UVLO)
- Thermal Shutdown Protection
- SOP8 Package

Applications

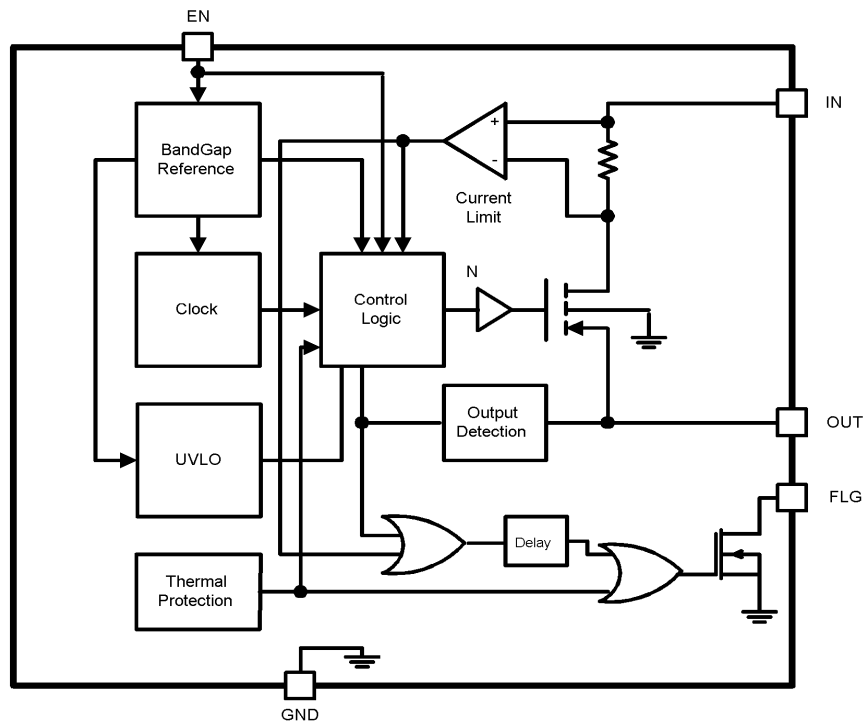
- High-Side Power Protection Switch
- USB Power Management
- Notebook, Motherboard PCs

General Description

The AT1601 is an integrated high-side power switch optimized for self-powered and bus-powered Universal Serial Bus (USB) applications. With built-in a charge pump circuitry to drive the internal MOSFET switch, the switch's low on-resistance meets USB voltage drop requirements. A flag output is available to indicate fault conditions to the local USB controller.

The AT1601 includes soft-start to limit inrush current during plug-in, 1.4A current limit to limit the output current to a safe level which meet the UL 25VA safety requirements, thermal shutdown to prevent catastrophic switch failure from high-current loads, under voltage lockout (UVLO) to ensure that the device remains off unless there is a valid input voltage present, and an enable input that is compatible with both 3.3V and 5V logic.

System Block

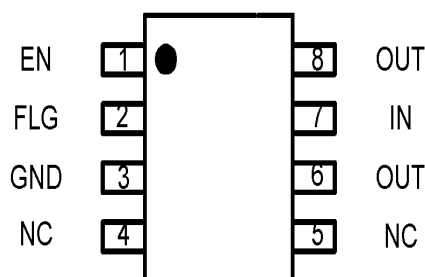


Aimtron reserves the right without notice to change this circuitry and specifications.

Ordering Information

| Part Number | Package | Marking | EN |
|-------------|------------|---|-------------|
| AT1601A | SOP8 | AT1601AS | Active High |
| AT1601A_GRE | SOP8,Green | AT1601AS,date code with one bottom line | |
| AT1601B | SOP8 | AT1601BS | Active Low |
| AT1601B_GRE | SOP8,Green | AT1601BS,date code with one bottom line | |

Pin Assignment



Pin Description

| Pin No. | Symbol | I/O | Description |
|---------|--------|-----|---|
| 1 | EN | I | Enable Input: AT1601A high active, AT1601B low active |
| 2 | FLG | O | Open-Drain Fault Flag Output |
| 3 | GND | P | Ground |
| 4,5 | NC | - | |
| 7 | IN | P | Input Power |
| 6,8 | OUT | P | Switch Output |

Absolute Maximum Ratings

| Item | Symbol | Ratings | Units |
|-------------------------------------|-------------------|------------------|-------|
| Storage temperature | T_{STG} | -55 ~ +150 | °C |
| Operating temperature | T_{OPR} | -30 ~ +85 | °C |
| IN,OUT,FLG,EN input voltage | | -0.3 ~ +6.5 | V |
| FLG Current | I_{FLG} | 50 | mA |
| OUT Current | I_{OUT} | Internal Limited | A |
| ESD Protection * | (Human Body Mode) | 2 | KV |
| Thermal Resistance | θ_{JA} | 160 | °C/W |
| Lead Temperature(Soldering, 10sec.) | | 260 | °C |

*Devices are ESD protected, handling precaution are recommended.

Recommended Operating Ratings

| Item | Symbol | Ratings | Units |
|-----------------------|-----------|---------|-------|
| Operating temperature | T_{OPR} | -20~+85 | °C |
| IN input voltage | | 1.8~5.5 | V |
| EN input voltage | | 0~5.5 | V |

Electrical Characteristics

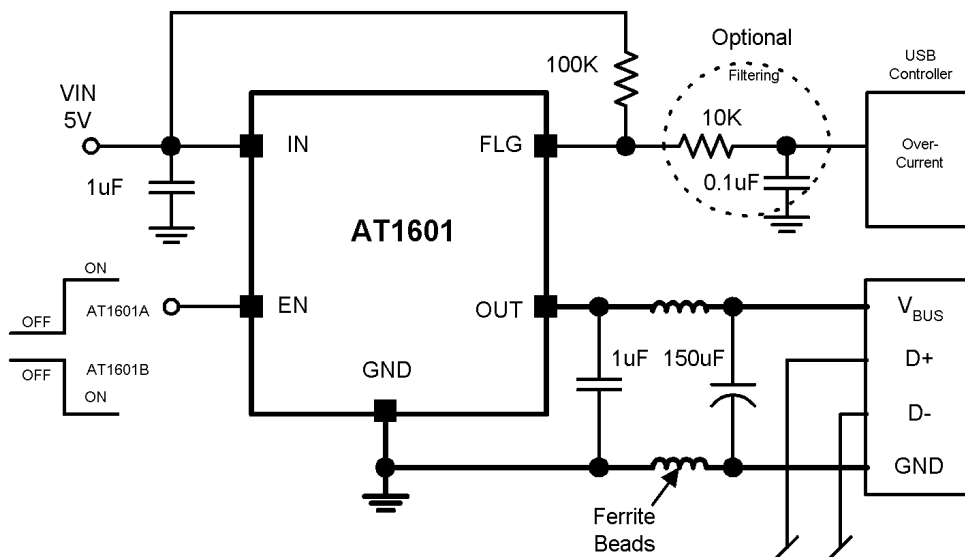
 ($V_{IN}=5.0V, T_a=+25^{\circ}C$)

| Parameter | Symbol | Condition | Values | | | Unit |
|--------------------------------|-----------------------|--|--------------|------|--------------|------------|
| | | | Min. | Typ. | Max. | |
| Input Supply Current | I_{IN1} | Switch Off, OUT=Open $V_{IN}=5.0V$ | - | 1 | 8 | μA |
| | | Switch Off, OUT=Open $V_{IN}=3.3V$ | - | 1 | 5 | μA |
| Input Supply Current | I_{IN2} | Switch On, OUT=Open $V_{IN}=5.0V$ | - | 120 | 160 | μA |
| | | Switch On, OUT=Open $V_{IN}=3.3V$ | - | 100 | 120 | μA |
| EN Enable Threshold | V_{OH} | Low to High Transition | - | - | $0.5*V_{CC}$ | V |
| | V_{OL} | High to Low Transition | $0.4*V_{CC}$ | - | - | V |
| EN Input Current | I_{EN} | EN=2.5V | - | 0.01 | 1 | μA |
| | | EN=1.0V | - | 0.01 | 1 | μA |
| UVLO Threshold | V_{UVLO} | IN rising | 1.5 | 1.7 | - | V |
| UVLO Hysteresis | Δ_{UVLO} | IN Falling | - | 0.1 | - | V |
| Switch Resistance | R_{ON} | IN=5V, $I_{OUT}=500mA$ | - | 110 | 140 | m Ω |
| | | IN=3.3V, $I_{OUT}=500mA$ | - | 130 | 180 | m Ω |
| Short Circuit Current Limit | I_{Limit} | Enable into Load, $R_{LOAD}=1\Omega$ | 1.0 | 1.4 | 2.0 | A |
| Short Circuit FoldBack Current | I_{SC} | $R_{LOAD}=0\Omega$, measure prior to thermal shutdown | - | 1.0 | - | A |
| OUT Leakage Current | $I_{leakage AT1601A}$ | EN=0, $R_{LOAD}=0\Omega$ | - | 1 | 10 | μA |
| | $I_{leakage AT1601B}$ | EN=IN, $R_{LOAD}=0\Omega$ | - | 1 | 10 | μA |
| OUT Turn-On Delay | t_{On-D} | $R_{LOAD}=10\Omega$ | - | 200 | - | μs |

| | | | | | | |
|------------------------|-------------|--|---|------|-----|----------|
| OUT Turn-On Rise Time | t_{On-R} | $R_{LOAD}=10\Omega, C_{LOAD}=100\mu F$ | - | 0.3 | - | ms |
| OUT Turn-Off Delay | t_{Off-D} | $R_{LOAD}=10\Omega$ | - | 5 | 20 | μs |
| OUT Turn-Off Fall Time | t_{Off-F} | $R_{LOAD}=10\Omega, C_{LOAD}=100\mu F$ | - | 0.3 | - | ms |
| FLG Output Resistance | R_{FLG} | $IN=5V, I_{FLG}=10mA$ | - | 10 | 25- | Ω |
| | | $IN=3.3V, I_{FLG}=10mA$ | - | 15 | 40 | Ω |
| FLG Off Current | I_{FLGL} | $FLG=IN$ | - | 0.01 | 1 | μA |
| FLG Delay Time | t_{FLGL} | From fault to FLG assertion | 8 | 12 | 15 | ms |

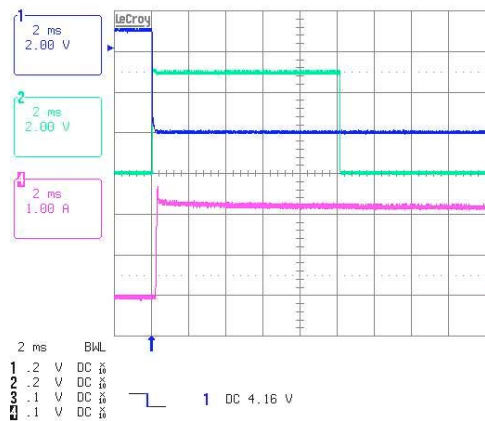
* For AT1601A, off is $\leq 2.0V$ and on is $\geq 2.5V$. For AT1601B, off is $\geq 2.5V$ and on is $\leq 2.0V$. ($IN=5V$)

Application Circuit

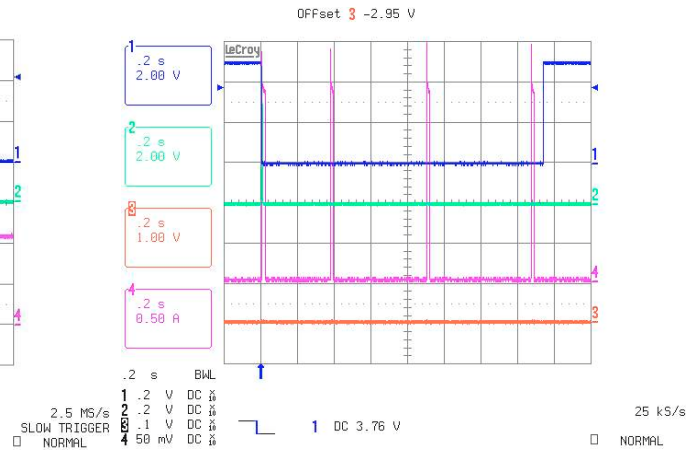


Typical Characteristics(VIN=5V,TA=25°C,AT1601A.)

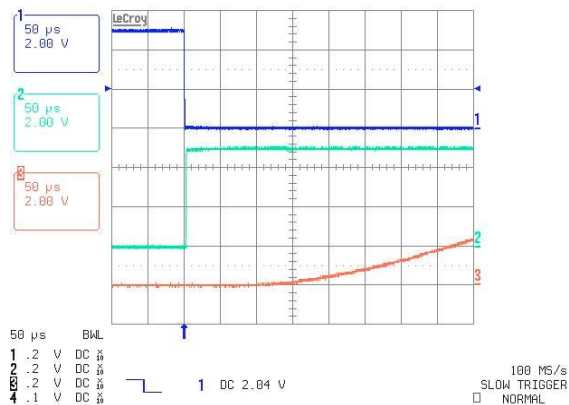
CH1:EN CH2:FLG CH4:I_{OUT}
FLG Delay waveform



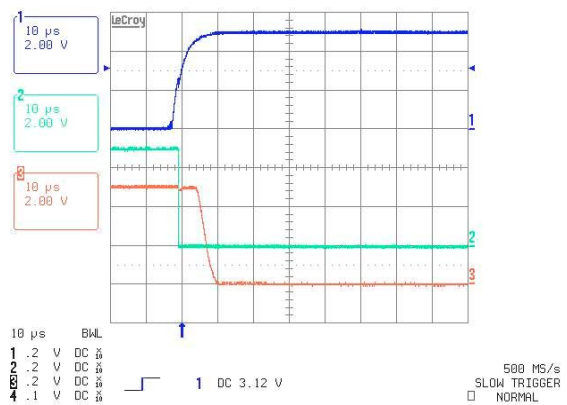
CH1:EN CH2:FLG CH3:V_{OUT} CH4:I_{OUT}
Short Circuit Response



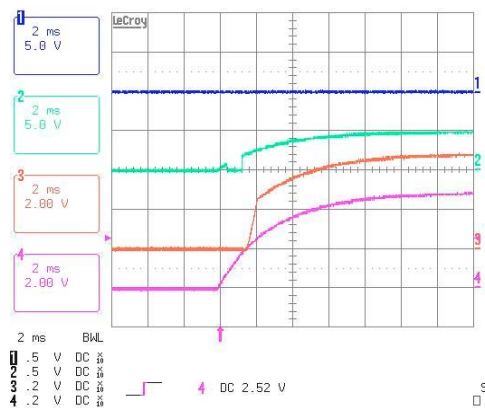
CH1:EN CH2:FLG CH3:V_{OUT}
Turn-on Delay waveform



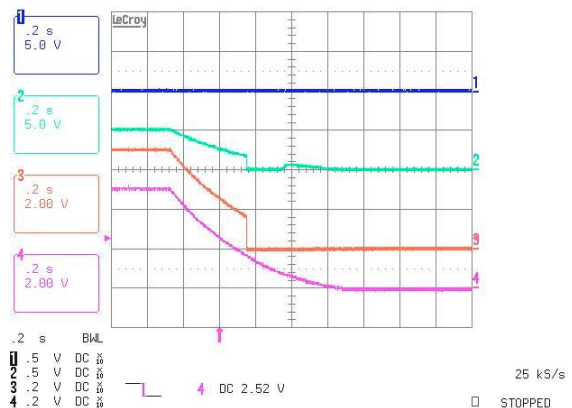
CH1:EN CH2:FLG CH3:V_{OUT}
Turn-off Delay waveform



CH1:EN CH2:FLG CH3:V_{out} CH4:V_{IN}
Power UP (UVLO)

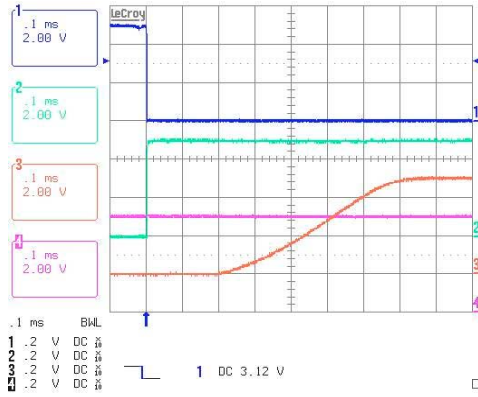


CH1:EN CH2:FLG CH3:V_{out} CH4:V_{IN}
Power Down (UVLO)



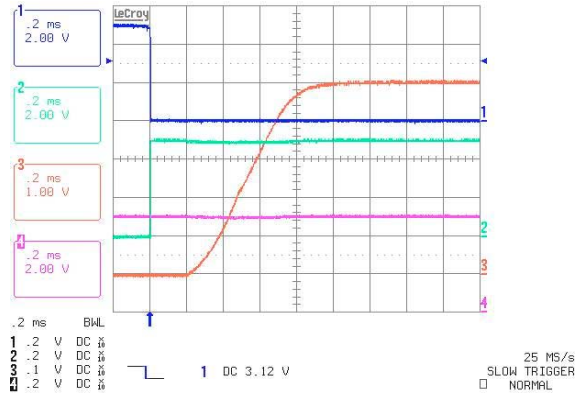
CH1:EN CH2:FLG CH3:V_{out} CH4:V_{IN}

Turn-on CL=47uF



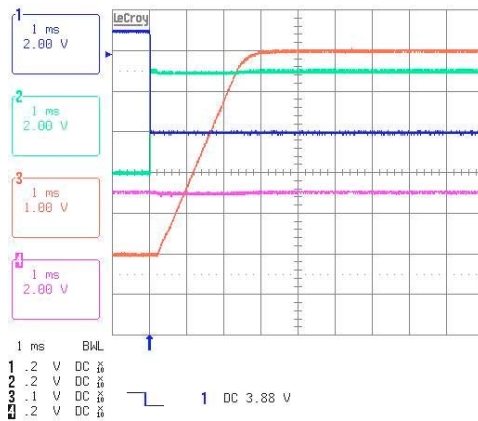
CH1:EN CH2:FLG CH3:V_{out} CH4:V_{IN}

Turn-on CL=220uF



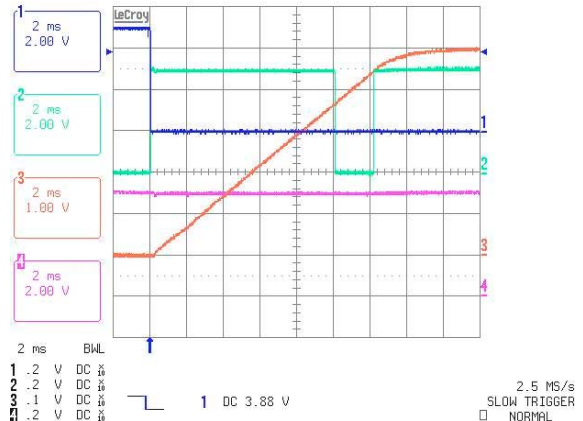
CH1:EN CH2:FLG CH3:V_{out} CH4:V_{IN}

Turn-on CL=1000uF

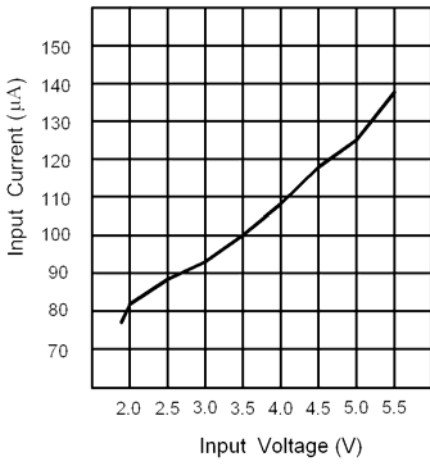


CH1:EN CH2:FLG CH3:V_{out} CH4:V_{IN}

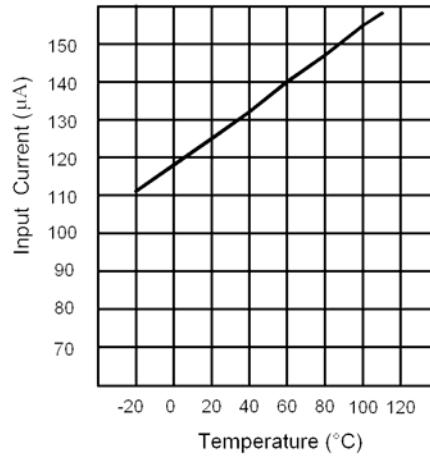
Turn-on CL=6000uF



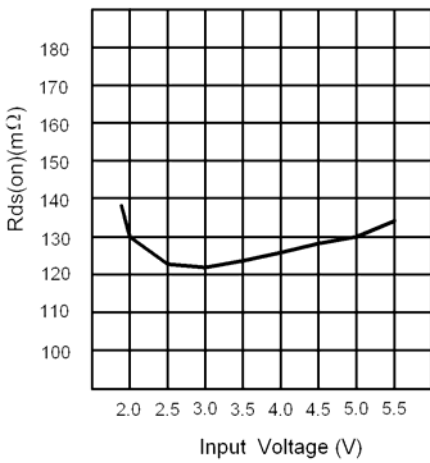
Input Current vs. Input Voltage



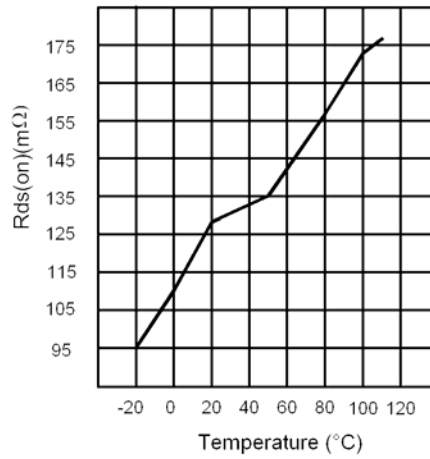
Input Current vs. Temperature



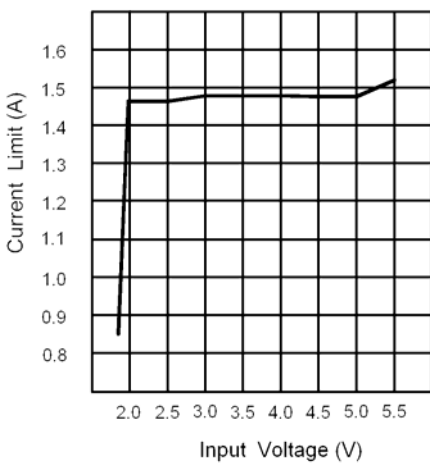
Rds(on) vs. Input Voltage



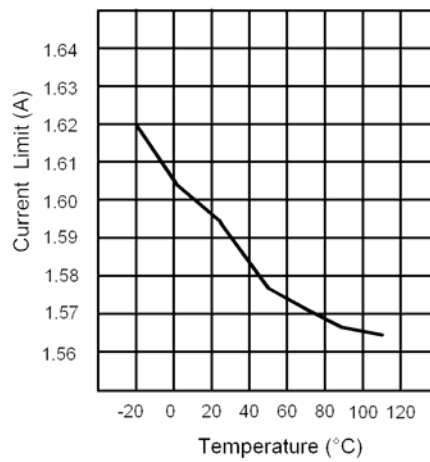
Rds(on) vs. Temperature



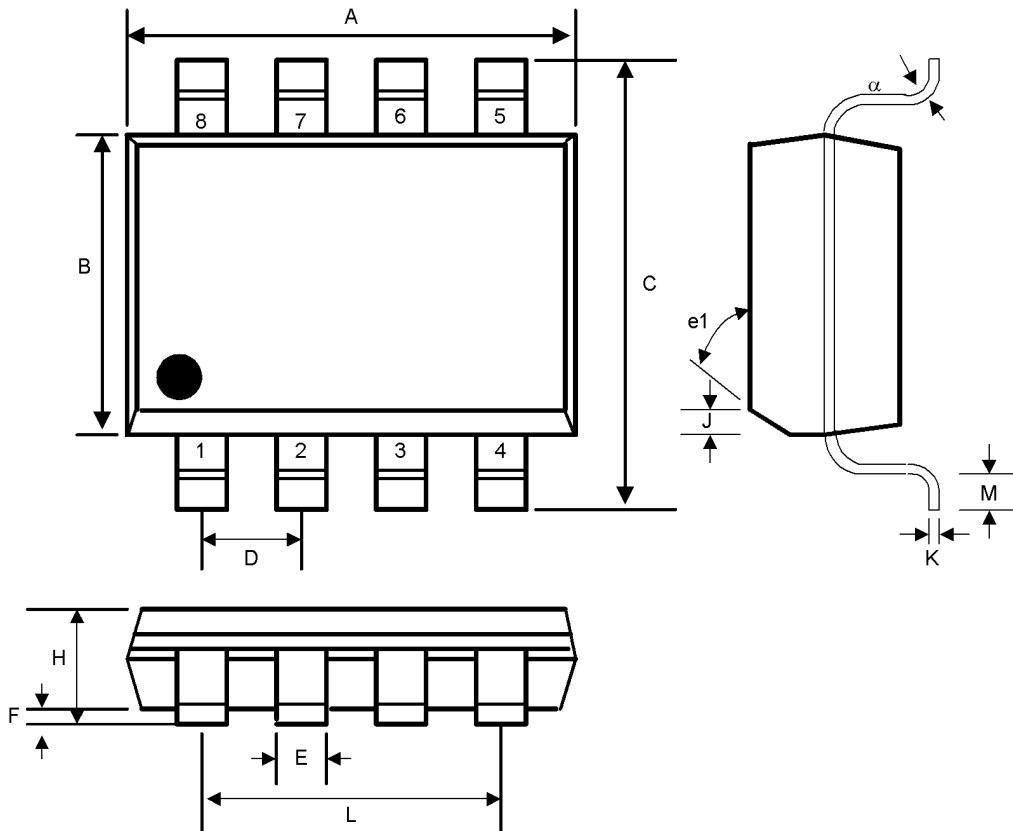
Current Limit vs. Input Voltage



Current Limit vs. Temperature



Package Description: SOP8



| SYMBOL | INCHES | | MILLIMETERS | | NOTES |
|--------|--------|-------|-------------|------|-------|
| | MIN | MAX | MIN | MAX | |
| A | 0.188 | 0.197 | 4.80 | 5.00 | - |
| B | 0.149 | 0.158 | 3.80 | 4.00 | - |
| C | 0.228 | 0.244 | 5.80 | 6.20 | - |
| D | 0.050 | BSC | 1.27 | BSC | - |
| E | 0.013 | 0.020 | 0.33 | 0.51 | - |
| F | 0.004 | 0.010 | 0.10 | 0.25 | - |
| H | 0.053 | 0.069 | 1.35 | 1.75 | - |
| J | 0.011 | 0.019 | 0.28 | 0.48 | - |
| K | 0.007 | 0.010 | 0.19 | 0.25 | - |
| M | 0.016 | 0.050 | 0.40 | 1.27 | - |
| L | 0.150 | REF | 3.81 | REF | - |
| e1 | 45° | | 45° | | - |
| alpha | 0° | 8° | 0° | 8° | - |