

## AUIPS2051L/AUIPS2052G

### INTELLIGENT POWER LOW SIDE SWITCH

#### Features

- Over temperature shutdown
- Over current shutdown
- Active clamp
- Low current & logic level input
- ESD protection
- Optimized Turn On/Off for EMI
- Diagnostic on the input current

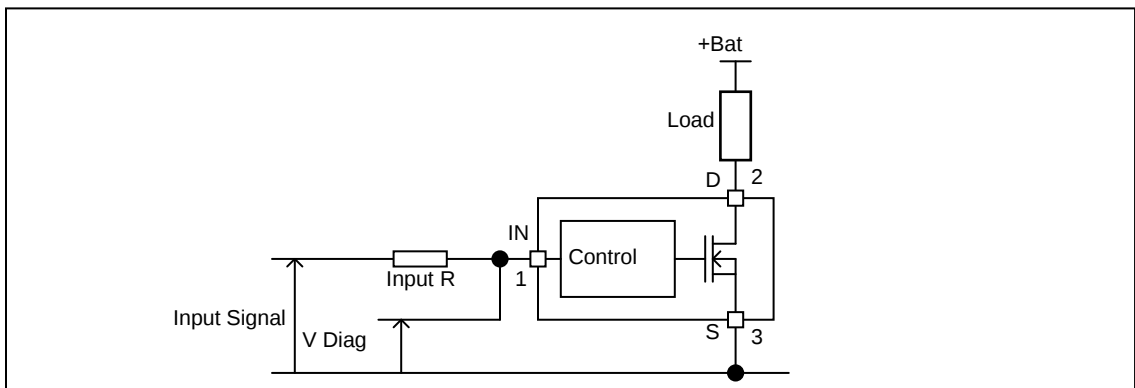
#### Applications

- Solenoids and relays
- 24V truck loads

#### Description

The AUIPS2051L/AUIPS2052G is a three terminal Intelligent Power Switch (IPS) that features a low side MOSFET with over-current, over-temperature, ESD protection and drain to source active clamp. The AUIPS2052 is a dual channel device while the AUIPS2051 is a single channel. This device offers protections and the high reliability required in harsh environments. The switch provides efficient protection by turning OFF the power MOSFET when the temperature exceeds 165°C or when the drain current reaches 1.8A. The device restarts once the input is cycled. A serial resistance connected to the input provides the diagnostic. The avalanche capability is significantly enhanced by the active clamp and covers most inductive load demagnetizations.

#### Typical Connection



#### Product Summary

|           |              |
|-----------|--------------|
| Rds(on)   | 300mΩ (max.) |
| Vclamp    | 70V          |
| Ishutdown | 1.8A (typ.)  |

#### Packages



SOT223  
AUIPS2051L



SO-8  
AUIPS2052G

## Qualification Information<sup>†</sup>

|                                   |                      |                                                                                                                                                                    |
|-----------------------------------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Qualification Level</b>        |                      | Automotive<br>(per AEC-Q100 <sup>††</sup> )                                                                                                                        |
|                                   |                      | Comments: This IC has passed an Automotive qualification. IR's Industrial and Consumer qualification level is granted by extension of the higher Automotive level. |
| <b>Moisture Sensitivity Level</b> |                      | SOT-223                                                                                                                                                            |
|                                   |                      | MSL2 <sup>††</sup> , 260°C<br>(per IPC/JEDEC J-STD-020)                                                                                                            |
|                                   |                      | 8L-SOICN                                                                                                                                                           |
|                                   |                      | MSL2 <sup>††</sup> , 260°C<br>(per IPC/JEDEC J-STD-020)                                                                                                            |
| <b>ESD</b>                        | Machine Model        | Class M3<br>(per AEC-Q-100-003)                                                                                                                                    |
|                                   | Human Body Model     | Class H2<br>(per AEC-Q-100-002)                                                                                                                                    |
|                                   | Charged Device Model | Class C5<br>(per AEC-Q-100-011)                                                                                                                                    |
| <b>IC Latch-Up Test</b>           |                      | ClassII, Level A<br>(per AEC-Q100-004)                                                                                                                             |
| <b>RoHS Compliant</b>             |                      | Yes                                                                                                                                                                |

† Qualification standards can be found at International Rectifier's web site <http://www.irf.com/>

†† Exceptions to AEC-Q100 requirements are noted in the qualification report.

## Absolute Maximum Ratings

Absolute maximum ratings indicate sustained limits beyond which damage to the device may occur. All voltage parameters are referenced to Ground lead. (Tambient=25°C unless otherwise specified).

| Symbol    | Parameter                                                                 | Min. | Max. | Units |
|-----------|---------------------------------------------------------------------------|------|------|-------|
| Vds       | Maximum drain to source voltage                                           | -0.3 | 60   | V     |
| Vds cont. | Maximum continuous drain to source voltage                                | -    | 35   | V     |
| Vin       | Maximum input voltage                                                     | -0.3 | 6    | V     |
| Isd cont. | Max diode continuous current (limited by thermal dissipation) Rth=125°C/W | —    | 1    | A     |
| Pd        | Maximum power dissipation (internally limited by thermal protection)      |      |      |       |
|           | Rth=60°C/W AUIPS2051L 1" sqr. footprint                                   | —    | 2    | W     |
|           | Rth=100°C/W AUIPS2052G std. footprint                                     | —    | 1.25 |       |
| ESD       | Electrostatic discharge voltage (Human body) C=100pF, R=1500Ω             |      |      |       |
|           | Between drain and source                                                  | —    | 4    | kV    |
|           | Other combinations                                                        | —    | 3    |       |
|           | Electrostatic discharge voltage (Machine Model) C=200pF, R=0Ω             |      |      |       |
|           | Between drain and source                                                  | —    | 0.5  |       |
|           | Other combinations                                                        | —    | 0.3  |       |
| Tj max.   | Max. storage & operating temperature junction temperature                 | -40  | 150  | °C    |

## Thermal Characteristics

| Symbol | Parameter                                                        | Typ. | Max. | Units |
|--------|------------------------------------------------------------------|------|------|-------|
| Rth1   | Thermal resistance junction to ambient SOT-223 std. footprint    | 100  | —    | °C/W  |
| Rth2   | Thermal resistance junction to ambient SOT-223 1" sqr. footprint | 60   | —    |       |
| Rth1   | Thermal resistance junction to ambient SO-8 std. Footprint       | 100  | —    |       |
|        | 1 die active                                                     |      |      |       |
| Rth1   | Thermal resistance junction to ambient SO-8 std. footprint       | 130  | —    |       |
|        | 2 die active                                                     |      |      |       |

note : Tj=Power dissipated in one channel x Rth

## Recommended Operating Conditions

These values are given for a quick design. For operation outside these conditions, please consult the application notes.

| Symbol      | Parameter                                                              | Min. | Max. | Units |
|-------------|------------------------------------------------------------------------|------|------|-------|
| VIH         | High level input voltage                                               | 4    | 5.5  |       |
| VIL         | Low level input voltage                                                | 0    | 0.5  |       |
| Ids         | Continuous drain current, Tambient=85°C, Tj=125°C, Vin=5V, Rth=100°C/W | —    | 0.9  | A     |
| Rin         | Recommended resistor in series with IN pin to generate a diagnostic    | 0.5  | 5    | kΩ    |
| Max. t rise | Max. input rising time                                                 | —    | 1    | μs    |

## Static Electrical Characteristics

$T_j = -40..150^{\circ}\text{C}$ ,  $V_{cc} = 28\text{V}$  (unless otherwise specified)

| Symbol                | Parameter                                                     | Min. | Typ. | Max. | Units         | Test Conditions                                    |
|-----------------------|---------------------------------------------------------------|------|------|------|---------------|----------------------------------------------------|
| R <sub>ds(on)</sub>   | ON state resistance $T_j = 25^{\circ}\text{C}$                | —    | 250  | 300  | m $\Omega$    | $V_{in} = 5\text{V}$ , $I_{ds} = 1\text{A}$        |
|                       | ON state resistance $T_j = 150^{\circ}\text{C}(2)$            | —    | 440  | 520  |               |                                                    |
| I <sub>dss1</sub>     | Drain to source leakage current                               | —    | 0.2  | 1    | $\mu\text{A}$ | $V_{cc} = 28\text{V}$ , $T_j = 25^{\circ}\text{C}$ |
| I <sub>dss2</sub>     | Drain to source leakage current                               | —    | 0.5  | 2    |               | $V_{cc} = 50\text{V}$ , $T_j = 25^{\circ}\text{C}$ |
| V <sub>clamp1</sub>   | Drain to source clamp voltage 1                               | 63   | 69   | —    | V             | $I_d = 20\text{mA}$ See fig. 3 & 4                 |
| V <sub>clamp2</sub>   | Drain to source clamp voltage 2                               | —    | 70   | 75   |               | $I_d = 150\text{mA}$                               |
| V <sub>in clamp</sub> | IN to source pin clamp voltage                                | 5.5  | 6.2  | 7.5  |               | $I_{in} = 1\text{mA}$                              |
| V <sub>th</sub>       | Input threshold voltage                                       | 1.1  | 2    | 2.7  |               | $I_d = 50\text{mA}$                                |
| I <sub>in, on</sub>   | ON state IN positive current                                  | 15   | 40   | 80   | $\mu\text{A}$ | $V_{in} = 5\text{V}$                               |
| I <sub>in, off</sub>  | OFF state IN positive current<br>( after protection latched ) | 150  | 250  | 350  |               |                                                    |

## Switching Electrical Characteristics

$V_{cc} = 28\text{V}$ , Resistive load =  $50\Omega$ ,  $R_{input} = 50\Omega$ ,  $V_{in} = 5\text{V}$ ,  $T_j = 25^{\circ}\text{C}$

| Symbol                             | Parameter                  | Min. | Typ. | Max. | Units         | Test Conditions |
|------------------------------------|----------------------------|------|------|------|---------------|-----------------|
| T <sub>don</sub>                   | Turn-on delay time to 20%  | 0.1  | 1    | 3    | $\mu\text{s}$ | See figure 2    |
| T <sub>r</sub>                     | Rise time 20% to 80%       | 0.1  | 0.3  | 2.5  |               |                 |
| T <sub>doff</sub>                  | Turn-off delay time to 80% | 1    | 1.8  | 3.5  |               |                 |
| T <sub>f</sub>                     | Fall time 80% to 20%       | 0.1  | 0.5  | 2.5  |               |                 |
| E <sub>on</sub> + E <sub>off</sub> | Turn on and off energy     | —    | 5    | —    | $\mu\text{J}$ |                 |

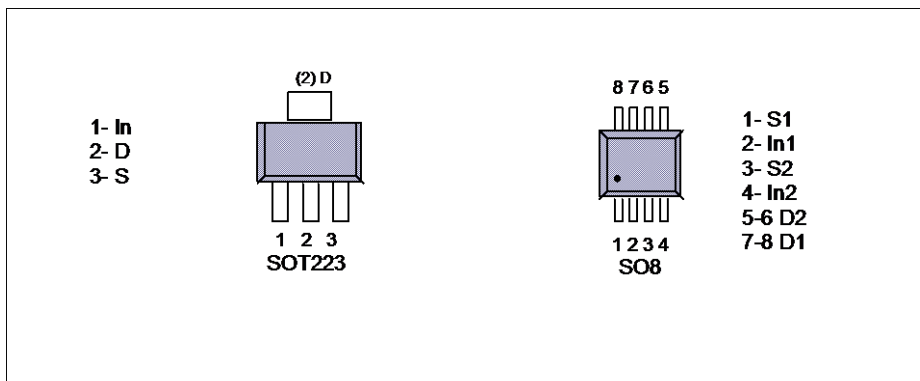
## Protection Characteristics

$T_j = -40..150^{\circ}\text{C}$ ,  $V_{cc} = 28\text{V}$  (unless otherwise specified)

| Symbol             | Parameter                     | Min.   | Typ. | Max. | Units              | Test Conditions                                   |
|--------------------|-------------------------------|--------|------|------|--------------------|---------------------------------------------------|
| T <sub>sd</sub>    | Over temperature threshold    | 150(2) | 165  | —    | $^{\circ}\text{C}$ | See figure 1                                      |
| I <sub>sd</sub>    | Over current threshold        | 1.2    | 1.8  | 3    | A                  | See figure 1                                      |
| V <sub>reset</sub> | IN protection reset threshold | 1.1    | 1.6  | 2    | V                  |                                                   |
| T <sub>reset</sub> | Time to reset protection      | 15(2)  | 50   | 500  | $\mu\text{s}$      | $V_{in} = 0\text{V}$ , $T_j = 25^{\circ}\text{C}$ |

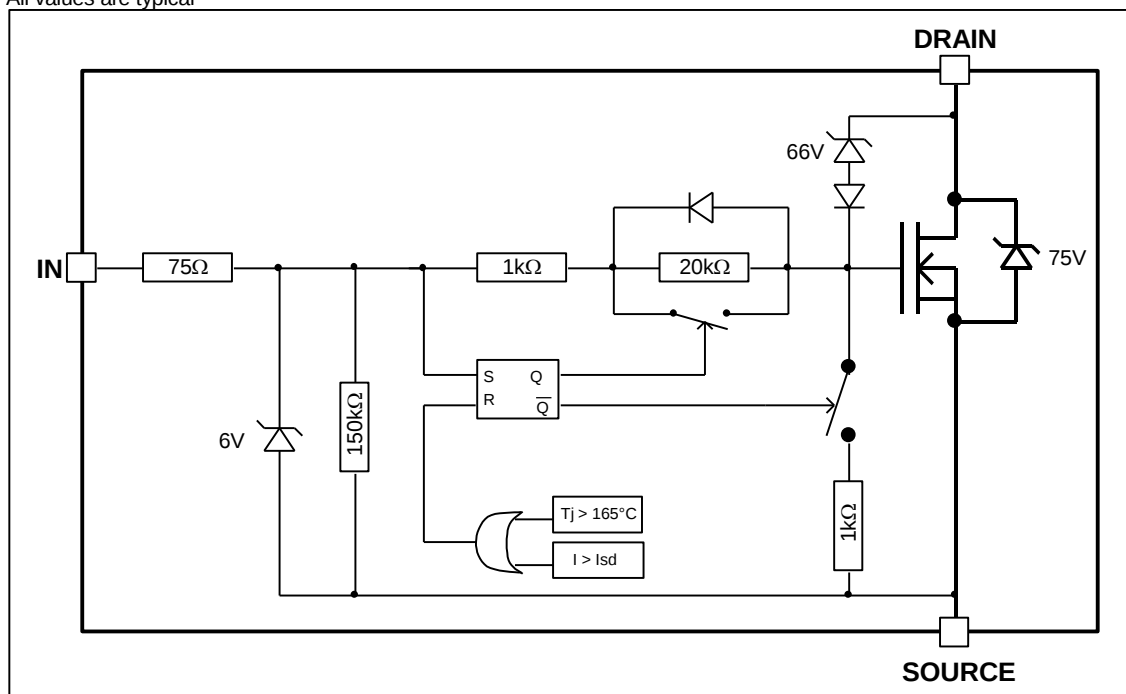
(2) Guaranteed by design

## Lead Assignments



## Functional Block Diagram

All values are typical



All curves are typical values. Operating in the shaded area is not recommended.

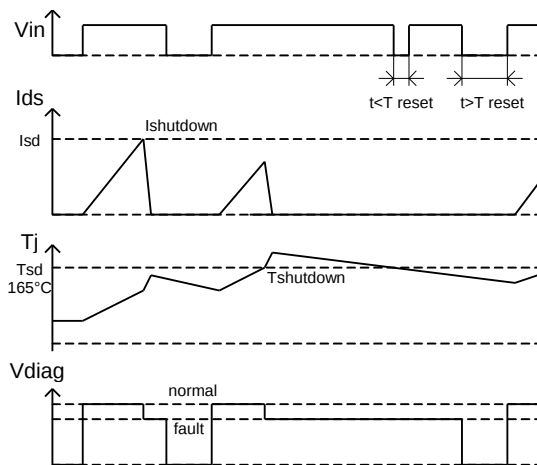


Figure 1 – Timing diagram

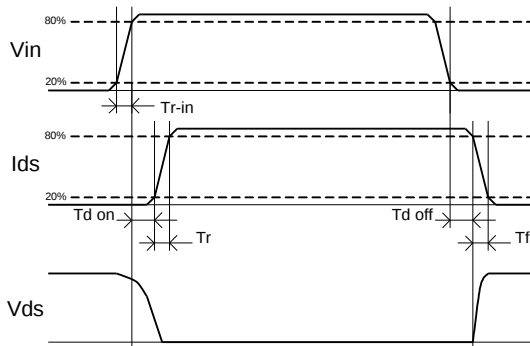


Figure 2 – IN rise time & switching definitions

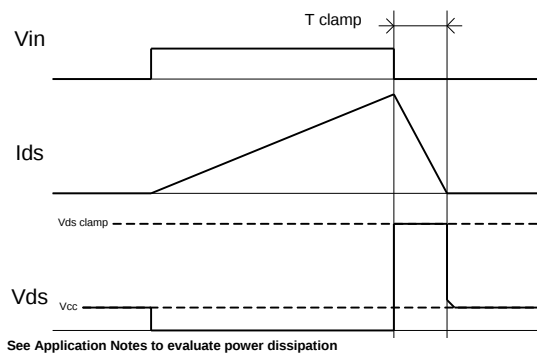


Figure 3 – Active clamp waveforms

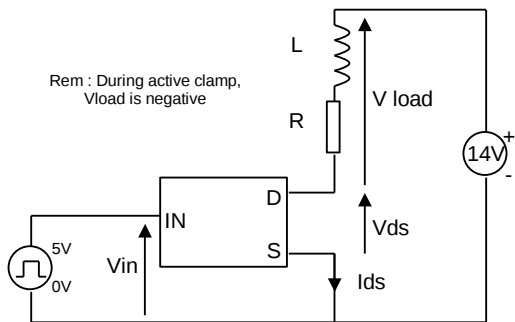
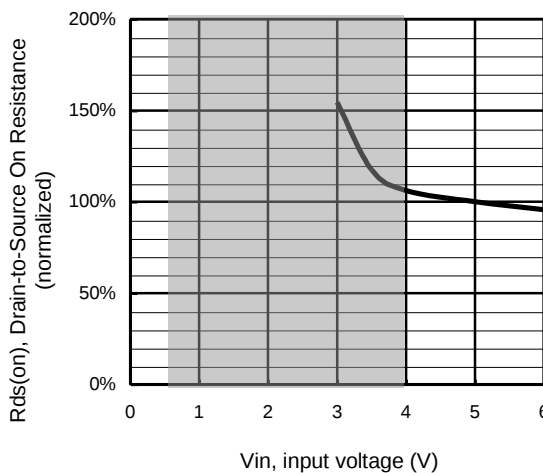
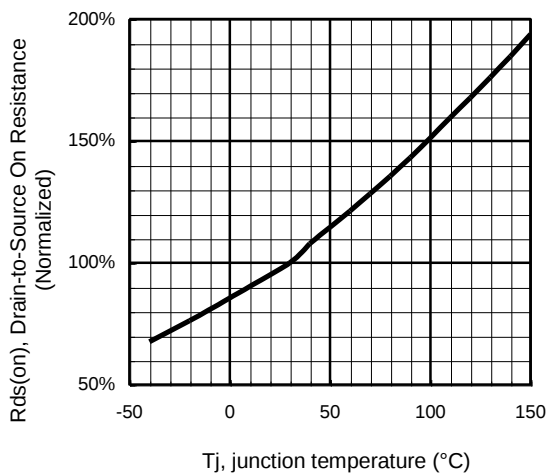


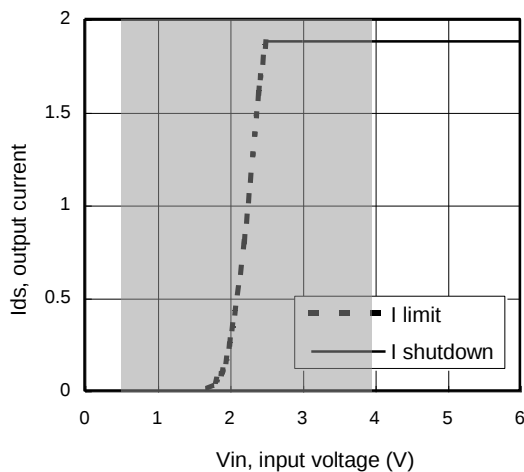
Figure 4 – Active clamp test circuit



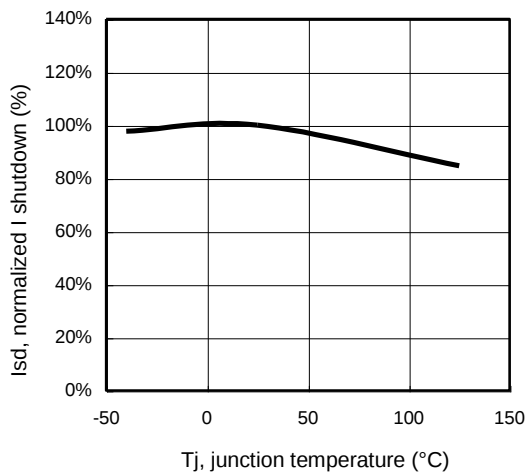
**Figure 5 – Normalized Rdson (%) Vs Input voltage (V)**



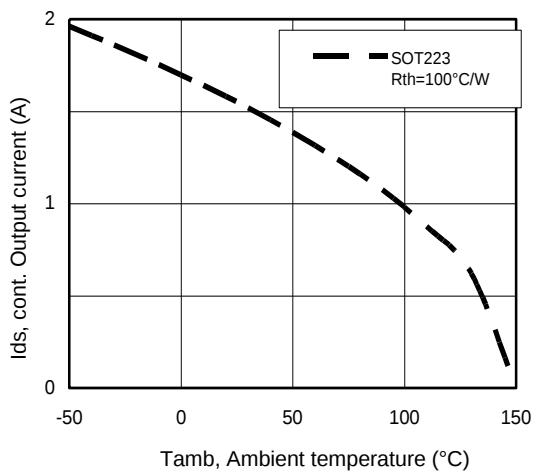
**Figure 6 - Normalized Rdson (%) Vs Tj (°C)**



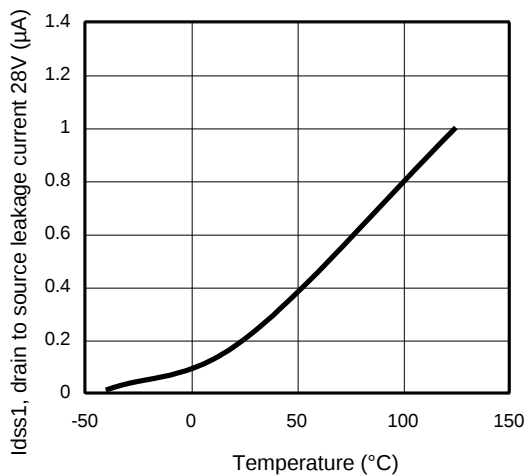
**Figure 7 – Current limitation and current shutdown Vs Input voltage (V)**



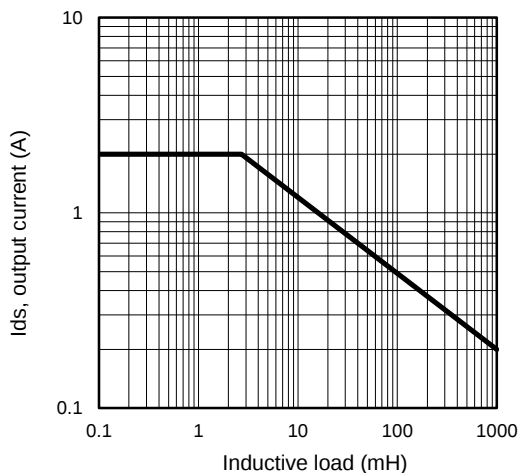
**Figure 8 – Normalized I shutdown (%) Vs junction temperature (°C)**



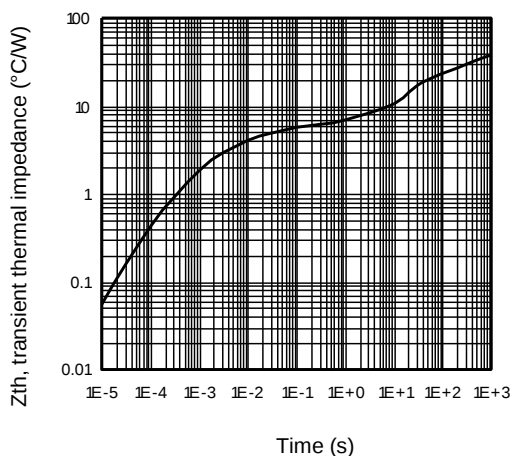
**Figure 9 – Max. continuous output current (A) Vs Ambient temperature (°C)**



**Figure 10 – Idss1 (μA) Vs temperature (°C)**

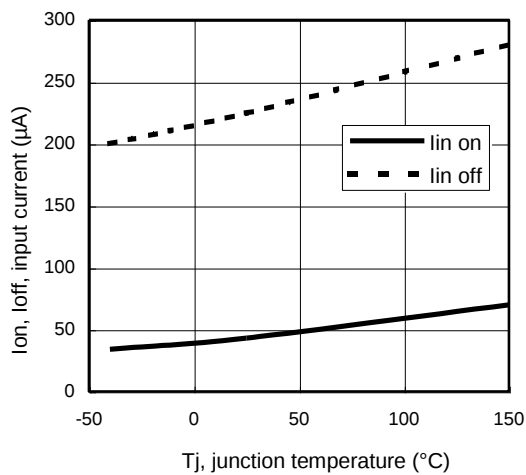


**Figure 11 – Max. output current (A) Vs Inductive load (mH)**

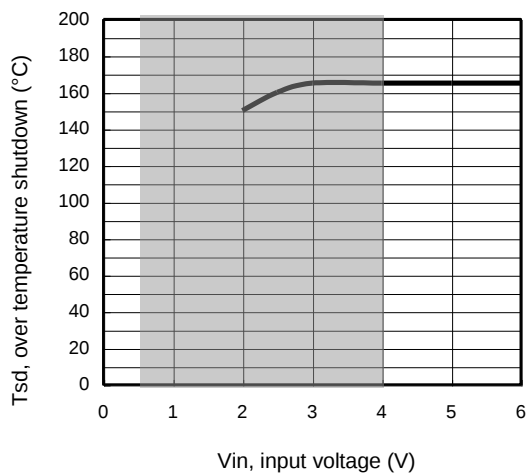


**Figure 12 – Transient thermal impedance (°C/W) Vs time (s)**

This is for single pulse when  $T_j=165^{\circ}\text{C}$  and for repetitive pulses when  $T_j<115^{\circ}\text{C}$  before turning off.

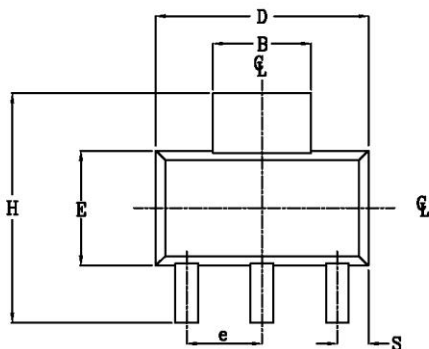


**Figure 13 – Input current (µA) On and Off Vs junction temperature (°C)**



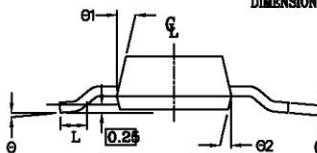
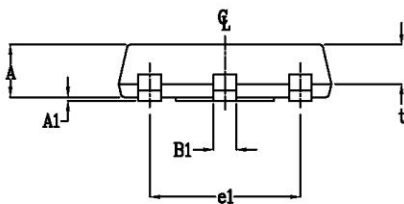
**Figure 14 – Over temperature shutdown (°C) Vs input voltage (V)**

## Case Outline - SOT-223



| POS | MILLIMETERS |      | INCHES     |       |
|-----|-------------|------|------------|-------|
| 1   | MAX         | MIN  | MAX        | MIN   |
| A   | 1.70        | 1.50 | .067       | .060  |
| AI  | 0.10        | 0.02 | .004       | .0008 |
| B   | 3.15        | 2.95 | .124       | .116  |
| BI  | 0.85        | 0.65 | .033       | .026  |
| C   | 0.35        | 0.25 | .014       | .010  |
| D   | 6.70        | 6.30 | .264       | .248  |
| e   | 2.30 NOM    |      | .0905 NOM  |       |
| e1  | 4.60 NOM    |      | .181 NOM   |       |
| E   | 3.70        | 3.30 | .146       | .130  |
| H   | 7.30        | 6.70 | .287       | .264  |
| S   | 1.05        | 0.85 | .041       | .033  |
| t   | 1.30        | 1.10 | .051       | .043  |
| Ø   | 10° MAX     |      | 10° MAX    |       |
| Ø1  | 16°         | 10°  | 16°        | 10°   |
| Ø2  | 16°         | 10°  | 16°        | 10°   |
| L   | 0.75 MIN    |      | 0.0296 MIN |       |

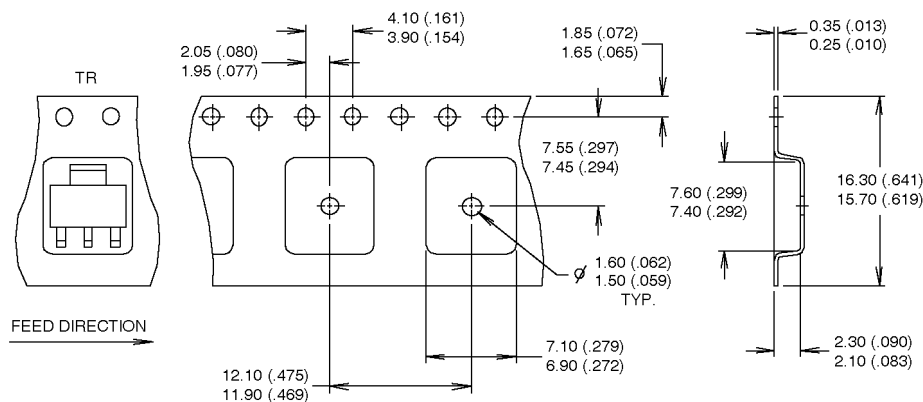
NOTE:  
1. PACKAGE OUTLINE EXCLUSIVE OF ANY MOLD FLASHES DIMENSION.  
2. PACKAGE OUTLINE EXCLUSIVE OF BURR DIMENSION.



Leads and drain are plated with 100% Sn

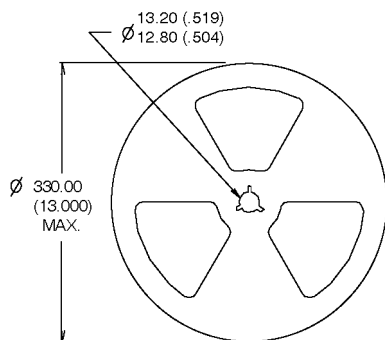
## Tape & Reel - SOT-223

Dimensions are shown in millimeters (inches)



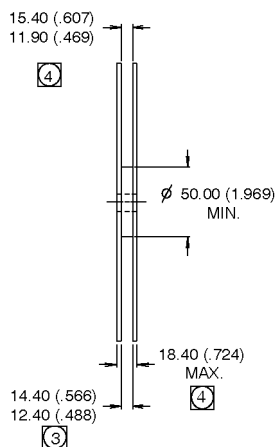
NOTES :

- NOTES:
1. CONTROLLING DIMENSION: MILLIMETER.
  2. OUTLINE CONFORMS TO EIA-481 & EIA-541.
  3. EACH ~~0330.00~~ (13.00) REEL CONTAINS 2,500 DEVICES.



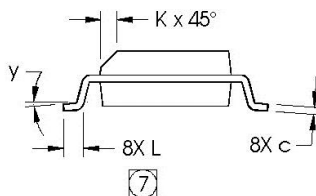
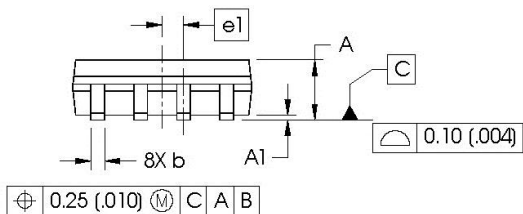
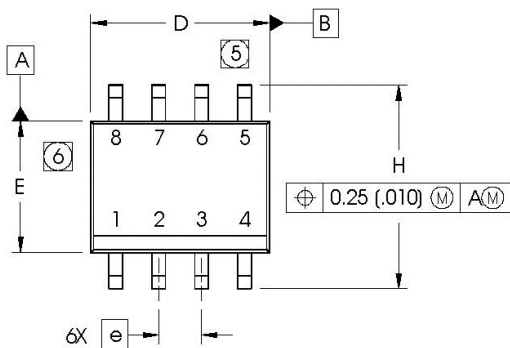
NOTES :

- 1. OUTLINE COMFORMS TO EIA-418-1.
- 2. CONTROLLING DIMENSION: MILLIMETER..
- ☒ 3. DIMENSION MEASURED @ HUB.
- ☒ 4. INCLUDES FLANGE DISTORTION @ OUTER EDGE.



## Case Outline - SO-8

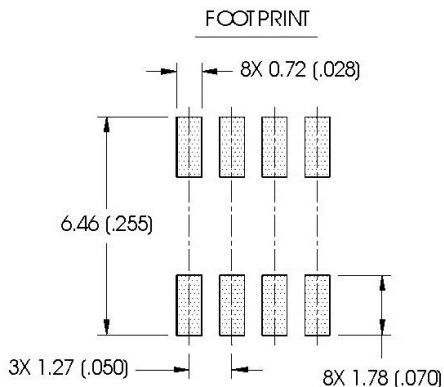
Dimensions are shown in millimeters (inches)



| DIM | INCHES     |       | MILLIMETERS |      |
|-----|------------|-------|-------------|------|
|     | MIN        | MAX   | MIN         | MAX  |
| A   | .0532      | .0688 | 1.35        | 1.75 |
| A1  | .0040      | .0098 | 0.10        | 0.25 |
| b   | .013       | .020  | 0.33        | 0.51 |
| c   | .0075      | .0098 | 0.19        | 0.25 |
| D   | .189       | .1968 | 4.80        | 5.00 |
| E   | .1497      | .1574 | 3.80        | 4.00 |
| e   | .050 BASIC |       | 1.27 BASIC  |      |
| e1  | .025 BASIC |       | 0.635 BASIC |      |
| H   | .2284      | .2440 | 5.80        | 6.20 |
| K   | .0099      | .0196 | 0.25        | 0.50 |
| L   | .016       | .050  | 0.40        | 1.27 |
| y   | 0°         | 8°    | 0°          | 8°   |

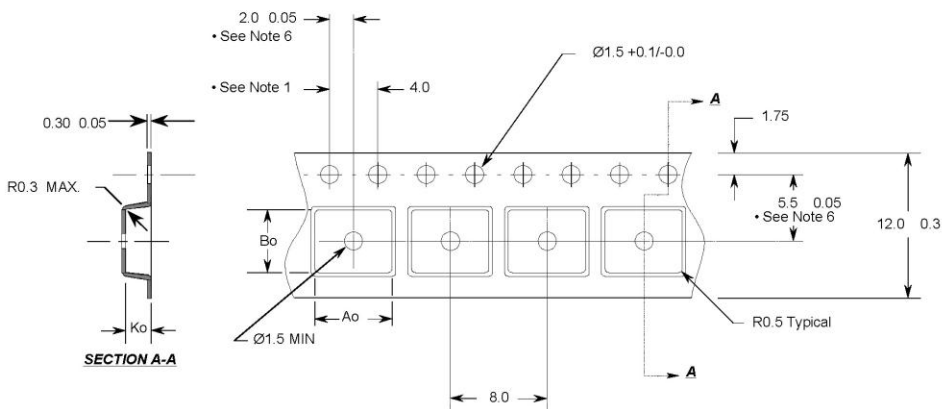
### NOTES:

1. DIMENSIONING & TOLERANCING PER ASME Y14.5M-1994.
2. CONTROLLING DIMENSION: MILLIMETER
3. DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).
4. OUTLINE CONFORMS TO JEDEC OUTLINE MS-012AA.
5. DIMENSION DOES NOT INCLUDE MOLD PROTRUSIONS. MOLD PROTRUSIONS NOT TO EXCEED 0.15 (.006).
6. DIMENSION DOES NOT INCLUDE MOLD PROTRUSIONS. MOLD PROTRUSIONS NOT TO EXCEED 0.25 (.010).
7. DIMENSION IS THE LENGTH OF LEAD FOR SOLDERING TO A SUBSTRATE.



Leads and drain are plated with 100% Sn

## Tape & Reel - SO-8



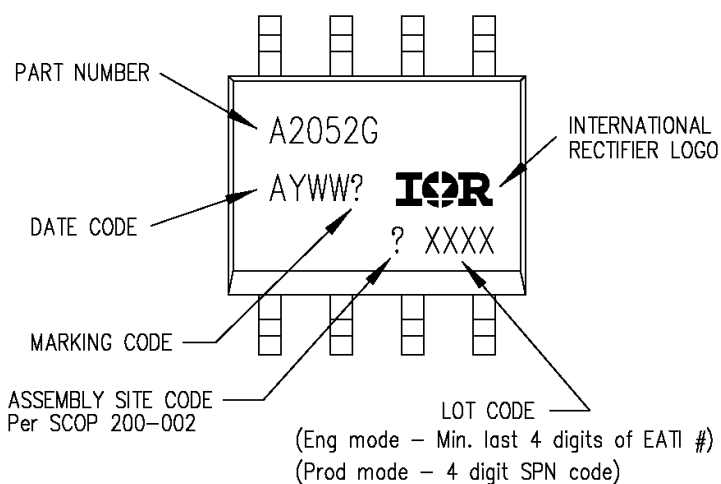
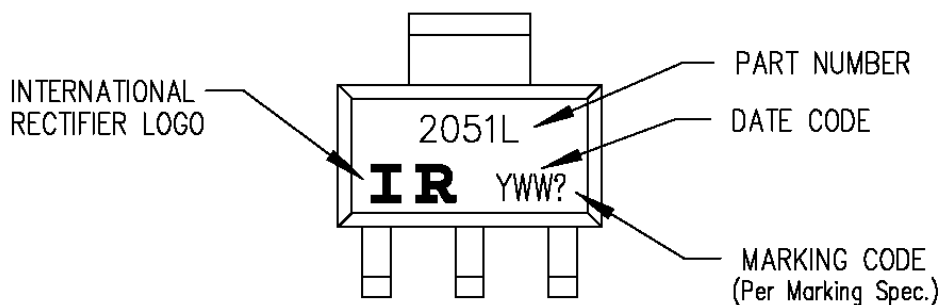
**Notes:**

1. 10 sprocket hole pitch cumulative tolerance 0.2
2. Camber not to exceed 1mm in 100mm
3. Material: Black Conductive Advantek Polystyrene
4. Ao and Bo measured on a plane 0.3mm above the bottom of the pocket
5. Ko measured from a plane on the inside bottom of the pocket to the top surface of the carrier.
6. Pocket position relative to sprocket hole measured as true position of pocket, not pocket hole.

$A_o = 6.4 \text{ mm}$   
 $B_o = 5.2 \text{ mm}$   
 $K_o = 2.1 \text{ mm}$

- All Dimensions in Millimeters -

## Part Marking Information



## Ordering Information

| Base Part Number | Package Type | Standard Pack |          | Complete Part Number |
|------------------|--------------|---------------|----------|----------------------|
|                  |              | Form          | Quantity |                      |
| AUIPS2051L       | SOT223       | Tube          | 80       | AUIPS2051L           |
|                  |              | Tape and reel | 2500     | AUIPS2051LTR         |
| AUIPS2052G       | SO8          | Tube          | 95       | AUIPS2052G           |
|                  |              | Tape and reel | 2500     | AUIPS2052GTR         |

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For technical support, please contact IR's Technical Assistance Center  
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## Revision History

| Revision | Date                            | Notes/Changes                                  |
|----------|---------------------------------|------------------------------------------------|
| A        | 30/10/08                        | First release                                  |
| B        | 23/03/2009                      | Add latch up information                       |
| C        | 15/09/2009                      | Add application section                        |
| D        | 21/02/2011                      | Update Fig 11                                  |
| E        | November, 14 <sup>th</sup> 2011 | Update T&R SOT223                              |
| F        | May 9 <sup>th</sup> , 2012      | Update the component number of the SOT223 tube |
|          |                                 |                                                |
|          |                                 |                                                |
|          |                                 |                                                |



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- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
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- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

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