

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

Description

The AUIPS2041(R)(L) 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. 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 5A. 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.

Product Summary

| | |
|-----------|--------------|
| Rds(on) | 130mΩ (max.) |
| Vclamp | 68V |
| Ishutdown | 5A (typ.) |

Packages

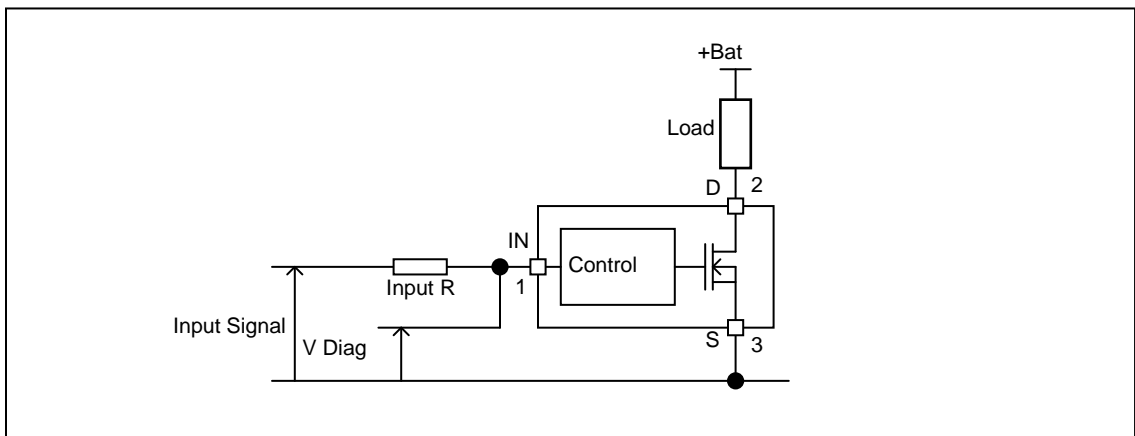


DPak
AUIPS2041R



SOT223
AUIPS2041L

Typical Connection



Qualification Information†

| | | | |
|-----------------------------------|----------------------|---|---|
| Qualification Level | | Automotive (per AEC-Q100 ^{††}) | |
| | | Comments: This family of ICs has passed an Automotive qualification. IR's Industrial and Consumer qualification level is granted by extension of the higher Automotive level. | |
| Moisture Sensitivity Level | | DPAK-3L | MSL1, 260°C (per IPC/JEDEC J-STD-020) |
| | | SOT223-3L | MSL2, 260°C ^{†††} (per IPC/JEDEC J-STD-020) |
| ESD | Machine Model | Class M4 (+/-450V) (per AEC-Q100-003) | |
| | Human Body Model | Class H3A (+/4500V) (per AEC-Q100-002) | |
| | Charged Device Model | Class C4 (+/-900V) (per AEC-Q100-011) | |
| IC Latch-Up Test | | ClassII, Level A (per AEC-Q100-004) | |
| RoHS Compliant | | 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.

††† Higher MSL ratings may be available for the specific package types listed here. Please contact your International Rectifier sales representative for further information.

Absolute Maximum Ratings

Absolute maximum ratings indicate sustained limits beyond which damage to the device may occur. (T_j= -40°C..150°C, V_{cc}=6..50V unless otherwise specified).

| Symbol | Parameter | Min. | Max. | Units |
|-----------------------|--|------|------|-------|
| V _{ds} | Maximum drain to source voltage | -0.3 | 60 | V |
| V _{in} | Maximum input voltage | -0.3 | 6 | V |
| I _{sd cont.} | Max diode continuous current (limited by thermal dissipation) R _{th} =125°C/W | — | 1.4 | A |
| P _d | Maximum power dissipation (internally limited by thermal protection) R _{th} =125°C/W | — | 1 | W |
| T _{j max.} | Max. storage & operating temperature junction temperature | -40 | 150 | °C |

Thermal Characteristics

| Symbol | Parameter | Typ. | Max. | Units |
|------------------|---|------|------|-------|
| R _{th1} | Thermal resistance junction to ambient IPS2041L | 100 | — | °C/W |
| R _{th2} | Thermal resistance junction to ambient with 1" square footprint | 50 | — | |
| R _{th1} | Thermal resistance junction to ambient IPS2041R D-Pak std. footprint | 70 | — | |
| R _{th2} | Thermal resistance junction to ambient IPS2041R D-Pak 1" sqr. footprint | 50 | — | |
| R _{th3} | Thermal resistance junction to case IPS2041R D-Pak | 4 | — | |

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 |
|------------------------|--|------|------|-------|
| V _{IH} | High level input voltage | 4 | 5.5 | |
| V _{IL} | Low level input voltage | 0 | 0.5 | |
| I _{ds} | Continuous drain current, T _{ambient} =85°C, T _j =125°C, V _{in} =5V, R _{th} =100°C/W | — | 1.4 | A |
| R _{in} | Recommended resistor in series with IN pin to generate a diagnostic | 0.5 | 5 | kΩ |
| Max L | Max recommended load inductance (including line inductance) (1) | — | 10 | mH |
| Max. t _{rise} | Max. input rising time | — | 1 | μs |

(1) Higher inductance is possible if maximum load current is limited - see figure 11

Static Electrical Characteristics

T_J = -40..150°C, V_{CC}=14V (unless otherwise specified), typical value are given for T_J=25°C

| Symbol | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|-----------------------|---|------|------|------|-------|--|
| R _{ds(on)} | ON state resistance T _J =25°C | — | 100 | 130 | mΩ | V _{in} =5V, I _{ds} =1A |
| | ON state resistance T _J =150°C(2) | — | 180 | 240 | | |
| I _{dss1} | Drain to source leakage current | — | 0.01 | 1 | μA | V _{CC} =14V, T _J =25°C |
| I _{dss2} | Drain to source leakage current | — | 0.04 | 2 | | V _{CC} =50V, T _J =25°C |
| V _{clamp1} | Drain to source clamp voltage 1 | 63 | 68 | — | V | I _d =20mA See fig. 3 & 4 |
| V _{clamp2} | Drain to source clamp voltage 2 | — | 68 | 75 | | |
| V _{in clamp} | IN to source pin clamp voltage | 5.5 | 6.2 | 7.5 | | |
| V _{th} | Input threshold voltage | 1.1 | 2 | 2.8 | | |
| I _{in, on} | ON state IN positive current | 10 | 40 | 80 | μA | V _{in} =5V |
| I _{in, off} | OFF state IN positive current (after protection latched) | 120 | 250 | 350 | | |

Switching Electrical Characteristics

T_J = -40..150°C, V_{CC}=14V, Resistive load=10Ω, R_{input}=50Ω, V_{in}=5V, typical value are given for T_J=25°C

| Symbol | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|------------------------------------|----------------------------|------|------|------|-------|-----------------|
| T _{d(on)} | Turn-on delay time to 20% | 0.25 | 1.3 | 4 | μs | See figure 2 |
| T _r | Rise time 20% to 80% | 0.1 | 0.9 | 2 | | |
| T _{d(off)} | Turn-off delay time to 80% | 1 | 3 | 8 | | |
| T _f | Fall time 80% to 20% | 0.1 | 0.6 | 3 | | |
| E _{on} + E _{off} | Turn on and off energy | — | 12 | — | μJ | |

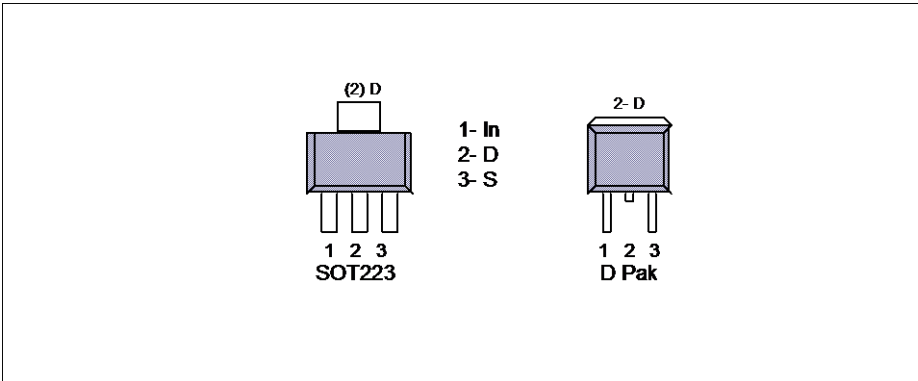
Protection Characteristics

T_J = -40..150°C, V_{CC}=14V (unless otherwise specified), typical value are given for T_J=25°C

| Symbol | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|--------------------|-------------------------------|--------|------|------|-------|-------------------------------------|
| T _{sd} | Over temperature threshold | 150(2) | 165 | — | °C | See figure 1 |
| I _{sd} | Over current threshold | 4 | 5.5 | 7.5 | A | T _J =25..150°C see fig 1 |
| | | 3.6 | 6 | 8 | | T _J = -40°C |
| V _{reset} | IN protection reset threshold | 0.9 | 1.6 | 2 | V | |
| T _{reset} | Time to reset protection | 15 | 50 | 500 | μs | V _{in} =0V |

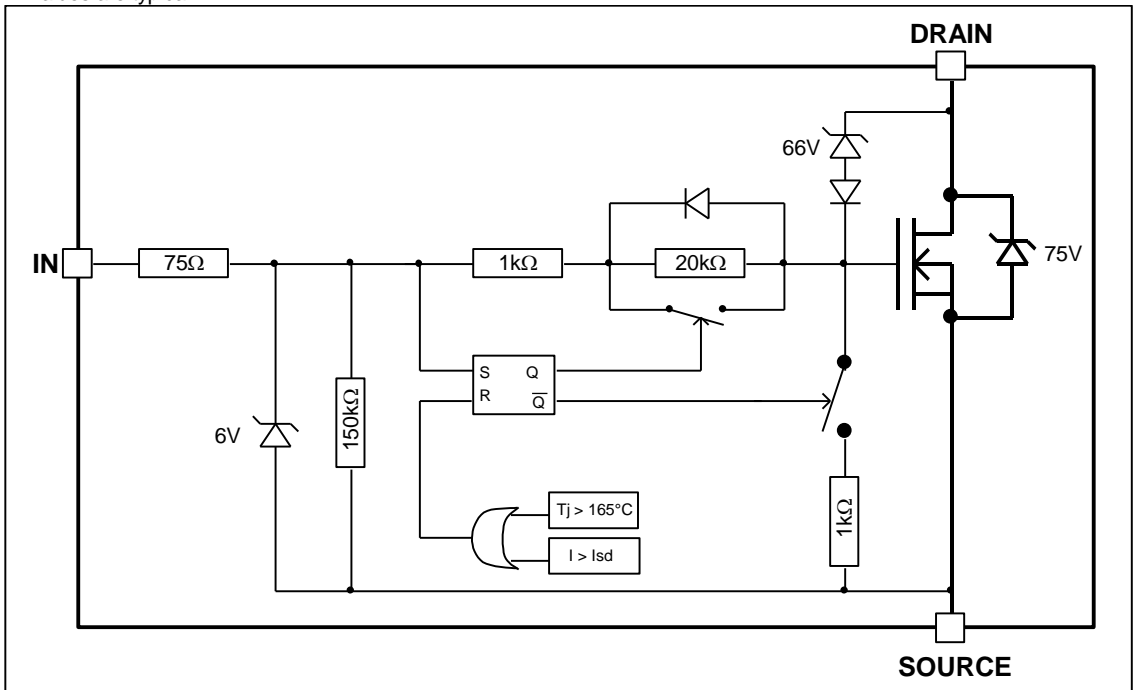
(2) Guaranteed by design

Lead Assignments



Functional Block Diagram

All values are typical



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

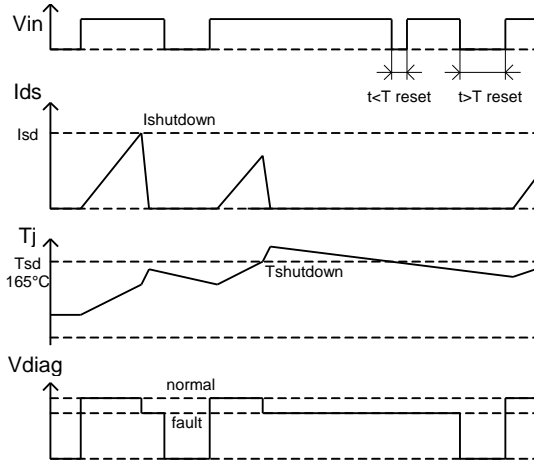


Figure 1 – Timing diagram

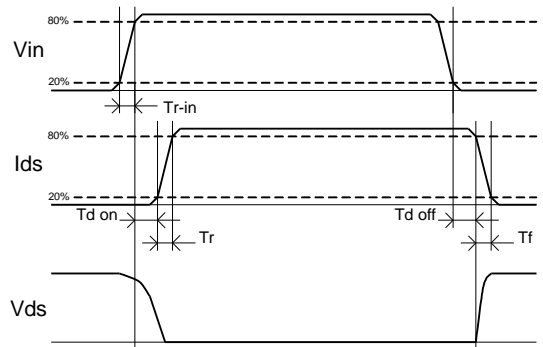


Figure 2 – IN rise time & switching definitions

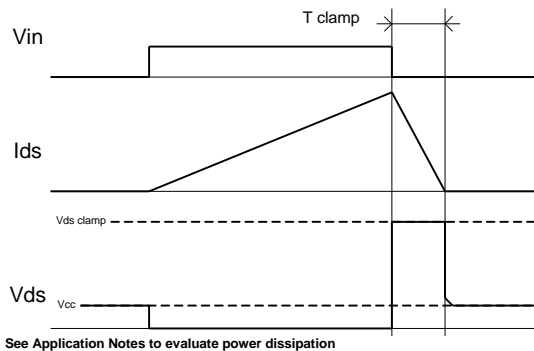


Figure 3 – Active clamp waveforms

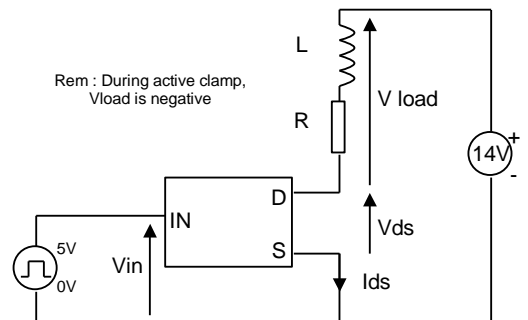


Figure 4 – Active clamp test circuit

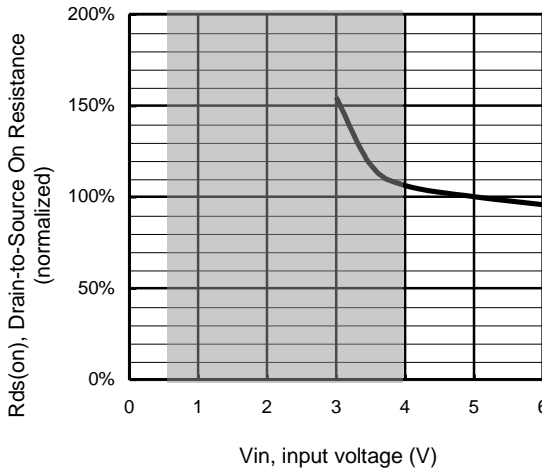


Figure 5 – Normalized Rds(on) (%) Vs Input voltage (V)

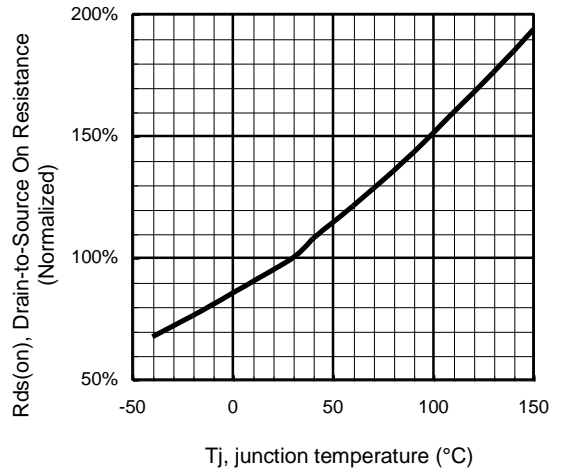


Figure 6 - Normalized Rds(on) (%) Vs Tj (°C)

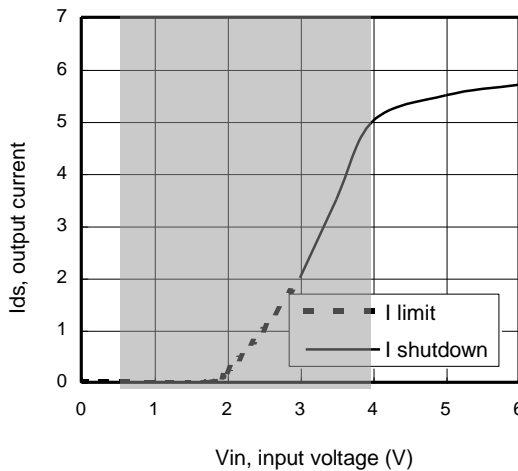


Figure 7 – Current limitation and current shutdown Vs Input voltage (V)

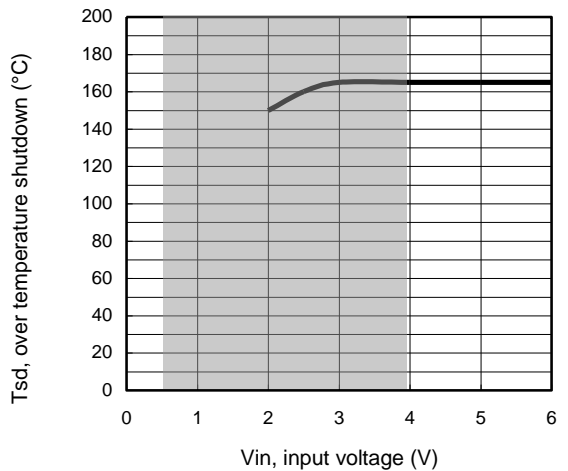


Figure 8 – Over temperature shutdown (°C) Vs input voltage (V)

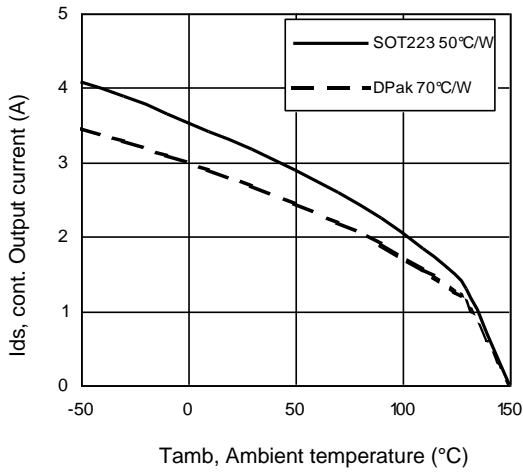


Figure 9 – Max. continuous output current (A) Vs Ambient temperature (°C)

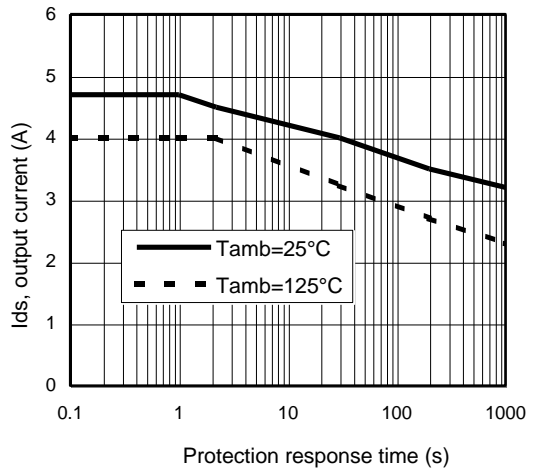


Figure 10 – Ids (A) Vs over temperature protection response time (s)

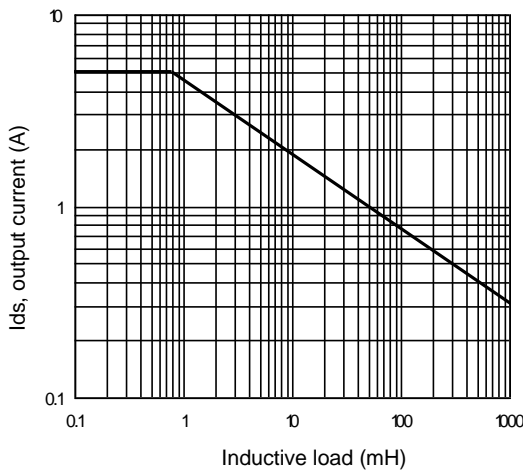


Figure 11 – Max. output current (A) Vs Inductive load (mH)

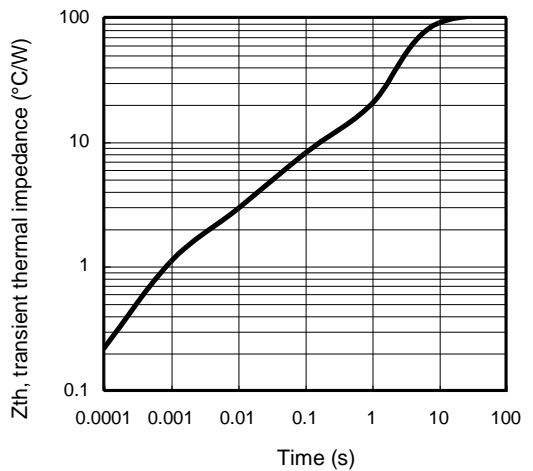
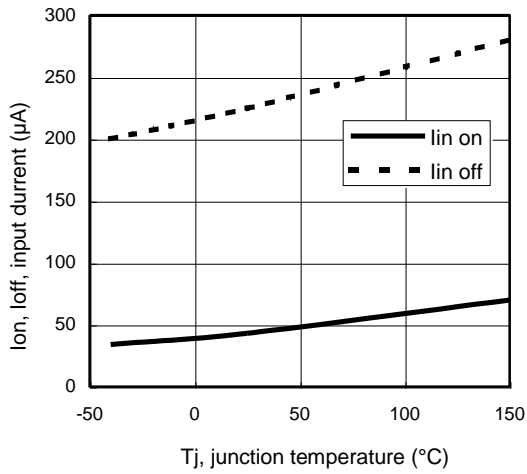
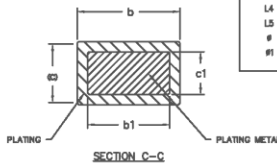
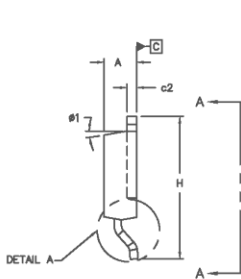
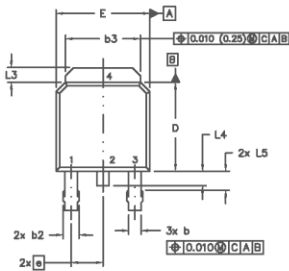
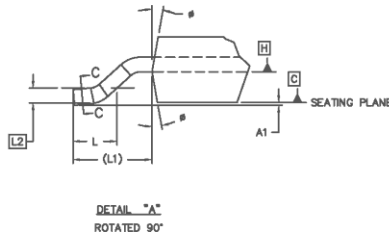
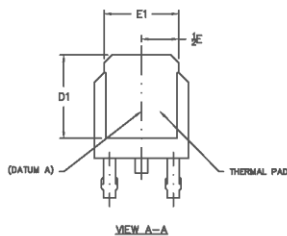


Figure 12 – Transient thermal impedance (°C/W) Vs time (s)



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

Case outline – Dpak - Automotive Q100 PbF MSL1 qualified



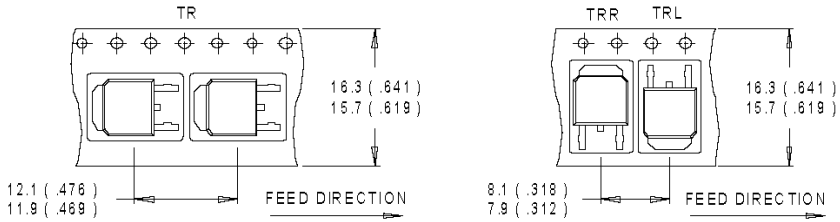
| SYMBOL | DIMENSIONS | | | | NOTES |
|--------|-------------|-------|-----------|-------|-------|
| | MILLIMETERS | | INCHES | | |
| | MIN. | MAX. | MIN. | MAX. | |
| A | 2.18 | 2.39 | .086 | .094 | |
| A1 | | 0.13 | | .005 | |
| b | 0.64 | 0.89 | .025 | .035 | 5 |
| b1 | 0.64 | 0.76 | .025 | 0.030 | 5 |
| b2 | 0.78 | 1.14 | .030 | .045 | |
| b3 | 4.65 | 5.46 | .185 | .215 | |
| c | 0.48 | 0.61 | .018 | .024 | 5 |
| c1 | 0.41 | 0.56 | .016 | .022 | 5 |
| c2 | .048 | 0.89 | .018 | .035 | 5 |
| D | 5.97 | 6.22 | .235 | .245 | 6 |
| D1 | 3.21 | - | .125 | - | 4 |
| E | 6.35 | 6.73 | .250 | .265 | 6 |
| E1 | 4.32 | - | .170 | - | 4 |
| e | 2.28 | | .090 BSC | | |
| H | 6.40 | 10.41 | .270 | .410 | |
| L | 1.40 | 1.78 | .055 | .070 | |
| L1 | 2.74 REF. | | .108 REF. | | |
| L2 | 0.81 BSC | | .020 BSC | | |
| L3 | 0.89 | 1.27 | .035 | .050 | |
| L4 | | 1.02 | | .040 | |
| L5 | 1.14 | 1.52 | .045 | .060 | |
| # | 0" | 10" | 0" | 10" | 3 |
| #1 | 0" | 15" | 0" | 15" | |

NOTES:

- 1.0 DIMENSIONING AND TOLERANCING PER ASME Y14.5 M- 1994.
- 2.0 DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS]
- 3.0 LEAD DIMENSION UNCONTROLLED IN L5
- 4.0 DIMENSION D1 AND E1 ESTABLISH A MINIMUM MOUNTING SURFACE FOR THERMAL PAD.
- 5.0 SECTION C-C DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN .005 [0.127] AND .010 [0.2540] FROM THE LEAD TIP.
- 6.0 DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
- 7.0 OUTLINE CONFORMS TO JEDEC OUTLINE TO-252AA.
- 8.0 LEADS AND DRAIN ARE PLATED WITH 100% Sn

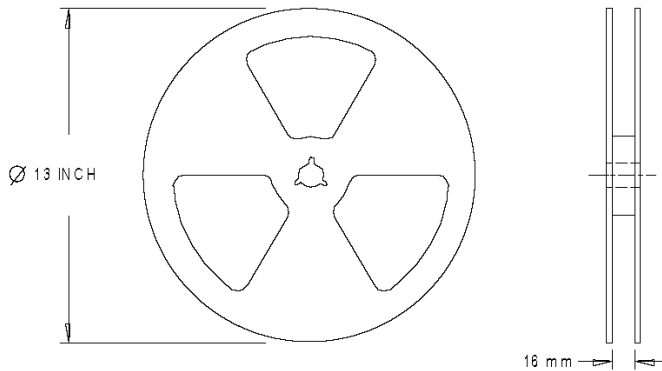
Tape & Reel – Dpak

Dimensions are shown in millimeters (inches)



NOTES :

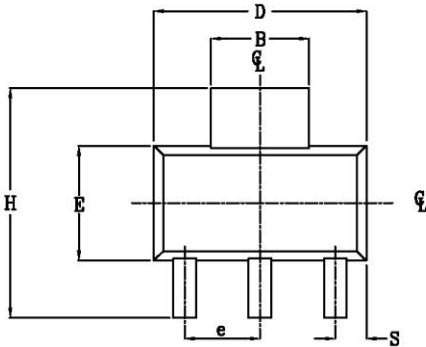
1. CONTROLLING DIMENSION : MILLIMETER.
2. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).
3. OUTLINE CONFORMS TO EIA-481 & EIA-541.



NOTES :

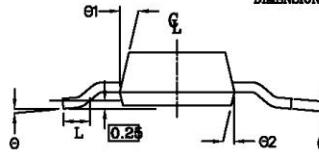
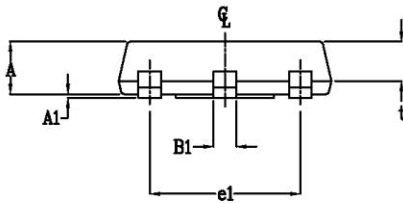
1. OUTLINE CONFORMS TO EIA-481.

Case Outline - SOT-223 - Automotive Q100 PbF MSL2 qualified



| POS | MILLIMETERS | | INCHES | |
|------------|-------------|------|------------|-------|
| | MAX | MIN | MAX | MIN |
| 1 | | | | |
| A | 1.70 | 1.50 | .067 | .060 |
| A1 | 0.10 | 0.02 | .004 | .0008 |
| B | 3.15 | 2.95 | .124 | .116 |
| B1 | 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 |
| Θ | 10° MAX | | 10° MAX | |
| $\Theta 1$ | 16° | 10° | 16° | 10° |
| $\Theta 2$ | 16° | 10° | 16° | 10° |
| L | 0.75 MIN | | 0.0295 MIN | |

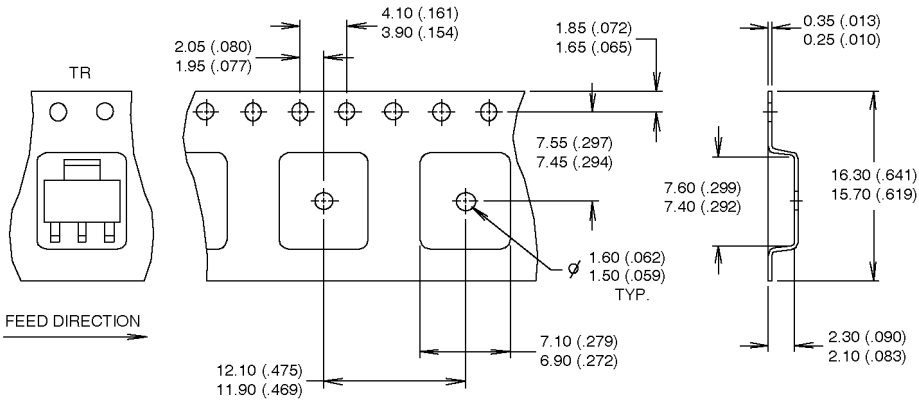
NOTE:
 1. PACKAGE OUTLINE EXCLUSIVE OF ANY MOLD FLASHES DIMENSION.
 2. PACKAGE OUTLINE EXCLUSIVE OF BURR DIMENSION.



Leads and drain are plated with 100% Sn

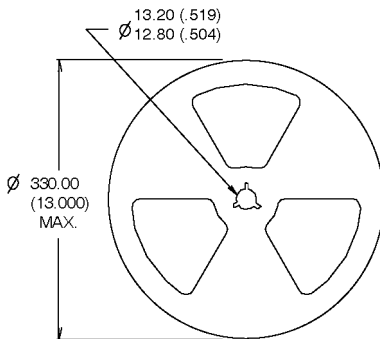
Tape & Reel - SOT-223

Dimensions are shown in millimeters (inches)



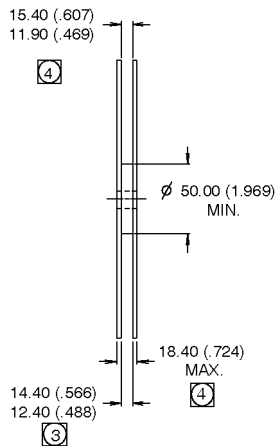
NOTES :

1. CONTROLLING DIMENSION: MILLIMETER.
2. OUTLINE CONFORMS TO EIA-481 & EIA-541.
3. EACH $\varnothing 330.00$ (13.00) REEL CONTAINS 2,500 DEVICES.

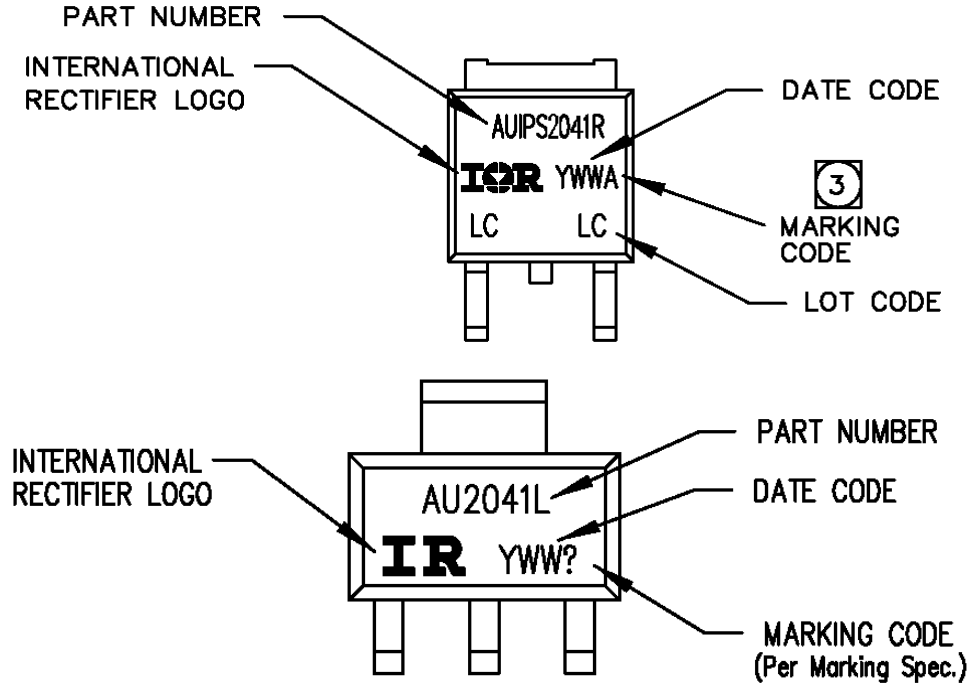


NOTES :

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



Part Marking Information



Ordering Information

| Base Part Number | Package Type | Standard Pack | | Complete Part Number |
|------------------|--------------|---------------------|----------|----------------------|
| | | Form | Quantity | |
| AUIPS2041L | D-Pak-5-Lead | Tube | 75 | AUIPS2041R |
| | | Tape and reel | 2000 | AUIPS2041RTR |
| | | Tape and reel left | 3000 | AUIPS2041RTRL |
| | | Tape and reel right | 3000 | AUIPS2041RTRR |
| AUIPS2041L | SOT223 | Tube | 80 | AUIPS2041L |
| | | Tape and reel | 2500 | AUIPS2041LTR |

IMPORTANT NOTICE

Unless specifically designated for the automotive market, International Rectifier Corporation and its subsidiaries (IR) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or services without notice. Part numbers designated with the "AU" prefix follow automotive industry and / or customer specific requirements with regards to product discontinuance and process change notification. All products are sold subject to IR's terms and conditions of sale supplied at the time of order acknowledgment.

IR warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with IR's standard warranty. Testing and other quality control techniques are used to the extent IR deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

IR assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using IR components. To minimize the risks with customer products and applications, customers should provide adequate design and operating safeguards.

Reproduction of IR information in IR data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alterations is an unfair and deceptive business practice. IR is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of IR products or serviced with statements different from or beyond the parameters stated by IR for that product or service voids all express and any implied warranties for the associated IR product or service and is an unfair and deceptive business practice. IR is not responsible or liable for any such statements.

IR products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or in other applications intended to support or sustain life, or in any other application in which the failure of the IR product could create a situation where personal injury or death may occur. Should Buyer purchase or use IR products for any such unintended or unauthorized application, Buyer shall indemnify and hold International Rectifier and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that IR was negligent regarding the design or manufacture of the product.

IR products are neither designed nor intended for use in military/aerospace applications or environments unless the IR products are specifically designated by IR as military-grade or "enhanced plastic." Only products designated by IR as military-grade meet military specifications. Buyers acknowledge and agree that any such use of IR products which IR has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

IR products are neither designed nor intended for use in automotive applications or environments unless the specific IR products are designated by IR as compliant with ISO/TS 16949 requirements and bear a part number including the designation "AU". Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, IR will not be responsible for any failure to meet such requirements.

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

<http://www.irf.com/technical-info/>

WORLD HEADQUARTERS:

101 N Sepulveda Blvd., El Segundo, California 90245

Tel: (310) 252-7105

Revision History

| Revision | Date | Notes/Changes |
|-----------------|---------------------------------|--|
| C | 26/02/2009 | AU number update / OV removed |
| D | 09/12/2010 | Final release |
| E | 14/03/2011 | Update part marking |
| F | November, 14 th 2011 | Update T&R SOT223 |
| G | May 9 th , 2012 | Update the component number of the SOT223 tube |
| | | |
| | | |
| | | |
| | | |

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[International Rectifier:](#)

[AUIPS2041L](#)