# LOW EMI CURRENT SENSE HIGH SIDE SWITCH

## Features

- Load current feedback
- Programmable over current shutdown
- Active clamp
- ESD protection
- Input referenced to Vcc
- Over temperature shutdown
- Switching time optimized for low EMI
- Reverse battery protection
- Lead-Free, Halogen-Free, RoHS compliant

## Description

The AUIR3320(S) is a fully protected 4 terminals high side switch. The input signal is referenced to Vcc. When the input voltage Vcc - Vin is higher than the specified threshold, the output power Mosfet is turned on. When the Vcc - Vin is lower than the specified Vil threshold, the output Mosfet is turned off. A current proportional to the power Mosfet current is sourced to the Ifb pin. Over current shutdown occurs when Vifb-Vin > 4.7V. The current shutdown threshold is adjusted by selecting the proper RIfb. Either over current and over temperature latches off the switch. The device is reset by pulling the input pin high. Other integrated protections (ESD, reverse battery, active clamp) make the switch very rugged in automotive environment.

## Product Summary

| | |
|---|---|
| Rds(on) | 4 mΩ max. |
| Vcc op. | 6 to 26V |
| Current Ratio | 6000 |
| Prog. Ishutdown | 10 to 55A |
| Vclamp | 40V |

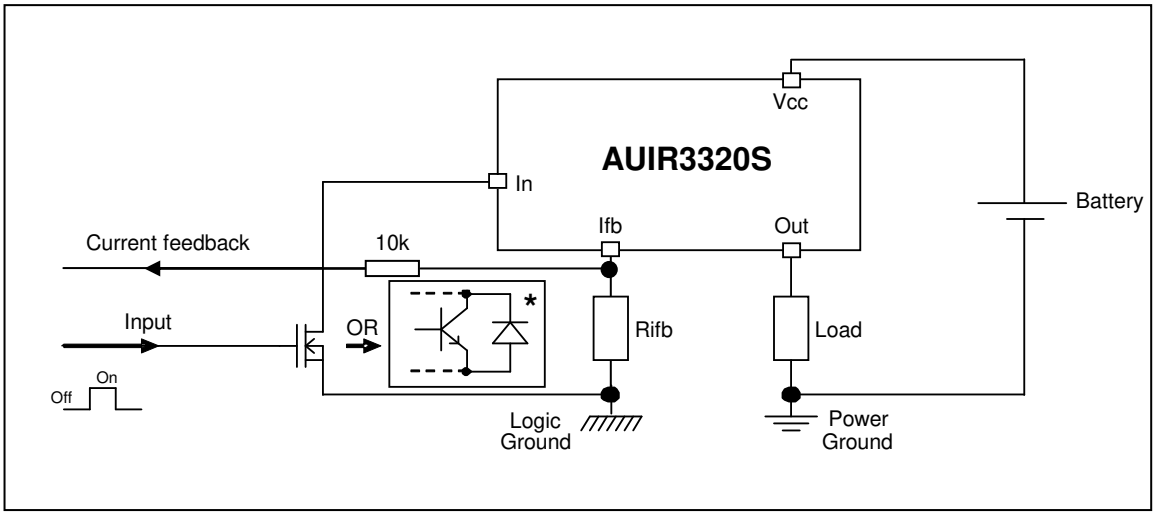
## Packages


**D²Pak**
**Pin 4 and 5 fused**
**AUIR3320S**

## Ordering Information

| Base Part Number | Package Type | Standard Pack | | Complete Part Number |
|---|---|---|---|---|
| | | Form | Quantity | |
| AUIR3320S | D2-Pak-5-Leads | Tape and reel left | 800 | AUIR3320STRL |

## Typical Connection




*The diode between the collector and the emitor is necessary for the reverse battery protection

## Absolute Maximum Ratings

Absolute maximum ratings indicate sustained limits beyond which damage to the device may occur. All voltage parameters are referenced to Vcc lead. (Tj=-40°..150°C, Vcc=6.26V Tambient=25°C unless otherwise specified).

| Symbol | Parameter | Min. | Max. | Units |
|---|---|---|---|---|
| Vcc-Vin | Maximum Vcc voltage | -16 | 37 | V |
| Vcc-Vin cont. | Maximum continuous Vcc voltage | -16 | 26 | |
| Vcc-Vfb | Maximum Ifb voltage | -16 | 33 | |
| Vcc-Vout | Maximum output voltage | -0.3 | 37 | |
| Ids cont. | Maximum body diode continuous current Rth=60°C/W (1) Tambient=25°C | — | 2.8 | A |
| Ids pulsed | Maximum body diode pulsed current (1) | — | 100 | |
| Pd | Maximum power dissipation Rth=60°C/W Tambient=25°C | — | 2 | W |
| Tj max. | Maximum operating junction temperature | -40 | 150 | °C |
| | Maximum storage temperature | -55 | 150 | |
| Min Rfb | Minimum on the resistor on Ifb pin | 0.3 | — | kΩ |
| Ifb max. | Max. Ifb current | -50 | 50 | mA |

(1) Limited by junction temperature. Pulsed is also limited by wiring

## Thermal Characteristics

| Symbol | Parameter | Typ. | Max. | Units |
|---|---|---|---|---|
| Rth1 | Thermal resistance junction to ambient D²-Pak Std footprint | 60 | — | °C/W |
| Rth2 | Thermal resistance junction to ambient D²-Pak 1" sqrt. footprint | 40 | — | |
| Rth3 | Thermal resistance junction to case D²-Pak | 0.7 | — | |

## 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 |
|---|---|---|---|---|
| Iout | Continuous output current | | | A |
| | Tambient=85°C, Rth=5°C/W, Tj=150°C | | 45 | |
| | Tambient=85°C, Rth=40°C/W, Tj=150°C | — | 16 | |
| Rifb | Recommended Ifb resistor (2)(3) | 0.3 | 3.5 | kΩ |
| Pulse min. | Minimum turn-on pulse width | 1 | — | ms |
| Fmax. | Maximum operating frequency | — | 200 | Hz |

(2) If Rifb is too low, the device can be damaged.
(3) If Rifb is too high, the device may not switch on.

## Protection Characteristics

Tj=-40°..150°C, Vcc=6..26V, Rifb=500 to 3.5kΩ. Typical value are given for Vcc=14V and Tj=25°C

| Symbol | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| Vifb-Vin@Isd | Over-current shutdown threshold | 3.8 | 4.7 | 5.9 | V | |
| Tsd | Over temperature threshold | — | 165 | — | °C | See fig. 5 |
| OV | Over voltage protection (not latched) | 26 | 29 | 33 | V | |
| Isdf | Fixed over current shutdown | 55 | 75 | 105 | A | Vifb<Vifb-Vin@Isd |
| Isd_560 | Programmable over current shutdown | 34 | 50 | 71 | | Rifb=560Ω |
| Treset | Time to reset protection | — | 50 | 500 | µs | See fig. 5 |
| Min. pulse | Min. pulse width (no WAIT state) | — | 900 | 2000 | | Tj=25°C |
| WAIT | WAIT function timer | 0.4 | 1 | 2 | ms | See fig. 4 and 5 |
| Rds(on) rev. | Reverse battery On state resistance, Tj=25°C | — | 4 | 6 | mΩ | Vcc-Vin=-14V, Iout=30A |
| | Tj=125°C | — | 6 | 9 | | |

## Static Electrical Characteristics

Tj=-40°..150°C, Vcc=6..26V (unless otherwise specified). Typical value are given for Vcc=14V and Tj=25°C

| Symbol | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| Vcc op. | Operating Voltage range | 6 | — | 26 | V | |
| Icc off | Supply leakage current | — | 1.5 | 5 | µA | Vin=Vcc, Vcc-Vout=14V, Vcc-Vifb=14V, Tj=25°C |
| Iin, on | On state IN positive current | 1.5 | 3 | 6 | mA | Vcc-Vin=14V, Tj=25°C |
| Vih | High level Input threshold voltage (4) | — | 5.4 | 6.3 | V | |
| Vil | Low level Input threshold voltage (4) | 4 | 4.9 | 5.8 | | |
| Vhyst | Input hysteresis Vih-Vil | 0.2 | 0.4 | 1.5 | | |
| Iout | Drain to source leakage current | — | 1.2 | 5 | µA | Vin=Vcc, Vcc-Vifb=0V, Vcc-Vout=14V, Tj=25°C |
| Rds(on) | On state resistance (5) Tj=25°C | — | 3.3 | 4 | mΩ | Iout=30A, Vcc-Vin=14V |
| | On state resistance (5) Tj=25°C | — | 3.5 | 5.5 | | Iout=17A, Vcc-Vin=6V |
| | On state resistance (5)(6) Tj=150°C | — | 5.5 | 6.5 | | Iout=30A, Vcc-Vin=14V |
| V clamp1 | Vcc to Vout clamp voltage 1 | 36 | 39 | 43 | V | Iout=50mA |
| V clamp2 | Vcc to Vout clamp voltage 2 | — | 40 | — | | Iout=30A, Tj=25°C |

(4) Input thresholds are measured directly between the input pin and the tab. Any parasitic resistance in common between the load current path and the input signal path can significantly affect the thresholds.
(5) Rdson is measured between the tab and the Out pin, 5mm away from the package.
(6) Guaranteed by design

## Switching Electrical Characteristics

Vcc=14V, Resistive load=0.5Ω, Tj=25°C

| Symbol | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| Tdon | Turn on delay time to 10% Vcc | 70 | 170 | 300 | µs | See figure 2 |
| tr1 | Rise time to Vcc-Vout=5V | 30 | 100 | 210 | | |
| tr2 | Rise time to Vcc-Vout=0.1Vcc | 30 | 125 | 250 | | |
| Eon | Turn on energy | — | 15 | — | mJ | |
| Tdoff | Turn off delay time | 30 | 70 | 140 | µs | |
| Tf | Fall time to Vout=10% of Vcc | 20 | 100 | 250 | | |
| Eoff | Turn off energy | — | 9 | — | mJ | |

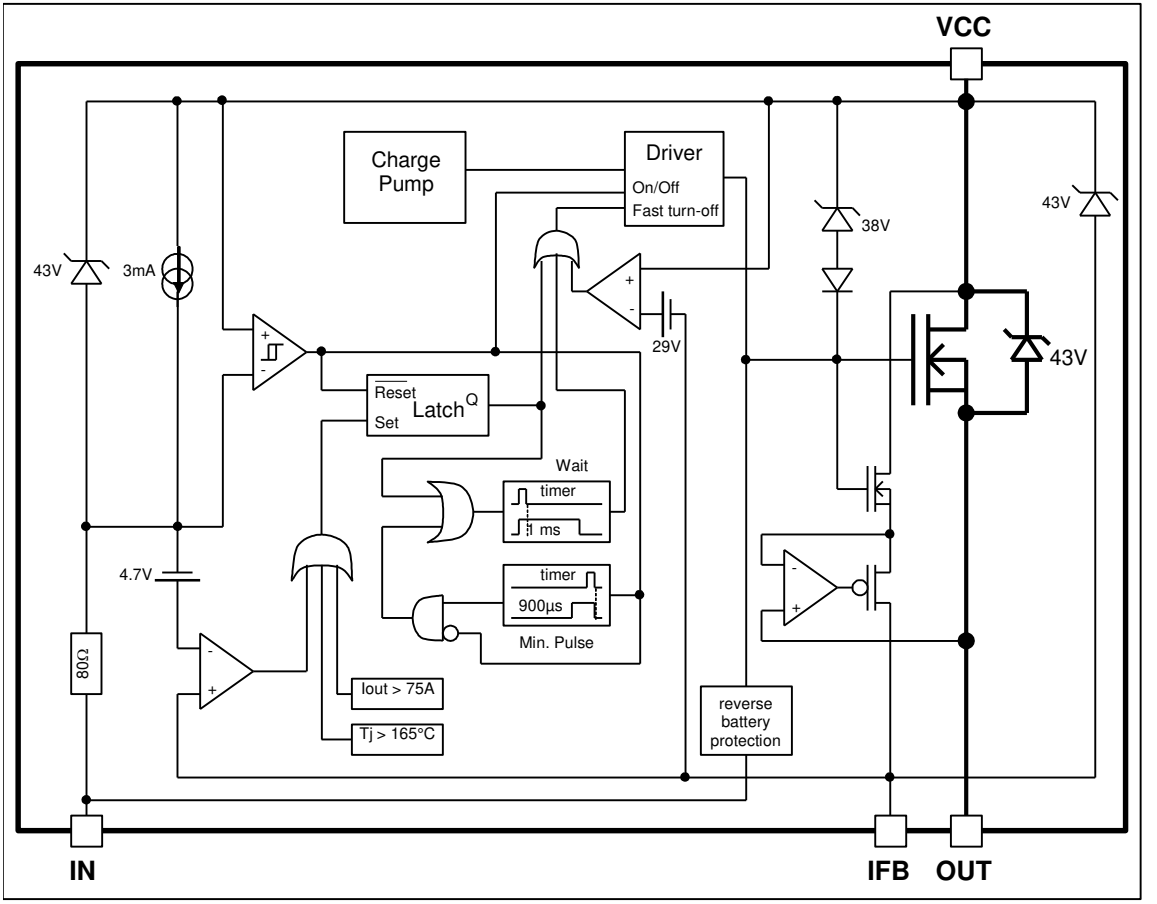
## Current Sense Characteristics

Tj=-40°..150°C, Vcc=6..26V (unless otherwise specified). Typical value are given for Vcc=14V and Tj=25°C

| Symbol | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| Ratio | I Load/Iifb current ratio | 4900 | 6000 | 6600 | — | Rifb=500Ω, Iout=30A |
| Ratio_TC | I Load/Iifb variation over temperature (6) | -4 | — | +4 | % | Tj=-40°C to 150°C |
| Offset | Load current diagnostic offset | -0.4 | 0 | +0.4 | A | Iout=2A |
| Trst | Ifb response time (low signal) | — | 1 | — | µs | 90% of the Iout step |

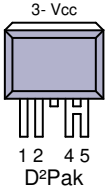
## Functional Block Diagram

All values are typical



## Lead Assignments

1- In
2- Ifb
3- Vcc (tab)
4- Out
5- Out



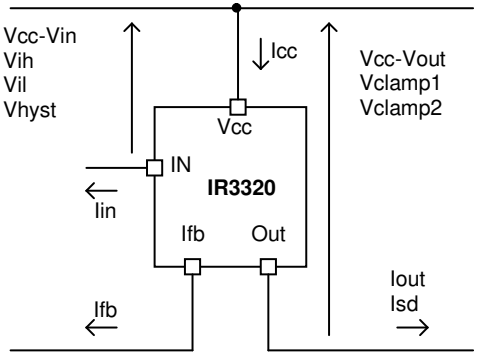




**Figure 1 – Voltages and current definitions**

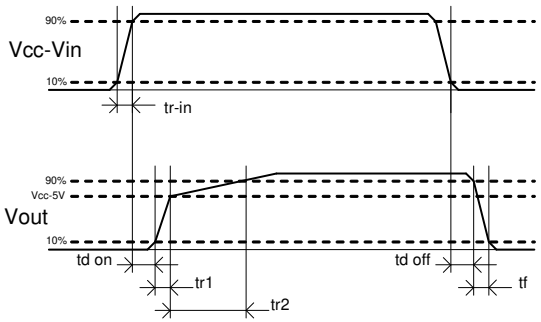



**Figure 2 – Switching time definitions**

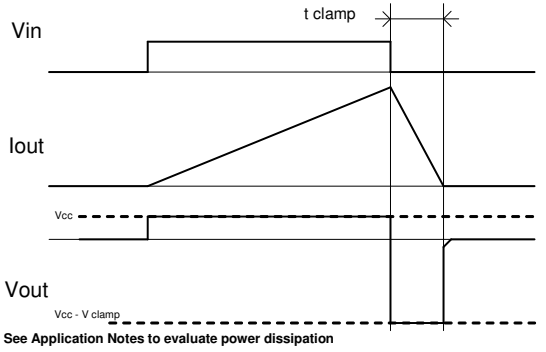



**Figure 3 – Active clamp waveforms**

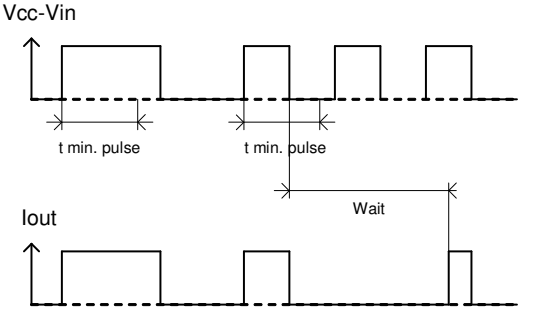



**Figure 4 – Min. pulse and Wait function**

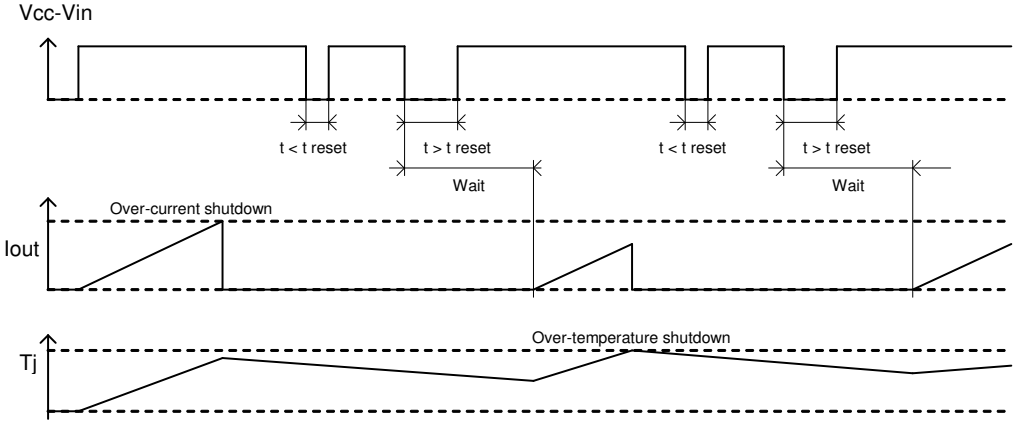



**Figure 5 – Protection Timing Diagrams**

All curves are typical characteristics. Tj=25°C, Rifb=500ohm, Vcc=14V (unless otherwise specified).

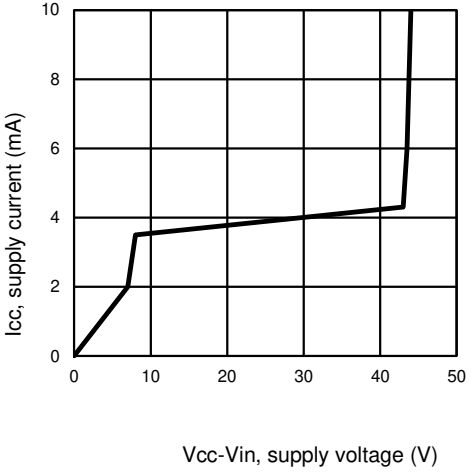



**Figure 6 – Icc (mA) Vs Vcc-Vin (V)**

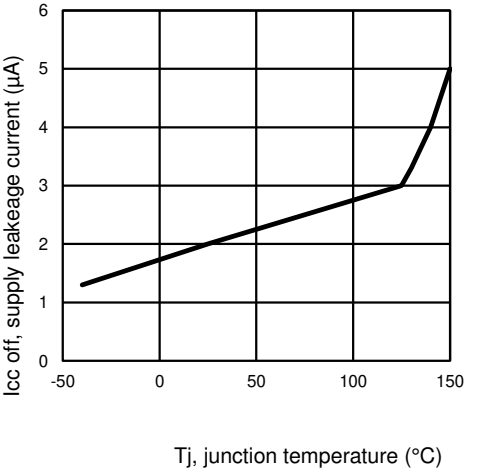



**Figure 7 – Icc off (µA) Vs Tj (°C)**

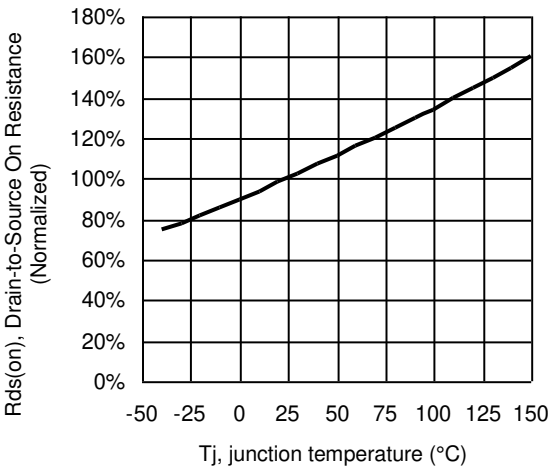



**Figure 8 - Normalized Rds(on) (%) Vs Tj (°C)**

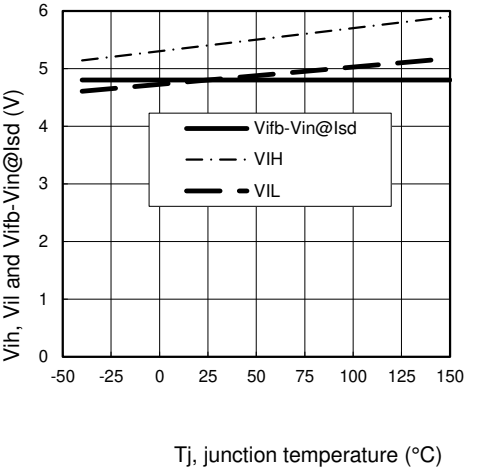



**Figure 9 – Vih, Vil and Vifb-Vin@Isd (V) Vs Tj (°C)**

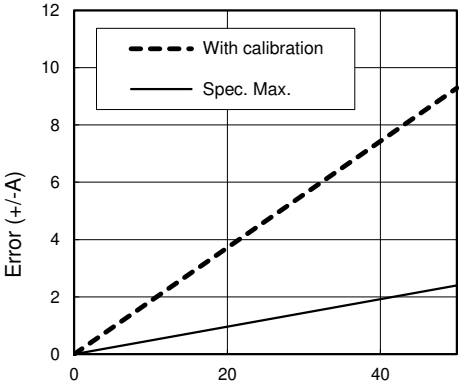



**Figure 10 – Error (+/- A) Vs I load (A)**

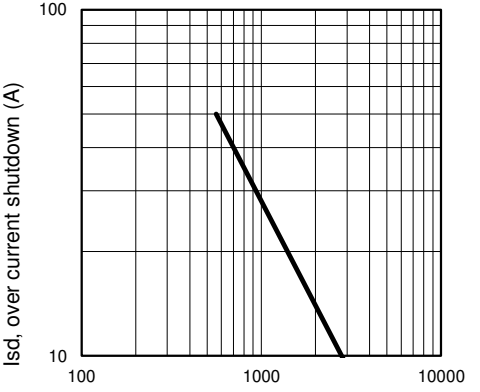



**Figure 11 – Ids (A) Vs Rifb (Ω)**

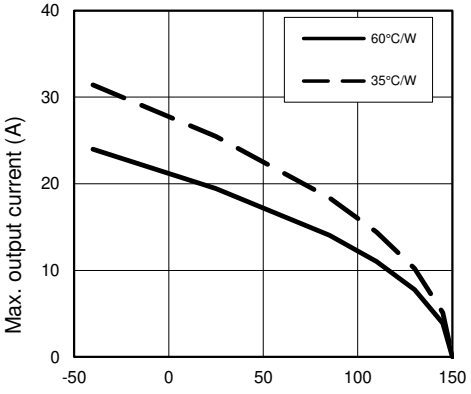



**Figure 12 – Max. Iout (A) Vs Tamb. (°C)**

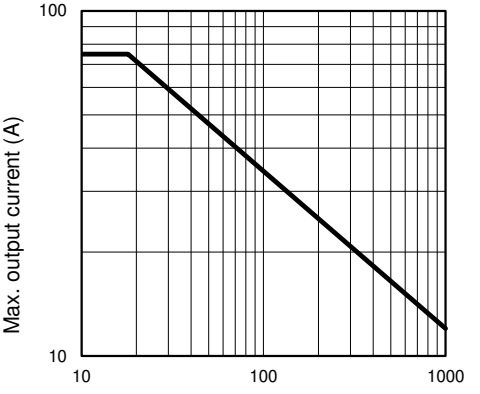



**Figure 13 – Max. Iout (A) Vs inductance (µH)**

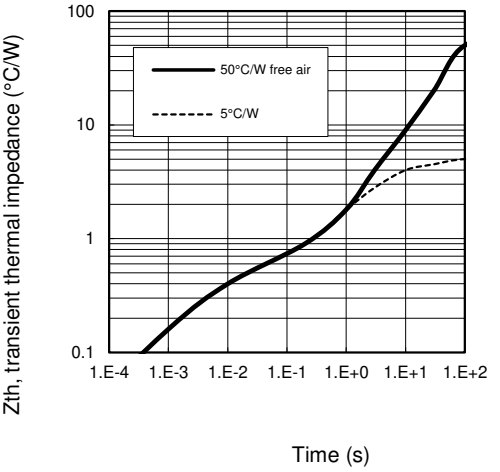
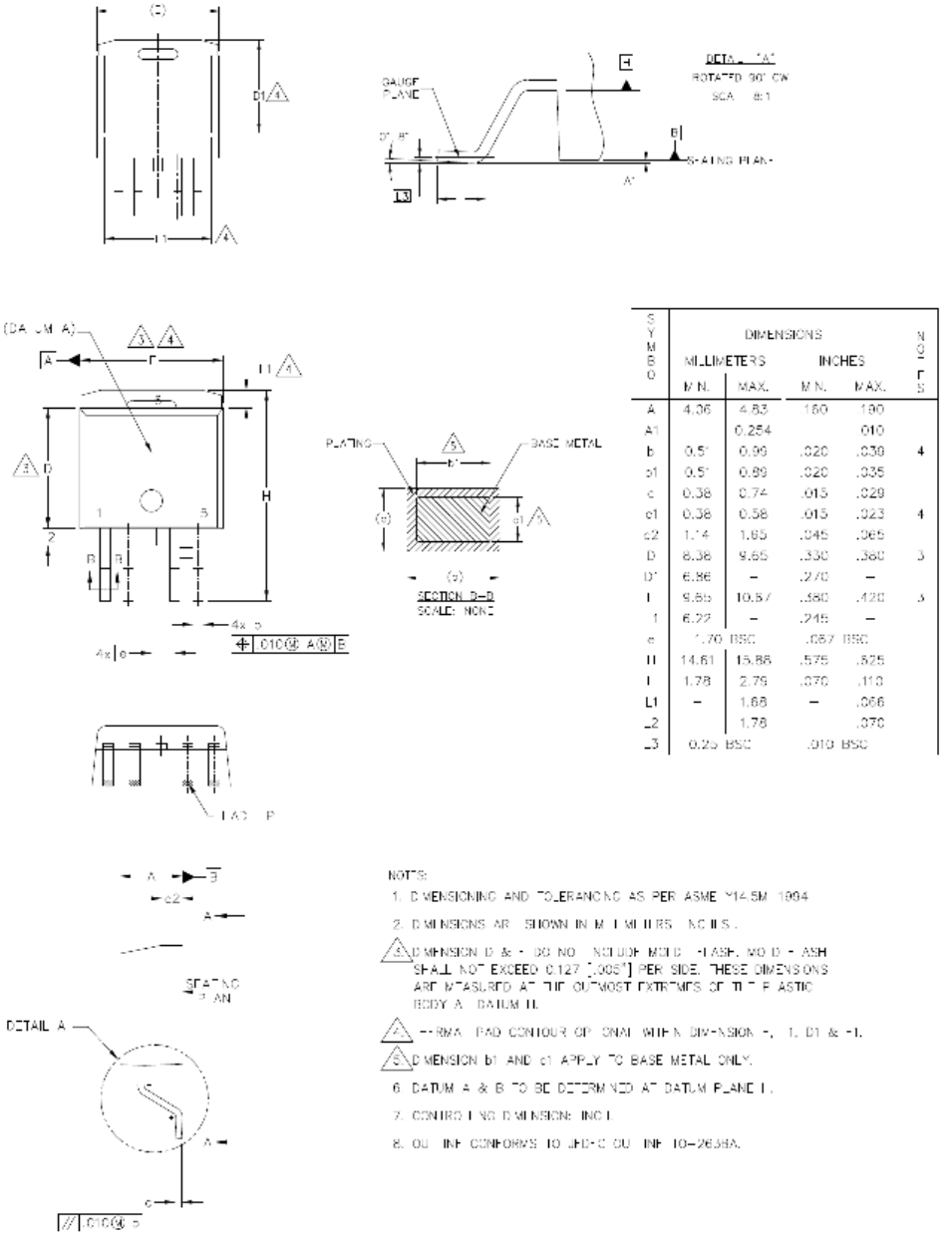



**Figure 14 – Transient thermal impedance (°C/W) Vs time (s)**

## Case Outline - D2PAK - 5 Leads

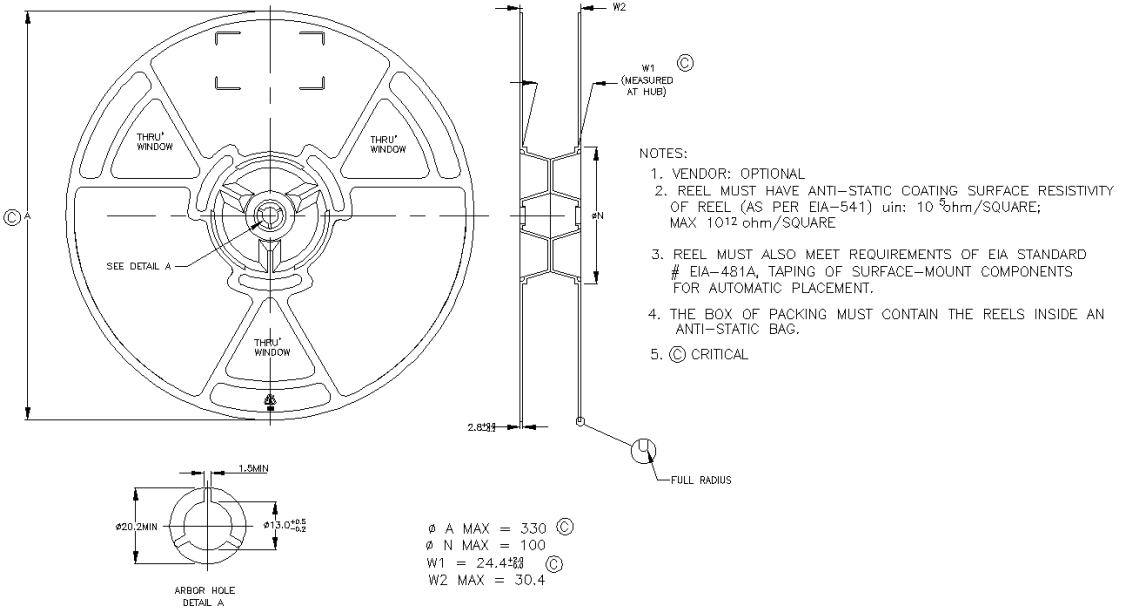



| SYMBOL | DIMENSIONS | | | | NOTES |
|---|---|---|---|---|---|
| | MILLIMETERS | | INCHES | | |
| | MIN. | MAX. | MIN. | MAX. | |
| A | 4.06 | 4.83 | .160 | .190 | |
| A1 | | 0.254 | | .010 | |
| b | 0.51 | 0.99 | .020 | .039 | 4 |
| b1 | 0.51 | 0.89 | .020 | .035 | |
| c | 0.38 | 0.74 | .015 | .029 | |
| c1 | 0.38 | 0.58 | .015 | .023 | 4 |
| c2 | 1.14 | 1.65 | .045 | .065 | |
| D | 8.38 | 9.65 | .330 | .380 | 3 |
| D1 | 6.86 | – | .270 | – | |
| E | 9.65 | 10.67 | .380 | .420 | 3 |
| E1 | 6.22 | – | .245 | – | |
| e | 1.70 BSC | | .067 BSC | | |
| H | 14.61 | 15.88 | .575 | .625 | |
| L | 1.78 | 2.79 | .070 | .110 | |
| L1 | – | 1.68 | – | .066 | |
| L2 | | 1.78 | | .070 | |
| L3 | 0.25 BSC | | .010 BSC | | |

NOTES:

1. DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M 1994.
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY. DATUM H.
4. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION E, L, D1 & E1.
5. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
6. DATUM A & B TO BE DETERMINED AT DATUM PLANE H.
7. CONTROLLING DIMENSION: INCH.
8. OUTLINE CONFORMS TO JEDEC OUTLINE TO-263BA.

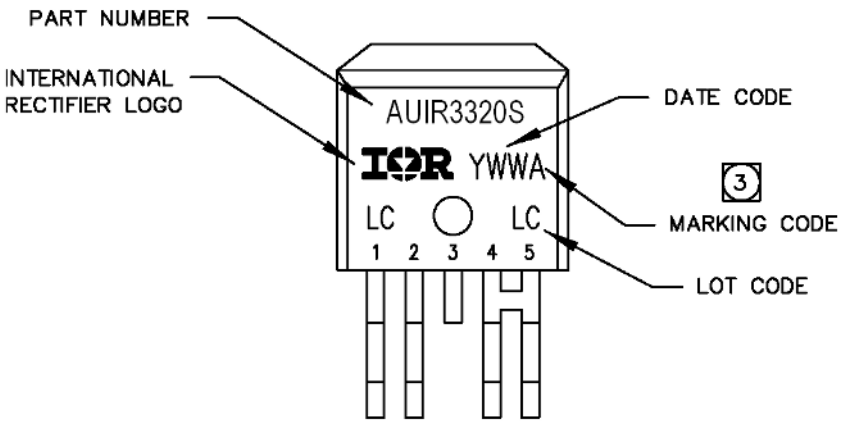
## Tape & Reel - D2PAK – 5 leads




NOTES:

1. VENDOR: OPTIONAL
2. REEL MUST HAVE ANTI–STATIC COATING SURFACE RESISTIVITY OF REEL (AS PER EIA–541) uin: $10^{5}$ ohm/SQUARE; MAX $10^{12}$ ohm/SQUARE
3. REEL MUST ALSO MEET REQUIREMENTS OF EIA STANDARD # EIA–481A, TAPING OF SURFACE–MOUNT COMPONENTS FOR AUTOMATIC PLACEMENT.
4. THE BOX OF PACKING MUST CONTAIN THE REELS INSIDE AN ANTI–STATIC BAG.
5. Ⓒ CRITICAL

## Part Marking Information




## Qualification Information†

| | | | |
|---|---|---|---|
| **Qualification Level** | | Automotive<br>(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** | | D2PAK-5L | MSL1, 260°C<br>(per IPC/JEDEC J-STD-020) |
| **ESD** | Machine Model | Class M3 (400V)<br>(per AEC-Q100-003) | |
| | Human Body Model | Class H2 (4,000 V)<br>(per AEC-Q100-002) | |
| | Charged Device Model | Class C4 (1000 V)<br>(per AEC-Q100-011) | |
| **IC Latch-Up Test** | | Class II, Level A<br>(per AEC-Q100-004) | |
| **RoHS Compliant** | | Yes | |

**Published by**
**Infineon Technologies AG**
**81726 München, Germany**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## Revision History

| Revision | Date | Notes/Changes |
|---|---|---|
| A7 | June, 4th 2012 | Initial release |
| A8 | August, 13rd 2012 | -Update switching limits<br>-Update Iratio max limit |
| A9 | August, 30th 2012 | Update Tj max. |
| Rev1.0 | July, 11th 2017 | - Page 'Case Outline - D2PAK - 5 Leads' updated<br>- Page 'Ordering information' updated<br>- Page 14 'Notice' updated |