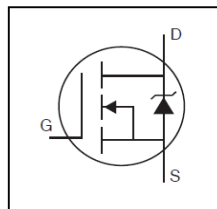


## Features

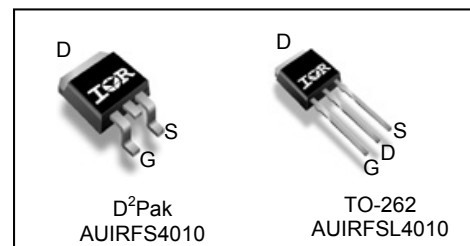
- Advanced Process Technology
- Ultra Low On-Resistance
- 175°C Operating Temperature
- Fast Switching
- Repetitive Avalanche Allowed up to  $T_{jmax}$
- Lead-Free, RoHS Compliant
- Automotive Qualified \*

## Description

Specifically designed for Automotive applications, this HEXFET® Power MOSFET utilizes the latest processing techniques to achieve extremely low on-resistance per silicon area. Additional features of this design are a 175°C junction operating temperature, fast switching speed and improved repetitive avalanche rating. These features combine to make this design an extremely efficient and reliable device for use in Automotive applications and a wide variety of other applications



|                          |              |
|--------------------------|--------------|
| $V_{DS}$                 | <b>100V</b>  |
| $R_{DS(on)}$ <b>typ.</b> | <b>3.9mΩ</b> |
| <b>max.</b>              | <b>4.7mΩ</b> |
| $I_D$                    | <b>180A</b>  |



|          |          |          |
|----------|----------|----------|
| <b>G</b> | <b>D</b> | <b>S</b> |
| Gate     | Drain    | Source   |

| Base part number | Package Type | Standard Pack      |          | Orderable Part Number |
|------------------|--------------|--------------------|----------|-----------------------|
|                  |              | Form               | Quantity |                       |
| AUIRFS4010       | TO-262       | Tube               | 50       | AUIRFS4010            |
| AUIRFS4010       | D²-Pak       | Tube               | 50       | AUIRFS4010            |
|                  |              | Tape and Reel Left | 800      | AUIRFS4010TRL         |

## Absolute Maximum Ratings

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 condition beyond those indicated in the specifications is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability. The thermal resistance and power dissipation ratings are measured under board mounted and still air conditions. Ambient temperature ( $T_A$ ) is 25°C, unless otherwise specified.

| Symbol                          | Parameter                                               | Max.                      | Units |
|---------------------------------|---------------------------------------------------------|---------------------------|-------|
| $I_D @ T_C = 25^\circ\text{C}$  | Continuous Drain Current, $V_{GS} @ 10\text{V}$         | 180                       | A     |
| $I_D @ T_C = 100^\circ\text{C}$ | Continuous Drain Current, $V_{GS} @ 10\text{V}$         | 127                       |       |
| $I_{DM}$                        | Pulsed Drain Current ①                                  | 720                       |       |
| $P_D @ T_C = 25^\circ\text{C}$  | Maximum Power Dissipation                               | 375                       | W     |
|                                 | Linear Derating Factor                                  | 2.5                       | W/°C  |
| $V_{GS}$                        | Gate-to-Source Voltage                                  | ± 20                      | V     |
| $E_{AS}$                        | Single Pulse Avalanche Energy (Thermally Limited) ②     | 318                       | mJ    |
| $I_{AR}$                        | Avalanche Current ①                                     | See Fig. 14, 15, 22a, 22b | A     |
| $E_{AR}$                        | Repetitive Avalanche Energy ①                           |                           | mJ    |
| $dv/dt$                         | Peak Diode Recovery ③                                   | 31                        | V/ns  |
| $T_J$                           | Operating Junction and                                  | -55 to + 175              | °C    |
| $T_{STG}$                       | Storage Temperature Range                               |                           |       |
|                                 | Soldering Temperature, for 10 seconds (1.6mm from case) |                           |       |

## Thermal Resistance

| Symbol          | Parameter                                 | Typ. | Max. | Units |
|-----------------|-------------------------------------------|------|------|-------|
| $R_{\theta JC}$ | Junction-to-Case ⑧ ⑨                      | —    | 0.40 | °C/W  |
| $R_{\theta JA}$ | Junction-to-Ambient (PCB Mount), D² Pak ⑦ | —    | 40   |       |

HEXFET® is a registered trademark of Infineon.

\*Qualification standards can be found at [www.infineon.com](http://www.infineon.com)

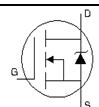
**Static @  $T_J = 25^\circ\text{C}$  (unless otherwise specified)**

|                                 | Parameter                            | Min. | Typ. | Max. | Units               | Conditions                                            |
|---------------------------------|--------------------------------------|------|------|------|---------------------|-------------------------------------------------------|
| $V_{(BR)DSS}$                   | Drain-to-Source Breakdown Voltage    | 100  | —    | —    | V                   | $V_{GS} = 0V, I_D = 250\mu A$                         |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient  | —    | 0.10 | —    | V/ $^\circ\text{C}$ | Reference to $25^\circ\text{C}$ , $I_D = 5mA$ ①       |
| $R_{DS(on)}$                    | Static Drain-to-Source On-Resistance | —    | 3.9  | 4.7  | m $\Omega$          | $V_{GS} = 10V, I_D = 106A$ ④                          |
| $V_{GS(th)}$                    | Gate Threshold Voltage               | 2.0  | —    | 4.0  | V                   | $V_{DS} = V_{GS}, I_D = 250\mu A$                     |
| $g_{fs}$                        | Forward Trans conductance            | 189  | —    | —    | S                   | $V_{DS} = 25V, I_D = 106A$                            |
| $R_G$                           | Internal Gate Resistance             | —    | 2.0  | —    | $\Omega$            |                                                       |
| $I_{DSS}$                       | Drain-to-Source Leakage Current      | —    | —    | 20   | $\mu A$             | $V_{DS} = 100V, V_{GS} = 0V$                          |
|                                 |                                      | —    | —    | 250  |                     | $V_{DS} = 100V, V_{GS} = 0V, T_J = 125^\circ\text{C}$ |
| $I_{GSS}$                       | Gate-to-Source Forward Leakage       | —    | —    | 100  | nA                  | $V_{GS} = 20V$                                        |
|                                 | Gate-to-Source Reverse Leakage       | —    | —    | -100 |                     | $V_{GS} = -20V$                                       |

**Dynamic Electrical Characteristics @  $T_J = 25^\circ\text{C}$  (unless otherwise specified)**

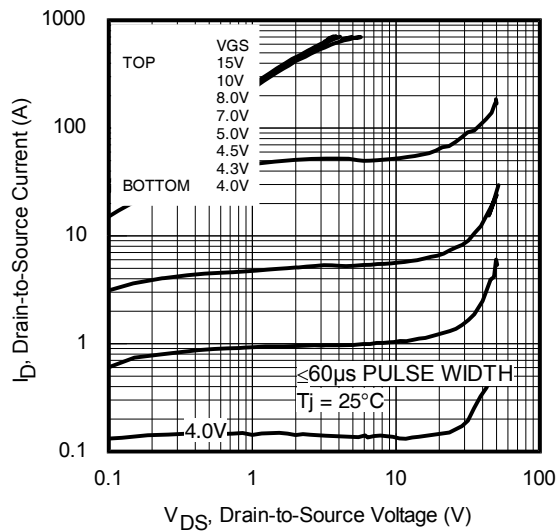
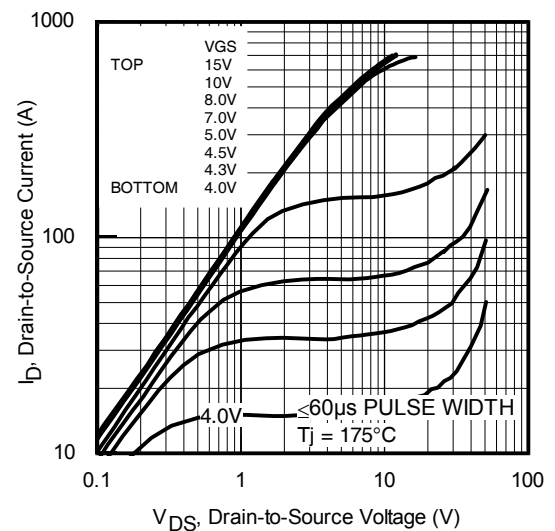
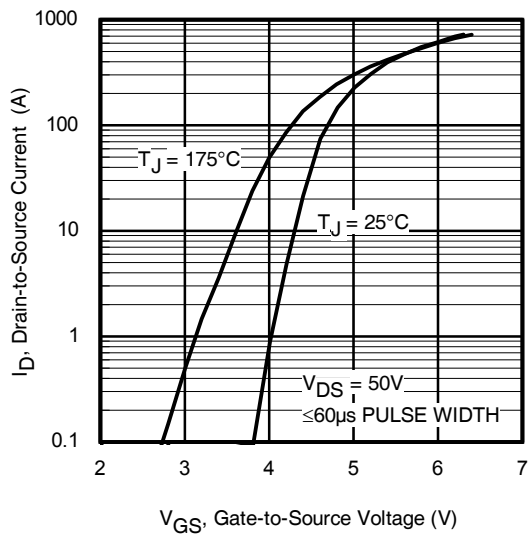
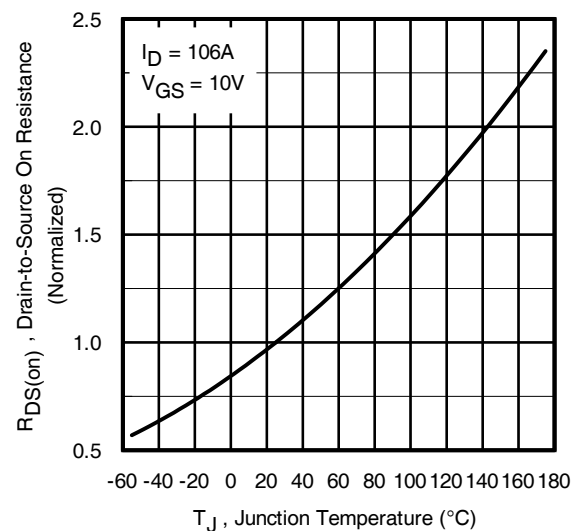
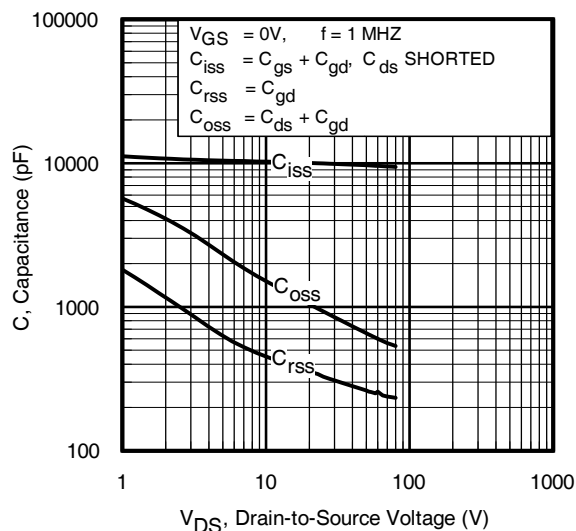
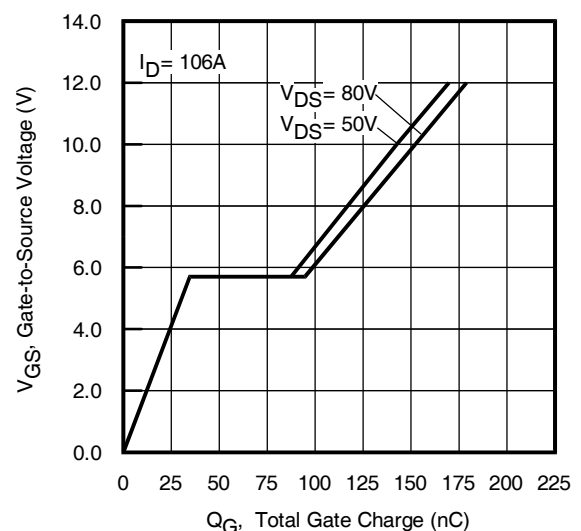
|                             |                                               |   |      |     |    |                                                                         |
|-----------------------------|-----------------------------------------------|---|------|-----|----|-------------------------------------------------------------------------|
| $Q_g$                       | Total Gate Charge                             | — | 143  | 215 | nC | $I_D = 106A$<br>$V_{DS} = 50V$<br>$V_{GS} = 10V$ ④                      |
| $Q_{gs}$                    | Gate-to-Source Charge                         | — | 38   | —   |    |                                                                         |
| $Q_{gd}$                    | Gate-to-Drain Charge                          | — | 50   | —   |    |                                                                         |
| $Q_{sync}$                  | Total Gate Charge Sync. ( $Q_g - Q_{gd}$ )    | — | 93   | —   |    |                                                                         |
| $t_{d(on)}$                 | Turn-On Delay Time                            | — | 21   | —   | ns | $V_{DD} = 65V$<br>$I_D = 106A$<br>$R_G = 2.7\Omega$<br>$V_{GS} = 10V$ ④ |
| $t_r$                       | Rise Time                                     | — | 86   | —   |    |                                                                         |
| $t_{d(off)}$                | Turn-Off Delay Time                           | — | 100  | —   |    |                                                                         |
| $t_f$                       | Fall Time                                     | — | 77   | —   |    |                                                                         |
| $C_{iss}$                   | Input Capacitance                             | — | 9575 | —   | pF | $V_{GS} = 0V$<br>$V_{DS} = 50V$<br>$f = 1.0MHz$ , See Fig. 5            |
| $C_{oss}$                   | Output Capacitance                            | — | 660  | —   |    |                                                                         |
| $C_{rss}$                   | Reverse Transfer Capacitance                  | — | 270  | —   |    |                                                                         |
| $C_{oss \text{ eff. (ER)}}$ | Effective Output Capacitance (Energy Related) | — | 757  | —   |    | $V_{GS} = 0V, V_{DS} = 0V \text{ to } 80V$ ⑥                            |
| $C_{oss \text{ eff. (TR)}}$ | Effective Output Capacitance (Time Related)   | — | 1112 | —   |    | $V_{GS} = 0V, V_{DS} = 0V \text{ to } 80V$ ⑤                            |

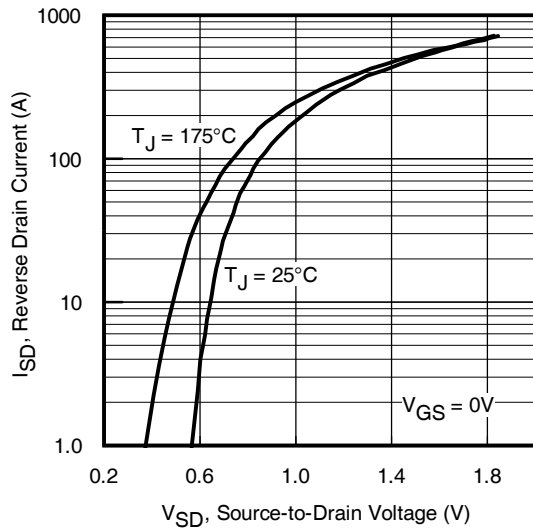
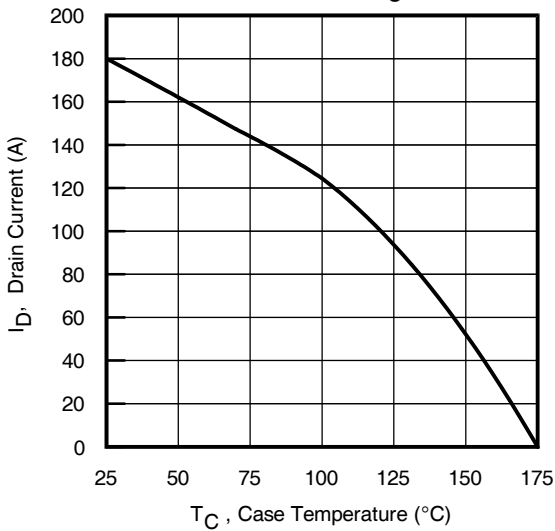
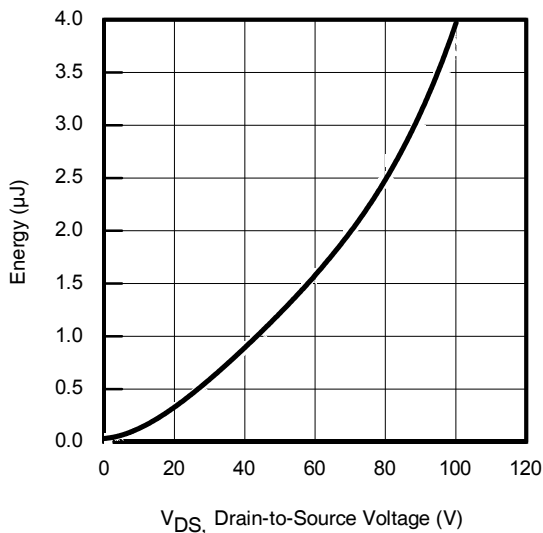
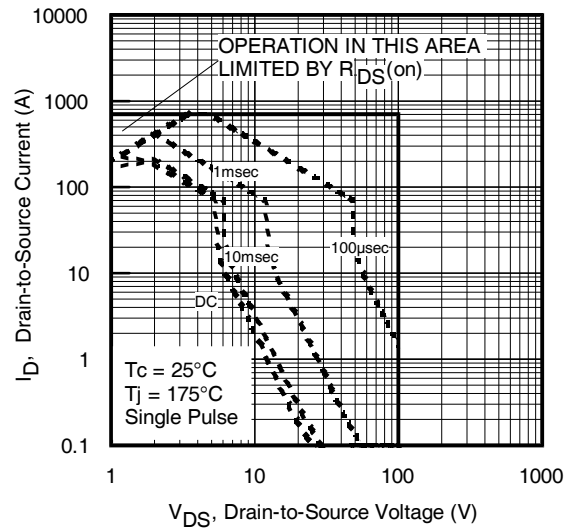
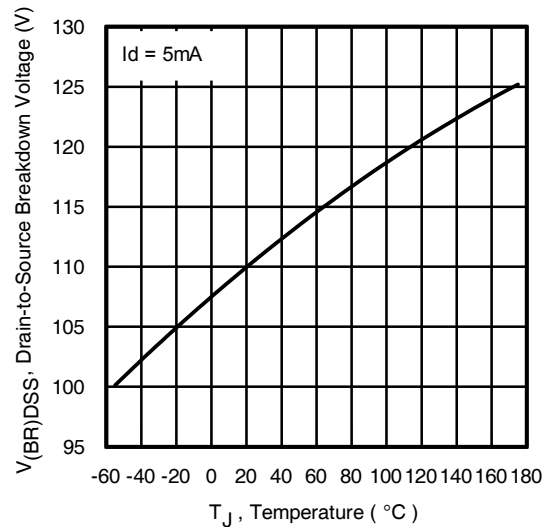
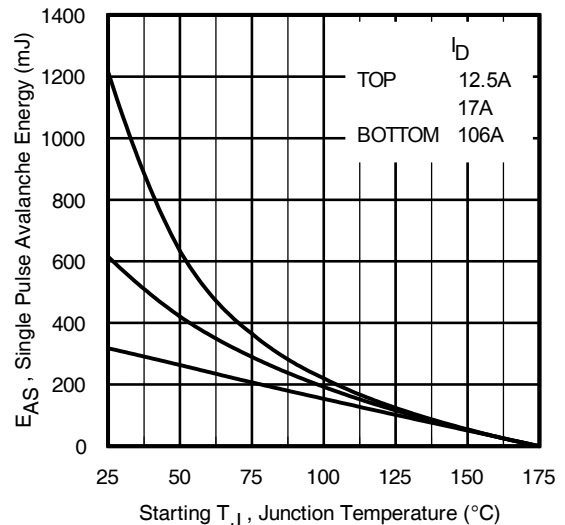
**Diode Characteristics**

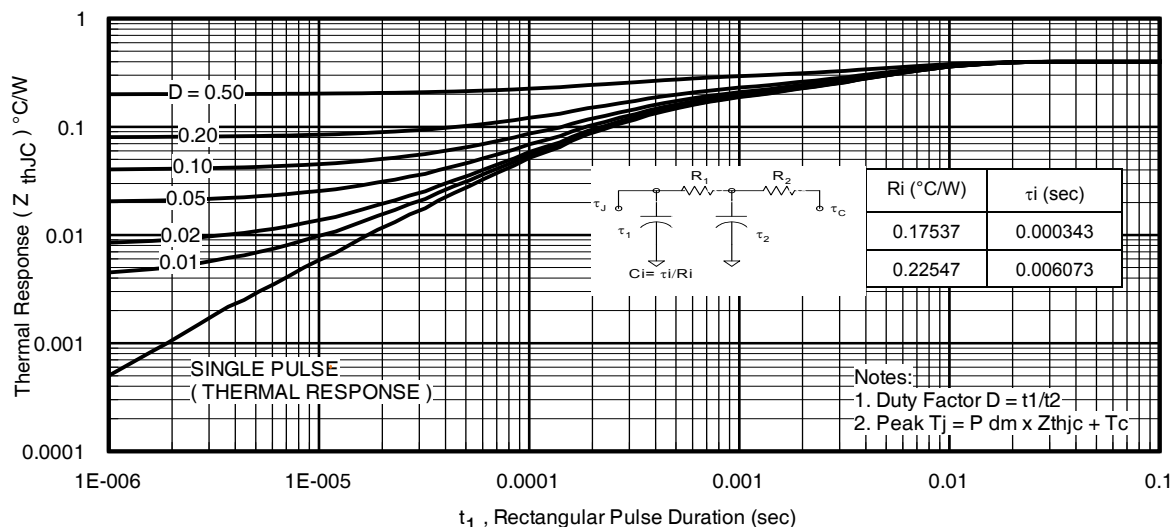
|                  | Parameter                                 | Min.                                                                                           | Typ. | Max. | Units | Conditions                                                                                                                                              |
|------------------|-------------------------------------------|------------------------------------------------------------------------------------------------|------|------|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| I <sub>S</sub>   | Continuous Source Current<br>(Body Diode) | —                                                                                              | —    | 180  | A     | MOSFET symbol showing the integral reverse p-n junction diode.<br> |
| I <sub>SM</sub>  | Pulsed Source Current<br>(Body Diode) ①   | —                                                                                              | —    | 720  |       |                                                                                                                                                         |
| V <sub>SD</sub>  | Diode Forward Voltage                     | —                                                                                              | —    | 1.3  | V     | T <sub>J</sub> = 25°C, I <sub>S</sub> = 106A, V <sub>GS</sub> = 0V ④                                                                                    |
| t <sub>rr</sub>  | Reverse Recovery Time                     | —                                                                                              | 72   | —    | ns    | T <sub>J</sub> = 25°C      V <sub>DD</sub> = 85V<br>T <sub>J</sub> = 125°C      I <sub>F</sub> = 106A,<br>di/dt = 100A/μs ④                             |
|                  |                                           | —                                                                                              | 81   | —    |       |                                                                                                                                                         |
| Q <sub>rr</sub>  | Reverse Recovery Charge                   | —                                                                                              | 210  | —    | nC    |                                                                                                                                                         |
|                  |                                           | —                                                                                              | 268  | —    |       | T <sub>J</sub> = 25°C<br>T <sub>J</sub> = 125°C                                                                                                         |
| I <sub>RRM</sub> | Reverse Recovery Current                  | —                                                                                              | 5.3  | —    | A     | T <sub>J</sub> = 25°C                                                                                                                                   |
| t <sub>on</sub>  | Forward Turn-On Time                      | Intrinsic turn-on time is negligible (turn-on is dominated by L <sub>S</sub> +L <sub>D</sub> ) |      |      |       |                                                                                                                                                         |

**Notes:**

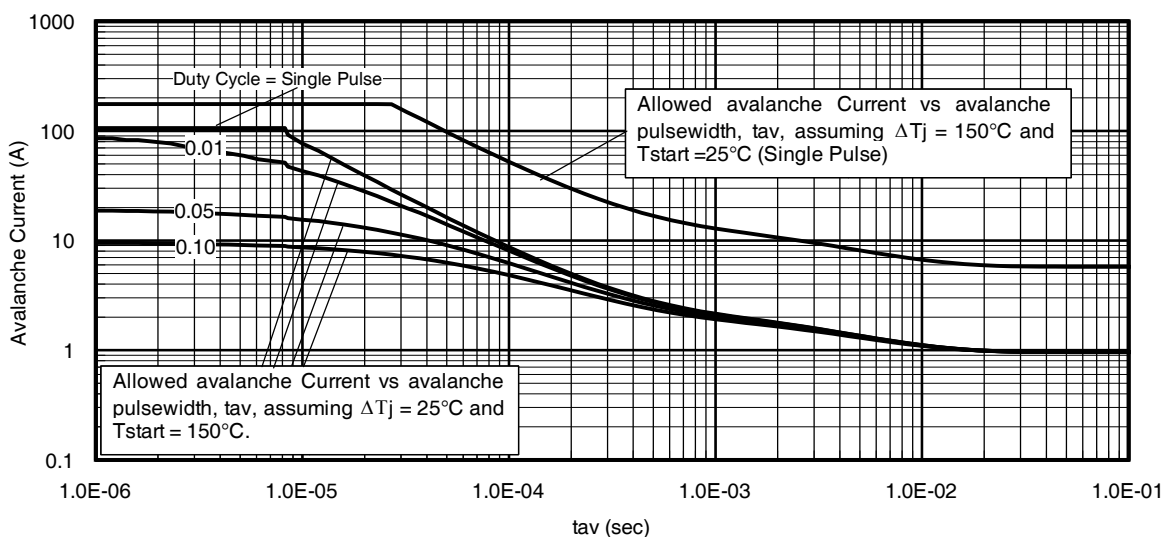
- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Limited by  $T_{Jmax}$ , starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.057mH$ ,  $R_G = 25\Omega$ ,  $I_{AS} = 106A$ ,  $V_{GS} = 10V$ . Part not recommended for use above this value.
- ③  $I_{SD} \leq 106A$ , di/dt  $\leq 1319A/\mu s$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  $T_J \leq 175^\circ\text{C}$ .
- ④ Pulse width  $\leq 400\mu s$ ; duty cycle  $\leq 2\%$ .
- ⑤  $C_{oss \text{ eff. (TR)}}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .
- ⑥  $C_{oss \text{ eff. (ER)}}$  is a fixed capacitance that gives the same energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .
- ⑦ When mounted on 1" square PCB (FR-4 or G-10 Material). For recommended footprint and soldering techniques refer to application note #AN-994
- ⑧  $R_\theta$  is measured at  $T_J$  approximately  $90^\circ\text{C}$ .
- ⑨  $R_{\theta JC}$  value shown is at time zero.


**Fig. 1** Typical Output Characteristics

**Fig. 2** Typical Output Characteristics

**Fig. 3** Typical Transfer Characteristics

**Fig. 4** Normalized On-Resistance vs. Temperature

**Fig 5.** Typical Capacitance vs. Drain-to-Source Voltage

**Fig 6.** Typical Gate Charge vs. Gate-to-Source Voltage

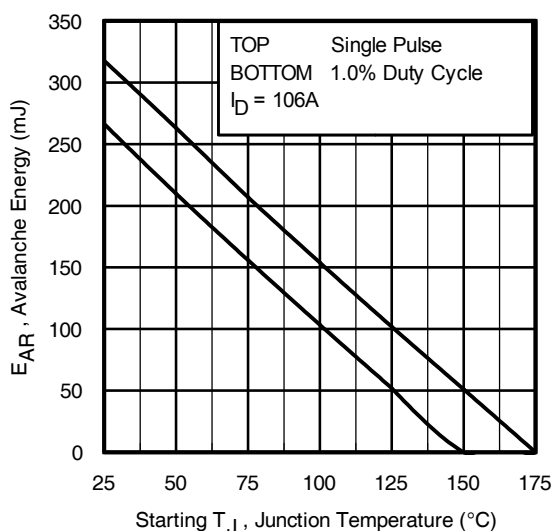

**Fig. 7** Typical Source-to-Drain Diode Forward Voltage

**Fig 9.** Maximum Drain Current vs. Case Temperature

**Fig 11.** Typical Coss Stored Energy

**Fig 8.** Maximum Safe Operating Area

**Fig 10.** Drain-to-Source Breakdown Voltage

**Fig 12.** Maximum Avalanche Energy vs. Drain Current



**Fig 13.** Maximum Effective Transient Thermal Impedance, Junction-to-Case



**Fig 14.** Avalanche Current vs. Pulse width



**Notes on Repetitive Avalanche Curves , Figures 14, 15:**  
(For further info, see AN-1005 at [www.infineon.com](http://www.infineon.com))

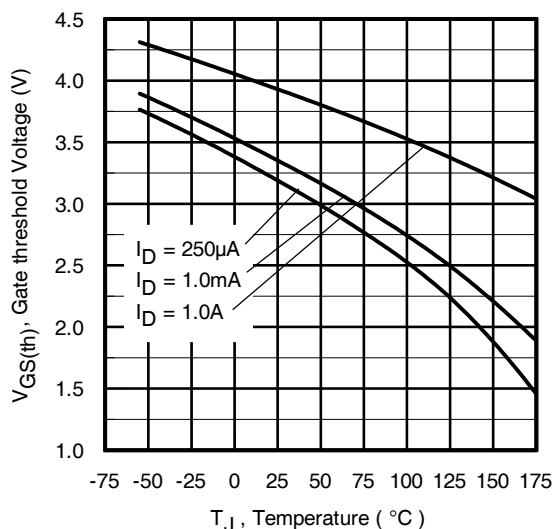
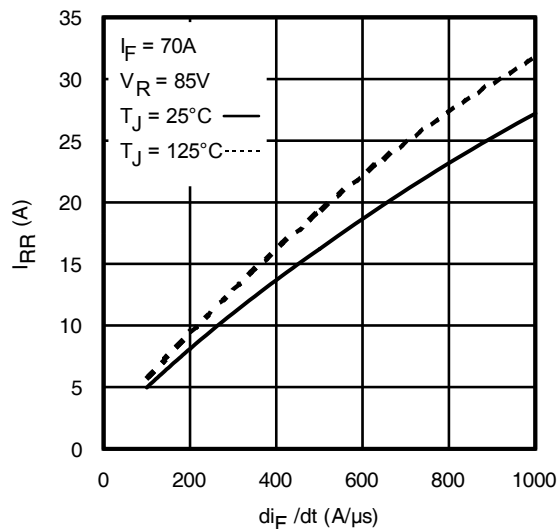
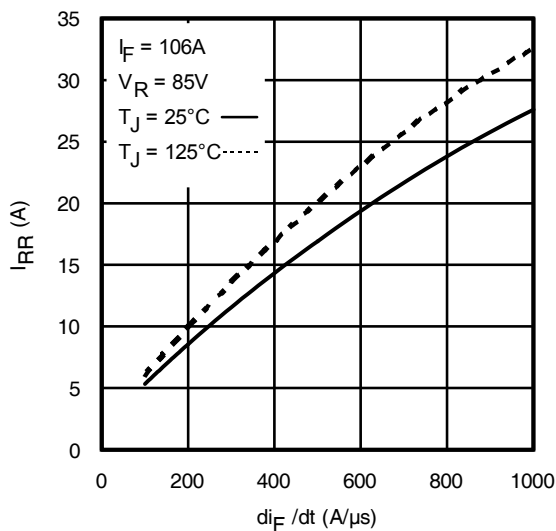
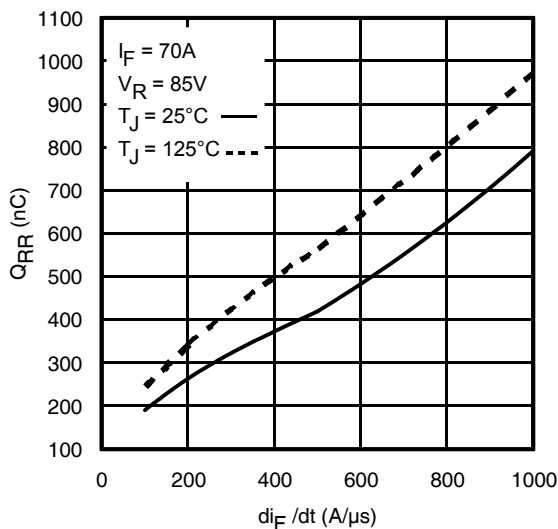
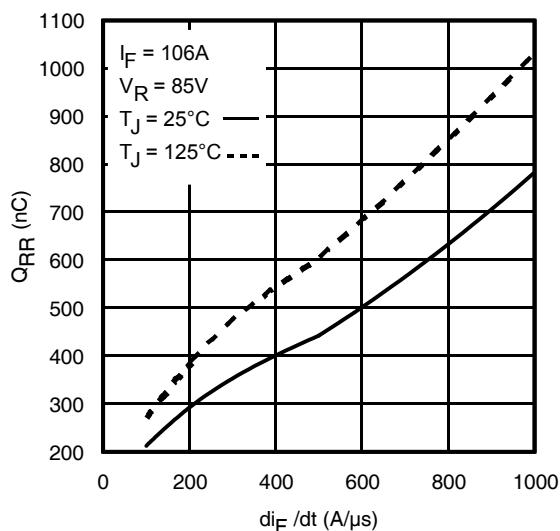
- Avalanche failures assumption:  
Purely a thermal phenomenon and failure occurs at a temperature far in excess of  $T_{jmax}$ . This is validated for every part type.
- Safe operation in Avalanche is allowed as long as  $T_{jmax}$  is not exceeded.
- Equation below based on circuit and waveforms shown in Figures 18a, 18b.
- $P_{D(ave)}$  = Average power dissipation per single avalanche pulse.
- $BV$  = Rated breakdown voltage (1.3 factor accounts for voltage increase during avalanche).
- $I_{av}$  = Allowable avalanche current.
- $\Delta T$  = Allowable rise in junction temperature, not to exceed  $T_{jmax}$  (assumed as 25°C in Figure 13, 14).  
 $t_{av}$  = Average time in avalanche.  
 $D$  = Duty cycle in avalanche =  $t_{av} \cdot f$   
 $Z_{thJC}(D, t_{av})$  = Transient thermal resistance, see Figures 13)

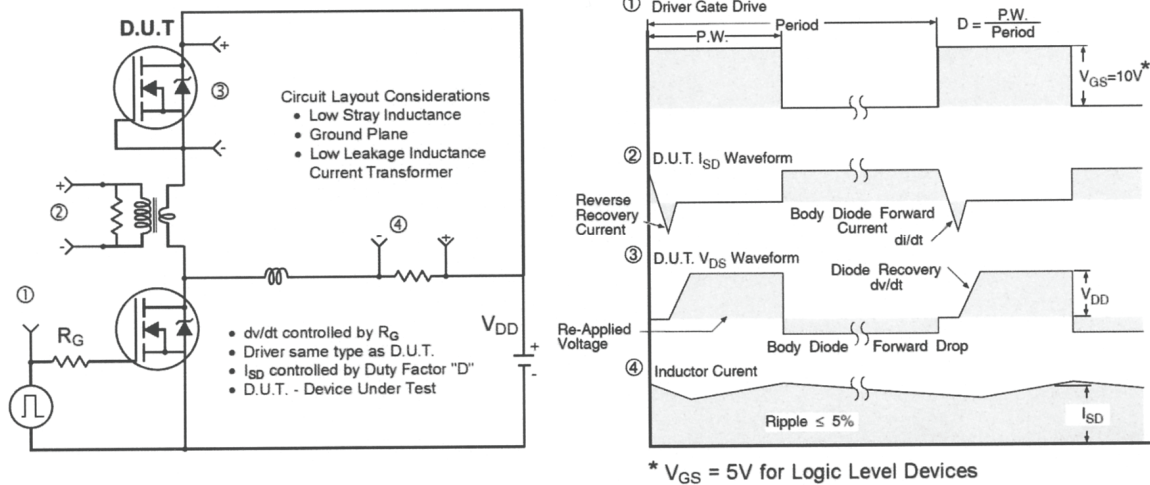
$$P_{D(ave)} = 1/2 (1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$$

$$I_{av} = 2\Delta T / [1.3 \cdot BV \cdot Z_{th}]$$

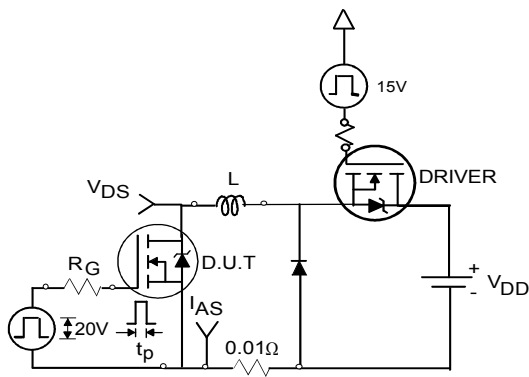
$$E_{AS(AR)} = P_{D(ave)} \cdot t_{av}$$

**Fig 15.** Maximum Avalanche Energy vs. Temperature

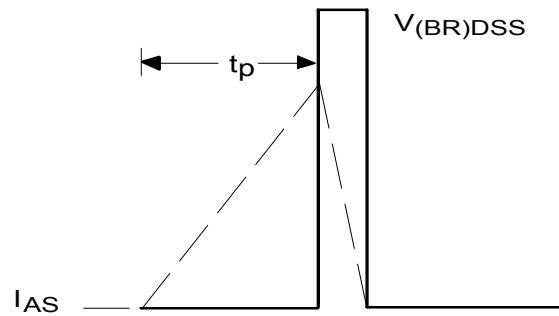

**Fig. 16.** Threshold Voltage vs. Temperature

**Fig. 17 -** Typical Recovery Current vs.  $di_F/dt$ 

**Fig. 18 -** Typical Recovery Current vs.  $di_F/dt$ 

**Fig. 19 -** Typical Stored Charge vs.  $di_F/dt$ 

**Fig. 20 -** Typical Stored Charge vs.  $di_F/dt$



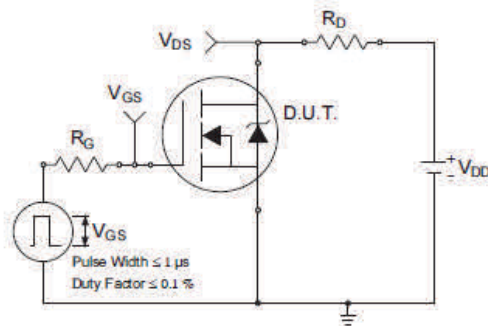
**Fig 21.** Peak Diode Recovery  $dv/dt$  Test Circuit for N-Channel HEXFET® Power MOSFETs



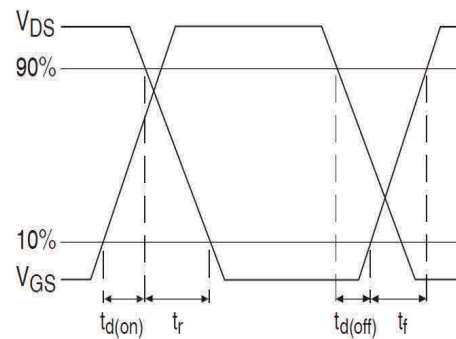
**Fig 22a.** Unclamped Inductive Test Circuit



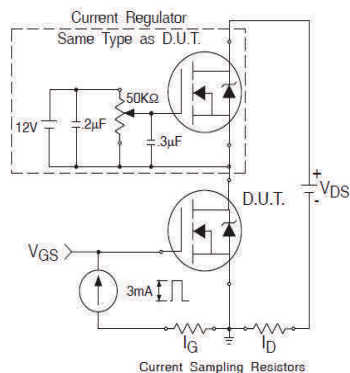
**Fig 22b.** Unclamped Inductive Waveforms



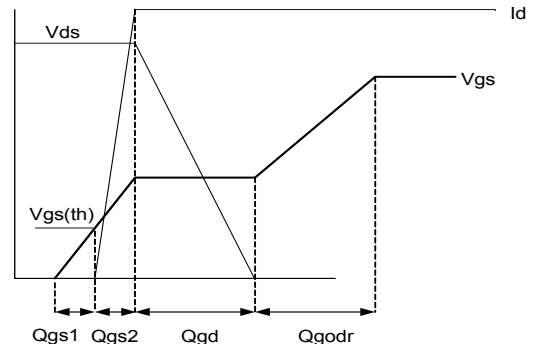
**Fig 23a.** Switching Time Test Circuit



**Fig 23b.** Switching Time Waveforms

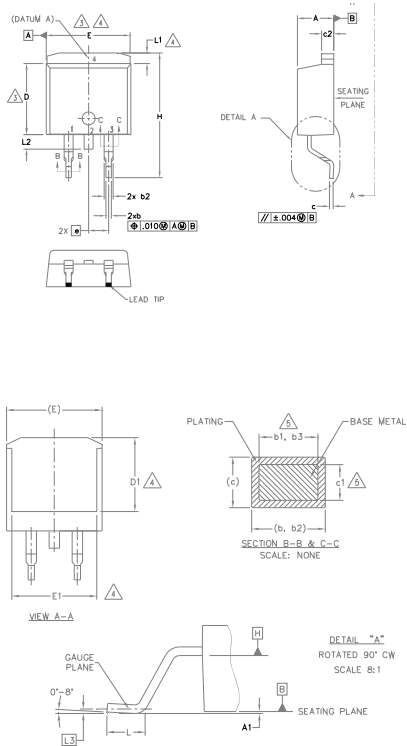


**Fig 24a.** Gate Charge Test Circuit



**Fig 24b.** Gate Charge Waveform

## D<sup>2</sup>Pak (TO-263AB) Package Outline (Dimensions are shown in millimeters (inches))



### NOTES:

1. DIMENSIONING AND TOLERANCING 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 [0.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY AT DATUM H.
4. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION E, L1, D1 & E1.
5. DIMENSION b1, b3 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-263AB.

| S<br>Y<br>M<br>B<br>O<br>L | DIMENSIONS  |       |          |      | N<br>O<br>T<br>E<br>S |
|----------------------------|-------------|-------|----------|------|-----------------------|
|                            | MILLIMETERS |       | INCHES   |      |                       |
|                            | MIN.        | MAX.  | MIN.     | MAX. |                       |
| A                          | 4.06        | 4.83  | .160     | .190 | 5                     |
| A1                         | 0.00        | 0.254 | .000     | .010 |                       |
| b                          | 0.51        | 0.99  | .020     | .039 |                       |
| b1                         | 0.51        | 0.89  | .020     | .035 |                       |
| b2                         | 1.14        | 1.78  | .045     | .070 |                       |
| b3                         | 1.14        | 1.73  | .045     | .068 | 5                     |
| c                          | 0.38        | 0.74  | .015     | .029 | 5                     |
| c1                         | 0.38        | 0.58  | .015     | .023 |                       |
| c2                         | 1.14        | 1.65  | .045     | .065 |                       |
| D                          | 8.38        | 9.65  | .330     | .380 |                       |
| D1                         | 6.86        | —     | .270     | —    |                       |
| E                          | 9.65        | 10.67 | .380     | .420 | 3,4                   |
| E1                         | 6.22        | —     | .245     | —    | 4                     |
| e                          | 2.54 BSC    |       | .100 BSC |      | 4                     |
| 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 |      |                       |

### LEAD ASSIGNMENTS

#### DIODES

- 1.- ANODE (TWO DIE) / OPEN (ONE DIE)
- 2.- CATHODE
- 3.- ANODE

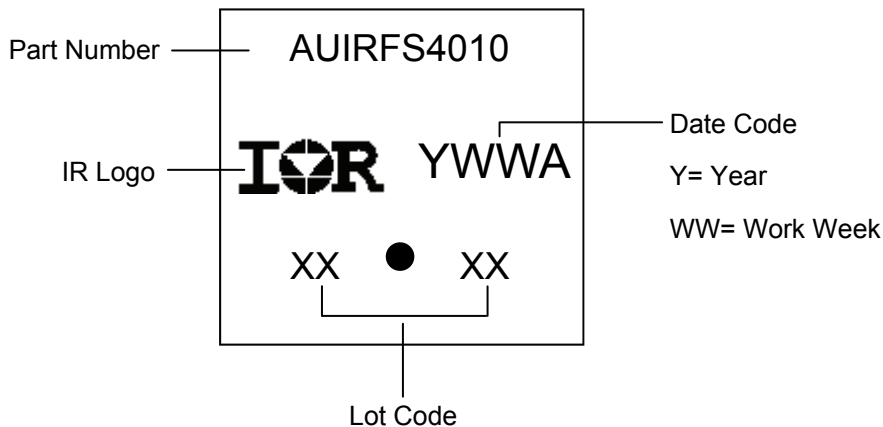
#### HEXFET

- 1.- GATE
- 2.- DRAIN
- 3.- SOURCE

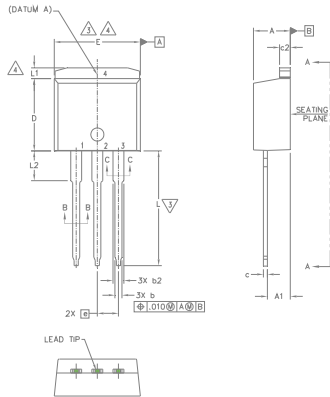
#### IGBTs, CoPACK

- 1.- GATE
- 2.- COLLECTOR
- 3.- EMITTER

## D<sup>2</sup>Pak (TO-263AB) Part Marking Information



## TO-262 Package Outline (Dimensions are shown in millimeters (inches))



### NOTES:

1. DIMENSIONING AND TOLERANCING 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 [0.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
4. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION E, L1, D1 & E1.
5. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
6. CONTROLLING DIMENSION: INCH.
7. OUTLINE CONFORM TO JEDEC TO-262 EXCEPT A1(max.), b(min.) AND D1(min.) WHERE DIMENSIONS DERIVED THE ACTUAL PACKAGE OUTLINE.

### LEAD ASSIGNMENTS

#### IGBTs, CoPACK

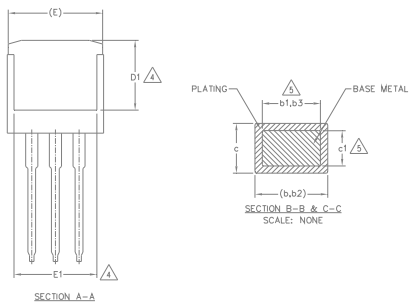
- 1.- GATE
- 2.- COLLECTOR
- 3.- EMITTER
- 4.- COLLECTOR

#### HEXFET

- 1.- GATE
- 2.- DRAIN
- 3.- SOURCE
- 4.- DRAIN

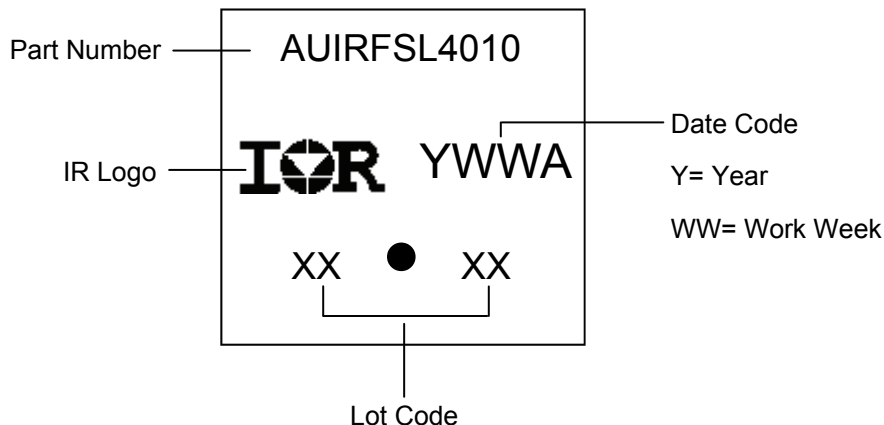
#### DIODES

- 1.- ANODE (TWO DIE) / OPEN (ONE DIE)
- 2, 4.- CATHODE
- 3.- ANODE



| SYM<br>BOL | DIMENSIONS  |       |          |      | NOTES              |
|------------|-------------|-------|----------|------|--------------------|
|            | MILLIMETERS |       | INCHES   |      |                    |
|            | MIN.        | MAX.  | MIN.     | MAX. |                    |
| A          | 4.06        | 4.83  | .160     | .190 | 5                  |
| A1         | 2.03        | 3.02  | .080     | .119 |                    |
| b          | 0.51        | 0.99  | .020     | .039 |                    |
| b1         | 0.51        | 0.89  | .020     | .035 |                    |
| b2         | 1.14        | 1.78  | .045     | .070 | 5                  |
| b3         | 1.14        | 1.73  | .045     | .068 |                    |
| c          | 0.38        | 0.74  | .015     | .029 |                    |
| c1         | 0.38        | 0.58  | .015     | .023 |                    |
| c2         | 1.14        | 1.65  | .045     | .065 | 3<br>4<br>3,4<br>4 |
| D          | 8.38        | 9.65  | .330     | .380 |                    |
| D1         | 6.86        | —     | .270     | —    |                    |
| E          | 9.65        | 10.67 | .380     | .420 |                    |
| E1         | 6.22        | —     | .245     |      | 4                  |
| e          | 2.54 BSC    |       | .100 BSC |      |                    |
| L          | 13.46       | 14.10 | .530     | .555 |                    |
| L1         | —           | 1.65  | —        | .065 |                    |
| L2         | 3.56        | 3.71  | .140     | .146 |                    |

## TO-262 Part Marking Information



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

**Qualification Information**

|                            |                      |                                                                                                                                                                               |      |
|----------------------------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| Qualification Level        |                      | Automotive<br>(per AEC-Q101)                                                                                                                                                  |      |
|                            |                      | Comments: This part number(s) passed Automotive qualification. Infineon's Industrial and Consumer qualification level is granted by extension of the higher Automotive level. |      |
| Moisture Sensitivity Level |                      | D <sup>2</sup> -Pak                                                                                                                                                           | MSL1 |
|                            |                      | TO-262                                                                                                                                                                        |      |
| ESD                        | Machine Model        | Class M4 (+/- 800V) <sup>†</sup><br>AEC-Q101-002                                                                                                                              |      |
|                            | Human Body Model     | Class H3A (+/- 6000V) <sup>†</sup><br>AEC-Q101-001                                                                                                                            |      |
|                            | Charged Device Model | Class C5 (+/- 2000V) <sup>†</sup><br>AEC-Q101-005                                                                                                                             |      |
| RoHS Compliant             |                      | Yes                                                                                                                                                                           |      |

† Highest passing voltage.

**Revision History**

| Date       | Comments                                                                                                                                 |
|------------|------------------------------------------------------------------------------------------------------------------------------------------|
| 10/27/2015 | <ul style="list-style-type: none"> <li>Updated datasheet with corporate template</li> <li>Corrected ordering table on page 1.</li> </ul> |
| 8/23/2017  | <ul style="list-style-type: none"> <li>Corrected part marking on pages 8,9</li> </ul>                                                    |

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