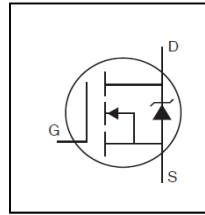


**Features**

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

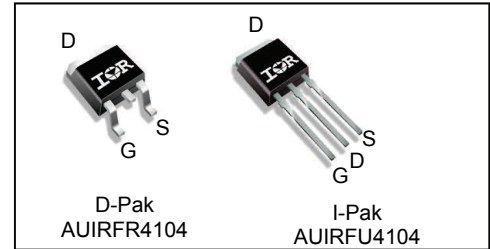
HEXFET® Power MOSFET



|                         |             |              |
|-------------------------|-------------|--------------|
| $V_{DSS}$               |             | <b>40V</b>   |
| $R_{DS(on)}$            | <b>max.</b> | <b>5.5mΩ</b> |
| $I_D$ (Silicon Limited) |             | <b>119A</b>  |
| $I_D$ (Package Limited) |             | <b>42A</b>   |

**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.



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

| Base part number | Package Type | Standard Pack      |          | Orderable Part Number |
|------------------|--------------|--------------------|----------|-----------------------|
|                  |              | Form               | Quantity |                       |
| AUIRFU4104       | I-Pak        | Tube               | 75       | AUIRFU4104            |
| AUIRFR4104       | D-Pak        | Tube               | 75       | AUIRFR4104            |
|                  |              | Tape and Reel Left | 3000     | AUIRFR4104TRL         |

**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 (TA) is 25°C, unless

| Symbol                    | Parameter                                                  | Max.                    | Units |
|---------------------------|------------------------------------------------------------|-------------------------|-------|
| $I_D @ T_C = 25^\circ C$  | Continuous Drain Current, $V_{GS} @ 10V$ (Silicon Limited) | 119                     | A     |
| $I_D @ T_C = 100^\circ C$ | Continuous Drain Current, $V_{GS} @ 10V$ (Silicon Limited) | 84                      |       |
| $I_D @ T_C = 25^\circ C$  | Continuous Drain Current, $V_{GS} @ 10V$ (Package Limited) | 42                      |       |
| $I_{DM}$                  | Pulsed Drain Current ①                                     | 480                     |       |
| $P_D @ T_C = 25^\circ C$  | Maximum Power Dissipation                                  | 140                     | W     |
|                           | Linear Derating Factor                                     | 0.95                    | W/°C  |
| $V_{GS}$                  | Gate-to-Source Voltage                                     | ± 20                    | V     |
| $E_{AS}$                  | Single Pulse Avalanche Energy (Thermally Limited) ②        | 145                     | mJ    |
| $E_{AS}$ (Tested)         | Single Pulse Avalanche Energy Tested Value ③               | 310                     |       |
| $I_{AR}$                  | Avalanche Current ④                                        | See Fig.15,16, 12a, 12b | A     |
| $E_{AR}$                  | Repetitive Avalanche Energy ⑤                              |                         | mJ    |
| $T_J$                     | Operating Junction and Storage Temperature Range           | -55 to + 175            | °C    |
| $T_{STG}$                 |                                                            |                         |       |

**Thermal Resistance**

| Symbol          | Parameter                          | Typ. | Max. | Units |
|-----------------|------------------------------------|------|------|-------|
| $R_{\theta JC}$ | Junction-to-Case ⑥                 | —    | 1.05 | °C/W  |
| $R_{\theta JA}$ | Junction-to-Ambient ( PCB Mount) ⑦ | —    | 50   |       |
| $R_{\theta JA}$ | Junction-to-Ambient                | —    | 110  |       |

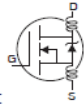
HEXFET® is a registered trademark of Infineon.

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

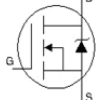
**Static @ T<sub>J</sub> = 25°C (unless otherwise specified)**

|                                        | Parameter                            | Min. | Typ.  | Max. | Units | Conditions                                                          |
|----------------------------------------|--------------------------------------|------|-------|------|-------|---------------------------------------------------------------------|
| V <sub>(BR)DSS</sub>                   | Drain-to-Source Breakdown Voltage    | 40   | —     | —    | V     | V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA                        |
| ΔV <sub>(BR)DSS</sub> /ΔT <sub>J</sub> | Breakdown Voltage Temp. Coefficient  | —    | 0.032 | —    | V/°C  | Reference to 25°C, I <sub>D</sub> = 1mA                             |
| R <sub>DS(on)</sub>                    | Static Drain-to-Source On-Resistance | —    | 4.3   | 5.5  | mΩ    | V <sub>GS</sub> = 10V, I <sub>D</sub> = 42A ③                       |
| V <sub>GS(th)</sub>                    | Gate Threshold Voltage               | 2.0  | —     | 4.0  | V     | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA          |
| g <sub>fs</sub>                        | Forward Trans conductance            | —    | —     | —    | S     | V <sub>DS</sub> = 10V, I <sub>D</sub> = 42A ③                       |
| I <sub>DSS</sub>                       | Drain-to-Source Leakage Current      | —    | —     | 20   | μA    | V <sub>DS</sub> = 40V, V <sub>GS</sub> = 0V                         |
|                                        |                                      | —    | —     | 250  |       | V <sub>DS</sub> = 40V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 125°C |
| I <sub>GSS</sub>                       | Gate-to-Source Forward Leakage       | —    | —     | 200  | nA    | V <sub>GS</sub> = 20V                                               |
|                                        | Gate-to-Source Reverse Leakage       | —    | —     | -200 |       | V <sub>GS</sub> = -20V                                              |

**Dynamic Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)**

|                       |                              |   |      |    |    |                                                                                                                                                                                                                                       |
|-----------------------|------------------------------|---|------|----|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Q <sub>g</sub>        | Total Gate Charge            | — | 59   | 89 | nC | I <sub>D</sub> = 42A<br>V <sub>DS</sub> = 32V<br>V <sub>GS</sub> = 10V ③                                                                                                                                                              |
| Q <sub>gs</sub>       | Gate-to-Source Charge        | — | 19   | —  |    |                                                                                                                                                                                                                                       |
| Q <sub>gd</sub>       | Gate-to-Drain Charge         | — | 24   | —  |    |                                                                                                                                                                                                                                       |
| t <sub>d(on)</sub>    | Turn-On Delay Time           | — | 17   | —  | ns | V <sub>DD</sub> = 20V<br>I <sub>D</sub> = 42A<br>R <sub>G</sub> = 6.8Ω<br>V <sub>GS</sub> = 10V ③                                                                                                                                     |
| t <sub>r</sub>        | Rise Time                    | — | 69   | —  |    |                                                                                                                                                                                                                                       |
| t <sub>d(off)</sub>   | Turn-Off Delay Time          | — | 37   | —  |    |                                                                                                                                                                                                                                       |
| t <sub>f</sub>        | Fall Time                    | — | 36   | —  |    |                                                                                                                                                                                                                                       |
| L <sub>D</sub>        | Internal Drain Inductance    | — | 4.5  | —  | nH | Between lead,<br>6mm (0.25in.)<br>from package<br>and center of die contact                                                                        |
| L <sub>S</sub>        | Internal Source Inductance   | — | 7.5  | —  |    |                                                                                                                                                                                                                                       |
| C <sub>iss</sub>      | Input Capacitance            | — | 2950 | —  | pF | V <sub>GS</sub> = 0V<br>V <sub>DS</sub> = 25V<br>f = 1.0MHz<br>V <sub>GS</sub> = 0V, V <sub>DS</sub> = 1.0V f = 1.0MHz<br>V <sub>GS</sub> = 0V, V <sub>DS</sub> = 32V f = 1.0MHz<br>V <sub>GS</sub> = 0V, V <sub>DS</sub> = 0V to 32V |
| C <sub>oss</sub>      | Output Capacitance           | — | 660  | —  |    |                                                                                                                                                                                                                                       |
| C <sub>rss</sub>      | Reverse Transfer Capacitance | — | 370  | —  |    |                                                                                                                                                                                                                                       |
| C <sub>oss</sub>      | Output Capacitance           | — | 2130 | —  |    |                                                                                                                                                                                                                                       |
| C <sub>oss</sub>      | Output Capacitance           | — | 590  | —  |    |                                                                                                                                                                                                                                       |
| C <sub>oss eff.</sub> | Effective Output Capacitance | — | 850  | —  |    |                                                                                                                                                                                                                                       |

**Diode Characteristics**

|                 | Parameter                                 | Min.                                                                                           | Typ. | Max. | Units | Conditions                                                                                                                                                    |
|-----------------|-------------------------------------------|------------------------------------------------------------------------------------------------|------|------|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| I <sub>S</sub>  | Continuous Source Current<br>(Body Diode) | —                                                                                              | —    | 42   | A     | MOSFET symbol<br>showing the<br>integral reverse<br>p-n junction diode.  |
| I <sub>SM</sub> | Pulsed Source Current<br>(Body Diode) ①   | —                                                                                              | —    | 480  |       |                                                                                                                                                               |
| V <sub>SD</sub> | Diode Forward Voltage                     | —                                                                                              | —    | 1.3  | V     | T <sub>J</sub> = 25°C, I <sub>S</sub> = 42A, V <sub>GS</sub> = 0V ③                                                                                           |
| t <sub>rr</sub> | Reverse Recovery Time                     | —                                                                                              | 28   | 42   | ns    | T <sub>J</sub> = 25°C, I <sub>F</sub> = 42A, V <sub>DD</sub> = 20V                                                                                            |
| Q <sub>rr</sub> | Reverse Recovery Charge                   | —                                                                                              | 24   | 36   | nC    | di/dt = 100A/μs ③                                                                                                                                             |
| 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. (See fig. 11)
- ② Limited by T<sub>Jmax</sub>, starting T<sub>J</sub> = 25°C, L = 0.16mH, R<sub>G</sub> = 25Ω, I<sub>AS</sub> = 42A, V<sub>GS</sub> = 10V. Part not recommended for use above this value.
- ③ Pulse width ≤ 1.0ms; duty cycle ≤ 2%.
- ④ C<sub>oss eff.</sub> is a fixed capacitance that gives the same charging time as C<sub>oss</sub> while V<sub>DS</sub> is rising from 0 to 80% V<sub>DSS</sub>
- ⑤ Limited by T<sub>Jmax</sub>, see Fig.12a, 12b, 15, 16 for typical repetitive avalanche performance.
- ⑥ This value determined from sample failure population, starting T<sub>J</sub> = 25°C, L = 0.16mH, R<sub>G</sub> = 25Ω, I<sub>AS</sub> = 42A, V<sub>GS</sub> = 10V.
- 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<sub>θ</sub> is measured at T<sub>J</sub> approximately 90°C.

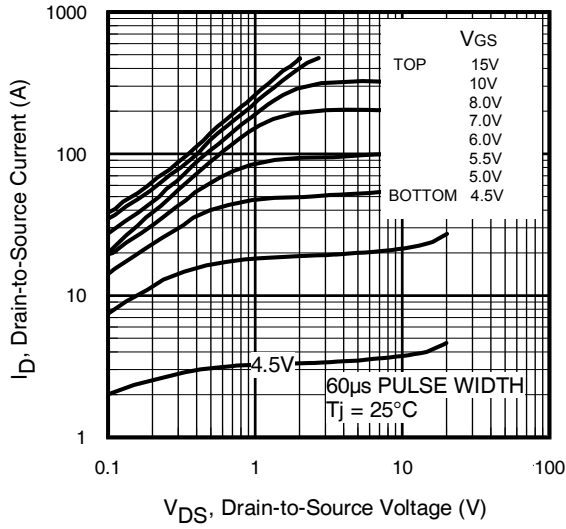


Fig. 1 Typical Output Characteristics

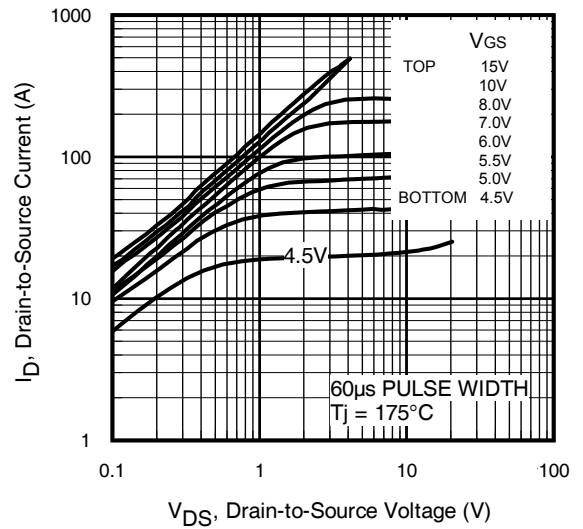


Fig. 2 Typical Output Characteristics

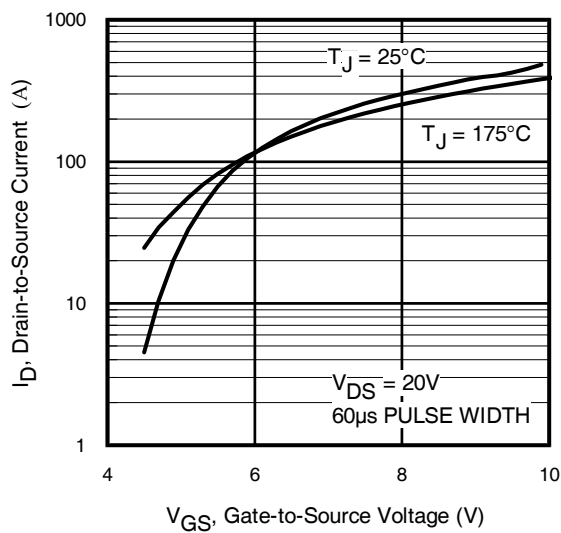


Fig. 3 Typical Transfer Characteristics

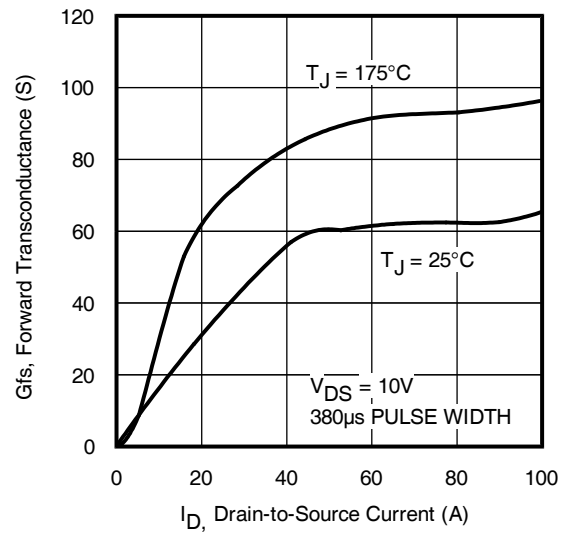
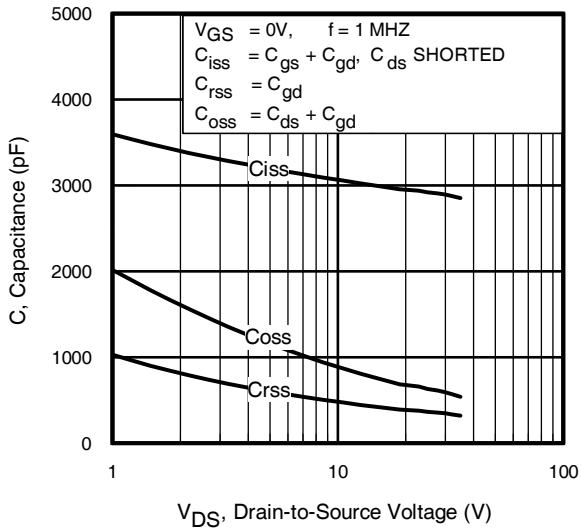
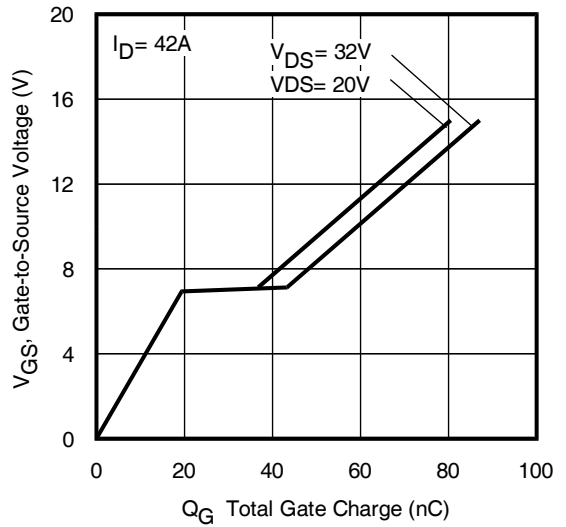


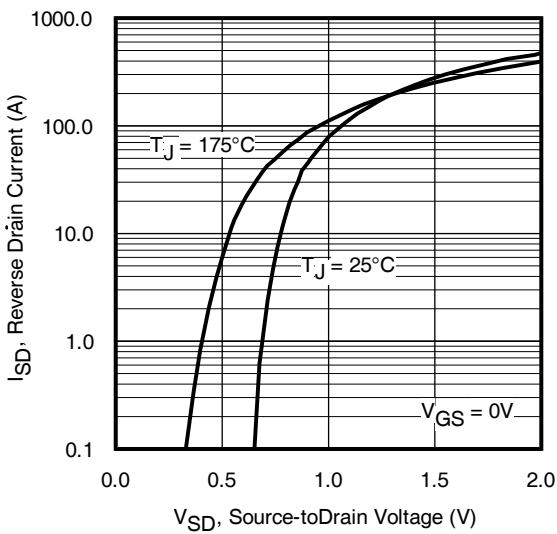
Fig. 4 Typical Forward Trans conductance Vs. Drain Current



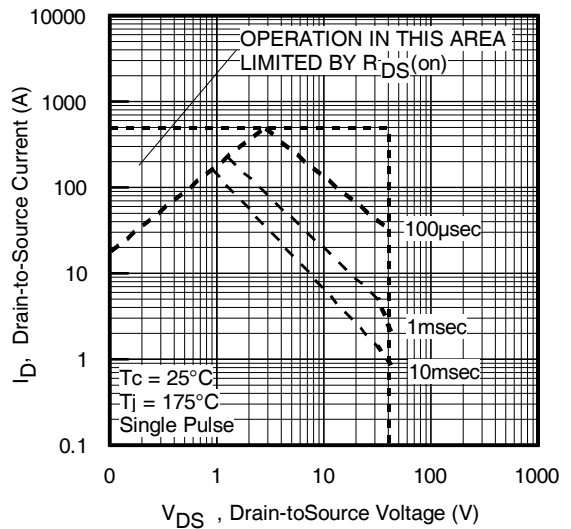
**Fig 5.** Typical Capacitance vs. Drain-to-Source Voltage



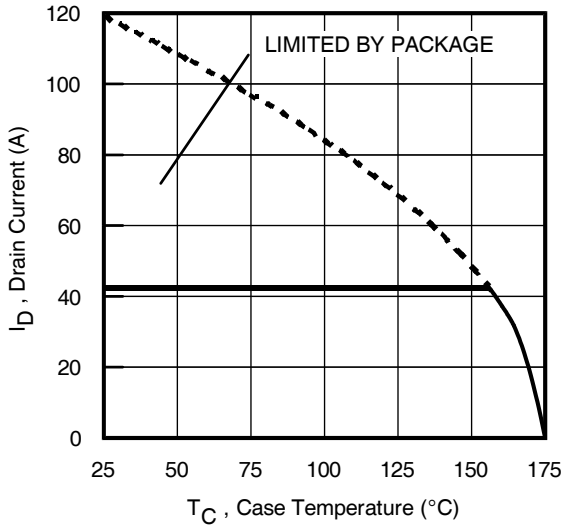
**Fig 6.** Typical Gate Charge vs. Gate-to-Source Voltage



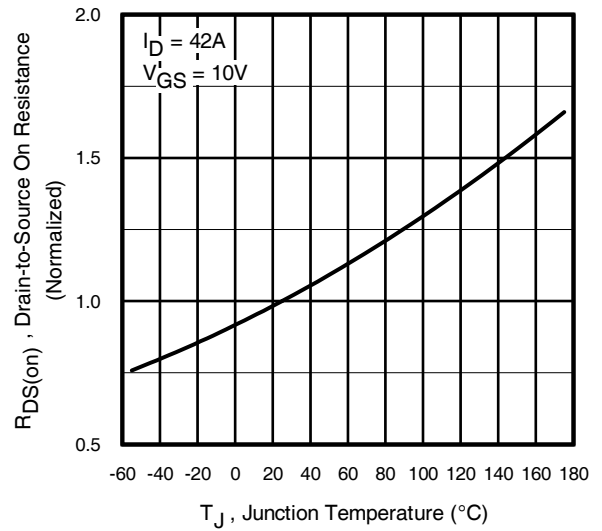
**Fig. 7** Typical Source-to-Drain Diode Forward Voltage



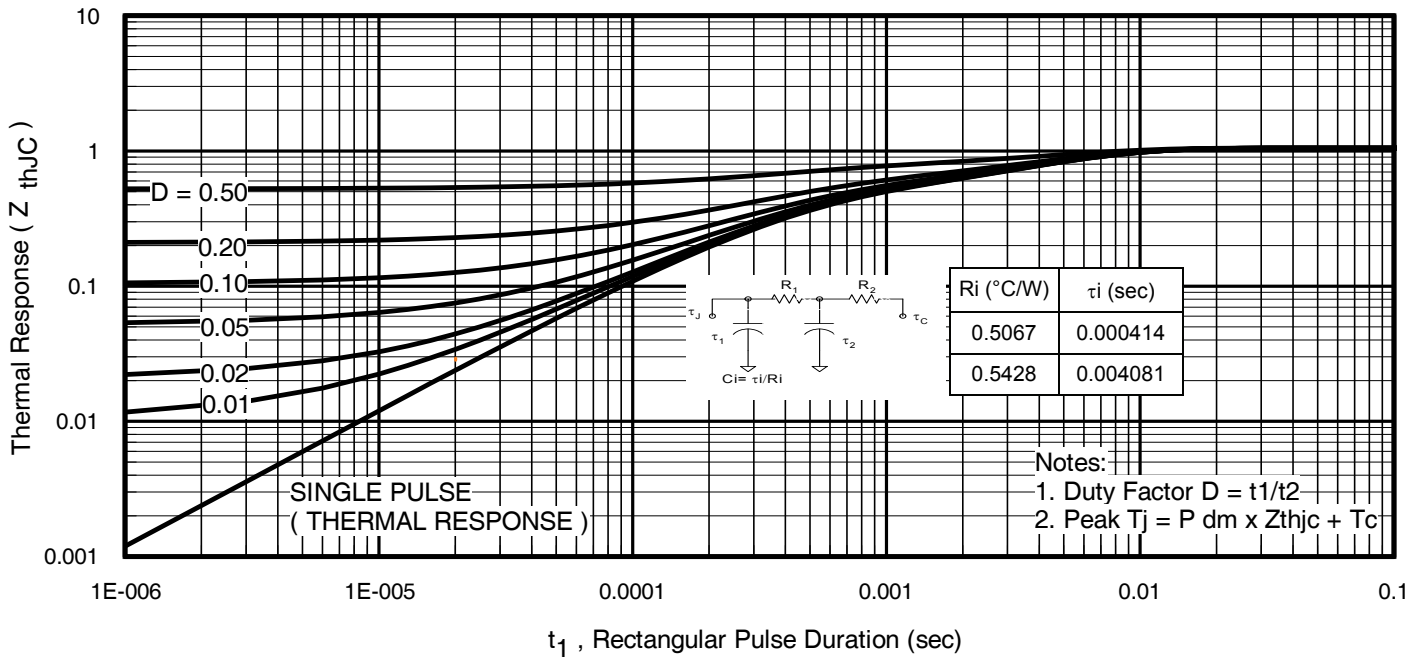
**Fig 8.** Maximum Safe Operating Area



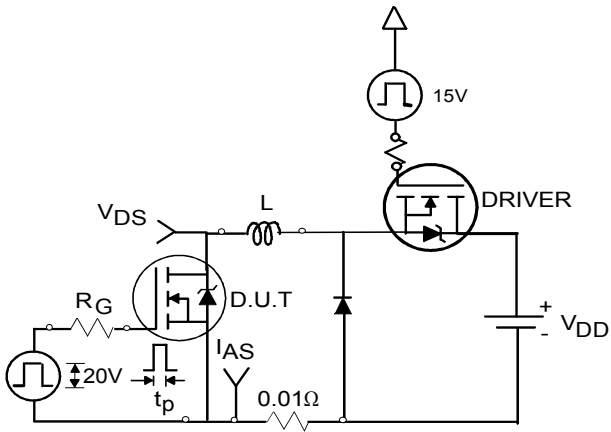
**Fig 9.** Maximum Drain Current Vs. Case Temperature



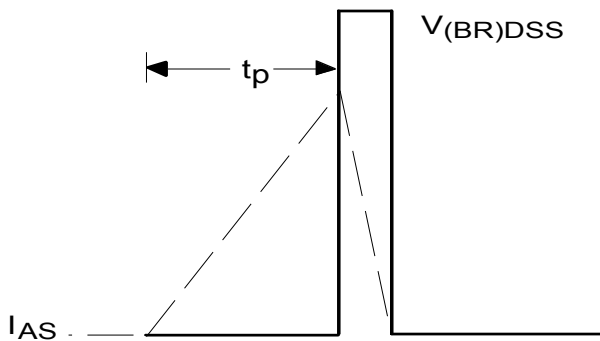
**Fig 10.** Normalized On-Resistance Vs. Temperature



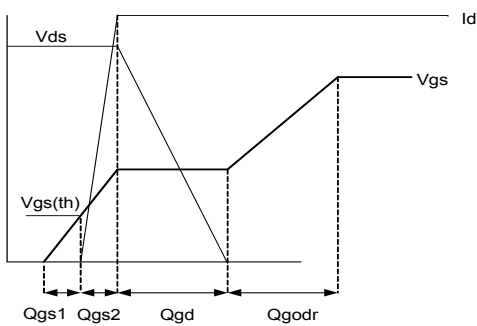
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case



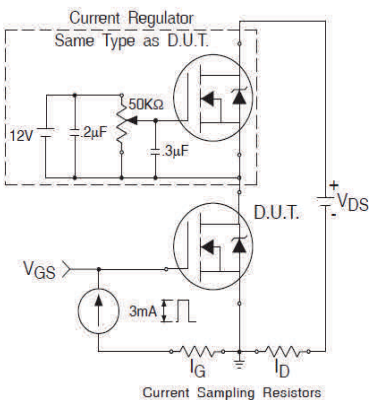
**Fig 12a.** Unclamped Inductive Test Circuit



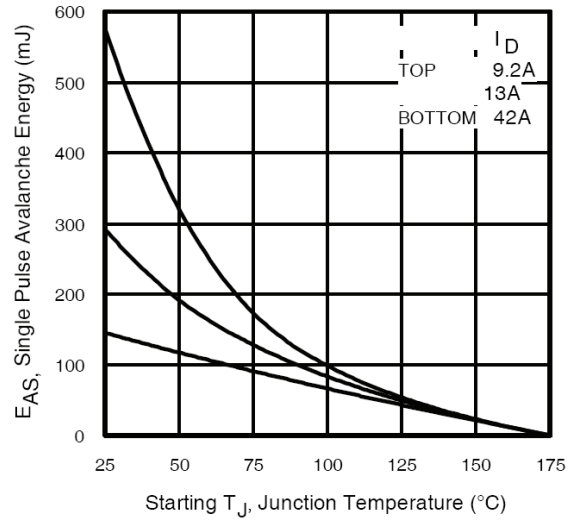
**Fig 12b.** Unclamped Inductive Waveforms



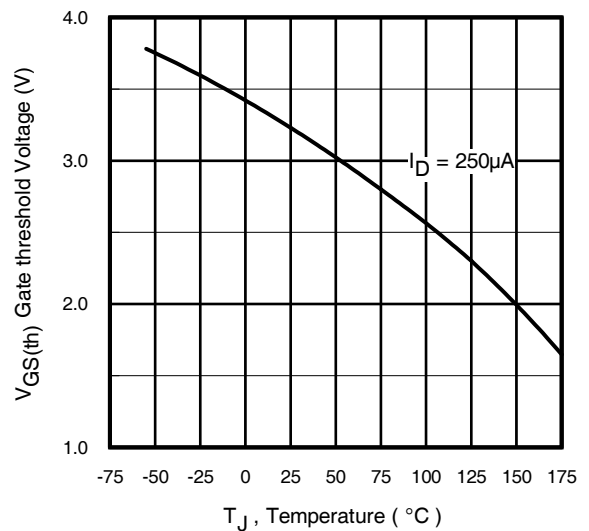
**Fig 13a.** Gate Charge Waveform



**Fig 13b.** Gate Charge Test Circuit



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



**Fig 14.** Threshold Voltage Vs. Temperature

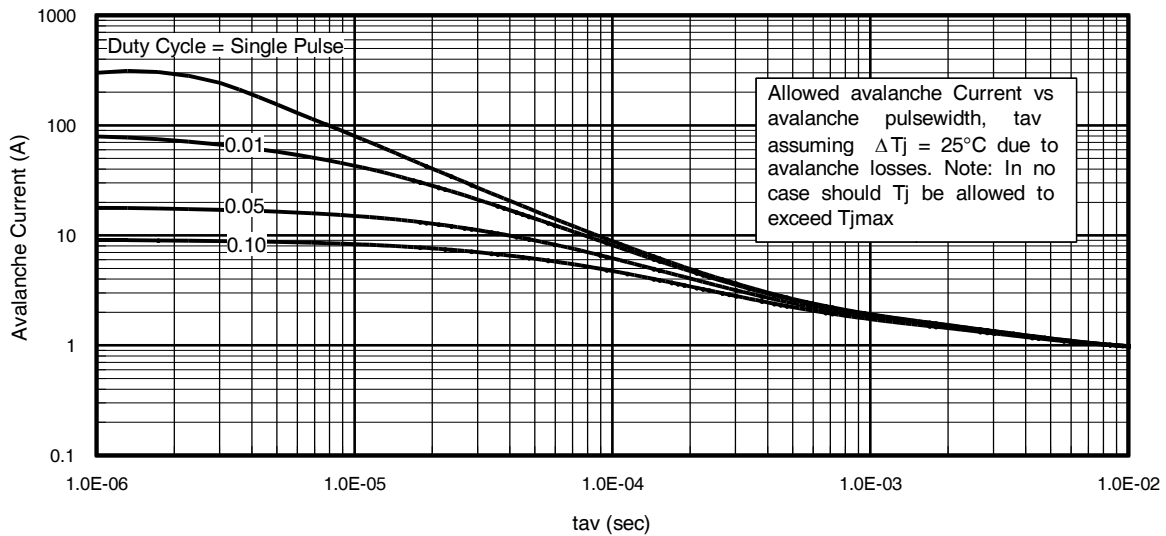


Fig 15. Typical Avalanche Current Vs. Pulse width

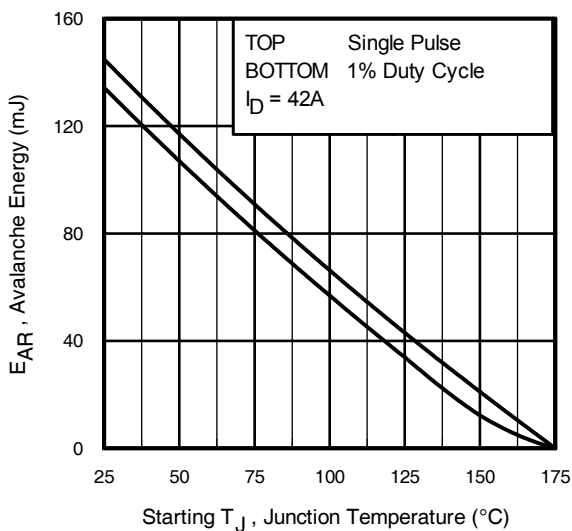


Fig 16. Maximum Avalanche Energy Vs. Temperature

Notes on Repetitive Avalanche Curves , Figures 15, 16:

(For further info, see AN-1005 at [www.infineon.com](http://www.infineon.com))

1. 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.
2. Safe operation in Avalanche is allowed as long as  $T_{jmax}$  is not exceeded.
3. Equation below based on circuit and waveforms shown in Figures 12a, 12b.
4.  $P_{D(ave)}$  = Average power dissipation per single avalanche pulse.
5.  $BV$  = Rated breakdown voltage (1.3 factor accounts for voltage increase during avalanche).
6.  $I_{av}$  = Allowable avalanche current.
7.  $\Delta T$  = Allowable rise in junction temperature, not to exceed  $T_{jmax}$  (assumed as 25°C in Figure 15, 16).  
 $t_{av}$  = Average time in avalanche.  
 $D$  = Duty cycle in avalanche =  $t_{av} \cdot f$   
 $Z_{thJC}(D, t_{av})$  = Transient thermal resistance, see Figures 13)

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

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

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

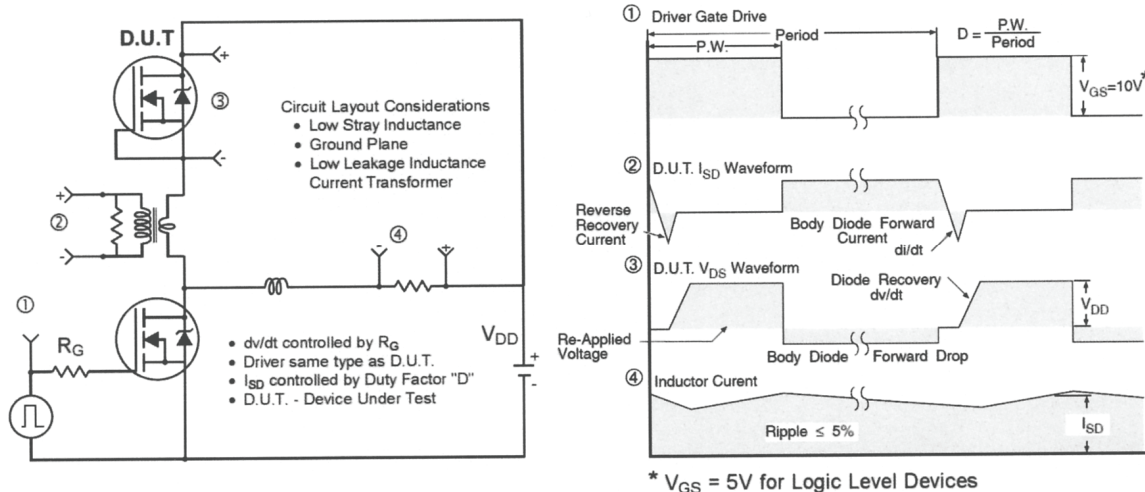


Fig 17. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

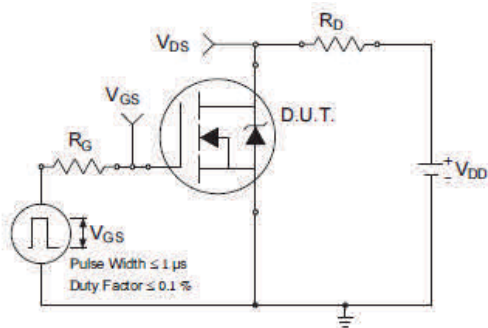


Fig 18a. Switching Time Test Circuit

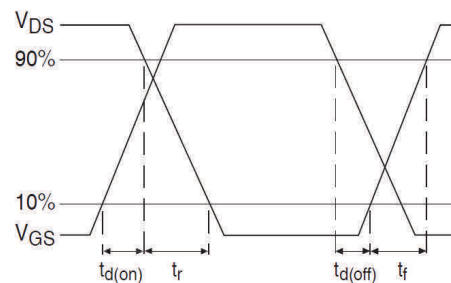
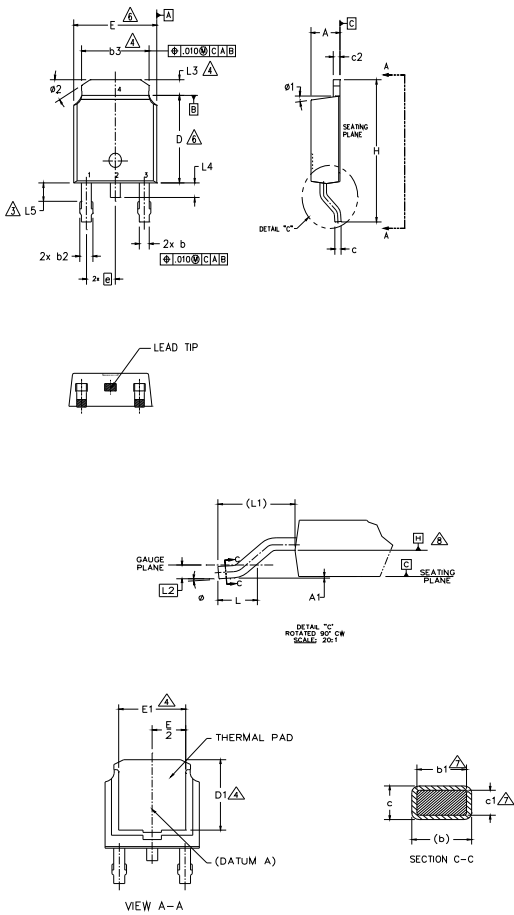


Fig 18b. Switching Time Waveforms

**D-Pak (TO-252AA) Package Outline (Dimensions are shown in millimeters (inches))**

**NOTES:**

- 1.- DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
- 2.- DIMENSION ARE SHOWN IN INCHES [MILLIMETERS]
- 3.- LEAD DIMENSION UNCONTROLLED IN L5.
- 4.- DIMENSION D1, E1, L3 & b3 ESTABLISH A MINIMUM MOUNTING SURFACE FOR THERMAL PAD.
- 5.- SECTION C-C DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN .005 AND 0.10 [0.13 AND 0.25] FROM THE LEAD TIP.
- 6.- DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005 [0.13] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
- 7.- DIMENSION b1 & c1 APPLIED TO BASE METAL ONLY.
- 8.- DATUM A & B TO BE DETERMINED AT DATUM PLANE H.
- 9.- OUTLINE CONFORMS TO JEDEC OUTLINE TO-252AA.

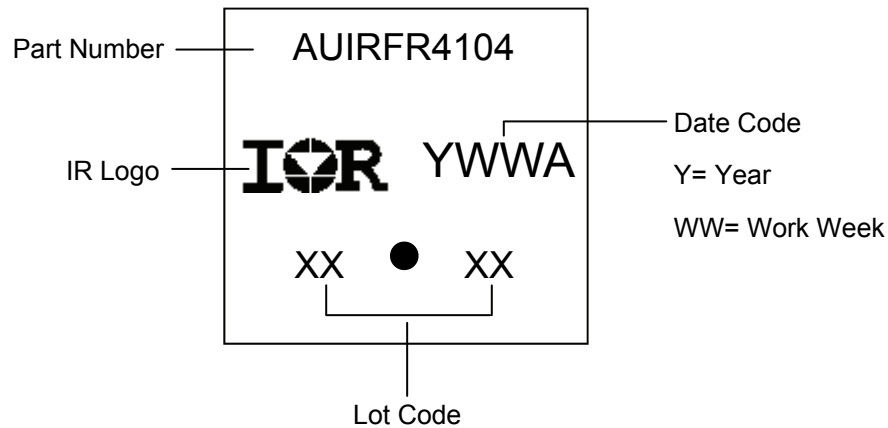
| SYMBOL | DIMENSIONS  |       |           |      | NOTES |
|--------|-------------|-------|-----------|------|-------|
|        | MILLIMETERS |       | INCHES    |      |       |
|        | MIN.        | MAX.  | MIN.      | MAX. |       |
| A      | 2.18        | 2.39  | .086      | .094 |       |
| A1     | -           | 0.13  | -         | .005 |       |
| b      | 0.64        | 0.89  | .025      | .035 |       |
| b1     | 0.65        | 0.79  | .025      | .031 | 7     |
| b2     | 0.76        | 1.14  | .030      | .045 |       |
| b3     | 4.95        | 5.46  | .195      | .215 | 4     |
| c      | 0.46        | 0.61  | .018      | .024 |       |
| c1     | 0.41        | 0.56  | .016      | .022 | 7     |
| c2     | 0.46        | 0.89  | .018      | .035 |       |
| D      | 5.97        | 6.22  | .235      | .245 | 6     |
| D1     | 5.21        | -     | .205      | -    | 4     |
| E      | 6.35        | 6.73  | .250      | .265 | 6     |
| E1     | 4.32        | -     | .170      | -    | 4     |
| e      | 2.29 BSC    |       | .090 BSC  |      |       |
| H      | 9.40        | 10.41 | .370      | .410 |       |
| L      | 1.40        | 1.78  | .055      | .070 |       |
| L1     | 2.74 BSC    |       | .108 REF. |      |       |
| L2     | 0.51 BSC    |       | .020 BSC  |      |       |
| L3     | 0.89        | 1.27  | .035      | .050 | 4     |
| L4     | -           | 1.02  | -         | .040 |       |
| L5     | 1.14        | 1.52  | .045      | .060 | 3     |
| φ      | 0"          | 10"   | 0"        | 10"  |       |
| φ1     | 0"          | 15"   | 0"        | 15"  |       |
| φ2     | 25"         | 35"   | 25"       | 35"  |       |

LEAD ASSIGNMENTS
HEXFET

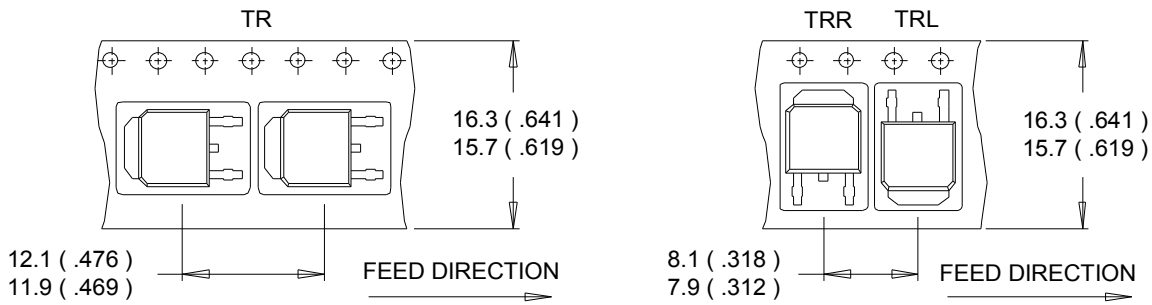
- 1.- GATE
- 2.- DRAIN
- 3.- SOURCE
- 4.- DRAIN

IGBT & CoPAK

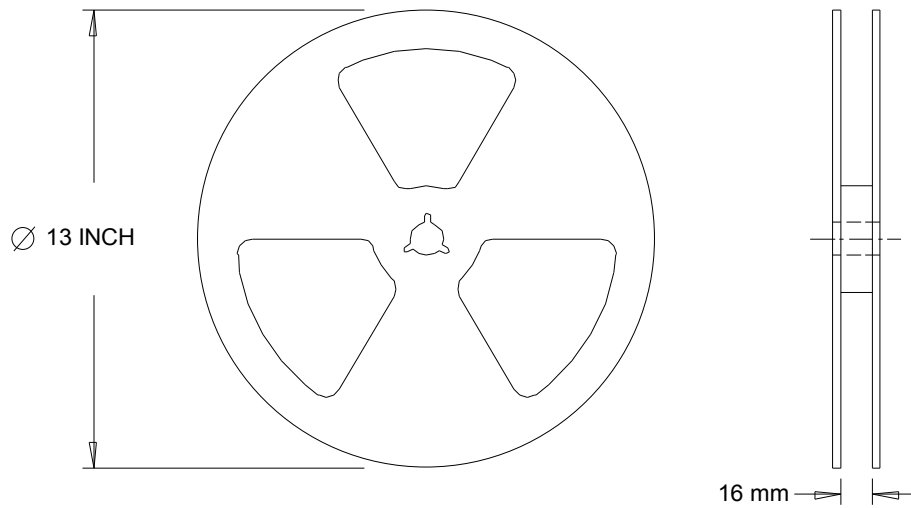
- 1.- GATE
- 2.- COLLECTOR
- 3.- EMITTER
- 4.- COLLECTOR

**D-Pak (TO-252AA) Part Marking Information**




**D-Pak (TO-252AA) Tape & Reel Information (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.

**Qualification Information**

|                                   |                      |                                                                                                                                                                               |      |
|-----------------------------------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <b>Qualification Level</b>        |                      | 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. |      |
| <b>Moisture Sensitivity Level</b> |                      | D-Pak                                                                                                                                                                         | MSL1 |
|                                   |                      | I-Pak                                                                                                                                                                         |      |
| <b>ESD</b>                        | Machine Model        | Class M4 (+/- 425V) <sup>†</sup><br>AEC-Q101-002                                                                                                                              |      |
|                                   | Human Body Model     | Class H1C (+/-1750V) <sup>†</sup><br>AEC-Q101-001                                                                                                                             |      |
|                                   | Charged Device Model | Class C5 (+/-625V) <sup>†</sup><br>AEC-Q101-005                                                                                                                               |      |
| <b>RoHS Compliant</b>             |                      | Yes                                                                                                                                                                           |      |

† Highest passing voltage.

**Revision History**

| Date       | Comments                                                                                                                                                                                                              |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12/1/2015  | <ul style="list-style-type: none"> <li>Updated datasheet with corporate template</li> <li>Corrected ordering table on page 1.</li> <li>Corrected typo RthJA (PCB Mount) from "40C/W" to "50C/W" on page 1.</li> </ul> |
| 10/05/2017 | <ul style="list-style-type: none"> <li>Corrected typo error on part marking on page 9 and 10.</li> </ul>                                                                                                              |

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