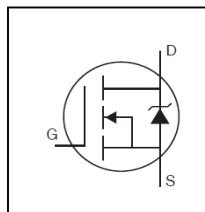


## HEXFET® Power MOSFET

**Application**

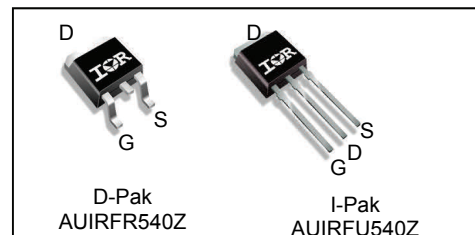
- Automatic Voltage Regulator (AVR)
- Solenoid Injection
- Body Control
- Low Power Automotive Applications



|              |      |               |
|--------------|------|---------------|
| $V_{DSS}$    |      | <b>100V</b>   |
| $R_{DS(on)}$ | typ. | <b>22.5mΩ</b> |
|              | max. | <b>28.5mΩ</b> |
| $I_D$        |      | <b>35A</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 |                       |
| AUIRFU540Z       | I-Pak        | Tube               | 75       | AUIRFU540Z            |
| AUIRFR540Z       | D-Pak        | Tube               | 75       | AUIRFR540Z            |
|                  |              | Tape and Reel Left | 3000     | AUIRFR540ZTRL         |

**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 |
|---------------------------------|-------------------------------------------------------------------|-------------------------|-------|
| $I_D @ T_C = 25^\circ\text{C}$  | Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Silicon Limited) | 35                      | A     |
| $I_D @ T_C = 100^\circ\text{C}$ | Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Silicon Limited) | 25                      |       |
| $I_{DM}$                        | Pulsed Drain Current ①                                            | 140                     |       |
| $P_D @ T_C = 25^\circ\text{C}$  | Maximum Power Dissipation                                         | 91                      | W     |
|                                 | Linear Derating Factor                                            | 0.61                    | W/°C  |
| $V_{GS}$                        | Gate-to-Source Voltage                                            | ± 20                    | V     |
| $E_{AS}$                        | Single Pulse Avalanche Energy (Thermally Limited) ②               | 39                      | mJ    |
| $E_{AS} \text{ (Tested)}$       | Single Pulse Avalanche Energy Tested Value ⑥                      | 75                      |       |
| $I_{AR}$                        | Avalanche Current ①                                               | See Fig.15,16, 12a, 12b | A     |
| $E_{AR}$                        | Repetitive Avalanche Energy ⑤                                     |                         | mJ    |
| $T_J$                           | Operating Junction and                                            | -55 to + 175            | °C    |
| $T_{STG}$                       | Storage Temperature Range                                         |                         |       |
|                                 | Soldering Temperature, for 10 seconds (1.6mm from case)           | 300                     |       |

**Thermal Resistance**

| Symbol          | Parameter                         | Typ. | Max. | Units |
|-----------------|-----------------------------------|------|------|-------|
| $R_{\theta JC}$ | Junction-to-Case ⑧                | —    | 1.64 | °C/W  |
| $R_{\theta JA}$ | Junction-to-Ambient (PCB Mount) ② | —    | 50   |       |
| $R_{\theta JA}$ | Junction-to-Ambient               | —    | 110  |       |

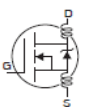
HEXFET® is a registered trademark of Infineon.

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

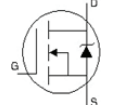
**Static @  $T_J = 25^\circ\text{C}$  (unless otherwise specified)**

|                                 | 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  | —    | 0.092 | —    | V/ $^\circ\text{C}$ | Reference to $25^\circ\text{C}$ , $I_D = 1\text{mA}$  |
| $R_{DS(on)}$                    | Static Drain-to-Source On-Resistance | —    | 22.5  | 28.5 | m $\Omega$          | $V_{GS} = 10V, I_D = 21A$ ③                           |
| $V_{GS(th)}$                    | Gate Threshold Voltage               | 2.0  | —     | 4.0  | V                   | $V_{DS} = V_{GS}, I_D = 50\mu A$                      |
| $g_{fs}$                        | Forward Trans conductance            | 28   | —     | —    | S                   | $V_{DS} = 25V, I_D = 21A$ ③                           |
| $I_{DSS}$                       | 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       | —    | —     | 200  | nA                  | $V_{GS} = 20V$                                        |
|                                 | Gate-to-Source Reverse Leakage       | —    | —     | -200 |                     | $V_{GS} = -20V$                                       |

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

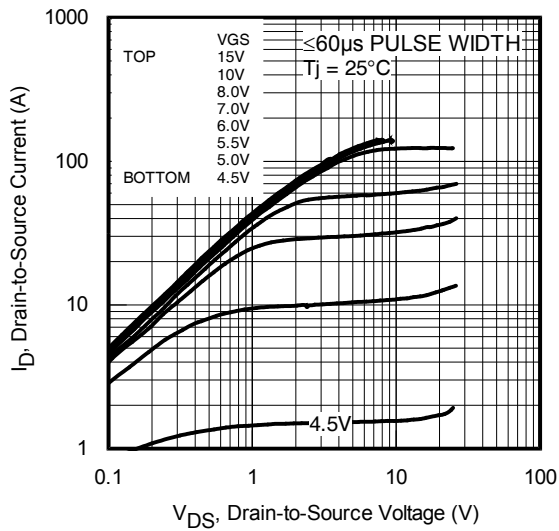
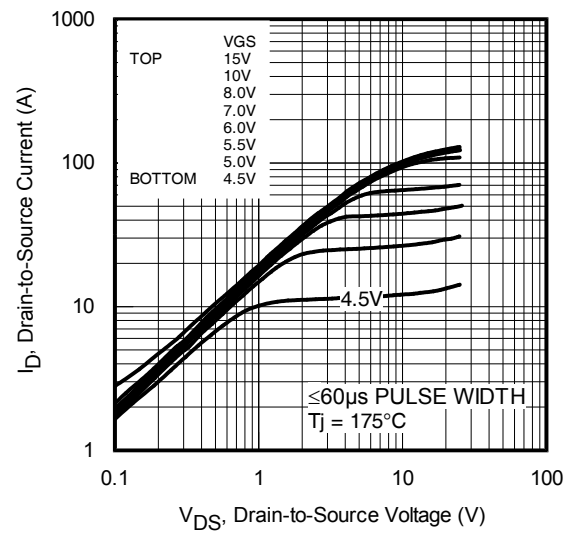
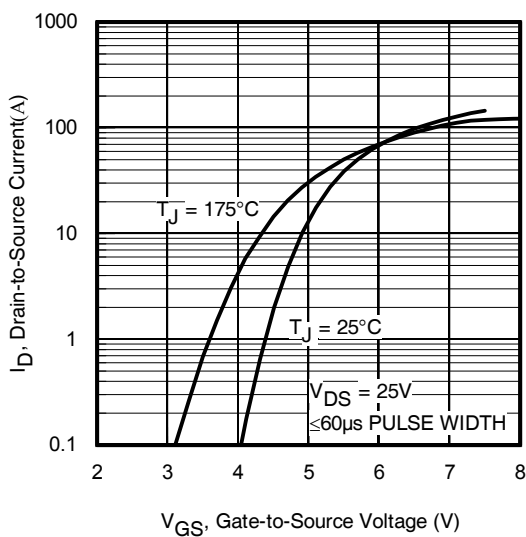
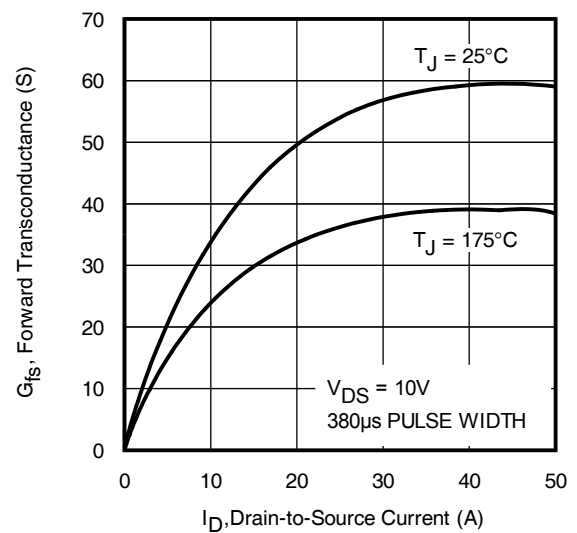
|                       |                              |   |      |    |    |                                                                                                                                                        |
|-----------------------|------------------------------|---|------|----|----|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| $Q_g$                 | Total Gate Charge            | — | 39   | 59 | nC | $I_D = 21A$                                                                                                                                            |
| $Q_{gs}$              | Gate-to-Source Charge        | — | 11   | —  |    | $V_{DS} = 50V$                                                                                                                                         |
| $Q_{gd}$              | Gate-to-Drain Charge         | — | 12   | —  |    | $V_{GS} = 10V$ ③                                                                                                                                       |
| $t_{d(on)}$           | Turn-On Delay Time           | — | 14   | —  | ns | $V_{DD} = 50V$                                                                                                                                         |
| $t_r$                 | Rise Time                    | — | 42   | —  |    | $I_D = 21A$                                                                                                                                            |
| $t_{d(off)}$          | Turn-Off Delay Time          | — | 43   | —  |    | $R_G = 13\Omega$                                                                                                                                       |
| $t_f$                 | Fall Time                    | — | 34   | —  |    | $V_{GS} = 10V$ ③                                                                                                                                       |
| $L_D$                 | Internal Drain Inductance    | — | 4.5  | —  | nH | Between lead, 6mm (0.25in.) from package and center of die contact  |
| $L_S$                 | Internal Source Inductance   | — | 7.5  | —  |    |                                                                                                                                                        |
| $C_{iss}$             | Input Capacitance            | — | 1690 | —  | pF | $V_{GS} = 0V$                                                                                                                                          |
| $C_{oss}$             | Output Capacitance           | — | 180  | —  |    | $V_{DS} = 25V$                                                                                                                                         |
| $C_{rss}$             | Reverse Transfer Capacitance | — | 100  | —  |    | $f = 1.0\text{MHz}$                                                                                                                                    |
| $C_{oss}$             | Output Capacitance           | — | 720  | —  |    | $V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0\text{MHz}$                                                                                                        |
| $C_{oss}$             | Output Capacitance           | — | 110  | —  |    | $V_{GS} = 0V, V_{DS} = 80V, f = 1.0\text{MHz}$                                                                                                         |
| $C_{oss\text{ eff.}}$ | Effective Output Capacitance | — | 190  | —  |    | $V_{GS} = 0V, V_{DS} = 0V \text{ to } 80V$ ④                                                                                                           |

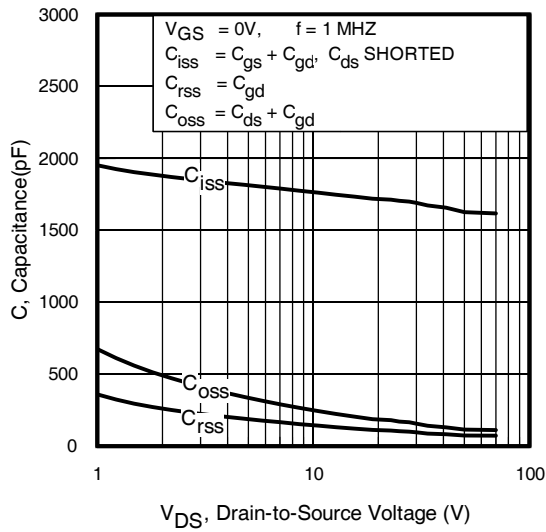
**Diode Characteristics**

|          | Parameter                              | Min.                                                                        | Typ. | Max. | Units | Conditions                                                                                                                                           |
|----------|----------------------------------------|-----------------------------------------------------------------------------|------|------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| $I_S$    | Continuous Source Current (Body Diode) | —                                                                           | —    | 35   | A     | MOSFET symbol showing the integral reverse p-n junction diode.  |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ①   | —                                                                           | —    | 140  |       |                                                                                                                                                      |
| $V_{SD}$ | Diode Forward Voltage                  | —                                                                           | —    | 1.3  | V     | $T_J = 25^\circ\text{C}, I_S = 21A, V_{GS} = 0V$ ③                                                                                                   |
| $t_{rr}$ | Reverse Recovery Time                  | —                                                                           | 32   | 48   | ns    | $T_J = 25^\circ\text{C}, I_F = 21A, V_{DD} = 50V$                                                                                                    |
| $Q_{rr}$ | Reverse Recovery Charge                | —                                                                           | 40   | 60   | nC    | $di/dt = 100A/\mu s$ ③                                                                                                                               |
| $t_{on}$ | Forward Turn-On Time                   | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S + L_D$ ) |      |      |       |                                                                                                                                                      |

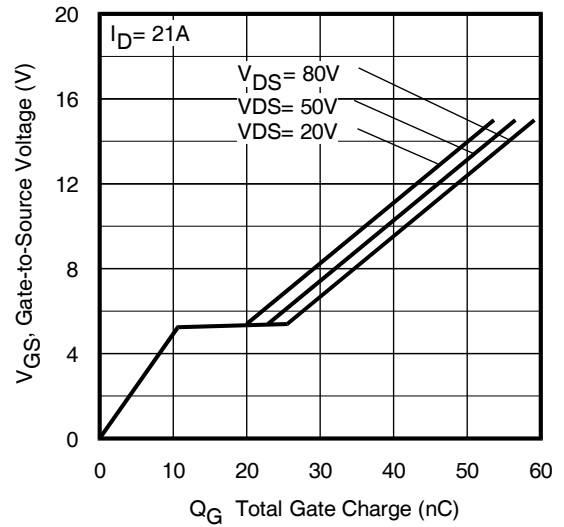
**Notes:**

- ① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11)
- ② Limited by  $T_{Jmax}$ , starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.17\text{mH}$ ,  $R_G = 25\Omega$ ,  $I_{AS} = 21A$ ,  $V_{GS} = 10V$ . Part not recommended for use above this value.
- ③ Pulse width  $\leq 1.0\text{ms}$ ; duty cycle  $\leq 2\%$ .
- ④  $C_{oss\text{ eff.}}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$
- ⑤ Limited by  $T_{Jmax}$ , see Fig.12a, 12b, 15, 16 for typical repetitive avalanche performance.
- ⑥ This value determined from sample failure population, 100% tested to this value in production.
- 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  $90^\circ\text{C}$ .

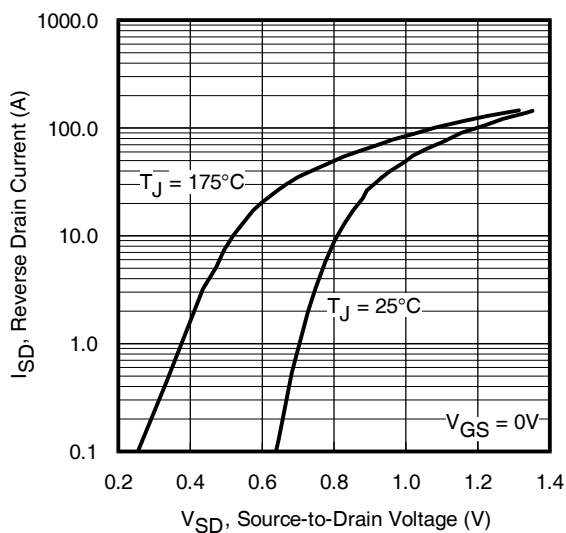

**Fig. 1** Typical Output Characteristics

**Fig. 2** Typical Output Characteristics

**Fig. 3** Typical Transfer Characteristics

**Fig. 4** Typical Forward Trans conductance Vs. Drain Current



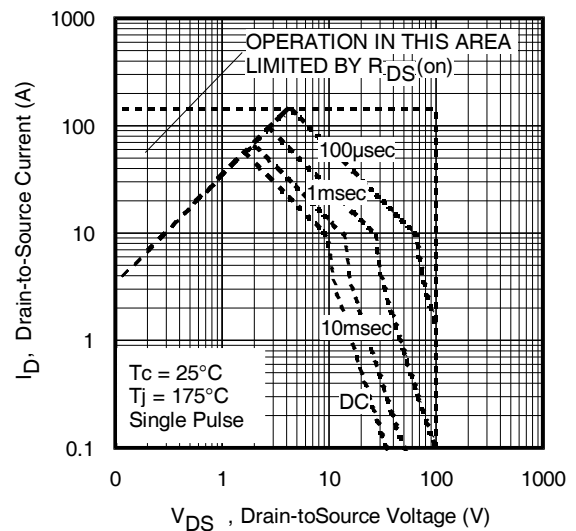
**Fig 5.** Typical Capacitance vs.  
Drain-to-Source Voltage



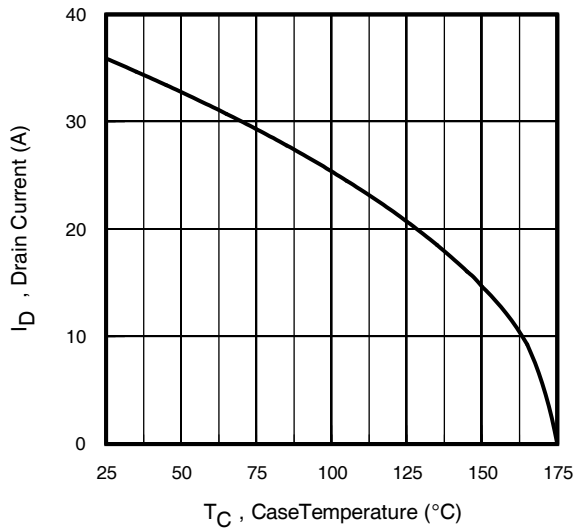
**Fig 6.** Typical Gate Charge vs.  
Gate-to-Source Voltage



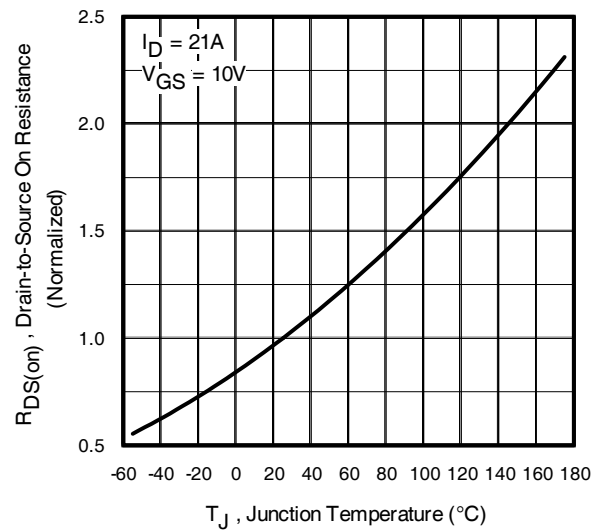
**Fig. 7** Typical Source-to-Drain Diode  
Forward Voltage



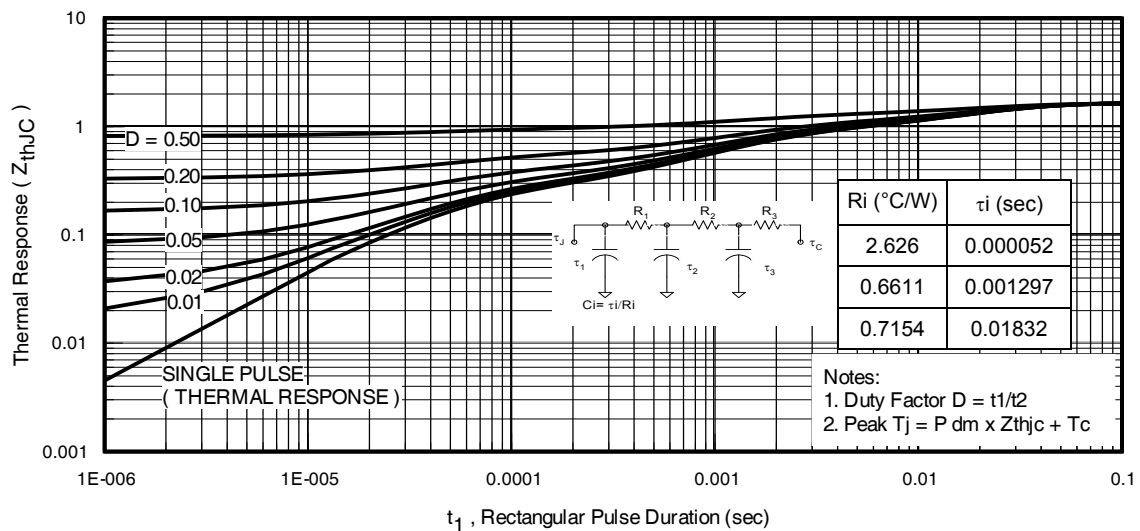
**Fig 8.** Maximum Safe Operating Area



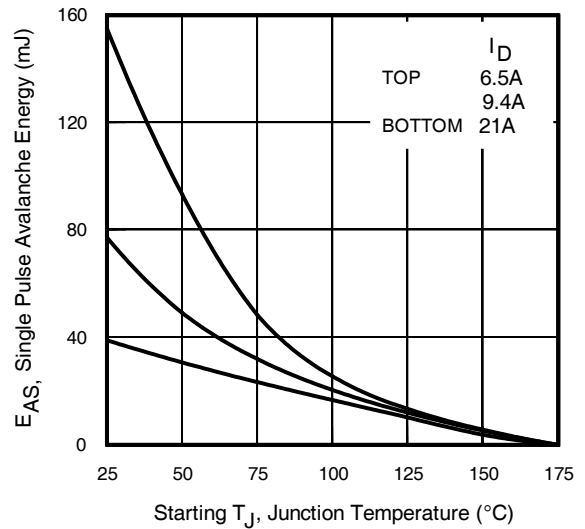
**Fig 9.** Maximum Drain Current Vs. Case Temperature

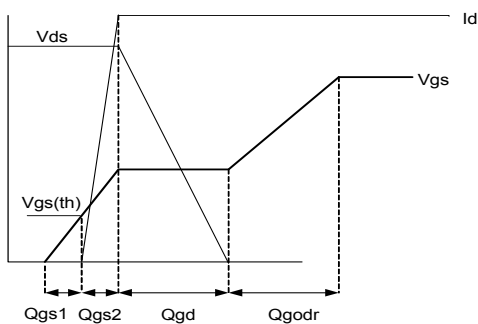
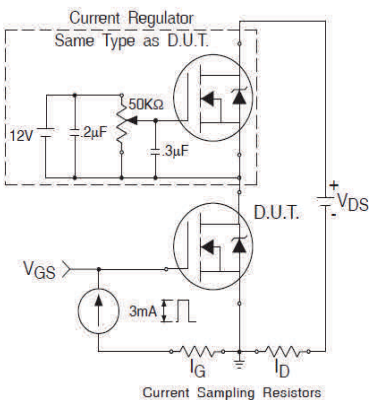
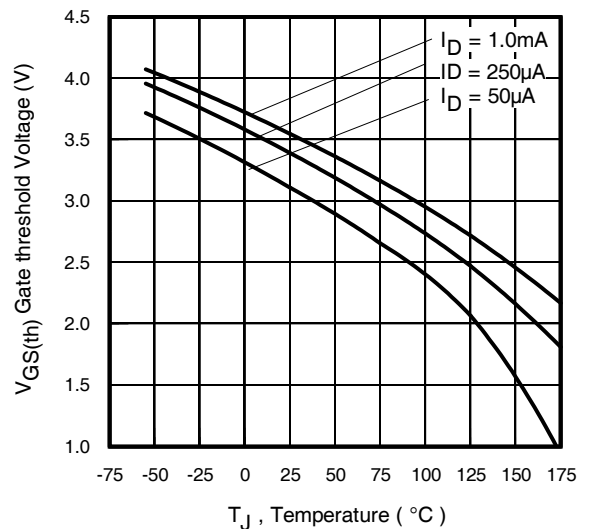


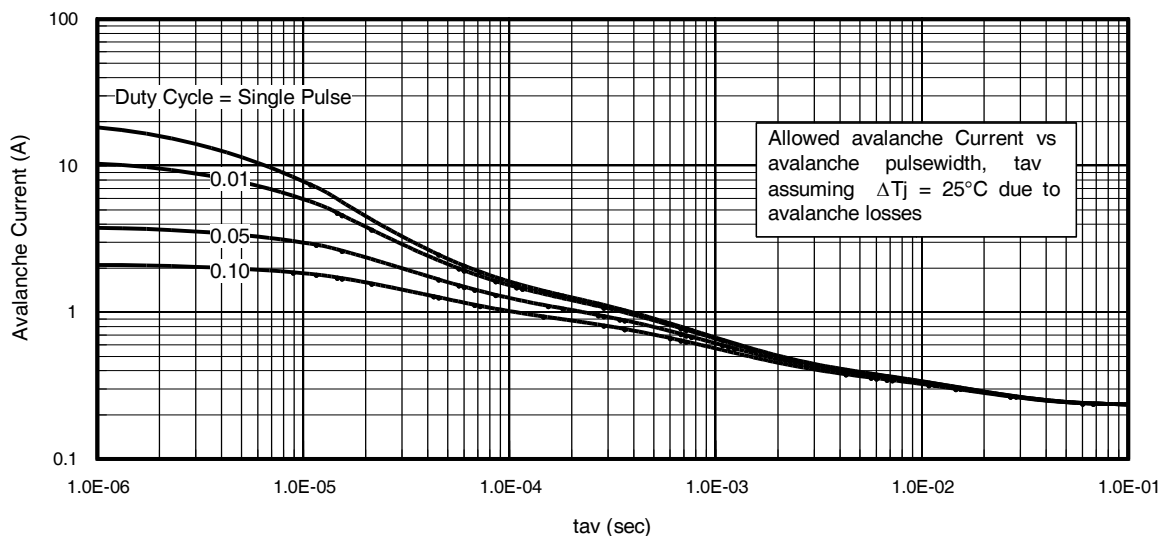
**Fig 10.** Normalized On-Resistance Vs. Temperature



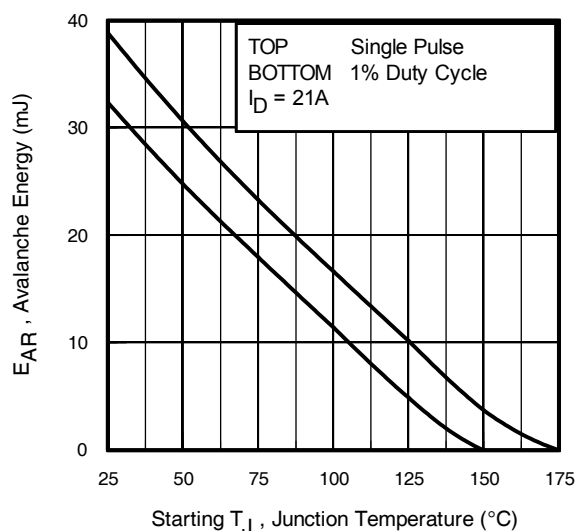
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case


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

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

**Fig 12b. Unclamped Inductive Waveforms**

**Fig 13a. Gate Charge Waveform**

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

**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)

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

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

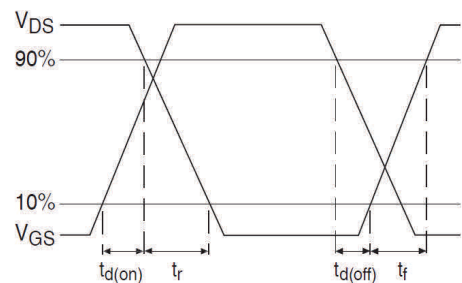
$$E_{AS (AR)} = P_D (ave) \cdot t_{av}$$



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

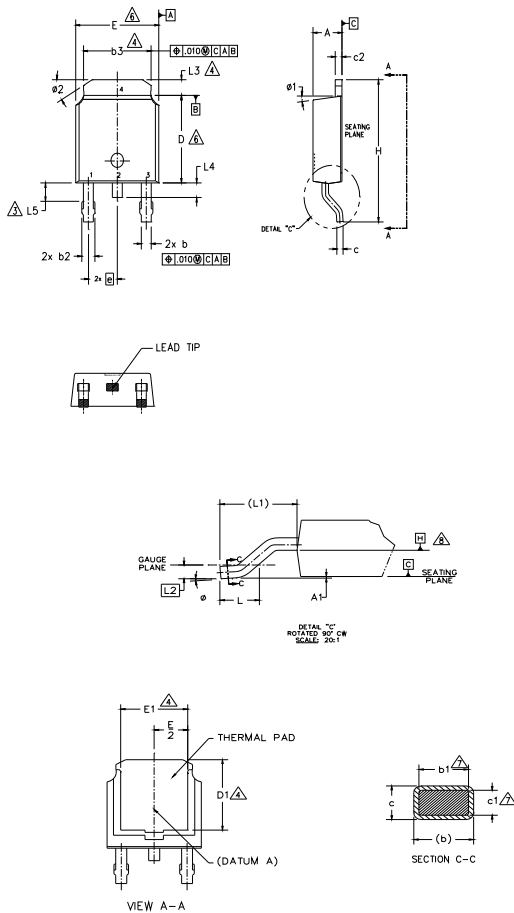


**Fig 18a.** Switching Time Test Circuit



**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     |
| ø      | 0°          | 10°   | 0°        | 10°  |       |
| ø1     | 0°          | 15°   | 0°        | 15°  |       |
| ø2     | 25°         | 35°   | 25°       | 35°  |       |

### LEAD ASSIGNMENTS

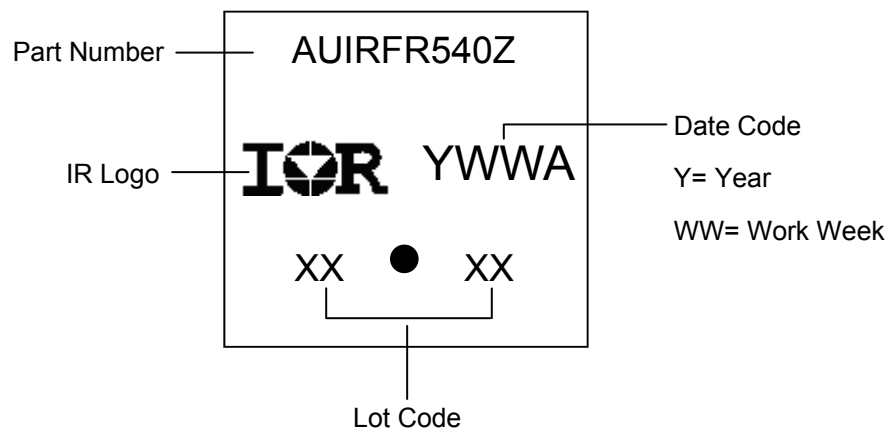
### HEXFET

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

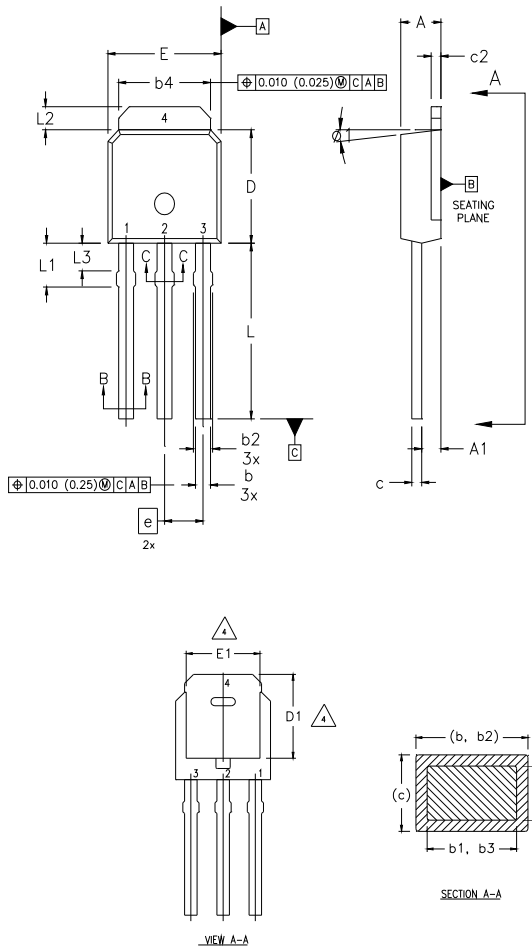
### IGBT & CoPAK

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

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



### I-Pak (TO-251AA) Package Outline (Dimensions are shown in millimeters (inches))



NOTES:

- 1 DIMENSIONING AND TOLERANCING PER ASME Y14.5 M- 1994.  
2 DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].  
3 DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED  
0.005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST  
EXTREMES OF THE PLASTIC BODY.  
4 THERMAL PAD CONTOUR OPTION WITHIN DIMENSION b4, L2, E1 & D1.  
5 LEAD DIMENSION UNCONTROLLED IN L3.  
6 DIMENSION b1, b3 APPLY TO BASE METAL ONLY.  
7 OUTLINE CONFORMS TO JEDEC OUTLINE TO-251AA.  
8 CONTROLLING DIMENSION : INCHES.

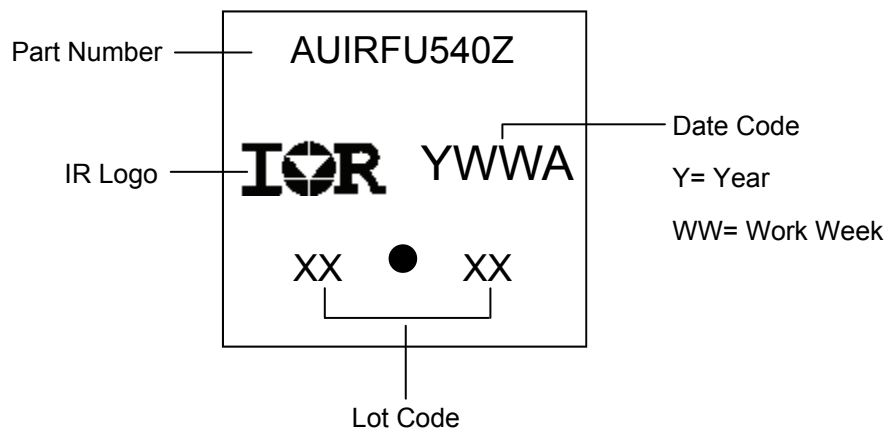
### LEAD ASSIGNMENTS

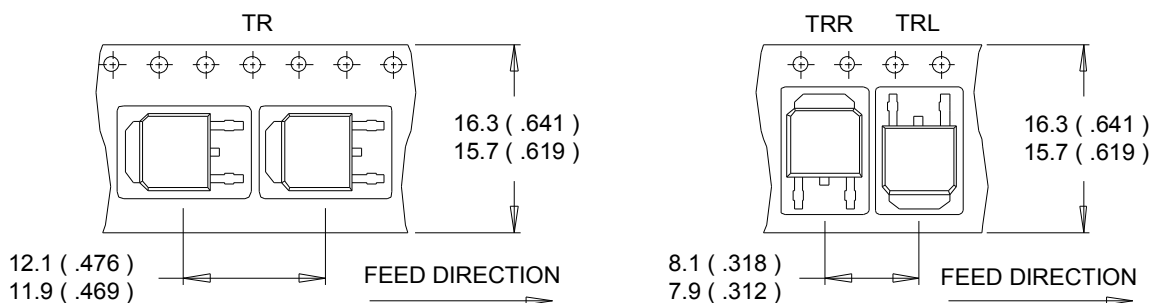
HEXFET

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

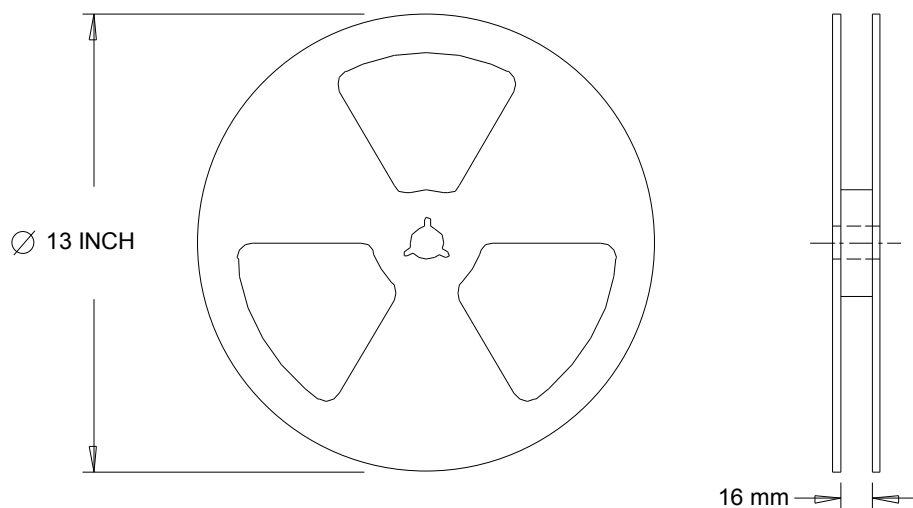
| SYMBOL | DIMENSIONS  |      |           |       | NOTES |
|--------|-------------|------|-----------|-------|-------|
|        | MILLIMETERS |      | INCHES    |       |       |
|        | MIN.        | MAX. | MIN.      | MAX.  |       |
| A      | 2.18        | 2.39 | 0.086     | .094  |       |
| A1     | 0.89        | 1.14 | 0.035     | 0.045 |       |
| b      | 0.64        | 0.89 | 0.025     | 0.035 |       |
| b1     | 0.64        | 0.79 | 0.025     | 0.031 | 4     |
| b2     | 0.76        | 1.14 | 0.030     | 0.045 |       |
| b3     | 0.76        | 1.04 | 0.030     | 0.041 |       |
| b4     | 5.00        | 5.46 | 0.195     | 0.215 | 4     |
| c      | 0.46        | 0.61 | 0.018     | 0.024 |       |
| c1     | 0.41        | 0.56 | 0.016     | 0.022 |       |
| c2     | .046        | 0.86 | 0.018     | 0.035 |       |
| D      | 5.97        | 6.22 | 0.235     | 0.245 | 3, 4  |
| D1     | 5.21        | —    | 0.205     | —     | 4     |
| E      | 6.35        | 6.73 | 0.250     | 0.265 | 3, 4  |
| E1     | 4.32        | —    | 0.170     | —     | 4     |
| e      | 2.29        |      | 0.090 BSC |       |       |
| L      | 8.89        | 9.60 | 0.350     | 0.380 |       |
| L1     | 1.91        | 2.29 | 0.075     | 0.090 |       |
| L2     | 0.89        | 1.27 | 0.035     | 0.050 | 4     |
| L3     | 1.14        | 1.52 | 0.045     | 0.060 | 5     |
| ø1     | 0"          | 15"  | 0"        | 15"   |       |

### I-Pak (TO-251AA) 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**

|                            |                      |                                                                                                                                                                               |      |
|----------------------------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 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-Pak                                                                                                                                                                         | MSL1 |
|                            |                      | I-Pak                                                                                                                                                                         |      |
| ESD                        | Machine Model        | Class M2 (+/-200V) <sup>†</sup><br>AEC-Q101-002                                                                                                                               |      |
|                            | Human Body Model     | Class H1B (+/-1000V) <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                                                                                                                                                                                                               |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 06/06/2014 | <ul style="list-style-type: none"> <li>Updated part number by the pictures of the parts to AU nomenclature on page 1.</li> </ul>                                                                                       |
| 12/02/2015 | <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 "40°C/W" to "50°C/W" on page 1</li> </ul> |
| 10/03/2017 | <ul style="list-style-type: none"> <li>Corrected typo error on package outline and part marking on page 9 and 10.</li> </ul>                                                                                           |

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