

**PDP SWITCH**

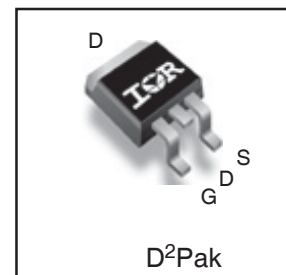
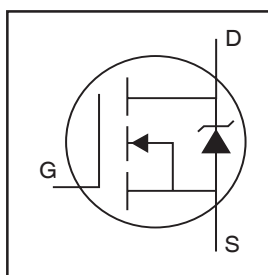
# IRFS4229PbF

## Features

- Advanced Process Technology
- Key Parameters Optimized for PDP Sustain, Energy Recovery and Pass Switch Applications
- Low  $E_{PULSE}$  Rating to Reduce Power Dissipation in PDP Sustain, Energy Recovery and Pass Switch Applications
- Low  $Q_G$  for Fast Response
- High Repetitive Peak Current Capability for Reliable Operation
- Short Fall & Rise Times for Fast Switching
- 175°C Operating Junction Temperature for Improved Ruggedness
- Repetitive Avalanche Capability for Robustness and Reliability

## Key Parameters

|                                          |     |    |
|------------------------------------------|-----|----|
| $V_{DS}$ min                             | 250 | V  |
| $V_{DS}$ (Avalanche) typ.                | 300 | V  |
| $R_{DS(ON)}$ typ. @ 10V                  | 42  | mΩ |
| $I_{RP}$ max @ $T_C = 100^\circ\text{C}$ | 91  | A  |
| $T_J$ max                                | 175 | °C |



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

## Description

This HEXFET® Power MOSFET is specifically designed for Sustain; Energy Recovery & Pass switch applications in Plasma Display Panels. This MOSFET utilizes the latest processing techniques to achieve low on-resistance per silicon area and low  $E_{PULSE}$  rating. Additional features of this MOSFET are 175°C operating junction temperature and high repetitive peak current capability. These features combine to make this MOSFET a highly efficient, robust and reliable device for PDP driving applications.

## Absolute Maximum Ratings

|                                      | Parameter                                | Max.             | Units |
|--------------------------------------|------------------------------------------|------------------|-------|
| $V_{GS}$                             | Gate-to-Source Voltage                   | ±30              | V     |
| $I_D$ @ $T_C = 25^\circ\text{C}$     | Continuous Drain Current, $V_{GS}$ @ 10V | 45               | A     |
| $I_D$ @ $T_C = 100^\circ\text{C}$    | Continuous Drain Current, $V_{GS}$ @ 10V | 32               |       |
| $I_{DM}$                             | Pulsed Drain Current ①                   | 180              |       |
| $I_{RP}$ @ $T_C = 100^\circ\text{C}$ | Repetitive Peak Current ⑤                | 91               |       |
| $P_D$ @ $T_C = 25^\circ\text{C}$     | Power Dissipation                        | 330              | W     |
| $P_D$ @ $T_C = 100^\circ\text{C}$    | Power Dissipation                        | 190              |       |
|                                      | Linear Derating Factor                   | 2.2              | W/°C  |
| $T_J$                                | Operating Junction and                   | -40 to + 175     | °C    |
| $T_{STG}$                            | Storage Temperature Range                |                  |       |
|                                      | Soldering Temperature for 10 seconds     | 300              |       |
|                                      | Mounting Torque, 6-32 or M3 Screw        | 10lb·in (1.1N·m) | N     |

## Thermal Resistance

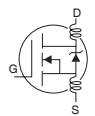
|                 | Parameter             | Typ. | Max.  | Units |
|-----------------|-----------------------|------|-------|-------|
| $R_{\theta JC}$ | Junction-to-Case ④    | —    | 0.45* |       |
| $R_{\theta JA}$ | Junction-to-Ambient ④ | —    | 62    |       |

\*  $R_{\theta JC}$  (end of life) for D<sup>2</sup>Pak and TO-262 = 0.65°C/W. This is the maximum measured value after 1000 temperature cycles from -55 to 150°C and is accounted for by the physical wearout of the die attach medium.

Notes ① through ⑤ are on page 9

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

|                                | Parameter                            | Min. | Typ. | Max. | Units                | Conditions                                                                                                  |
|--------------------------------|--------------------------------------|------|------|------|----------------------|-------------------------------------------------------------------------------------------------------------|
| $BV_{DSS}$                     | Drain-to-Source Breakdown Voltage    | 250  | —    | —    | V                    | $V_{GS} = 0V, I_D = 250\mu A$                                                                               |
| $\Delta BV_{DSS}/\Delta T_J$   | Breakdown Voltage Temp. Coefficient  | —    | 210  | —    | mV/ $^\circ\text{C}$ | Reference to $25^\circ\text{C}$ , $I_D = 1\text{mA}$                                                        |
| $R_{DS(on)}$                   | Static Drain-to-Source On-Resistance | —    | 42   | 48   | m $\Omega$           | $V_{GS} = 10V, I_D = 26A$ ③                                                                                 |
| $V_{GS(th)}$                   | Gate Threshold Voltage               | 3.0  | —    | 5.0  | V                    | $V_{DS} = V_{GS}, I_D = 250\mu A$                                                                           |
| $\Delta V_{GS(th)}/\Delta T_J$ | Gate Threshold Voltage Coefficient   | —    | -14  | —    | mV/ $^\circ\text{C}$ |                                                                                                             |
| $I_{DSS}$                      | Drain-to-Source Leakage Current      | —    | —    | 20   | $\mu A$              | $V_{DS} = 250V, V_{GS} = 0V$                                                                                |
|                                |                                      | —    | —    | 200  |                      | $V_{DS} = 250V, V_{GS} = 0V, T_J = 125^\circ\text{C}$                                                       |
| $I_{GSS}$                      | Gate-to-Source Forward Leakage       | —    | —    | 100  | nA                   | $V_{GS} = 20V$                                                                                              |
|                                | Gate-to-Source Reverse Leakage       | —    | —    | -100 |                      | $V_{GS} = -20V$                                                                                             |
| $g_{fs}$                       | Forward Transconductance             | 83   | —    | —    | S                    | $V_{DS} = 25V, I_D = 26A$                                                                                   |
| $Q_g$                          | Total Gate Charge                    | —    | 72   | 110  | nC                   | $V_{DD} = 125V, I_D = 26A, V_{GS} = 10V$ ③                                                                  |
| $Q_{gd}$                       | Gate-to-Drain Charge                 | —    | 26   | —    |                      |                                                                                                             |
| $t_{d(on)}$                    | Turn-On Delay Time                   | —    | 18   | —    | ns                   | $V_{DD} = 125V, V_{GS} = 10V$ ③<br>$I_D = 26A$<br>$R_G = 2.4\Omega$<br>See Fig. 22                          |
| $t_r$                          | Rise Time                            | —    | 31   | —    |                      |                                                                                                             |
| $t_{d(off)}$                   | Turn-Off Delay Time                  | —    | 30   | —    |                      |                                                                                                             |
| $t_f$                          | Fall Time                            | —    | 21   | —    |                      |                                                                                                             |
| $t_{st}$                       | Shoot Through Blocking Time          | 100  | —    | —    | ns                   | $V_{DD} = 200V, V_{GS} = 15V, R_G = 4.7\Omega$                                                              |
| $E_{PULSE}$                    | Energy per Pulse                     | —    | 790  | —    | $\mu J$              | $L = 220\text{nH}, C = 0.3\mu F, V_{GS} = 15V$<br>$V_{DS} = 200V, R_G = 4.7\Omega, T_J = 25^\circ\text{C}$  |
|                                |                                      | —    | 1390 | —    |                      | $L = 220\text{nH}, C = 0.3\mu F, V_{GS} = 15V$<br>$V_{DS} = 200V, R_G = 4.7\Omega, T_J = 100^\circ\text{C}$ |
| $C_{iss}$                      | Input Capacitance                    | —    | 4560 | —    | pF                   | $V_{GS} = 0V$                                                                                               |
| $C_{oss}$                      | Output Capacitance                   | —    | 390  | —    |                      | $V_{DS} = 25V$                                                                                              |
| $C_{rss}$                      | Reverse Transfer Capacitance         | —    | 100  | —    |                      | $f = 1.0\text{MHz}$ ,                                                                                       |
| $C_{oss \text{ eff.}}$         | Effective Output Capacitance         | —    | 290  | —    |                      | $V_{GS} = 0V, V_{DS} = 0V \text{ to } 200V$                                                                 |
| $L_D$                          | Internal Drain Inductance            | —    | 4.5  | —    | nH                   | Between lead,<br>and center of die contact                                                                  |
| $L_S$                          | Internal Source Inductance           | —    | 7.5  | —    |                      |                                                                                                             |

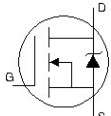


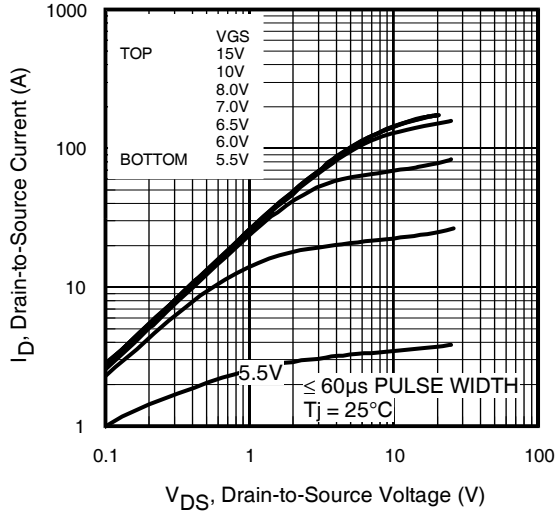
## Avalanche Characteristics

|                     | Parameter                       | Typ. | Max. | Units |
|---------------------|---------------------------------|------|------|-------|
| $E_{AS}$            | Single Pulse Avalanche Energy ② | —    | 130  | mJ    |
| $E_{AR}$            | Repetitive Avalanche Energy ①   | —    | 33   | mJ    |
| $V_{DS(Avalanche)}$ | Repetitive Avalanche Voltage ①  | 300  | —    | V     |
| $I_{AS}$            | Avalanche Current ②             | —    | 26   | A     |

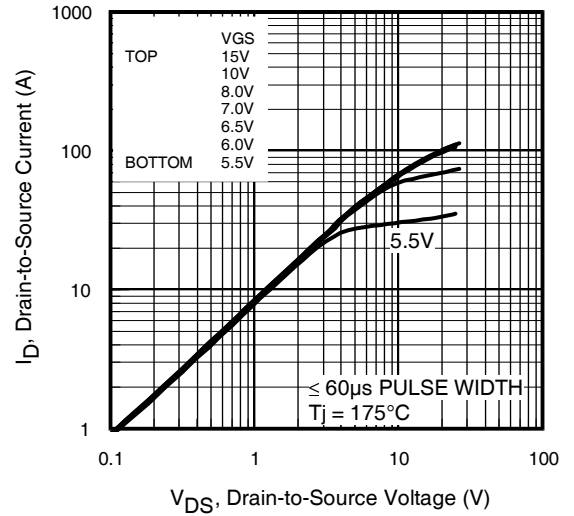
## Diode Characteristics

|                                | Parameter                                 | Min. | Typ. | Max. | Units | Conditions                                                              |
|--------------------------------|-------------------------------------------|------|------|------|-------|-------------------------------------------------------------------------|
| $I_S @ T_C = 25^\circ\text{C}$ | Continuous Source Current<br>(Body Diode) | —    | —    | 45   | A     | MOSFET symbol<br>showing the<br>integral reverse<br>p-n junction diode. |
| $I_{SM}$                       | Pulsed Source Current<br>(Body Diode) ①   | —    | —    | 180  |       |                                                                         |
| $V_{SD}$                       | Diode Forward Voltage                     | —    | —    | 1.3  | V     | $T_J = 25^\circ\text{C}, I_S = 26A, V_{GS} = 0V$ ③                      |
| $t_{rr}$                       | Reverse Recovery Time                     | —    | 190  | 290  | ns    | $T_J = 25^\circ\text{C}, I_F = 26A, V_{DD} = 50V$                       |
| $Q_{rr}$                       | Reverse Recovery Charge                   | —    | 840  | 1260 | nC    | $di/dt = 100A/\mu s$ ③                                                  |

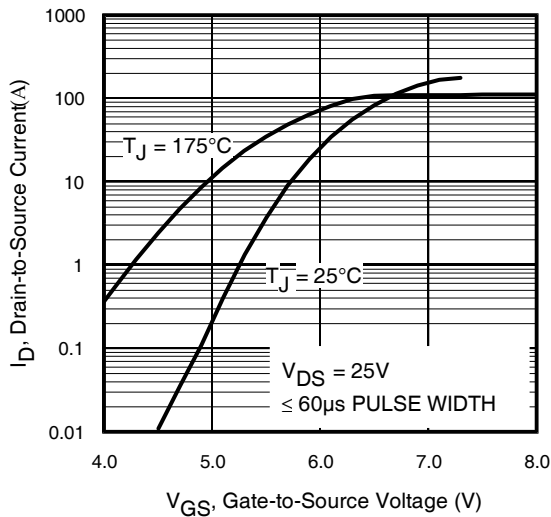




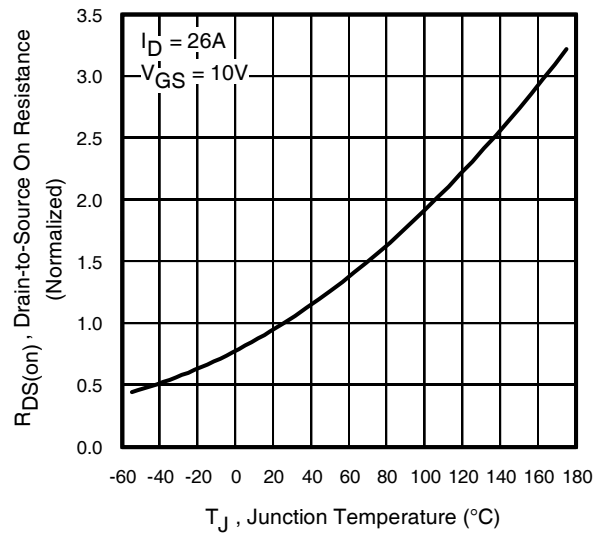
**Fig 1.** Typical Output Characteristics



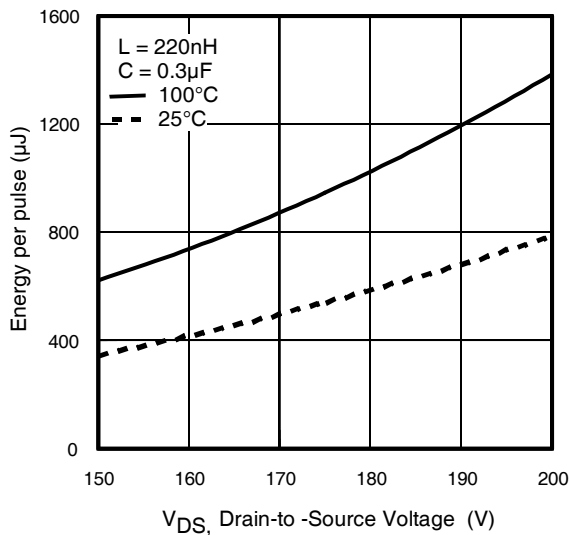
**Fig 2.** Typical Output Characteristics



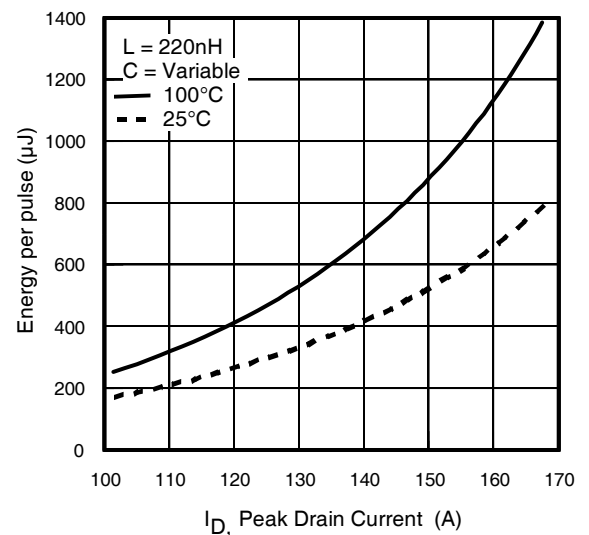
**Fig 3.** Typical Transfer Characteristics



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



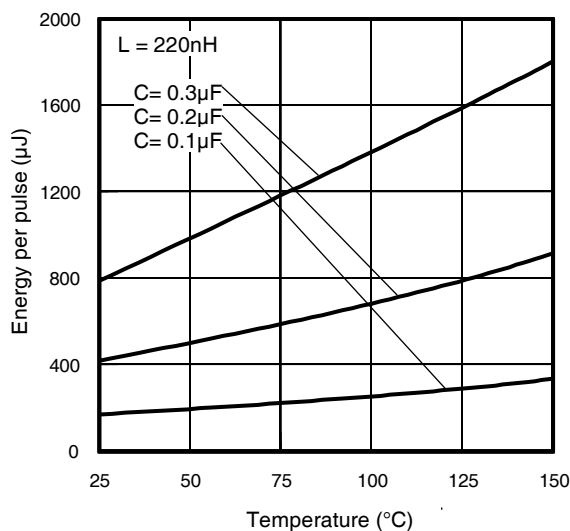
**Fig 5.** Typical  $E_{PULSE}$  vs. Drain-to-Source Voltage  
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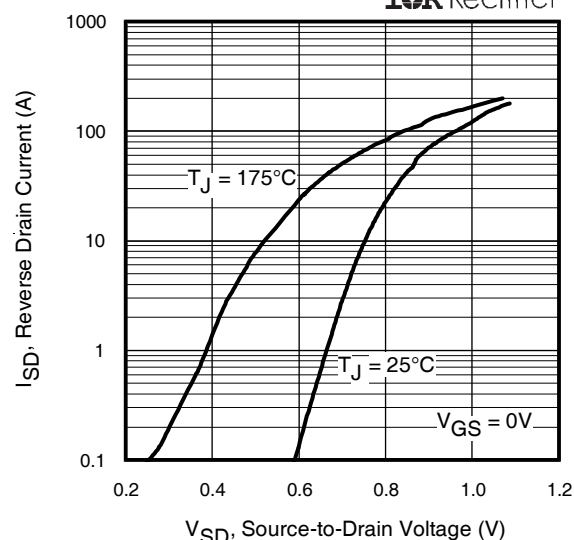
**Fig 6.** Typical  $E_{PULSE}$  vs. Drain Current

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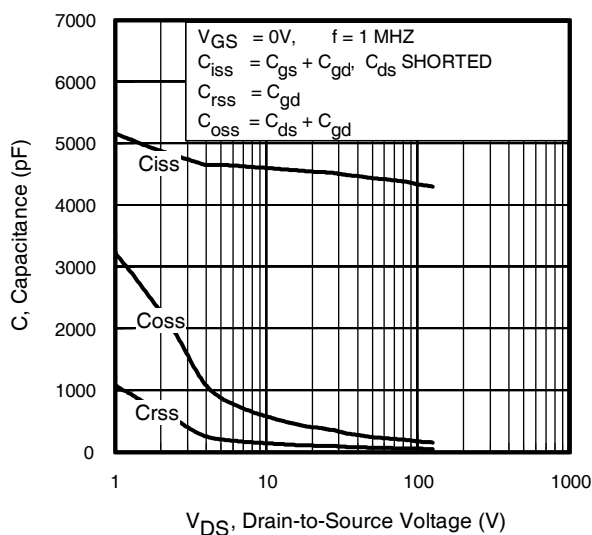
International  
**IR** Rectifier



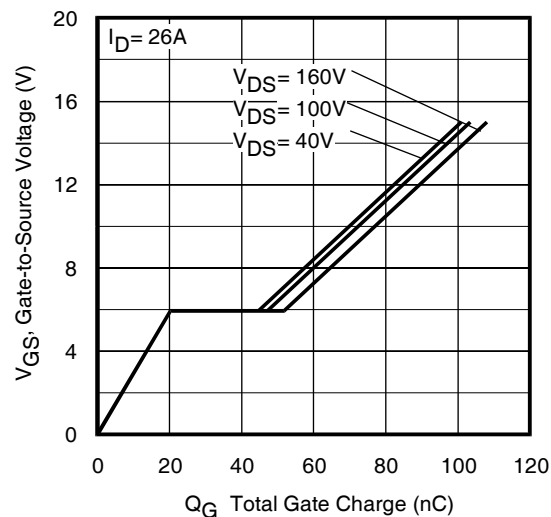
**Fig 7.** Typical  $E_{PULSE}$  vs. Temperature



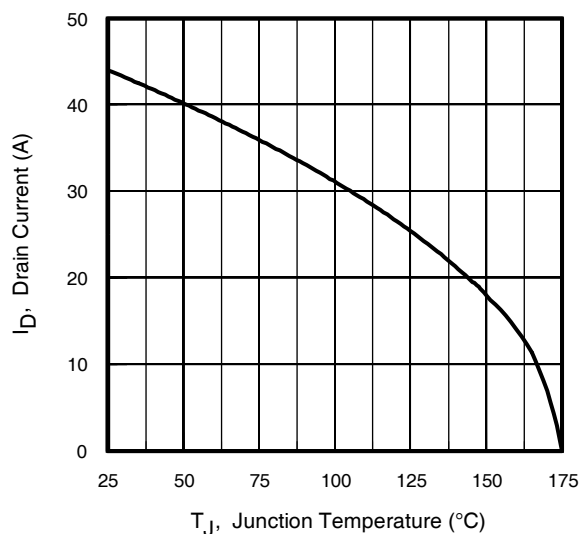
**Fig 8.** Typical Source-Drain Diode Forward Voltage



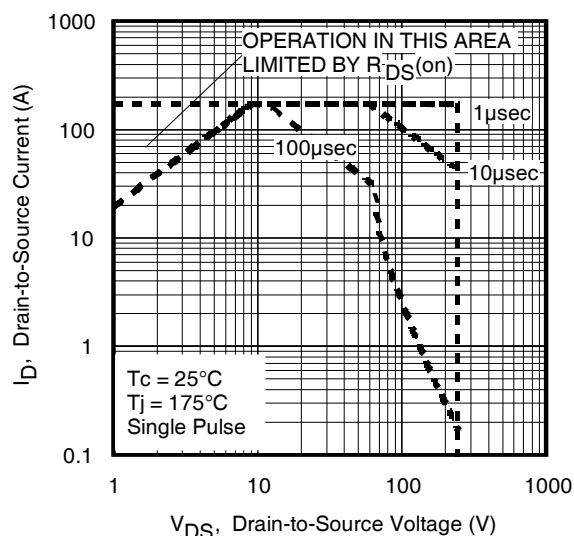
**Fig 9.** Typical Capacitance vs. Drain-to-Source Voltage



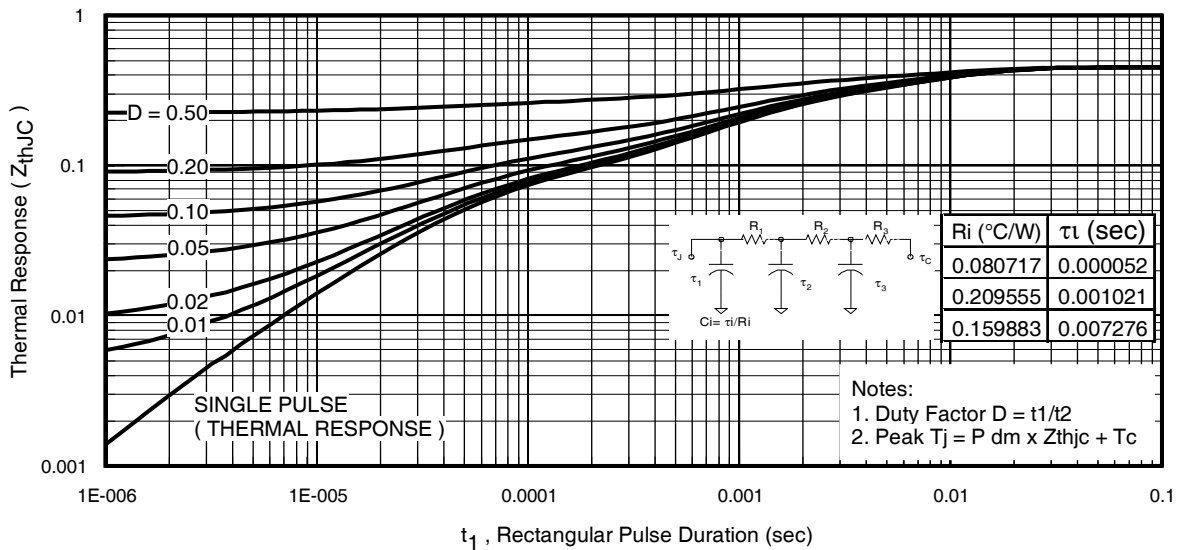
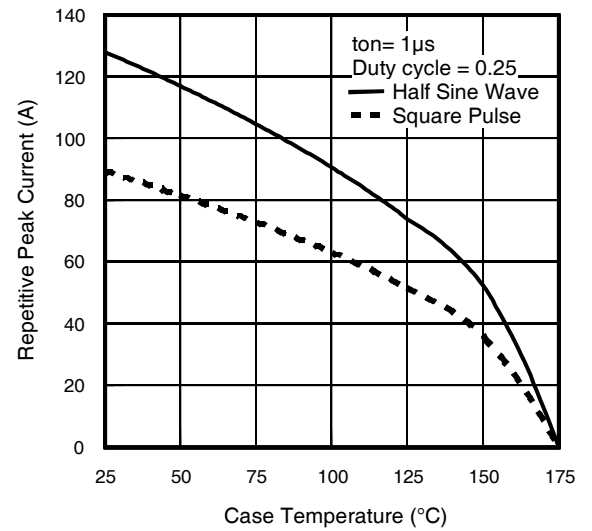
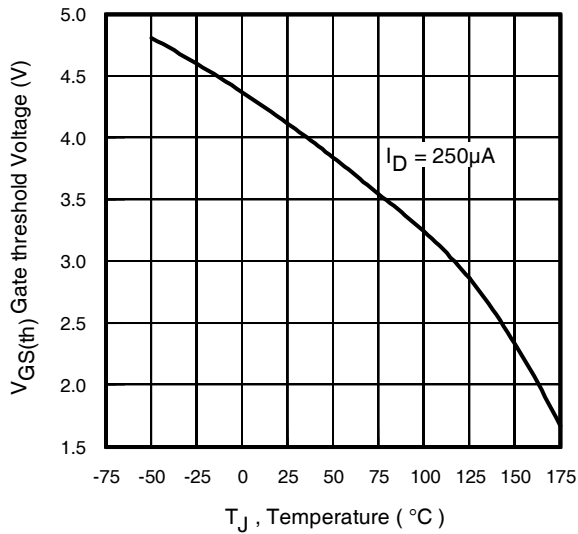
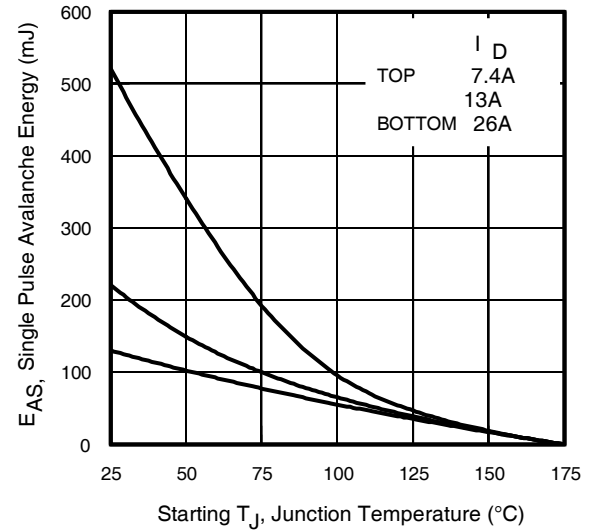
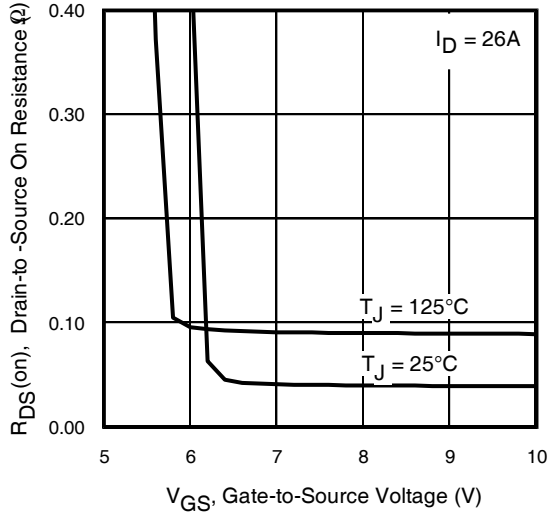
**Fig 10.** Typical Gate Charge vs. Gate-to-Source Voltage

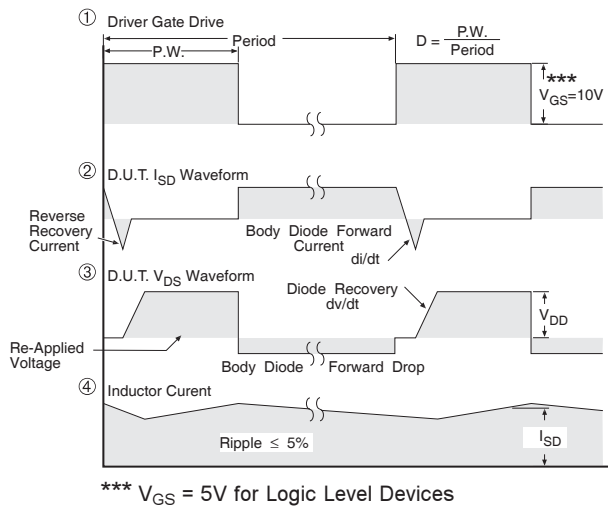
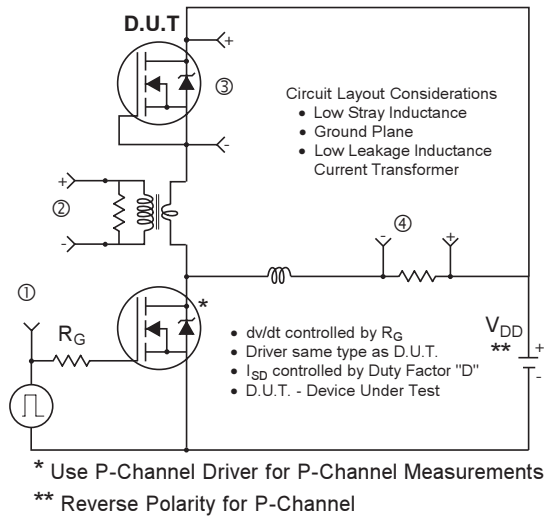


**Fig 11.** Maximum Drain Current vs. Case Temperature

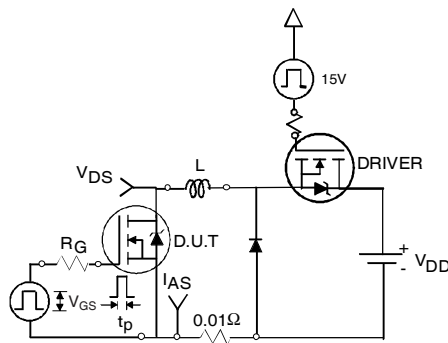


**Fig 12.** Maximum Safe Operating Area

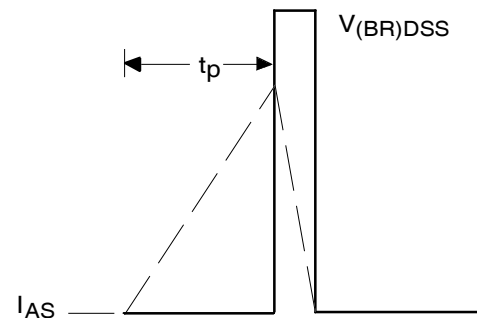




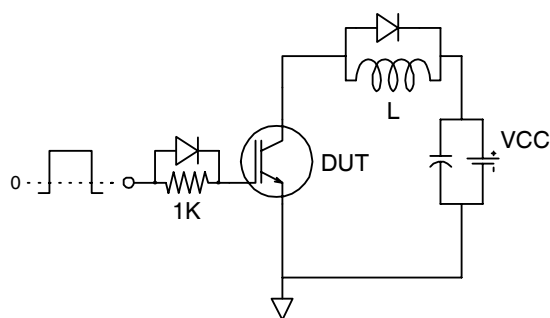
**Fig 18.** Diode Reverse Recovery Test Circuit for HEXFET® Power MOSFETs



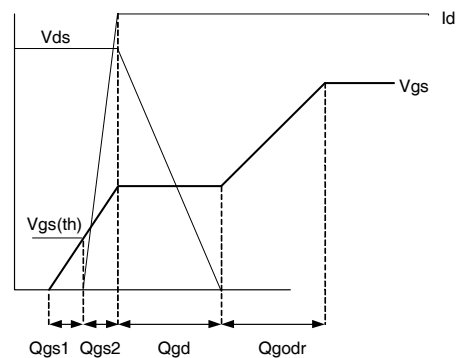
**Fig 19a.** Unclamped Inductive Test Circuit



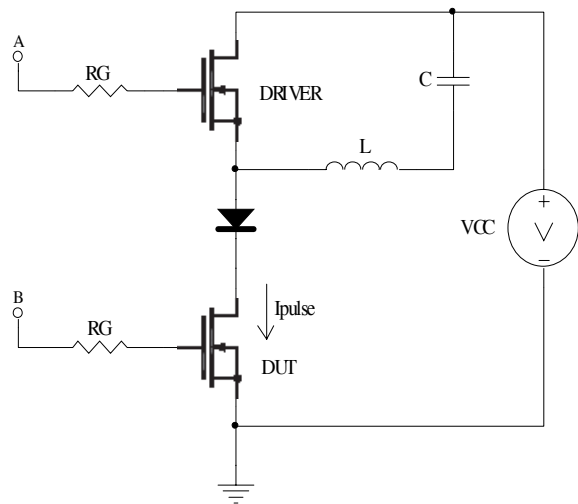
**Fig 19b.** Unclamped Inductive Waveforms



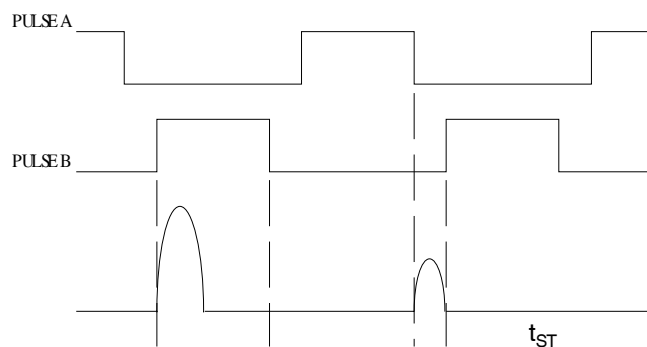
**Fig 20a.** Gate Charge Test Circuit



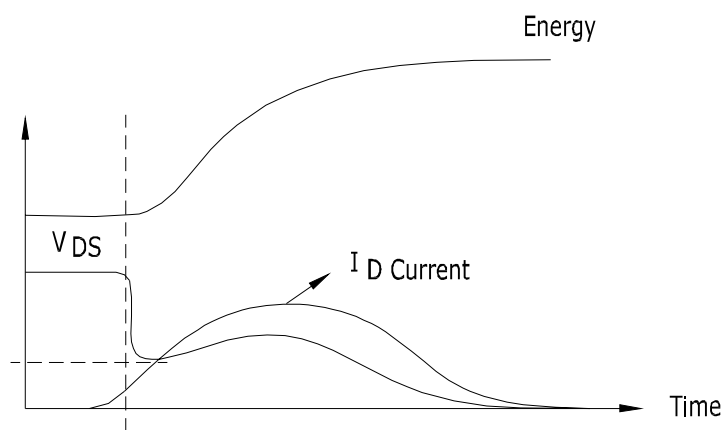
**Fig 20b.** Gate Charge Waveform



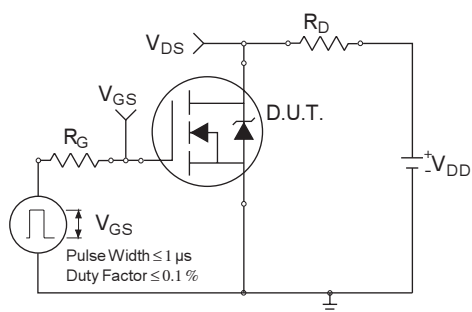
**Fig 21a.**  $t_{st}$  and  $E_{PULSE}$  Test Circuit



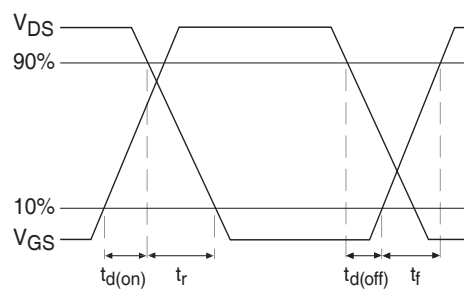
**Fig 21b.**  $t_{st}$  Test Waveforms



**Fig 21c.**  $E_{PULSE}$  Test Waveforms



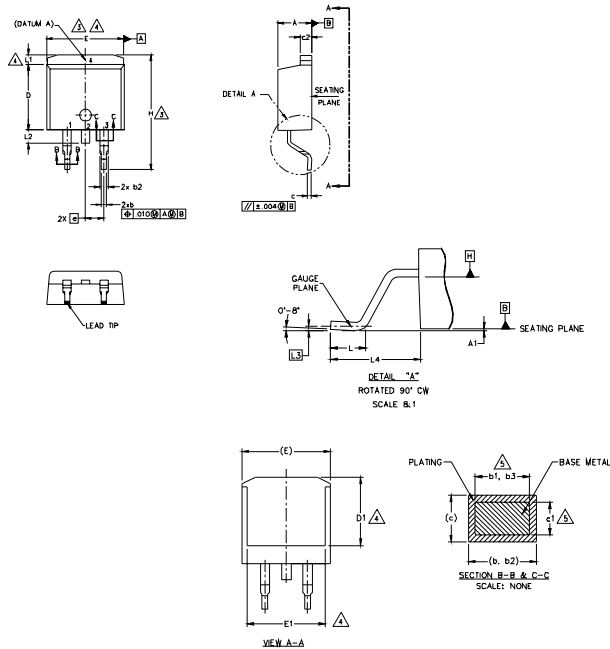
**Fig 22a.** Switching Time Test Circuit



**Fig 22b.** Switching Time Waveforms

## D<sup>2</sup>Pak (TO-263AB) Package Outline

Dimensions are shown in millimeters (inches)



### LEAD ASSIGNMENTS

#### DIODES

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

#### HEXFET

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

#### IGBTs, CoPACK

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

| SYMBOL | DIMENSIONS  |       |          |      | NOTES |
|--------|-------------|-------|----------|------|-------|
|        | 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 | 3     |
| D1     | 6.86        | —     | .270     | —    | 4     |
| E      | 9.65        | 10.67 | .380     | .420 | 3,4   |
| E1     | 6.22        | —     | .245     | —    | 4     |
| e      | 2.54 BSC    |       | .100 BSC |      |       |
| H      | 14.61       | 15.88 | .575     | .625 | 4     |
| L      | 1.78        | 2.79  | .070     | .110 |       |
| L1     | —           | 1.65  | —        | .066 |       |
| L2     | —           | 1.78  | —        | .070 |       |
| L3     | 0.25 BSC    |       | .010 BSC |      |       |
| L4     | 4.78        | 5.28  | .188     | .208 |       |

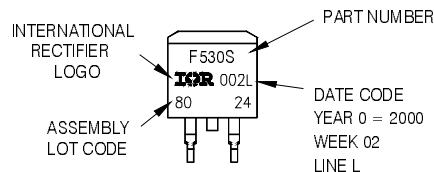
### NOTES:

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 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.

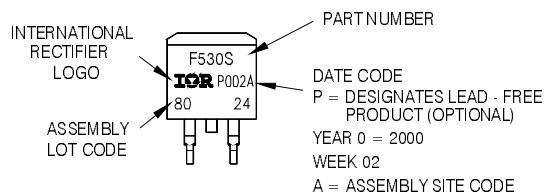
## D<sup>2</sup>Pak Part Marking Information

EXAMPLE: THIS IS AN IRF530S WITH  
LOT CODE 8024  
ASSEMBLED ON WW 02, 2000  
IN THE ASSEMBLY LINE 'L'

Note: "P" in assembly line position  
indicates "Lead - Free"

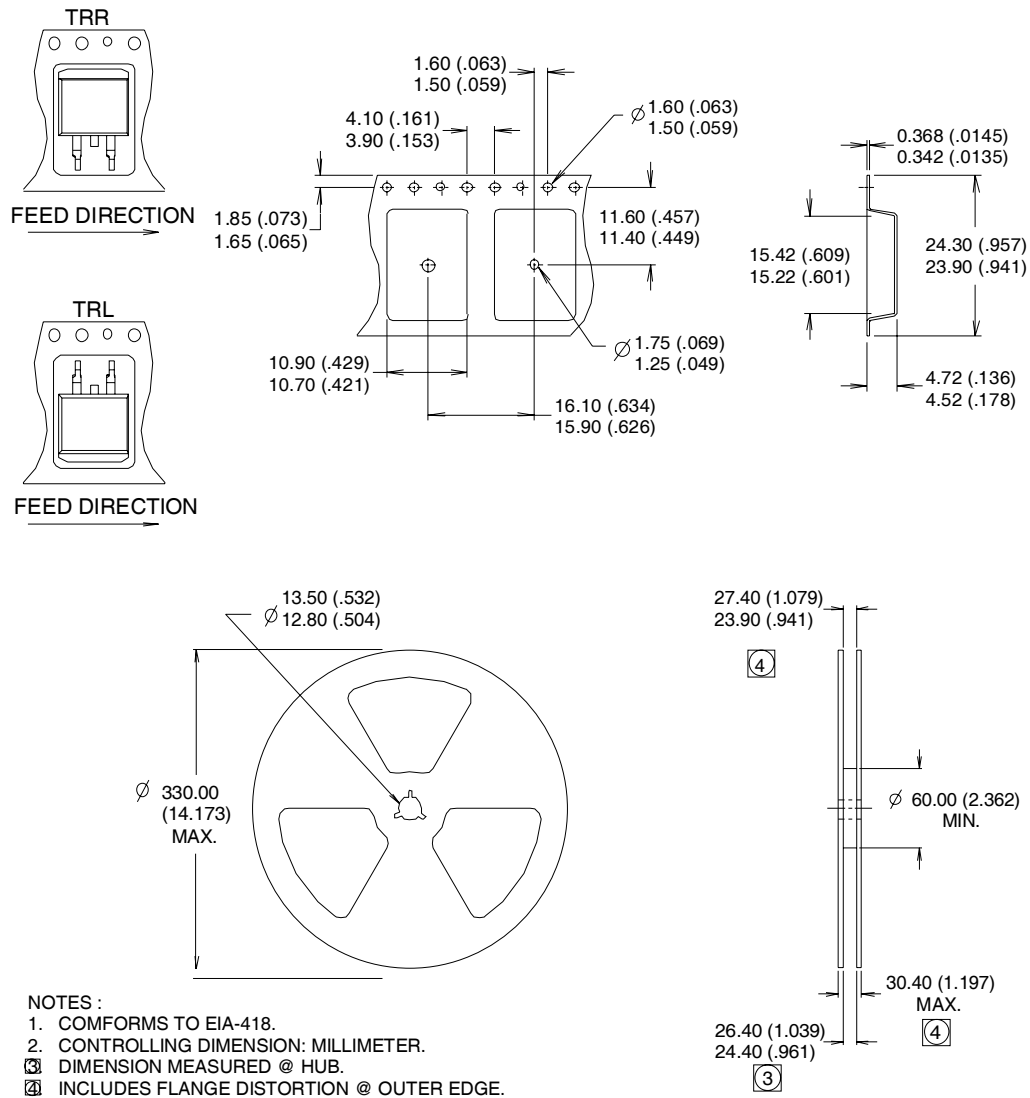


OR



Note: For the most current drawing please refer to IR website at: <http://www.irf.com/package/>

## D<sup>2</sup>Pak Tape & Reel Information



### Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.37\text{mH}$ ,  $R_G = 25\Omega$ ,  $I_{AS} = 26\text{A}$ .
- ③ Pulse width  $\leq 400\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- ④  $R_\theta$  is measured at  $T_J$  of approximately  $90^\circ\text{C}$ .
- ⑤ Half sine wave with duty cycle = 0.25,  $t_{on} = 1\mu\text{sec}$ .

**Note:** For the most current drawing please refer to IR website at: <http://www.irf.com/package/>

Data and specifications subject to change without notice.  
This product has been designed and qualified for the Industrial market.  
Qualification Standards can be found on IR's Web site.

International  
**IR** Rectifier

**IR WORLD HEADQUARTERS:** 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105  
TAC Fax: (310) 252-7903

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## WARNINGS

Due to technical requirements products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office.

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