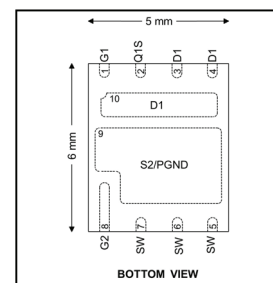
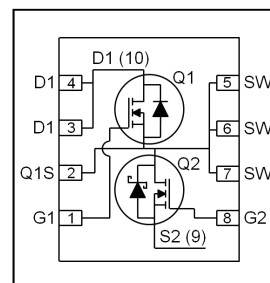


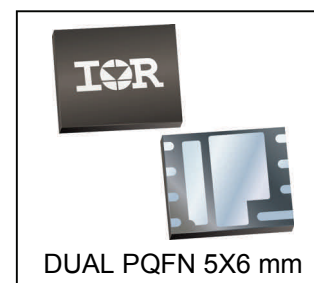
HEXFET® Power MOSFET

|                                           | Q1   | Q2   |    |
|-------------------------------------------|------|------|----|
| $V_{DS}$                                  | 25   | 25   | V  |
| $R_{DS(on)} \max$<br>(@ $V_{GS} = 4.5V$ ) | 4.60 | 1.45 | mΩ |
| $Q_g$ (typical)                           | 10   | 31   | nC |
| $I_D$<br>(@ $T_C = 25^\circ C$ )          | 35⑦  | 35⑦  | A  |



### Applications

- Control and Synchronous MOSFETs for synchronous buck converters



### Features

|                                                         |
|---------------------------------------------------------|
| Control and synchronous MOSFETs in one package          |
| Low charge control MOSFET (10nC typical)                |
| Low $R_{DS(on)}$ synchronous MOSFET (<1.45mΩ)           |
| Intrinsic Schottky Diode with Low Forward Voltage on Q2 |
| RoHS Compliant, Halogen-Free                            |
| MSL1, Industrial Qualification                          |

results in



### Benefits

|                            |
|----------------------------|
| Increased power density    |
| Lower switching losses     |
| Lower conduction losses    |
| Lower Switching Losses     |
| Environmentally friendlier |
| Increased reliability      |

| Base part number | Package Type        | Standard Pack |          | Orderable Part Number |
|------------------|---------------------|---------------|----------|-----------------------|
|                  |                     | Form          | Quantity |                       |
| IRFH4253DPbF     | Dual PQFN 5mm x 6mm | Tape and Reel | 4000     | IRFH4253DTRPbF        |

### Absolute Maximum Ratings

|                          | Parameter                                                                        | Q1 Max.      | Q2 Max. | Units |
|--------------------------|----------------------------------------------------------------------------------|--------------|---------|-------|
| $V_{GS}$                 | Gate-to-Source Voltage                                                           | $\pm 20$     |         | V     |
| $I_D @ T_C = 25^\circ C$ | Continuous Drain Current, $V_{GS} @ 4.5V$                                        | 64⑥⑦         | 145⑥⑦   | A     |
| $I_D @ T_C = 70^\circ C$ | Continuous Drain Current, $V_{GS} @ 4.5V$                                        | 51⑥⑦         | 116⑥⑦   |       |
| $I_D @ T_C = 25^\circ C$ | Continuous Drain Current, $V_{GS} @ 4.5V$<br>(Source Bonding Technology Limited) | 35⑦          | 35⑦     |       |
| $I_{DM}$                 | Pulsed Drain Current                                                             | 120          | 580⑧    | W     |
| $P_D @ T_C = 25^\circ C$ | Power Dissipation                                                                | 31           | 50      |       |
| $P_D @ T_C = 70^\circ C$ | Power Dissipation                                                                | 20           | 32      |       |
|                          | Linear Derating Factor                                                           | 0.25         | 0.40    | W/°C  |
| $T_J$<br>$T_{STG}$       | Operating Junction and<br>Storage Temperature Range                              | -55 to + 150 |         | °C    |

### Thermal Resistance

|                          | Parameter             | Q1 Max. | Q2 Max. | Units |
|--------------------------|-----------------------|---------|---------|-------|
| $R_{\theta JC}$ (Bottom) | Junction-to-Case ④    | 4.0     | 2.5     | °C/W  |
| $R_{\theta JC}$ (Top)    | Junction-to-Case ④    | 20      | 13      |       |
| $R_{\theta JA}$          | Junction-to-Ambient ⑤ | 34      | 38      |       |
| $R_{\theta JA} (<10s)$   | Junction-to-Ambient ⑤ | 24      | 24      |       |

Notes ① through ⑧ are on page 12

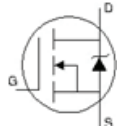
**Static @ T<sub>J</sub> = 25°C (unless otherwise specified)**

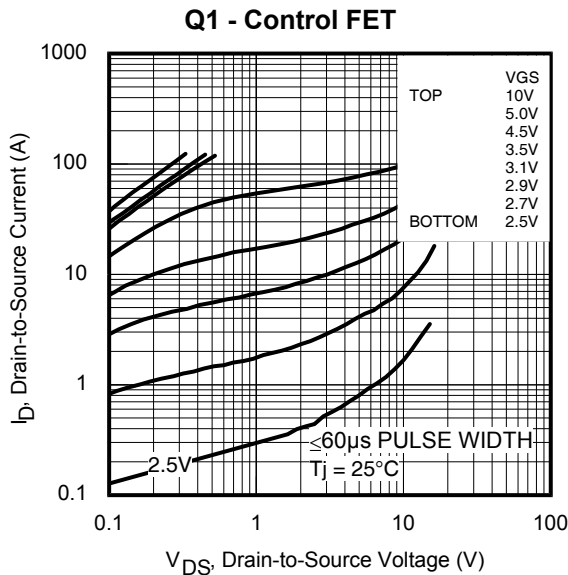
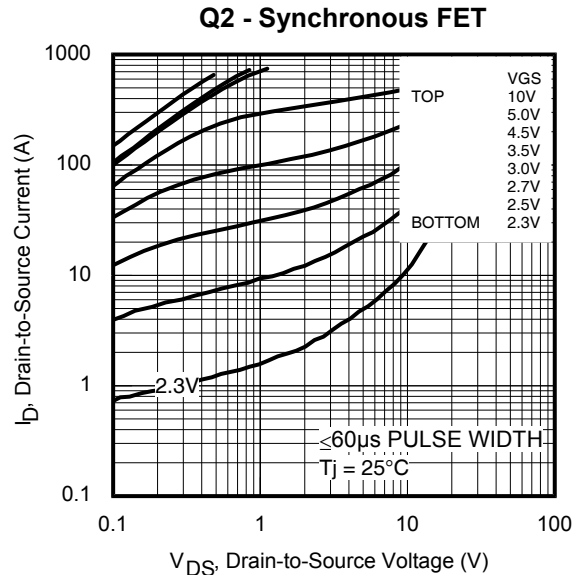
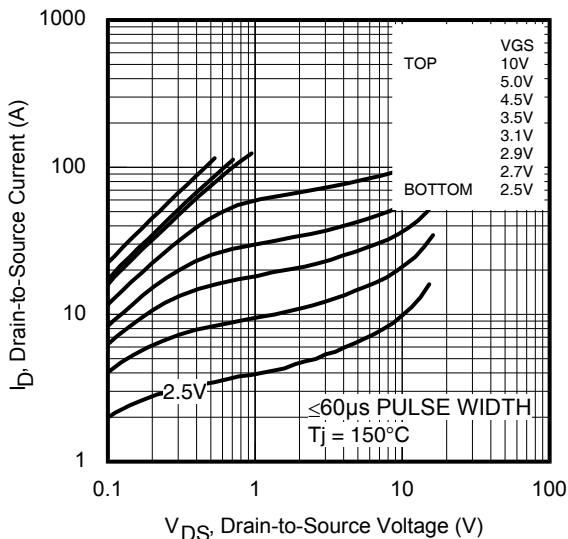
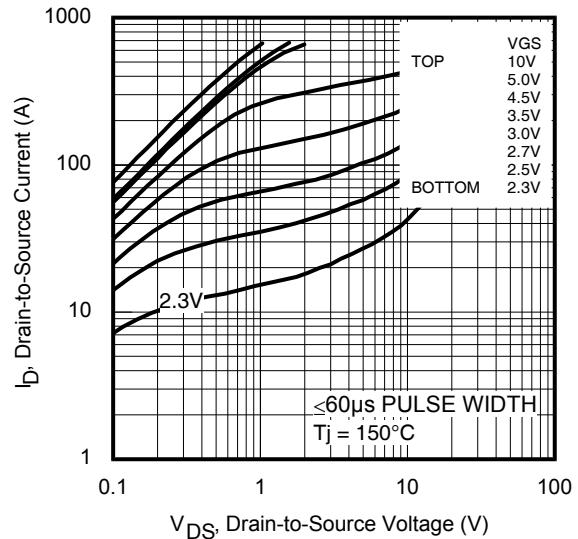
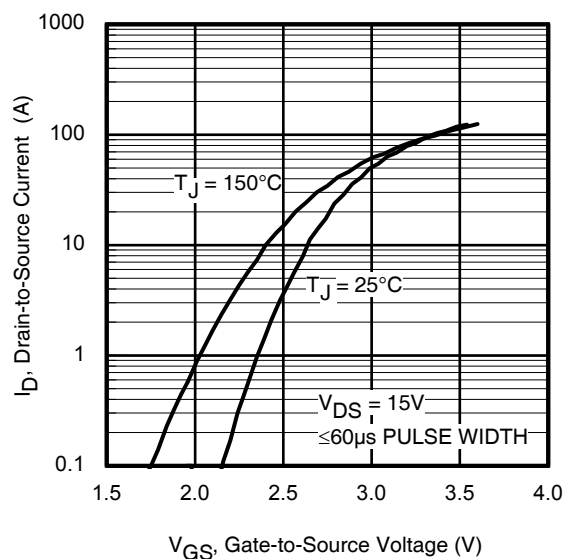
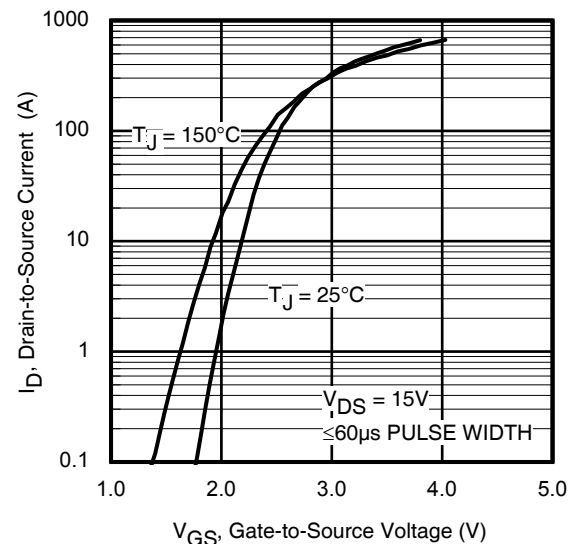
|                                       | Parameter                                           |       | Min. | Typ. | Max. | Units | Conditions                                                                                                                                                                                                 |
|---------------------------------------|-----------------------------------------------------|-------|------|------|------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| BV <sub>DSS</sub>                     | Drain-to-Source Breakdown Voltage                   | Q1    | 25   | —    | —    | V     | V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA                                                                                                                                                               |
|                                       |                                                     | Q2    | 25   | —    | —    |       | V <sub>GS</sub> = 0V, I <sub>D</sub> = 1.0mA                                                                                                                                                               |
| ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>   | Breakdown Voltage Temp. Coefficient                 | Q1    | —    | 22   | —    | mV/°C | Reference to 25°C, I <sub>D</sub> = 1.0mA                                                                                                                                                                  |
|                                       |                                                     | Q2    | —    | 22   | —    |       | Reference to 25°C, I <sub>D</sub> = 10mA                                                                                                                                                                   |
| R <sub>DS(on)</sub>                   | Static Drain-to-Source On-Resistance                | Q1    | —    | 2.50 | 3.20 | mΩ    | V <sub>GS</sub> = 10V, I <sub>D</sub> = 30A ③                                                                                                                                                              |
|                                       |                                                     | Q2    | —    | 0.90 | 1.10 |       | V <sub>GS</sub> = 10V, I <sub>D</sub> = 30A ③                                                                                                                                                              |
|                                       |                                                     | Q1    | —    | 3.70 | 4.60 |       | V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 30A ③                                                                                                                                                             |
|                                       |                                                     | Q2    | —    | 1.15 | 1.45 |       | V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 30A ③                                                                                                                                                             |
| V <sub>GS(th)</sub>                   | Gate Threshold Voltage                              | Q1    | 1.1  | 1.6  | 2.1  | V     | Q1: V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 35μA                                                                                                                                              |
|                                       |                                                     | Q2    | 1.1  | 1.6  | 2.1  |       | Q2: V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 100μA                                                                                                                                             |
| ΔV <sub>GS(th)</sub> /ΔT <sub>J</sub> | Gate Threshold Voltage Coefficient                  | Q1    | —    | -5.7 | —    | mV/°C | Q1: V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 35μA                                                                                                                                              |
|                                       |                                                     | Q2    | —    | -8.9 | —    |       | Q2: V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 100μA                                                                                                                                             |
| I <sub>DSS</sub>                      | Drain-to-Source Leakage Current                     | Q1    | —    | —    | 1.0  | μA    | V <sub>DS</sub> = 20V, V <sub>GS</sub> = 0V                                                                                                                                                                |
|                                       |                                                     | Q2    | —    | —    | 250  |       | V <sub>DS</sub> = 20V, V <sub>GS</sub> = 0V                                                                                                                                                                |
| I <sub>GSS</sub>                      | Gate-to-Source Forward Leakage                      | Q1/Q2 | —    | —    | 100  | nA    | V <sub>GS</sub> = 20V                                                                                                                                                                                      |
|                                       | Gate-to-Source Reverse Leakage                      | Q1/Q2 | —    | —    | -100 |       | V <sub>GS</sub> = -20V                                                                                                                                                                                     |
| g <sub>fs</sub>                       | Forward Transconductance                            | Q1    | 131  | —    | —    | S     | V <sub>DS</sub> = 10V, I <sub>D</sub> = 30A                                                                                                                                                                |
|                                       |                                                     | Q2    | 164  | —    | —    |       | V <sub>DS</sub> = 10V, I <sub>D</sub> = 30A                                                                                                                                                                |
| Q <sub>g</sub>                        | Total Gate Charge                                   | Q1    | —    | 10   | 15   | nC    | Q1<br>V <sub>DS</sub> = 13V<br>V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 30A<br><br>Q2<br>V <sub>DS</sub> = 13V<br>V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 30A                                             |
|                                       |                                                     | Q2    | —    | 31   | 47   |       |                                                                                                                                                                                                            |
| Q <sub>gs1</sub>                      | Pre-V <sub>th</sub> Gate-to-Source Charge           | Q1    | —    | 2.5  | —    |       |                                                                                                                                                                                                            |
|                                       |                                                     | Q2    | —    | 4.9  | —    |       |                                                                                                                                                                                                            |
| Q <sub>gs2</sub>                      | Post-V <sub>th</sub> Gate-to-Source Charge          | Q1    | —    | 1.6  | —    |       |                                                                                                                                                                                                            |
|                                       |                                                     | Q2    | —    | 5.4  | —    |       |                                                                                                                                                                                                            |
| Q <sub>gd</sub>                       | Gate-to-Drain Charge                                | Q1    | —    | 3.8  | —    |       |                                                                                                                                                                                                            |
|                                       |                                                     | Q2    | —    | 12   | —    |       |                                                                                                                                                                                                            |
| Q <sub>godr</sub>                     | Gate Charge Overdrive                               | Q1    | —    | 2.1  | —    |       |                                                                                                                                                                                                            |
|                                       |                                                     | Q2    | —    | 8.7  | —    |       |                                                                                                                                                                                                            |
| Q <sub>sw</sub>                       | Switch Charge (Q <sub>gs2</sub> + Q <sub>gd</sub> ) | Q1    | —    | 5.4  | —    |       |                                                                                                                                                                                                            |
|                                       |                                                     | Q2    | —    | 17.4 | —    |       |                                                                                                                                                                                                            |
| Q <sub>oss</sub>                      | Output Charge                                       | Q1    | —    | 10   | —    | nC    | V <sub>DS</sub> = 16V, V <sub>GS</sub> = 0V                                                                                                                                                                |
|                                       |                                                     | Q2    | —    | 31   | —    |       |                                                                                                                                                                                                            |
| R <sub>G</sub>                        | Gate Resistance                                     | Q1    | —    | 2.4  | —    | Ω     |                                                                                                                                                                                                            |
|                                       |                                                     | Q2    | —    | 1.1  | —    |       |                                                                                                                                                                                                            |
| t <sub>d(on)</sub>                    | Turn-On Delay Time                                  | Q1    | —    | 10   | —    | ns    | Q1<br>V <sub>DS</sub> = 13V V <sub>GS</sub> = 4.5V<br>I <sub>D</sub> = 30A, R <sub>G</sub> = 1.8Ω<br><br>Q2<br>V <sub>DS</sub> = 13V V <sub>GS</sub> = 4.5V<br>I <sub>D</sub> = 30A, R <sub>G</sub> = 1.8Ω |
|                                       |                                                     | Q2    | —    | 16   | —    |       |                                                                                                                                                                                                            |
| t <sub>r</sub>                        | Rise Time                                           | Q1    | —    | 61   | —    |       |                                                                                                                                                                                                            |
|                                       |                                                     | Q2    | —    | 98   | —    |       |                                                                                                                                                                                                            |
| t <sub>d(off)</sub>                   | Turn-Off Delay Time                                 | Q1    | —    | 13   | —    |       |                                                                                                                                                                                                            |
|                                       |                                                     | Q2    | —    | 26   | —    |       |                                                                                                                                                                                                            |
| t <sub>f</sub>                        | Fall Time                                           | Q1    | —    | 15   | —    |       |                                                                                                                                                                                                            |
|                                       |                                                     | Q2    | —    | 65   | —    |       |                                                                                                                                                                                                            |
| C <sub>iss</sub>                      | Input Capacitance                                   | Q1    | —    | 1314 | —    | pF    | V <sub>GS</sub> = 0V<br>V <sub>DS</sub> = 13V<br>f = 1.0MHz                                                                                                                                                |
|                                       |                                                     | Q2    | —    | 3756 | —    |       |                                                                                                                                                                                                            |
| C <sub>oss</sub>                      | Output Capacitance                                  | Q1    | —    | 365  | —    |       |                                                                                                                                                                                                            |
|                                       |                                                     | Q2    | —    | 1205 | —    |       |                                                                                                                                                                                                            |
| C <sub>rss</sub>                      | Reverse Transfer Capacitance                        | Q1    | —    | 92   | —    |       |                                                                                                                                                                                                            |
|                                       |                                                     | Q2    | —    | 286  | —    |       |                                                                                                                                                                                                            |

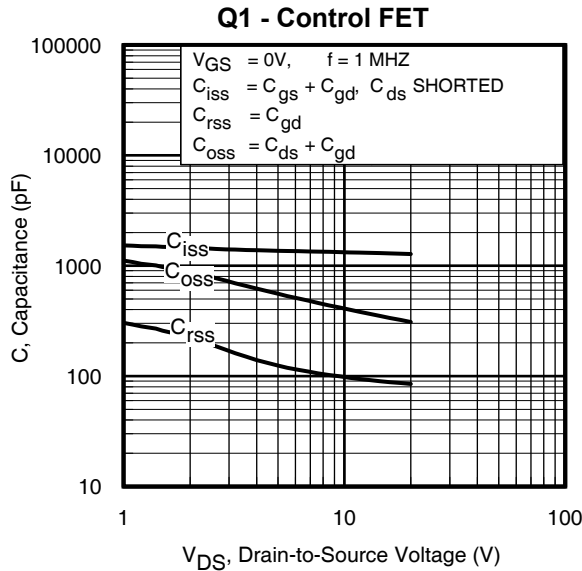
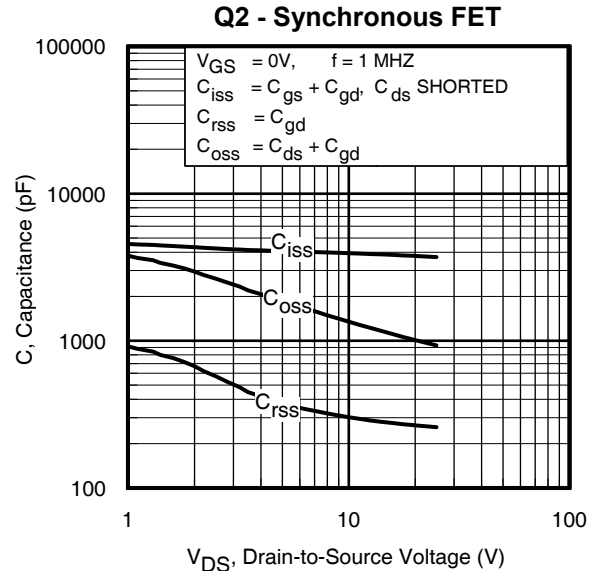
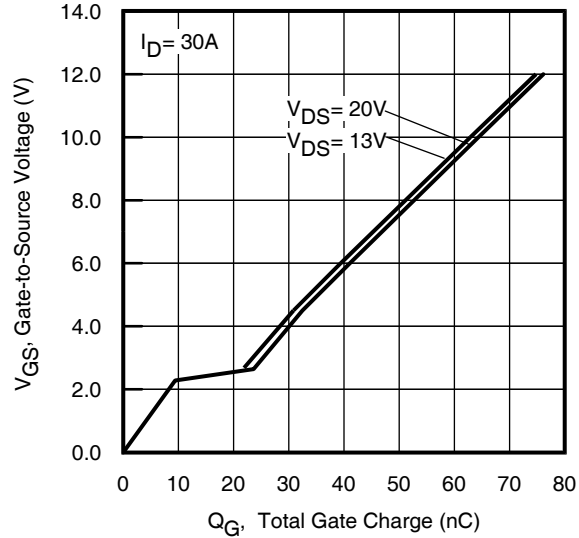
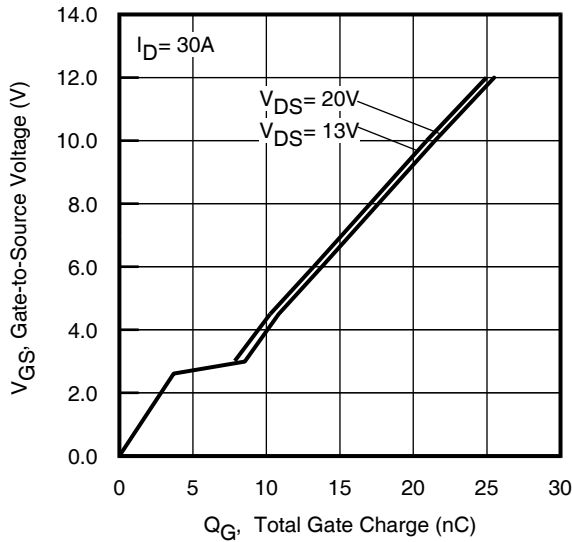
### Avalanche Characteristics

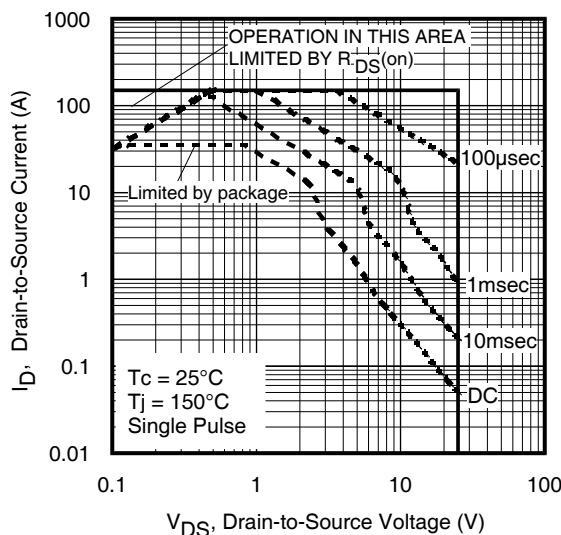
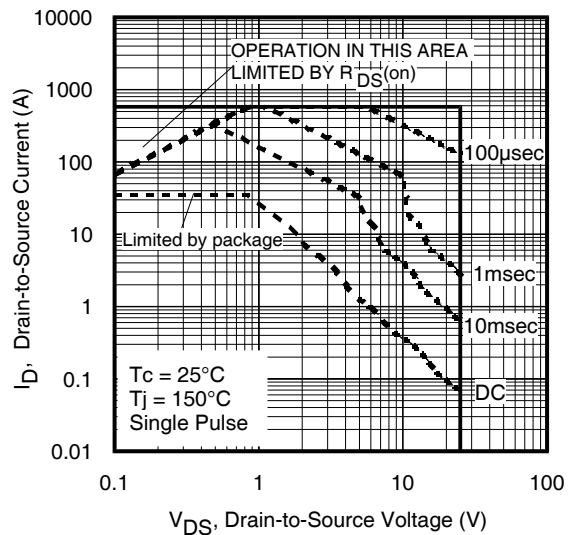
|          | Parameter                       | Typ. | Q1 Max. | Q2 Max. | Units |
|----------|---------------------------------|------|---------|---------|-------|
| $E_{AS}$ | Single Pulse Avalanche Energy ② | —    | 61      | 568     | mJ    |
| $I_{AR}$ | Avalanche Current ①             | —    | 30      | 60      | A     |

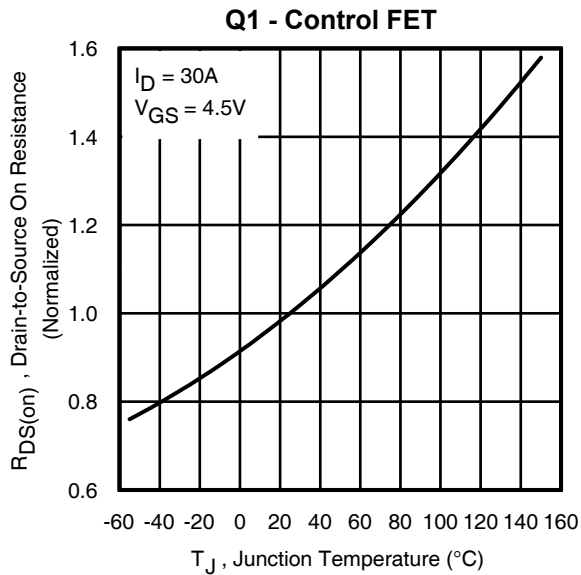
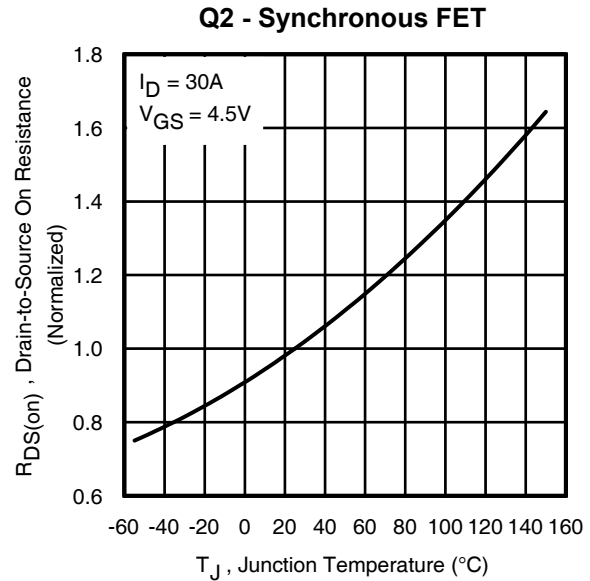
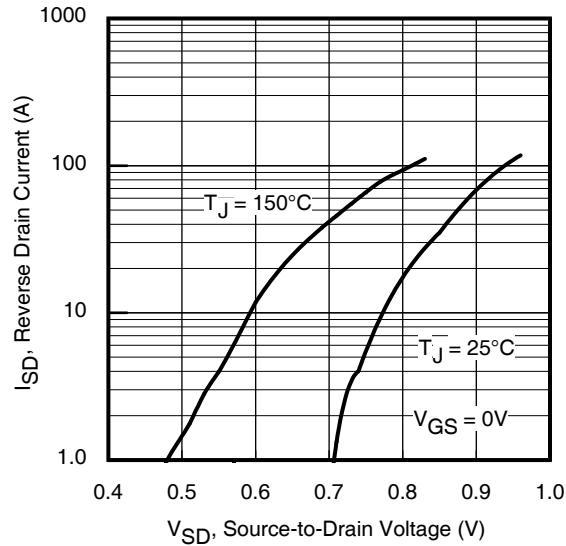
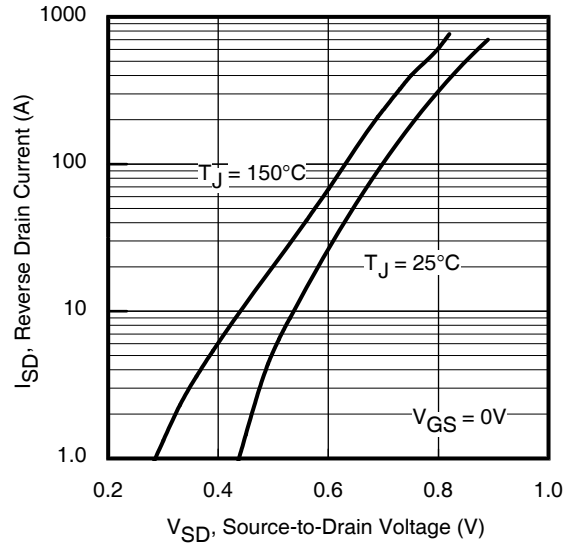
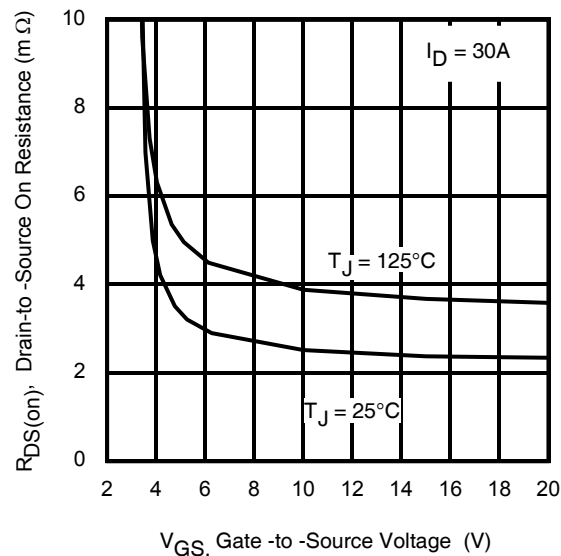
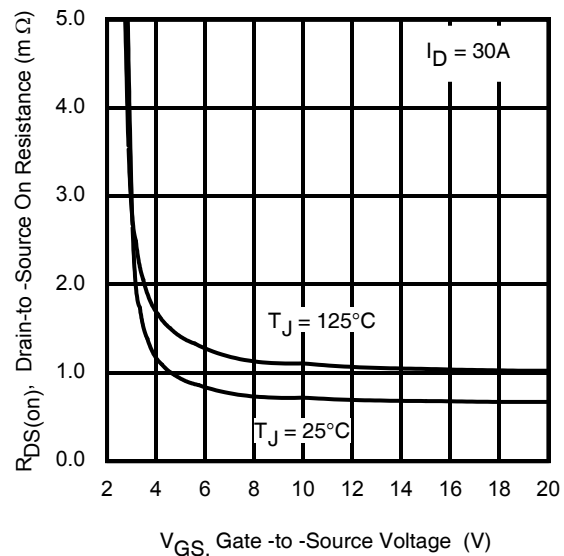
### Diode Characteristics

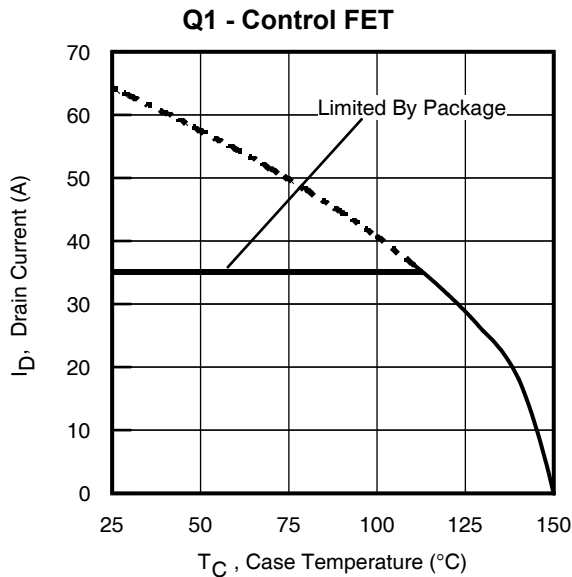
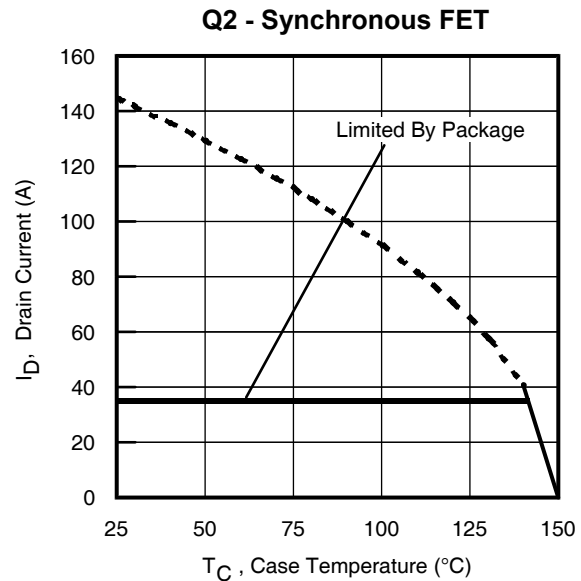
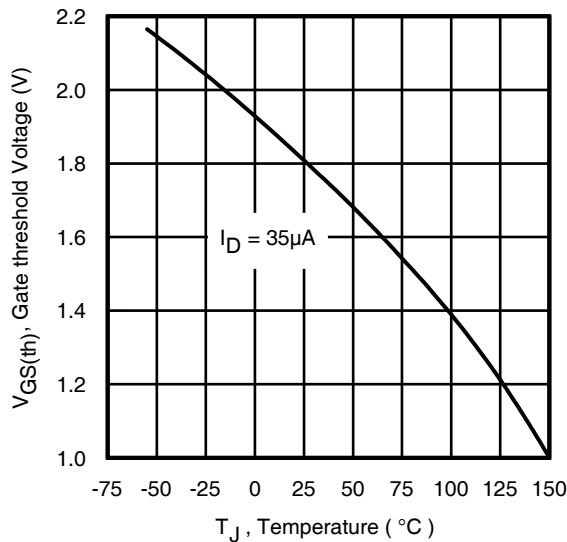
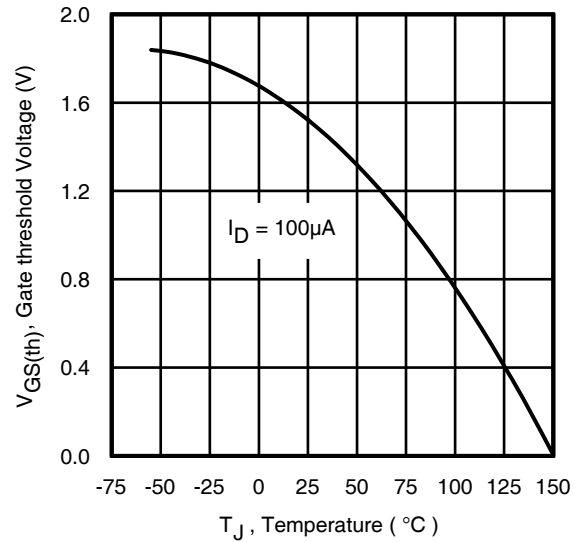
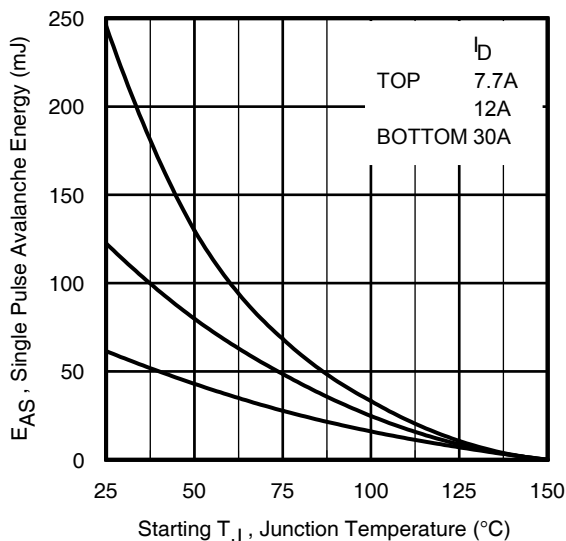
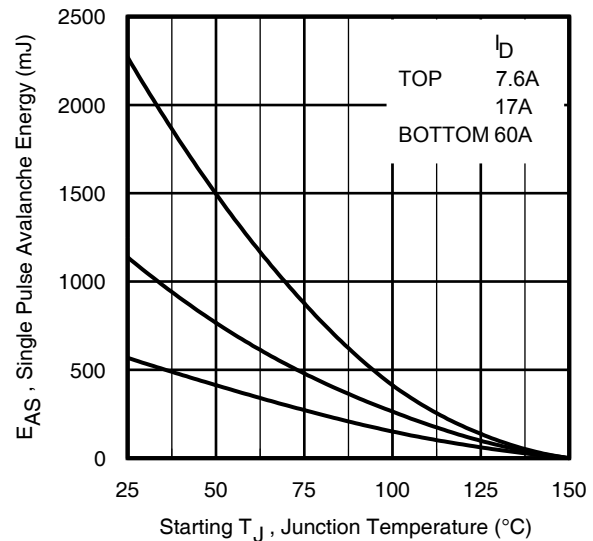
|          | Parameter                                 |    | Min. | Typ. | Max. | Units | Conditions                                                                                                                                         |
|----------|-------------------------------------------|----|------|------|------|-------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| $I_S$    | Continuous Source Current<br>(Body Diode) | Q1 | —    | —    | 35⑦  | A     | MOSFET symbol showing the integral reverse p-n junction diode.  |
|          |                                           | Q2 | —    | —    | 35⑦  |       |                                                                                                                                                    |
| $I_{SM}$ | Pulsed Source Current<br>(Body Diode)     | Q1 | —    | —    | 120  | A     | $T_J = 25^\circ\text{C}$ , $I_S = 30\text{A}$ , $V_{GS} = 0\text{V}$ ③                                                                             |
|          |                                           | Q2 | —    | —    | 580⑧ |       |                                                                                                                                                    |
| $V_{SD}$ | Diode Forward Voltage                     | Q1 | —    | —    | 1.0  | V     | $T_J = 25^\circ\text{C}$ , $I_S = 30\text{A}$ , $V_{GS} = 0\text{V}$ ③                                                                             |
|          |                                           | Q2 | —    | —    | 0.75 |       | $T_J = 25^\circ\text{C}$ , $I_S = 30\text{A}$ , $V_{GS} = 0\text{V}$ ③                                                                             |
| $t_{rr}$ | Reverse Recovery Time                     | Q1 | —    | 16   | —    | ns    | $T_J = 25^\circ\text{C}$ , $I_F = 30\text{A}$<br>$V_{DD} = 13\text{V}$ , $di/dt = 235\text{A}/\mu\text{s}$ ③                                       |
|          |                                           | Q2 | —    | 29   | —    |       |                                                                                                                                                    |
| $Q_{rr}$ | Reverse Recovery Charge                   | Q1 | —    | 13   | —    | nC    | $T_J = 25^\circ\text{C}$ , $I_F = 30\text{A}$<br>$V_{DD} = 13\text{V}$ , $di/dt = 250\text{A}/\mu\text{s}$ ③                                       |
|          |                                           | Q2 | —    | 41   | —    |       |                                                                                                                                                    |

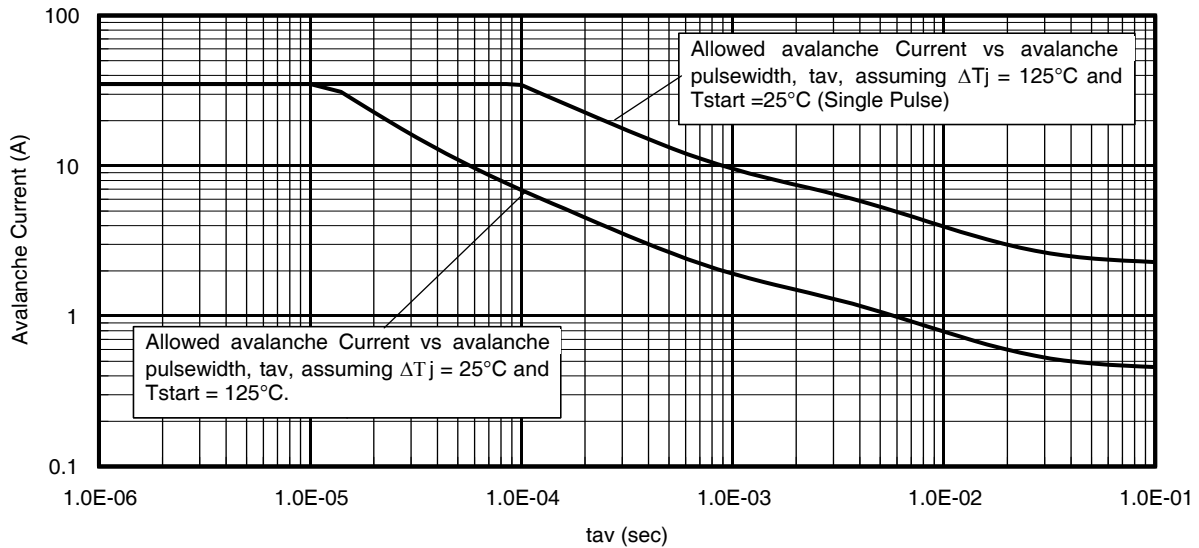
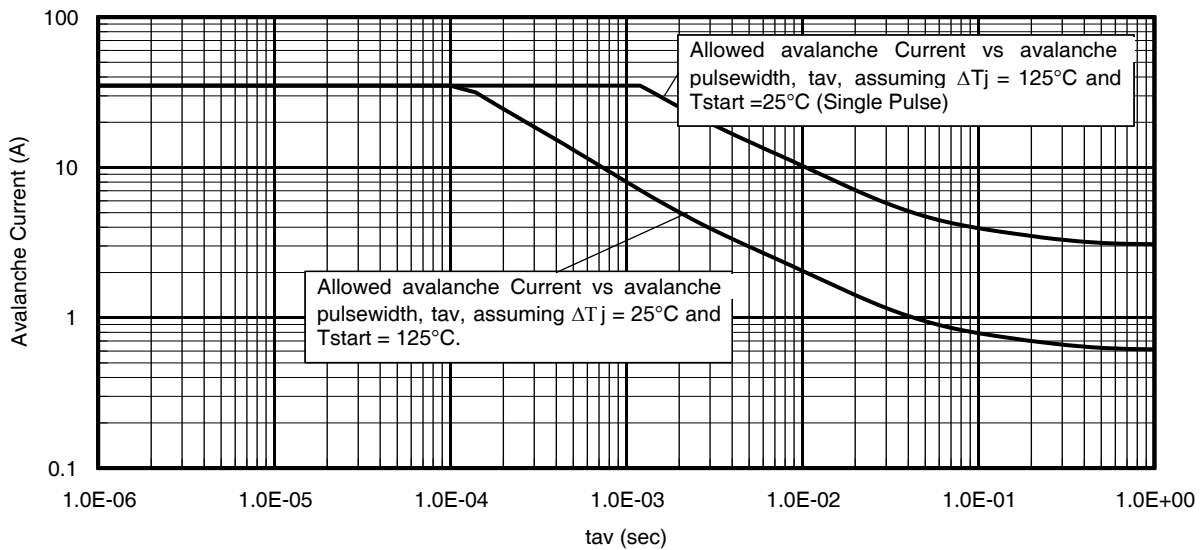
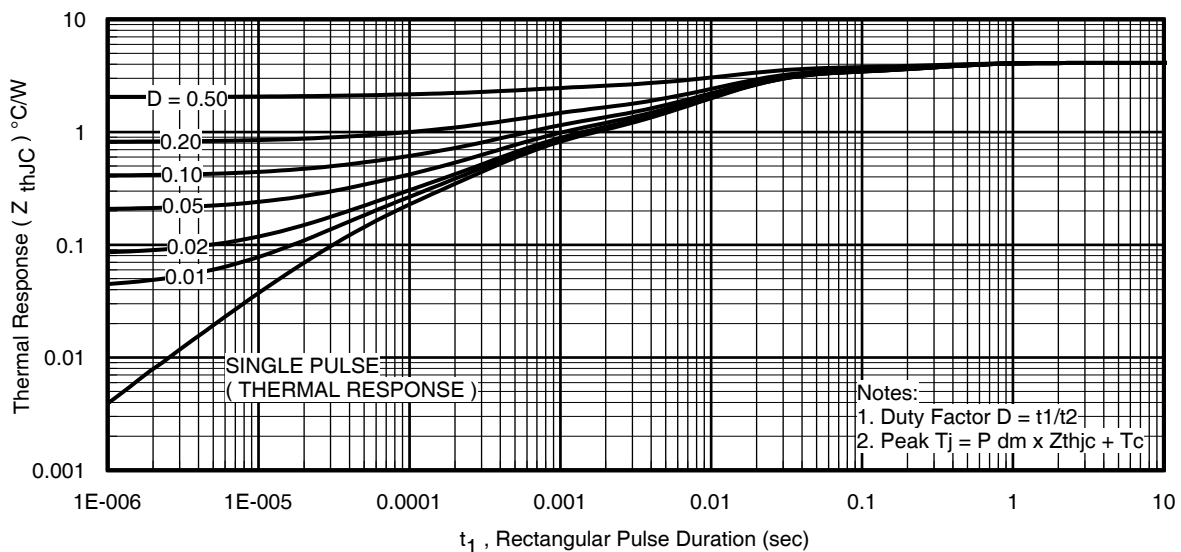

**Fig 1.** Typical Output Characteristics

**Fig 2.** Typical Output Characteristics

**Fig 3.** Typical Output Characteristics

**Fig 4.** Typical Output Characteristics

**Fig 5.** Typical Transfer Characteristics

**Fig 6.** Typical Transfer Characteristics

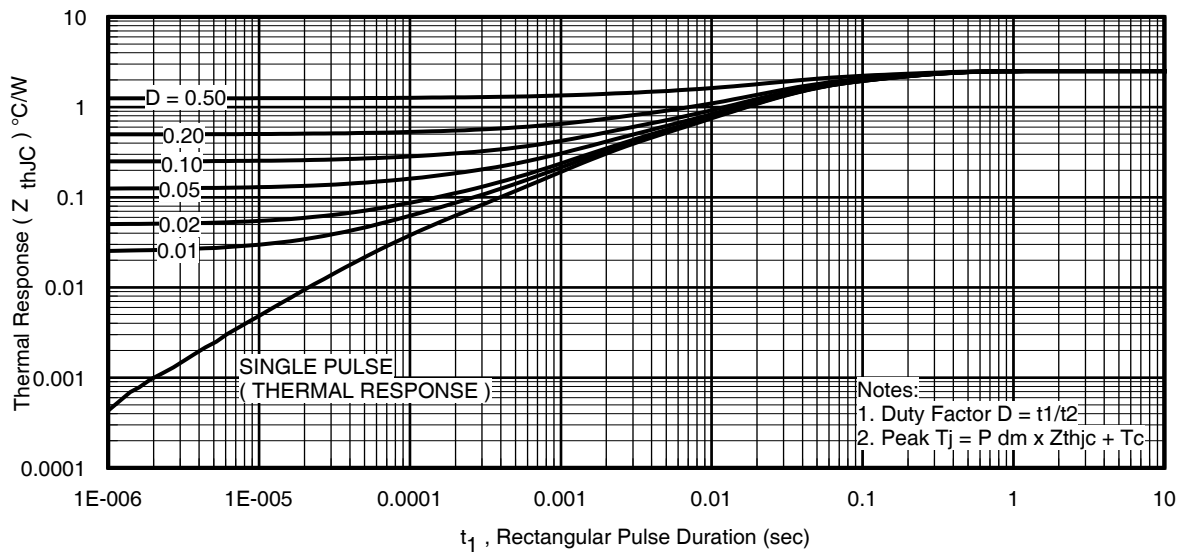

**Fig 7.** Typical Capacitance vs. Drain-to-Source Voltage

**Fig 8.** Typical Capacitance vs. Drain-to-Source Voltage

**Fig 9.** Typical Gate Charge vs. Gate-to-Source Voltage

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

**Fig 11.** Maximum Safe Operating Area

**Fig 12.** Maximum Safe Operating Area

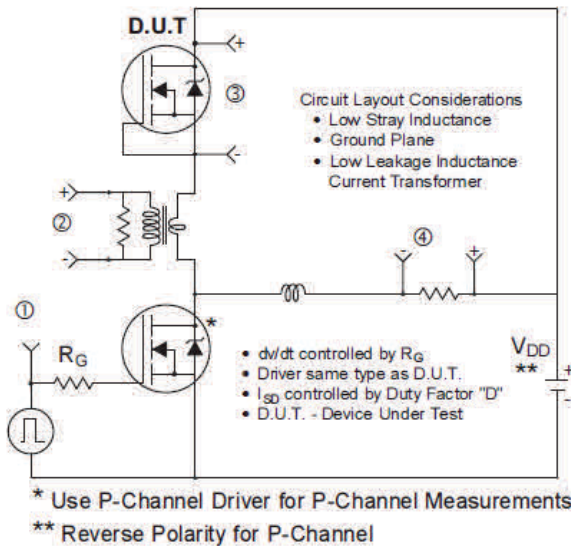

**Fig 13.** Normalized On-Resistance vs. Temperature

**Fig 14.** Normalized On-Resistance vs. Temperature

**Fig 15.** Typical Source-Drain Diode Forward Voltage

**Fig 16.** Typical Source-Drain Diode Forward Voltage

**Fig 17.** Typical On-Resistance vs. Gate Voltage

**Fig 18.** Typical On-Resistance vs. Gate Voltage


**Fig 19.** Maximum Drain Current vs. Case Temperature

**Fig 20.** Maximum Drain Current vs. Case Temperature

**Fig 21.** Threshold Voltage vs. Temperature

**Fig 22.** Threshold Voltage vs. Temperature

**Fig 23.** Maximum Avalanche Energy vs. Drain Current

**Fig 24.** Maximum Avalanche Energy vs. Drain Current

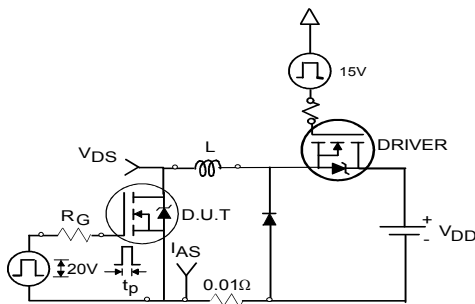
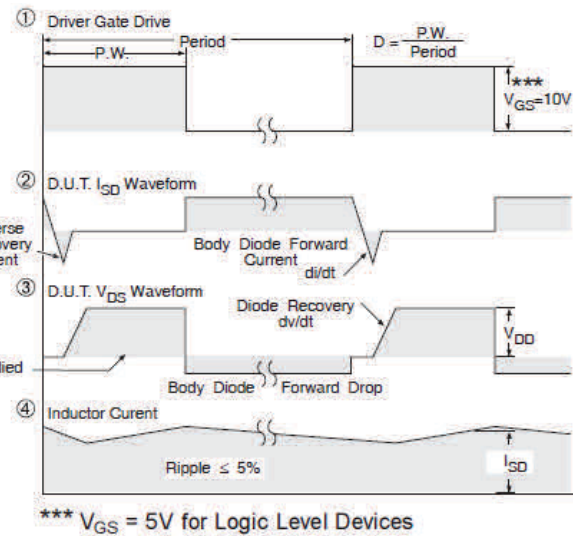

**Fig 25. Max Avalanche Current vs. Pulse Width (Q1)**

**Fig 26. Max Avalanche Current vs. Pulse Width (Q2)**

**Fig 27. Maximum Effective Transient Thermal Impedance, Junction-to-Case (Q1)**



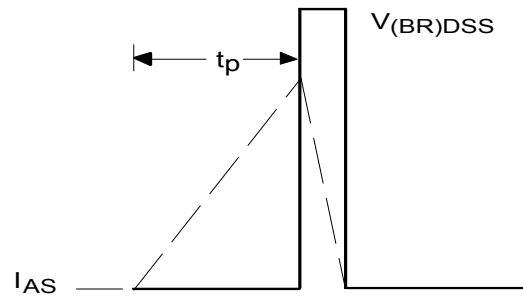
**Fig 28.** Maximum Effective Transient Thermal Impedance, Junction-to-Case (Q2)



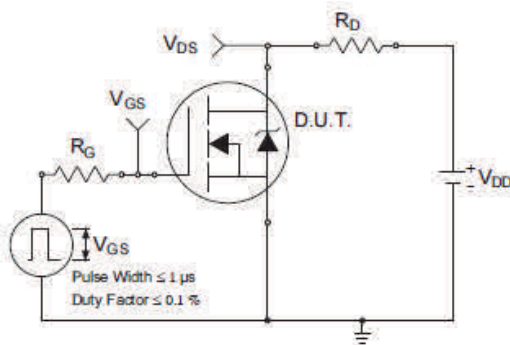
**Fig 29. Peak Diode Recovery  $dv/dt$  Test Circuit for N-Channel HEXFET® Power MOSFETs**



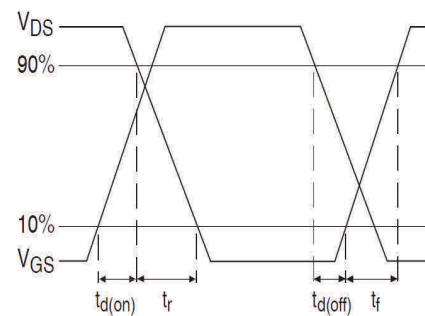
**Fig 30a. Unclamped Inductive Test Circuit**



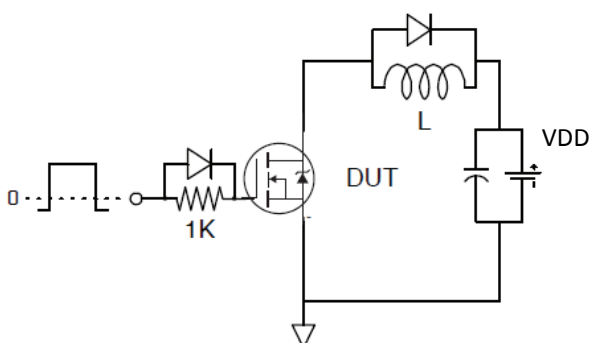
**Fig 30b. Unclamped Inductive Waveforms**



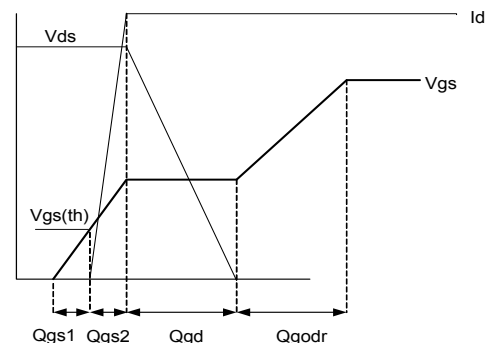
**Fig 31a. Switching Time Test Circuit**



**Fig 31b. Switching Time Waveforms**

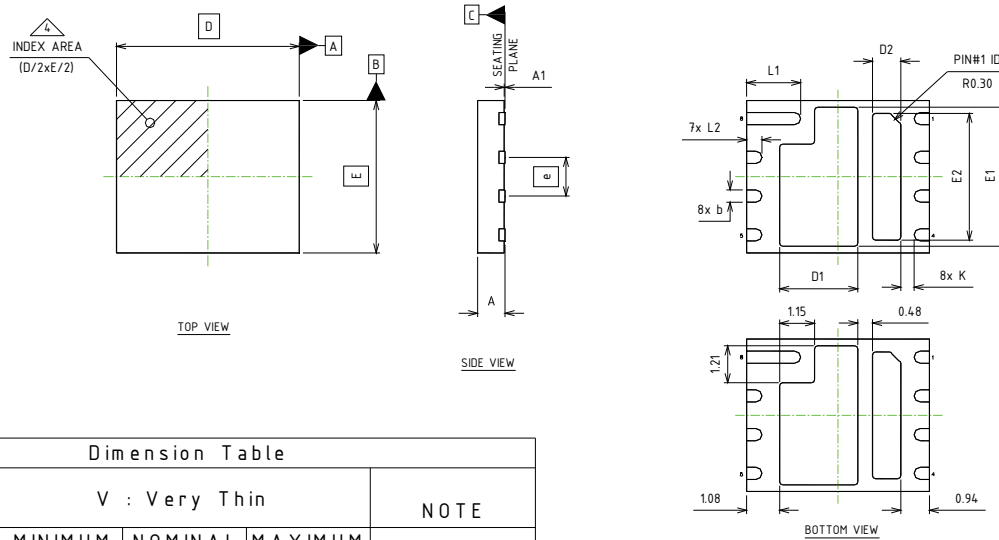


**Fig 32a. Gate Charge Test Circuit**



**Fig 32b. Gate Charge Waveform**

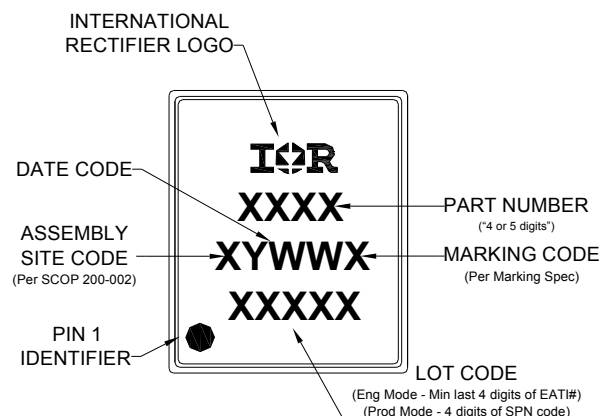
## Dual PQFN 5x6 Outline "H" Package Details



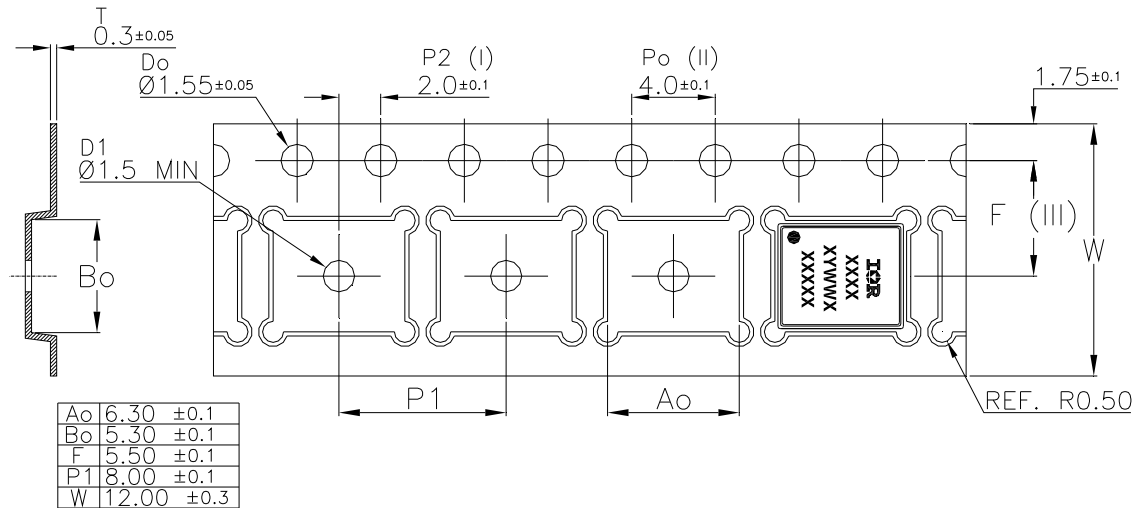
| Dimension Table     |               |         |         |      |
|---------------------|---------------|---------|---------|------|
| Thickness<br>Symbol | V : Very Thin |         |         | NOTE |
|                     | MINIMUM       | NOMINAL | MAXIMUM |      |
| A                   | 0.80          | 0.90    | 1.00    |      |
| A1                  | 0.00          | 0.02    | 0.05    |      |
| b                   | 0.30          | 0.40    | 0.50    | 6    |
| D                   | 6.00 BSC      |         |         |      |
| E                   | 5.00 BSC      |         |         |      |
| e                   | 1.27 BSC      |         |         |      |
| D1                  | 2.42          | 2.57    | 2.67    |      |
| E1                  | 4.41          | 4.56    | 4.66    |      |
| D2                  | 0.78          | 0.93    | 1.03    |      |
| E2                  | 4.01          | 4.16    | 4.26    |      |
| K                   | 0.20          | ---     | ---     |      |
| L1                  | 1.67          | 1.77    | 1.87    |      |
| L2                  | 0.40          | 0.50    | 0.60    |      |

For more information on board mounting, including footprint and stencil recommendation, please refer to application note AN-1136: <http://www.irf.com/technical-info/appnotes/an-1136.pdf>  
 For more information on package inspection techniques, please refer to application note AN-1154: <http://www.irf.com/technical-info/appnotes/an-1154.pdf>

## PQFN 5x6 Outline "H" Part Marking



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

**Dual PQFN 5x6 Outline Tape and Reel**


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

**Qualification Information<sup>†</sup>**

| Qualification level        | Industrial<br>(per JEDEC JESD47F <sup>††</sup> guidelines ) |                                               |
|----------------------------|-------------------------------------------------------------|-----------------------------------------------|
| Moisture Sensitivity Level | DUAL PQFN 5mm x 6mm                                         | MSL1<br>(per JEDEC J-STD-020D <sup>††</sup> ) |
| RoHS Compliant             | Yes                                                         |                                               |

<sup>†</sup> Qualification standards can be found at International Rectifier's web site <http://www.irf.com/product-info/reliability>

<sup>††</sup> Applicable version of JEDEC standard at the time of product release.

**Notes:**

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting  $T_J = 25^{\circ}\text{C}$ ,  
Q1:  $L = 0.14\text{mH}$ ,  $R_G = 50\Omega$ ,  $I_{AS} = 30\text{A}$ ;  
Q2:  $L = 0.32\text{mH}$ ,  $R_G = 50\Omega$ ,  $I_{AS} = 60\text{A}$ .
- ③ Pulse width  $\leq 400\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- ④  $R_{\theta}$  is measured at  $T_J$  approximately  $90^{\circ}\text{C}$ .
- ⑤ When mounted on 1 inch square PCB (FR-4). Please refer to AN-994 for more details:  
<http://www.irf.com/technical-info/appnotes/an-994.pdf>
- ⑥ Calculated continuous current based on maximum allowable junction temperature.
- ⑦ Current is limited to Q1 = 35A & Q2 = 35A by source bonding technology.
- ⑧ Pulsed drain current is limited to 140A by source bonding technology.

# Revision History

| Date       | Comments                                                                                                                                                                                                                |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 08/06/2013 | <ul style="list-style-type: none"> <li>Added the Fast/RFET logo, on page 1.</li> <li>Changed the package limitation current from 45A to 35A, on page 1.</li> <li>Added the part marking drawing, on page 11.</li> </ul> |
| 01/16/2014 | <ul style="list-style-type: none"> <li>Updated the MSL level from MSL2 to MSL1, on page 1 &amp; 12.</li> </ul>                                                                                                          |
| 05/21/2014 | <ul style="list-style-type: none"> <li>Updated fig. 25 to show the max avalanche plateau at 35A, on page 8.</li> <li>Corrected fig. 26 to cap the curves at package limitation current of 35A, on page 8.</li> </ul>    |

International  
 Rectifier

IR WORLD HEADQUARTERS: 101 N. Sepulveda Blvd., El Segundo, California 90245, USA

To contact International Rectifier, please visit <http://www.irf.com/whoto-call/>