

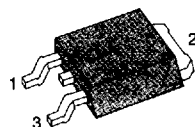
## FEATURES

- Lower  $R_{DS(on)}$
- Improved inductive ruggedness
- Fast switching times
- Rugged polysilicon gate cell structure
- Lower input capacitance
- Extended safe operating area
- Improved high temperature reliability

## PRODUCT SUMMARY

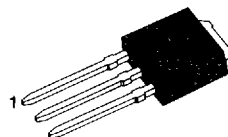
| Part Number  | V <sub>DS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|--------------|-----------------|---------------------|----------------|
| IRFR320/U320 | 400V            | 1.8 $\Omega$        | 3.1A           |
| IRFR321/U321 | 350V            | 1.8 $\Omega$        | 3.1A           |

D-PAK



1.Gate 2.Drain 3.Source  
IRFR320/321

I-PAK



1.Gate 2.Drain 3.Source  
IRFU320/321

## ABSOLUTE MAXIMUM RATINGS

| Characteristic                                                             | Symbol                            | IRFR320/U320 | IRFR321/U321 | Unit            |
|----------------------------------------------------------------------------|-----------------------------------|--------------|--------------|-----------------|
| Drain-Source Voltage (1)                                                   | V <sub>DS</sub>                   | 400          | 350          | V <sub>dc</sub> |
| Drain-Gate Voltage (R <sub>GS</sub> =1.0M $\Omega$ )                       | V <sub>DGR</sub>                  | 400          | 350          | V <sub>dc</sub> |
| Gate-Source Voltage                                                        | V <sub>GS</sub>                   | $\pm 20$     |              | V <sub>dc</sub> |
| Continuous Drain Current T <sub>c</sub> =25 °C                             | I <sub>D</sub>                    | 3.1          |              | A <sub>dc</sub> |
| Continuous Drain Current T <sub>c</sub> =100 °C                            | I <sub>D</sub>                    | 2.2          |              | A <sub>dc</sub> |
| Drain Current - Pulsed (3)                                                 | I <sub>DM</sub>                   | 12.4         |              | A <sub>dc</sub> |
| Single Pulsed Avalanche Energy (4)                                         | E <sub>AS</sub>                   | 190          |              | mJ              |
| Avalanche Current                                                          | I <sub>AS</sub>                   | 3.1          |              | A               |
| Total Power Dissipation at T <sub>c</sub> =25 °C                           | P <sub>D</sub>                    | 42           |              | Watts           |
| Derate above 25 °C                                                         |                                   | 0.33         |              | W/ °C           |
| Operating and Storage<br>Junction Temperature Range                        | T <sub>J</sub> , T <sub>stg</sub> | -55 to +150  |              | °C              |
| Maximum Lead Temp. for Soldering<br>Purposes, 1/8" from case for 5 seconds | T <sub>L</sub>                    | 300          |              | °C              |

Notes : (1) T<sub>J</sub>=25°C to 150°C

(2) Pulse test : Pulse width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$

(3) Repetitive rating : Pulse width limited by max. junction temperature

(4) L=31mH, V<sub>dd</sub>=50V, R<sub>G</sub>=25  $\Omega$ , Starting T<sub>J</sub>=25°C

**ELECTRICAL CHARACTERISTICS** ( $T_c=25^\circ\text{C}$  unless otherwise specified)

| Symbol              | Characteristic                       | Min | Typ  | Max  | Units    | Test Conditions                                                                                                                                                             |
|---------------------|--------------------------------------|-----|------|------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| BV <sub>DSS</sub>   | Drain-Source Breakdown Voltage       |     |      |      |          |                                                                                                                                                                             |
|                     | IRFR320/U320                         | 400 | -    | -    | V        | V <sub>GS</sub> =0V, I <sub>D</sub> =250 $\mu$ A                                                                                                                            |
|                     | IRFR321/U321                         | 350 | -    | -    | V        |                                                                                                                                                                             |
| 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> =250 $\mu$ A                                                                                                              |
| I <sub>GSS</sub>    | Gate-Source Leakage Forward          | -   | -    | 100  | nA       | V <sub>GS</sub> =20V                                                                                                                                                        |
| I <sub>GSS</sub>    | Gate-Source Leakage Reverse          | -   | -    | -100 | nA       | V <sub>GS</sub> =-20V                                                                                                                                                       |
| I <sub>DSS</sub>    | Zero Gate Voltage Drain Current      | -   | -    | 250  | $\mu$ A  | V <sub>DS</sub> =Max. Rating, V <sub>GS</sub> =0V                                                                                                                           |
|                     |                                      |     |      | 1000 | $\mu$ A  | V <sub>DS</sub> =0.8 Max. Rating, V <sub>GS</sub> =0V, T <sub>c</sub> =125 $^\circ\text{C}$                                                                                 |
| R <sub>DS(on)</sub> | Static Drain-Source On Resistance(2) | -   | -    | 1.8  | $\Omega$ | V <sub>GS</sub> =10V, I <sub>D</sub> =1.6A                                                                                                                                  |
| g <sub>fs</sub>     | Forward Transconductance (2)         | 1.0 | 2.2  | -    | $\mu$    | V <sub>DS</sub> $\geq$ 50V, I <sub>D</sub> =1.6A                                                                                                                            |
| C <sub>iss</sub>    | Input Capacitance                    | -   | 400  | -    | pF       | V <sub>GS</sub> =0V, V <sub>DS</sub> =25V, f=1.0MHz                                                                                                                         |
| C <sub>oss</sub>    | Output Capacitance                   | -   | 59.3 | -    | pF       |                                                                                                                                                                             |
| C <sub>rss</sub>    | Reverse Transfer Capacitance         | -   | 27   | -    | pF       |                                                                                                                                                                             |
| t <sub>d(on)</sub>  | Turn-On Delay Time                   | -   | 10   | 15   | pF       | V <sub>DD</sub> =0.5 BV <sub>DSS</sub> , I <sub>D</sub> =3.1A, Z <sub>O</sub> =18 $\Omega$<br>(MOSFET switching times are essentially independent of operating temperature) |
| t <sub>r</sub>      | Rise Time                            | -   | 14   | 20   | ns       |                                                                                                                                                                             |
| t <sub>d(off)</sub> | Turn-Off Delay Time                  | -   | 30   | 45   | ns       |                                                                                                                                                                             |
| t <sub>f</sub>      | Fall Time                            | -   | 13   | 20   | ns       |                                                                                                                                                                             |
| Q <sub>g</sub>      | Total Gate Charge                    | -   | -    | 25   | ns       | V <sub>GS</sub> =10V, I <sub>D</sub> =3.1A, V <sub>DS</sub> =0.8 Max. Rating<br>(Gate charge is essentially independent of operating temperature)                           |
| Q <sub>gs</sub>     | Gate-Source Charge                   | -   | 3.0  | -    | nC       |                                                                                                                                                                             |
| Q <sub>gd</sub>     | Gate-Drain ("Miller") Charge         | -   | 11   | -    | nC       |                                                                                                                                                                             |

**THERMAL RESISTANCE**

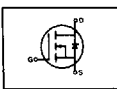
| Symbol            | Characteristics     |     | All | Units | Remark                                    |
|-------------------|---------------------|-----|-----|-------|-------------------------------------------|
| R <sub>thJC</sub> | Junction-to-Case    | MAX | 3.0 | K/W   |                                           |
| R <sub>thCS</sub> | Case-to-Sink        | TYP | 1.0 | K/W   | Mounting surface flat, smooth and greased |
| R <sub>thJA</sub> | Junction-to-Ambient | MAX | 80  | K/W   | Free Air Operation                        |

Notes : (1) T<sub>J</sub>=25 $^\circ\text{C}$  to 150 $^\circ\text{C}$

(2) Pulse test : Pulse width  $\leq$  300 $\mu$ s, Duty Cycle  $\leq$  2%

(3) Repetitive rating : Pulse width limited by max. junction temperature

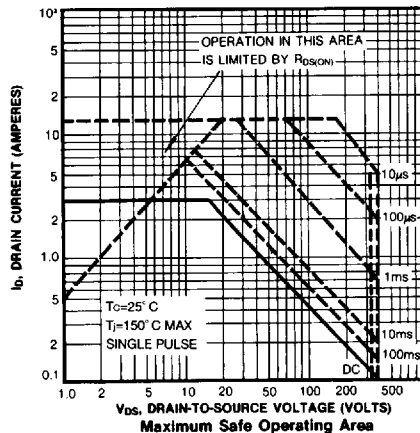
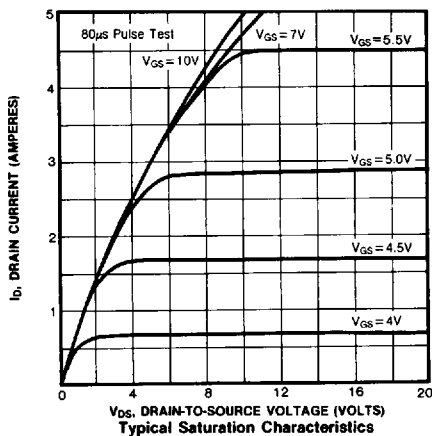
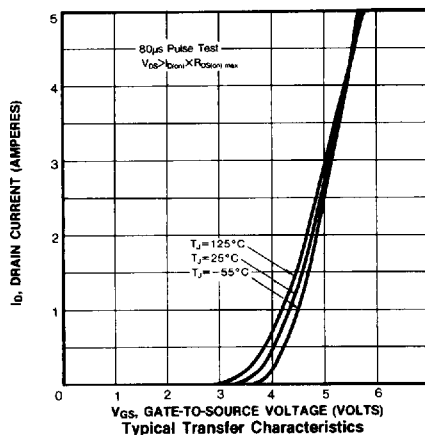
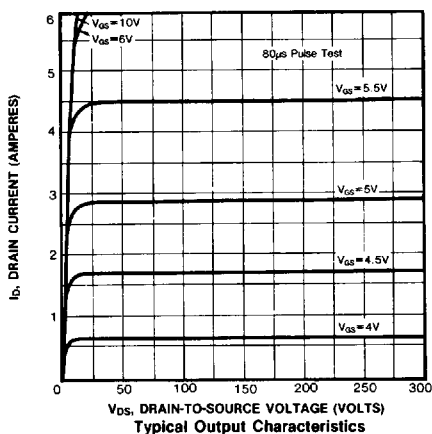
**SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS**

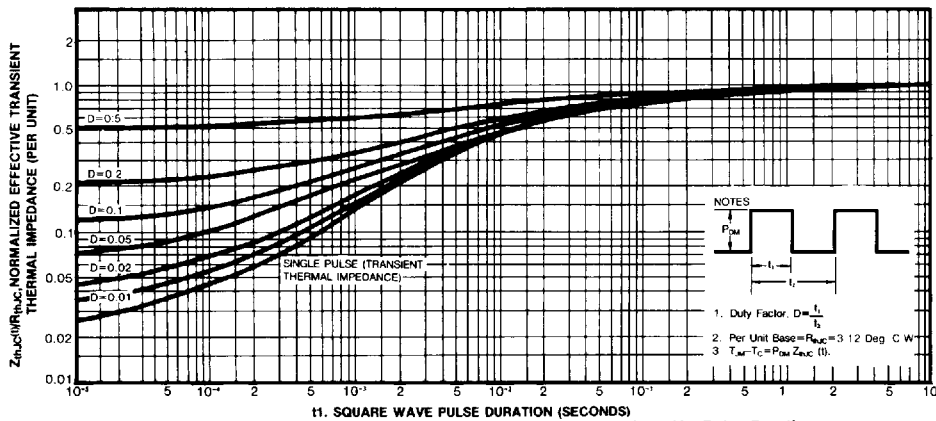
| Symbol   | Characteristic                            | Min | Typ | Max  | Units | Test Conditions                                                                                                                                                           |
|----------|-------------------------------------------|-----|-----|------|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $I_S$    | Continuous Source Current<br>(Body Diode) | -   | -   | 3.1  | A     | Modified MOSFET<br>symbol showing the<br>integral reverse<br>P-N junction rectifier<br> |
| $I_{SM}$ | Pulse Source Current<br>(Body Diode) (3)  | -   | -   | 12.4 | A     |                                                                                                                                                                           |
| $V_{SD}$ | Diode Forward Voltage (2)                 | -   | -   | 1.8  | V     | $T_J=25^\circ\text{C}$ , $I_S=3.1\text{A}$ , $V_{GS}=0\text{V}$                                                                                                           |
| $t_{rr}$ | Reverse Recovery Time                     | -   | 270 | -    | ns    | $T_J=25^\circ\text{C}$ , $I_F=3.1\text{A}$ , $dI_F/dt=100\text{A}/\mu\text{S}$                                                                                            |

Notes : (1)  $T_J=25^\circ\text{C}$  to  $150^\circ\text{C}$

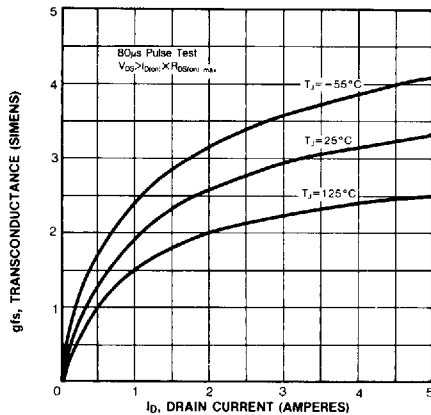
(2) Pulse test : Pulse width  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 2\%$

(3) Repetitive rating : Pulse width limited by max. junction temperature

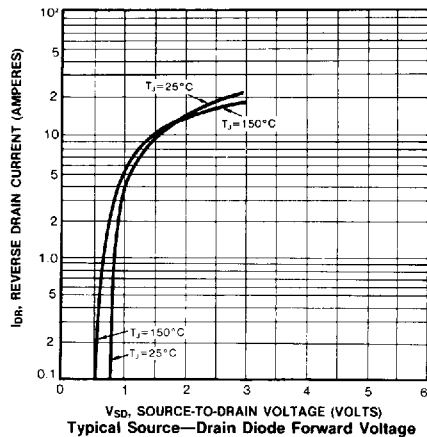




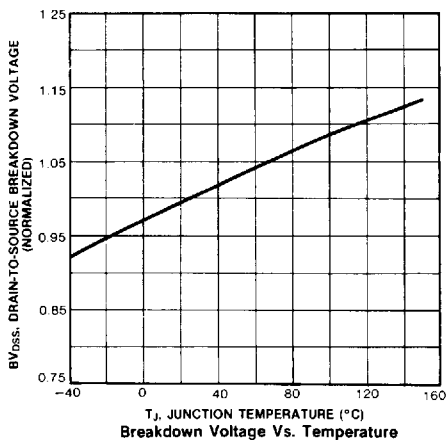
Maximum Effective Transient Thermal Impedance Junction-to-Case Vs. Pulse Duration



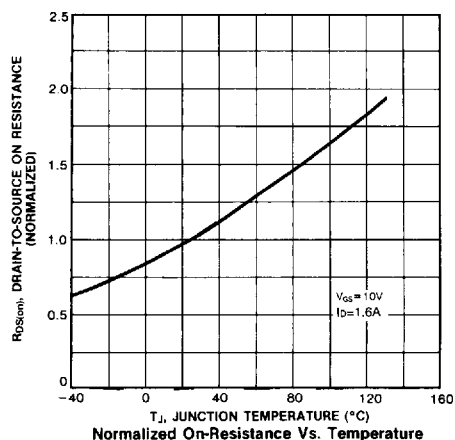
Typical Transconductance Vs. Drain Current



Typical Source-Drain Diode Forward Voltage



Breakdown Voltage Vs. Temperature



Normalized On-Resistance Vs. Temperature

