

IRFP440R, IRFP441R, IRFP442R, IRFP443R

**Avalanche Energy Rated
 N-Channel Power MOSFETs**

8A and 7A, 500V-400V
 $r_{DS(on)} = 0.85\Omega$ and 1.1Ω

Features:

- Single pulse avalanche energy rated
- SOA is power-dissipation limited
- Nanosecond switching speeds
- Linear transfer characteristics
- High input impedance

The IRFP440R, IRFP441R, IRFP442R and IRFP443R are advanced power MOSFETs designed, tested, and guaranteed to withstand a specified level of energy in the breakdown avalanche mode of operation. These are n-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

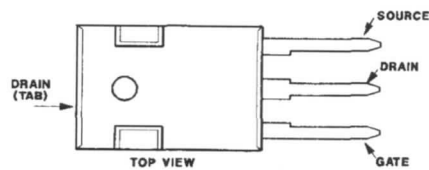
The IRFP-types are supplied in the JEDEC TO-247 plastic package.

N-CHANNEL ENHANCEMENT MODE



TERMINAL DIAGRAM

TERMINAL DESIGNATION



JEDEC TO-247

Absolute Maximum Ratings

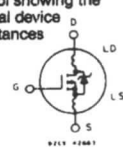
| Parameter | IRFP440R | IRFP441R | IRFP442R | IRFP443R | Units |
|---|---|----------|----------|----------|---------------------|
| V_{DS} Drain - Source Voltage ① | 500 | 450 | 500 | 450 | V |
| V_{DGR} Drain - Gate Voltage ($R_{GS} = 20\text{ K}\Omega$) ① | 500 | 450 | 500 | 450 | V |
| $I_D @ T_C = 25^\circ\text{C}$ Continuous Drain Current | 8.0 | 8.0 | 7.0 | 7.0 | A |
| $I_D @ T_C = 100^\circ\text{C}$ Continuous Drain Current | 5.0 | 5.0 | 4.0 | 4.0 | A |
| I_{DM} Pulsed Drain Current ③ | 32 | 32 | 28 | 28 | A |
| V_{GS} Gate - Source Voltage | ± 20 | | | | V |
| $P_D @ T_C = 25^\circ\text{C}$ Max. Power Dissipation | 125 (See Fig. 14) | | | | W |
| Linear Derating Factor | 1.0 (See Fig. 14) | | | | W/ $^\circ\text{C}$ |
| E_{AS} Single Pulse Avalanche Energy Rating ④ | 480 | | | | mJ |
| T_J Operating Junction and Storage Temperature Range | -55 to 150 | | | | $^\circ\text{C}$ |
| T_{stg} Lead Temperature | 300 (0.063 in. (1.6mm) from case for 10s) | | | | $^\circ\text{C}$ |



NJ Semi-Conductors reserves the right to change test conditions, parameter limits and package dimensions without notice. Information furnished by NJ Semi-Conductors is believed to be both accurate and reliable at the time of going to press. However, NJ Semi-Conductors assumes no responsibility for any errors or omissions discovered in its use. NJ Semi-Conductors encourages customers to verify that datasheets are current before placing orders.

IRFP440R, IRFP441R, IRFP442R, IRFP443R


Electrical Characteristics @ $T_c = 25^\circ\text{C}$ (Unless Otherwise Specified)

| Parameter | Type | Min. | Typ. | Max. | Units | Test Conditions | |
|--|----------------------|------|------|------|----------|---|---|
| BV _{DSS} Drain - Source Breakdown Voltage | IRFP440R IRFP442R | 500 | — | — | V | V _{GS} = 0V I _D = 250 μ A | |
| | IRFP441R IRFP443R | 450 | — | — | V | | |
| V _{GS(th)} Gate Threshold Voltage | ALL | 2.0 | — | 4.0 | V | V _{DS} = V _{GS} , I _D = 250 μ A | |
| I _{GSS} Gate-Source Leakage Forward | ALL | — | — | 100 | nA | V _{GS} = 20V | |
| I _{GSS} Gate-Source Leakage Reverse | ALL | — | — | -100 | nA | V _{GS} = -20V | |
| I _{OSS} Zero Gate Voltage Drain Current | ALL | — | — | 250 | μ A | V _{GS} = Max. Rating, V _{DS} = 0V | |
| | | — | — | 1000 | μ A | V _{GS} = Max. Rating x 0.8, V _{DS} = 0V, T _C = 125 $^\circ$ C | |
| I _{D(on)} On-State Drain Current ① | IRFP440R IRFP441R | 8.0 | — | — | A | V _{DS} > I _{D(on)} x R _{D(on)} max., V _{GS} = 10V | |
| | IRFP442R IRFP443R | 7.0 | — | — | A | | |
| R _{D(on)} Static Drain-Source On-State Resistance ② | IRFP440R IRFP441R | — | 0.8 | 0.85 | Ω | V _{GS} = 10V, I _D = 4.0A | |
| | IRFP442R IRFP443R | — | 1.0 | 1.1 | Ω | | |
| | | ALL | — | — | — | | — |
| g _{fs} Forward Transconductance ② | ALL | 4.0 | 6.5 | — | S(V) | V _{DS} > I _{D(on)} x R _{D(on)} max., I _D = 4.0A | |
| C _{iss} Input Capacitance | ALL | — | 1225 | — | pF | V _{GS} = 0V, V _{DS} = 25V, f = 1.0 MHz See Fig. 10 | |
| C _{oss} Output Capacitance | ALL | — | 200 | — | pF | | |
| C _{rss} Reverse Transfer Capacitance | ALL | — | 85 | — | pF | | |
| t _{don} Turn-On Delay Time | ALL | — | 17 | 35 | ns | V _{DD} = 200V, I _D = 4.0A, Z ₀ = 4.7 Ω See Fig. 17 | |
| t _r Rise Time | ALL | — | 5 | 15 | ns | | |
| t _{doff} Turn-Off Delay Time | ALL | — | 42 | 90 | ns | (MOSFET switching times are essentially independent of operating temperature.) | |
| t _f Fall Time | ALL | — | 14 | 30 | ns | | |
| Q _g Total Gate Charge (Gate-Source Plus Gate-Drain) | ALL | — | 42 | 60 | nC | V _{GS} = 10V, I _D = 10A, V _{DS} = 0.8 Max. Rating. See Fig. 18 for test circuit. (Gate charge is essentially independent of operating temperature.) | |
| Q _{gs} Gate-Source Charge | ALL | — | 20 | — | nC | | |
| Q _{gd} Gate-Drain ("Miller") Charge | ALL | — | 22 | — | nC | | |
| L _D Internal Drain Inductance | ALL | — | 5.0 | — | nH | Measured between the contact screw on header that is closer to source and gate pins and center of die. |  <p>Modified MOSFET symbol showing the internal device inductances</p> |
| L _S Internal Source Inductance | ALL | — | 12.5 | — | nH | Measured from the source pin, 6 mm (0.25 in.) from header and source bonding pad. | |

Thermal Resistance

| | | | | | | |
|---------------------------------------|-----|---|-----|-----|--------------------|---|
| R _{thJC} Junction-to-Case | ALL | — | — | 1.0 | $^\circ\text{C/W}$ | |
| R _{thCS} Case-to-Sink | ALL | — | 0.1 | — | $^\circ\text{C/W}$ | Mounting surface flat, smooth, and greased. |
| R _{thJA} Junction-to-Ambient | ALL | — | — | 30 | $^\circ\text{C/W}$ | Free Air Operation |

Source-Drain Diode Ratings and Characteristics

| | | | | | | |
|---|----------------------|---|------|-----|---------|---|
| I _S Continuous Source Current (Body Diode) | IRFP440R IRFP441R | — | — | 8.0 | A | Modified MOSFET symbol showing the integral reverse P-N junction rectifier. |
| | IRFP442R IRFP443R | — | — | 7.0 | A | |
| I _{SM} Pulse Source Current (Body Diode) ③ | IRFP440R IRFP441R | — | — | 32 | A |  |
| | IRFP442R IRFP443R | — | — | 28 | A | |
| V _{SD} Diode Forward Voltage ② | IRFP440R IRFP441R | — | — | 2.0 | V | T _C = 25 $^\circ$ C, I _S = 8.0A, V _{GS} = 0V |
| | IRFP442R IRFP443R | — | — | 1.9 | V | T _C = 25 $^\circ$ C, I _S = 7.0A, V _{GS} = 0V |
| t _r Reverse Recovery Time | ALL | — | 1100 | — | ns | T _J = 150 $^\circ$ C, I _r = 8.0A, di/dt = 100A/ μ s |
| Q _{RR} Reverse Recovered Charge | ALL | — | 6.4 | — | μ C | T _J = 150 $^\circ$ C, I _r = 8.0A, di/dt = 100A/ μ s |
| t _{on} Forward Turn-on Time | ALL | Intrinsic turn-on time is negligible. Turn-on speed is substantially controlled by L _S + L _D . | | | | |

① T_J = 25 $^\circ$ C to 150 $^\circ$ C. ② Pulse Test: Pulse width \leq 300 μ s, Duty Cycle \leq 2%.

③ Repetitive Rating: Pulse width limited by max. junction temperature. See Transient Thermal Impedance Curve (Fig. 5).

④ V_{DD} = 50V, starting T_J = 25 $^\circ$ C, L = 11 mH, R_{DS(on)} = 50 Ω , I_{peak} = 8.8A. See figures 15, 16.