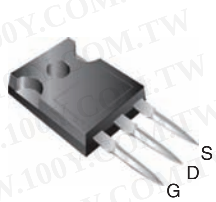
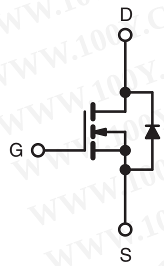
# Power MOSFET

| PRODUCT SUMMARY | | |
|---|---|---|
| $V_{DS}$ (V) | 200 | |
| $R_{DS(on)}$ (Ω) | $V_{GS}$ = 10 V | 0.18 |
| $Q_g$ (Max.) (nC) | 70 | |
| $Q_{gs}$ (nC) | 13 | |
| $Q_{gd}$ (nC) | 39 | |
| Configuration | Single | |

TO-247




N-Channel MOSFET

## FEATURES

- Dynamic dV/dt Rating
- Repetitive Avalanche Rated
- Isolated Central Mounting Hole
- Fast Switching
- Ease of Paralleling
- Simple Drive Requirements
- Lead (Pb)-free Available

Pb Available

RoHS* COMPLIANT

## DESCRIPTION

Third generation Power MOSFETs from Vishay provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

The TO-247 package is preferred for commercial-industrial applications where higher power levels preclude the use of TO-220 devices. The TO-247 is similar but superior to the earlier TO-218 package because its isolated mounting hole. It also provides greater creepage distances between pins to meet the requirements of most safety specifications.

| ORDERING INFORMATION | |
|---|---|
| Package | TO-247 |
| Lead (Pb)-free | IRFP240PbF |
| | SiHFP240-E3 |
| SnPb | IRFP240 |
| | SiHFP240 |

**ABSOLUTE MAXIMUM RATINGS** $T_C$ = 25 °C, unless otherwise noted

| PARAMETER | | | SYMBOL | LIMIT | UNIT |
|---|---|---|---|---|---|
| Drain-Source Voltage | | | $V_{DS}$ | 200 | V |
| Gate-Source Voltage | | | $V_{GS}$ | ± 20 | V |
| Continuous Drain Current | $V_{GS}$ at 10 V | $T_C$ = 25 °C | $I_D$ | 20 | A |
| | | $T_C$ = 100 °C | | 12 | A |
| Pulsed Drain Current[a] | | | $I_{DM}$ | 80 | A |
| Linear Derating Factor | | | | 1.2 | W/°C |
| Single Pulse Avalanche Energy[b] | | | $E_{AS}$ | 510 | mJ |
| Repetitive Avalanche Current[a] | | | $I_{AR}$ | 20 | A |
| Repetitive Avalanche Energy[a] | | | $E_{AR}$ | 15 | mJ |
| Maximum Power Dissipation | $T_C$ = 25 °C | | $P_D$ | 150 | W |
| Peak Diode Recovery dV/dt[c] | | | dV/dt | 5.0 | V/ns |
| Operating Junction and Storage Temperature Range | | | $T_J$, $T_{stg}$ | - 55 to + 150 | °C |
| Soldering Recommendations (Peak Temperature) | for 10 s | | | 300[d] | °C |
| Mounting Torque | 6-32 or M3 screw | | | 10 | lbf · in |
| | | | | 1.1 | N · m |

**Notes**

a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).

b. $V_{DD}$ = 50 V, starting $T_J$ = 25 °C, L = 1.9 mH, $R_G$ = 25 Ω, $I_{AS}$ = 20 A (see fig. 12).

c. $I_{SD} \le 18$ A, dI/dt ≤ 150 A/µs, $V_{DD} \le V_{DS}$, $T_J \le 150$ °C.

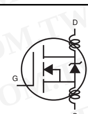
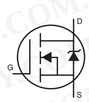
d. 1.6 mm from case.

* Pb containing terminations are not RoHS compliant, exemptions may apply

VISHAY.

| THERMAL RESISTANCE RATINGS | | | | |
|---|---|---|---|---|
| PARAMETER | SYMBOL | TYP. | MAX. | UNIT |
| Maximum Junction-to-Ambient | $R_{thJA}$ | - | 40 | °C/W |
| Case-to-Sink, Flat, Greased Surface | $R_{thCS}$ | 0.24 | - | |
| Maximum Junction-to-Case (Drain) | $R_{thJC}$ | - | 0.83 | |

**SPECIFICATIONS** $T_J$ = 25 °C, unless otherwise noted

| PARAMETER | SYMBOL | TEST CONDITIONS | | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|---|
| **Static** | | | | | | | |
| Drain-Source Breakdown Voltage | $V_{DS}$ | $V_{GS}$ = 0 V, $I_D$ = 250 µA | | 200 | - | - | V |
| $V_{DS}$ Temperature Coefficient | $\Delta V_{DS}/T_J$ | Reference to 25 °C, $I_D$ = 1 mA | | - | 0.29 | - | V/°C |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS} = V_{GS}$, $I_D$ = 250 µA | | 2.0 | - | 4.0 | V |
| Gate-Source Leakage | $I_{GSS}$ | $V_{GS}$ = ± 20 V | | - | - | ± 100 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = 200 V, $V_{GS}$ = 0 V | | - | - | 25 | µA |
| | | $V_{DS}$ = 160 V, $V_{GS}$ = 0 V, $T_J$ = 125 °C | | - | - | 250 | |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS}$ = 10 V | $I_D$ = 12 A[b] | - | - | 0.18 | Ω |
| Forward Transconductance | $g_{fs}$ | $V_{DS}$ = 50 V, $I_D$ = 12 A[b] | | 6.9 | - | - | S |
| **Dynamic** | | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V, $V_{DS}$ = 25 V, f = 1.0 MHz, see fig. 5 | | - | 1300 | - | pF |
| Output Capacitance | $C_{oss}$ | | | - | 400 | - | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | - | 130 | - | |
| Total Gate Charge | $Q_g$ | $V_{GS}$ = 10 V | $I_D$ = 18 A, $V_{DS}$ = 160 V, see fig. 6 and 13[b] | - | - | 70 | nC |
| Gate-Source Charge | $Q_{gs}$ | | | - | - | 13 | |
| Gate-Drain Charge | $Q_{gd}$ | | | - | - | 39 | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD}$ = 100 V, $I_D$ = 18 A, $R_G$ = 9.1 Ω, $R_D$ = 5.4 Ω, see fig. 10[b] | | - | 14 | - | ns |
| Rise Time | $t_r$ | | | - | 51 | - | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | - | 45 | - | |
| Fall Time | $t_f$ | | | - | 36 | - | |
| Internal Drain Inductance | $L_D$ | Between lead, 6 mm (0.25") from package and center of die contact  | | - | 5.0 | - | nH |
| Internal Source Inductance | $L_S$ | | | - | 13 | - | |
| **Drain-Source Body Diode Characteristics** | | | | | | | |
| Continuous Source-Drain Diode Current | $I_S$ | MOSFET symbol showing the integral reverse p - n junction diode  | | - | - | 20 | A |
| Pulsed Diode Forward Current[a] | $I_{SM}$ | | | - | - | 80 | |
| Body Diode Voltage | $V_{SD}$ | $T_J$ = 25 °C, $I_S$ = 20 A, $V_{GS}$ = 0 V[b] | | - | - | 2.0 | V |
| Body Diode Reverse Recovery Time | $t_{rr}$ | $T_J$ = 25 °C, $I_F$ = 18 A, dI/dt = 100 A/µs[b] | | - | 300 | 610 | ns |
| Body Diode Reverse Recovery Charge | $Q_{rr}$ | | | - | 3.4 | 7.1 | µC |
| Forward Turn-On Time | $t_{on}$ | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$) | | | | | |

**Notes**

a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
b. Pulse width ≤ 300 µs; duty cycle ≤ 2 %.

**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted

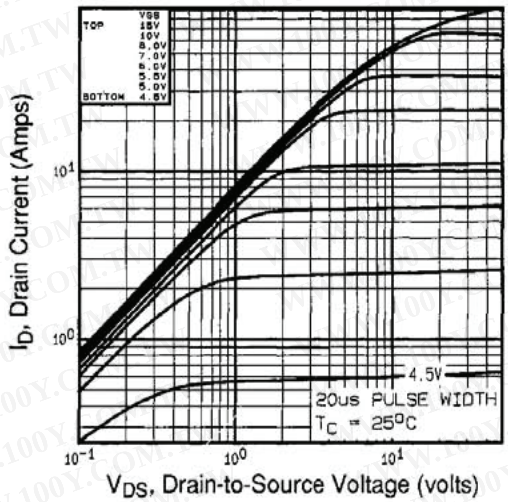


Fig. 1 - Typical Output Characteristics, $T_C$ = 25 °C

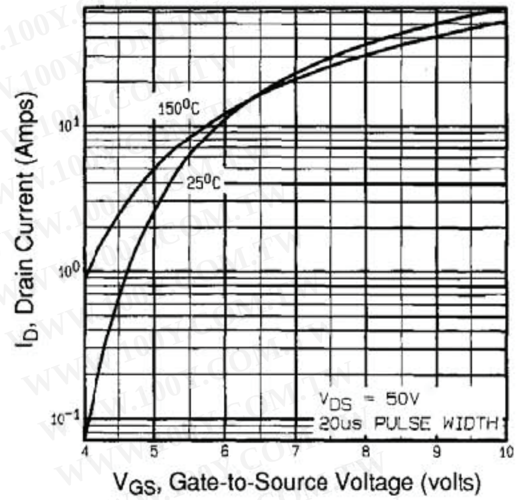


Fig. 3 - Typical Transfer Characteristics

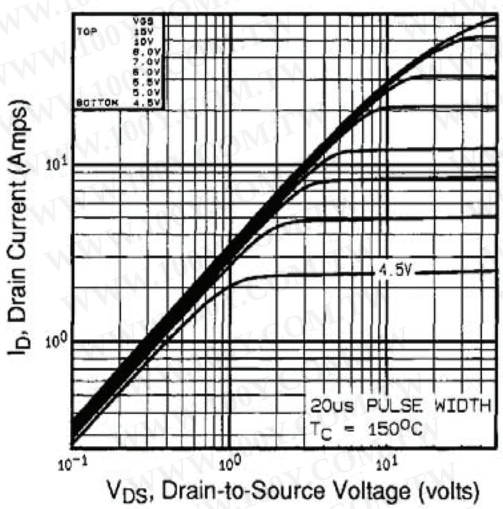


Fig. 2 - Typical Output Characteristics, $T_C$ = 150 °C

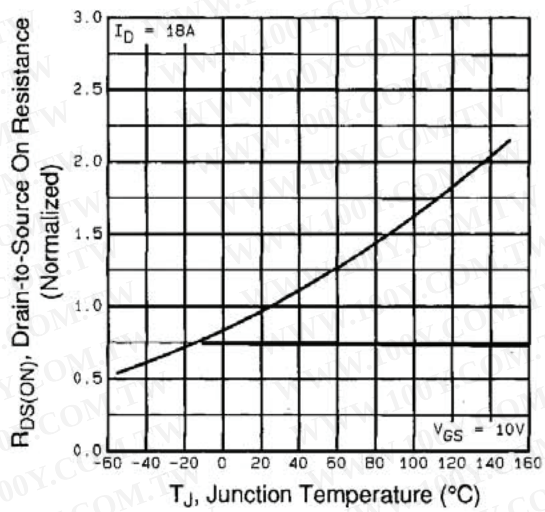


Fig. 4 - Normalized On-Resistance vs. Temperature

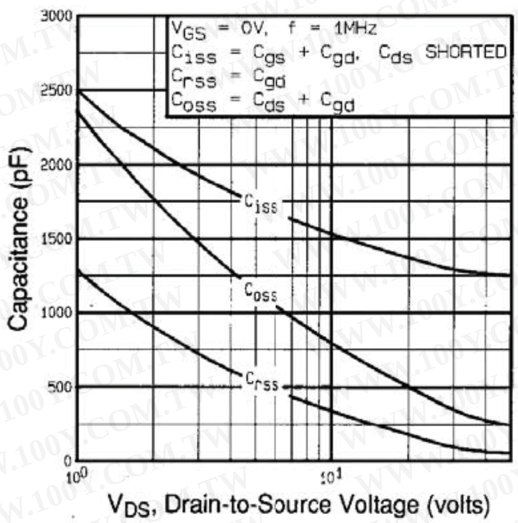



**Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage**

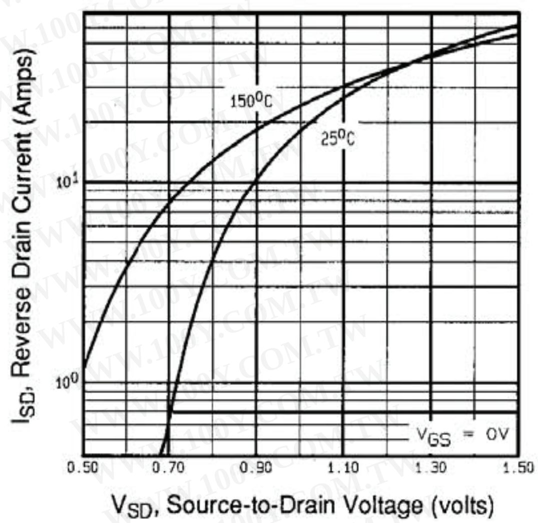



**Fig. 7 - Typical Source-Drain Diode Forward Voltage**

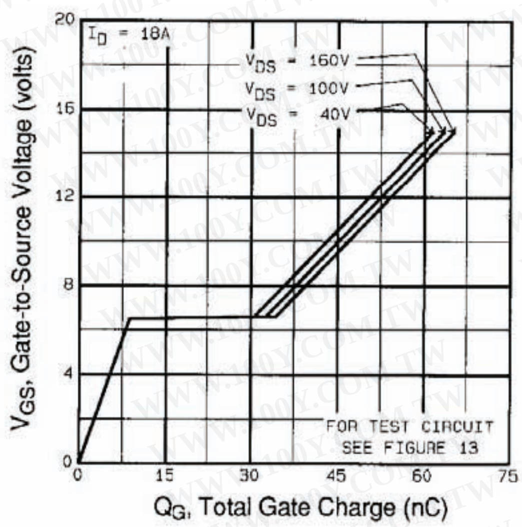



**Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage**

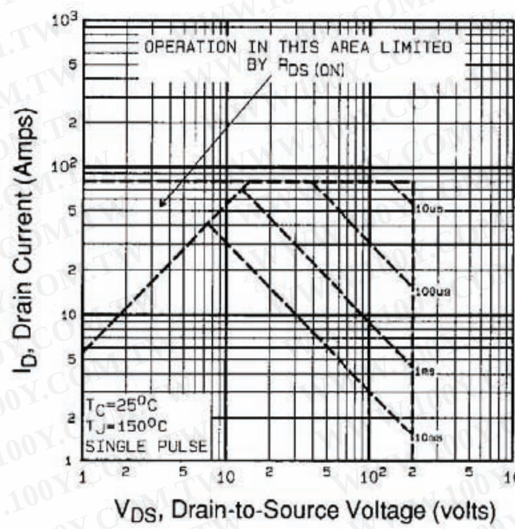



**Fig. 8 - Maximum Safe Operating Area**

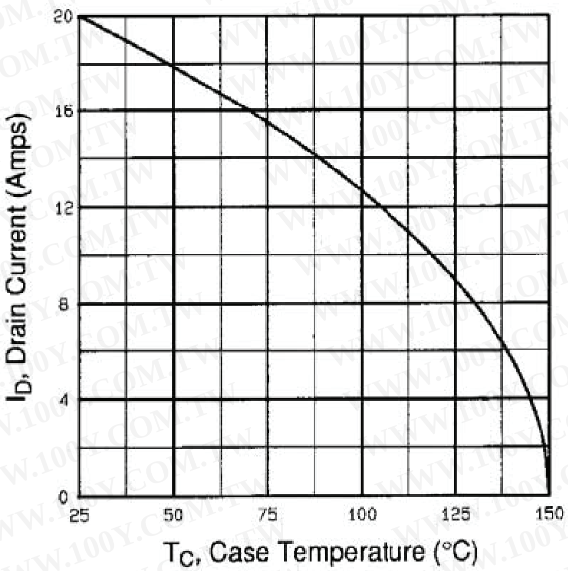



Fig. 9 - Maximum Drain Current vs. Case Temperature

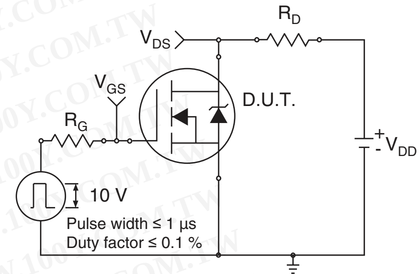



Fig. 10a - Switching Time Test Circuit

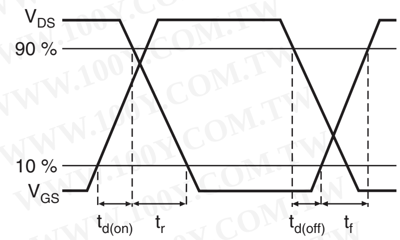



Fig. 10b - Switching Time Waveforms

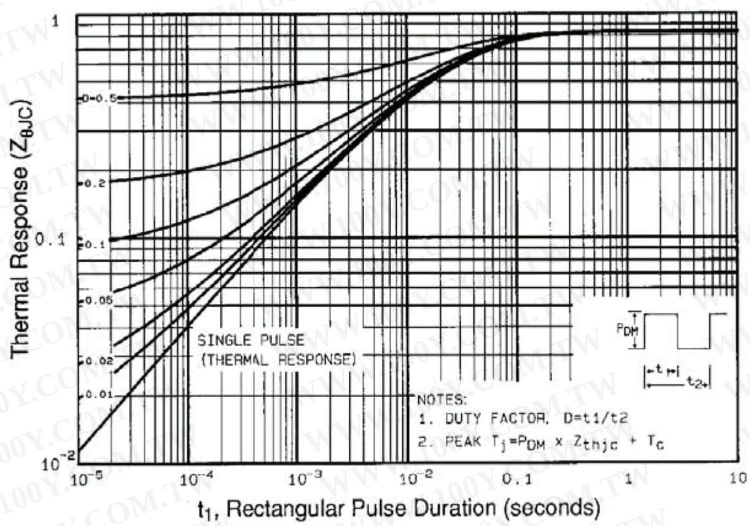



Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

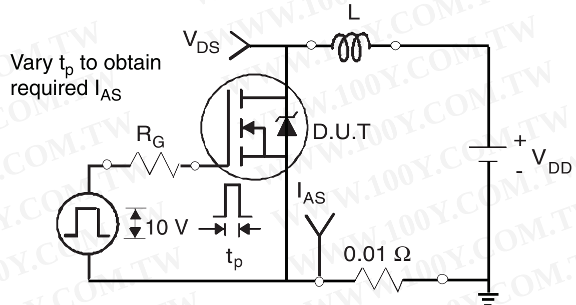



**Fig. 12a - Unclamped Inductive Test Circuit**

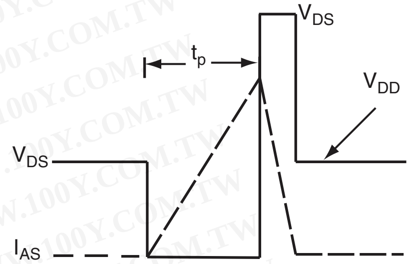



**Fig. 12b - Unclamped Inductive Waveforms**

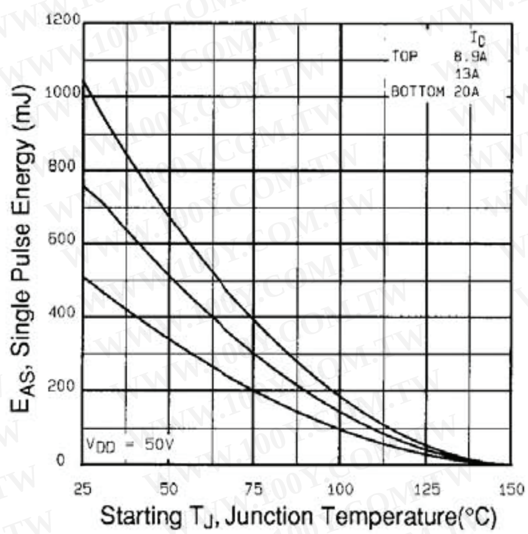



**Fig. 12c - Maximum Avalanche Energy vs. Drain Current**



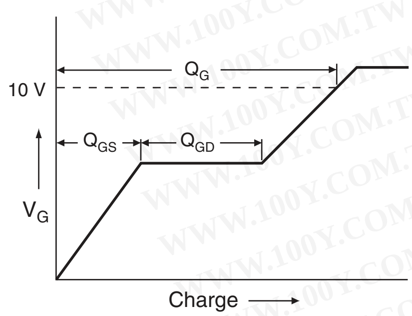



**Fig. 13a - Basic Gate Charge Waveform**

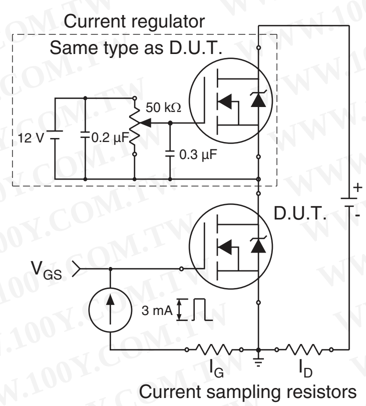
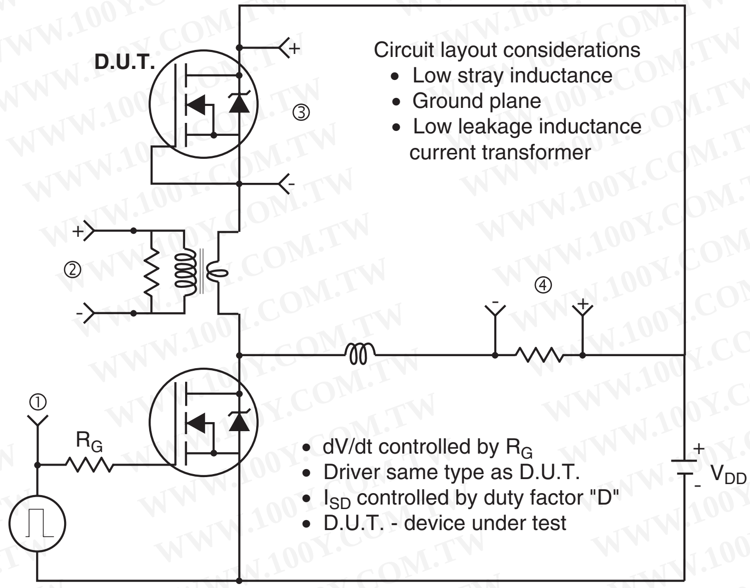
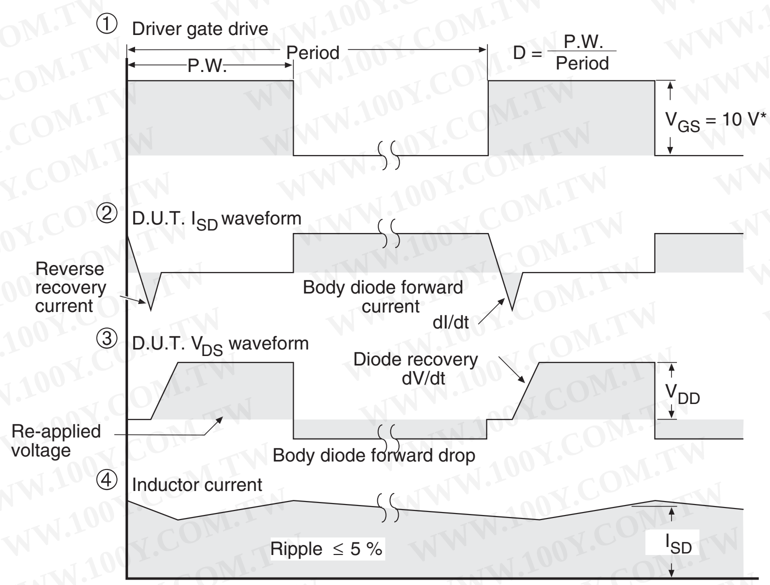



**Fig. 13b - Gate Charge Test Circuit**

## Peak Diode Recovery dV/dt Test Circuit




* $V_{GS}$ = 5 V for logic level devices

**Fig. 14 - For N-Channel**



*Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data,*

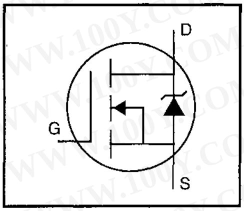
# International IOR Rectifier

# IRFP240



HEXFET® Power MOSFET

- Dynamic dv/dt Rating
- Repetitive Avalanche Rated
- Isolated Central Mounting Hole
- Fast Switching
- Ease of Paralleling
- Simple Drive Requirements




$V_{DSS} = 200V$

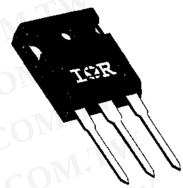
$R_{DS(on)} = 0.18\Omega$

$I_D = 20A$

## Description

Third Generation HEXFETs from International Rectifier provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

The TO-247 package is preferred for commercial–industrial applications where higher power levels preclude the use of TO-220 devices. The TO-247 is similar but superior to the earlier TO-218 package because of its isolated mounting hole. It also provides greater creepage distance between pins to meet the requirements of most safety specifications.



TO-247AC

DATA SHEETS

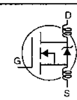
## Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---|---|---|---|
| $I_D$ @ $T_C = 25°C$ | Continuous Drain Current, $V_{GS}$ @ 10 V | 20 | A |
| $I_D$ @ $T_C = 100°C$ | Continuous Drain Current, $V_{GS}$ @ 10 V | 12 | |
| $I_{DM}$ | Pulsed Drain Current ① | 80 | |
| $P_D$ @ $T_C = 25°C$ | Power Dissipation | 150 | W |
| | Linear Derating Factor | 1.2 | W/°C |
| $V_{GS}$ | Gate-to-Source Voltage | ±20 | V |
| $E_{AS}$ | Single Pulse Avalanche Energy ② | 510 | mJ |
| $I_{AR}$ | Avalanche Current ① | 20 | A |
| $E_{AR}$ | Repetitive Avalanche Energy ① | 15 | mJ |
| dv/dt | Peak Diode Recovery dv/dt ③ | 5.0 | V/ns |
| $T_J$, $T_{STG}$ | Operating Junction and Storage Temperature Range | -55 to +150 | °C |
| | Soldering Temperature, for 10 seconds | 300 (1.6mm from case) | |
| | Mounting Torque, 6-32 or M3 screw | 10 lbf•in (1.1 N•m) | |

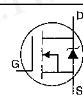
## Thermal Resistance

| | Parameter | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| $R_{\theta JC}$ | Junction-to-Case | — | — | 0.83 | °C/W |
| $R_{\theta CS}$ | Case-to-Sink, Flat, Greased Surface | — | 0.24 | — | |
| $R_{\theta JA}$ | Junction-to-Ambient | — | — | 40 | |

## Electrical Characteristics @ $T_J = 25°C$ (unless otherwise specified)

| | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-to-Source Breakdown Voltage | 200 | — | — | V | $V_{GS}$=0V, $I_D$= 250μA |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient | — | 0.29 | — | V/°C | Reference to 25°C, $I_D$= 1mA |
| $R_{DS(on)}$ | Static Drain-to-Source On-Resistance | — | — | 0.18 | Ω | $V_{GS}$=10V, $I_D$=12A ④ |
| $V_{GS(th)}$ | Gate Threshold Voltage | 2.0 | — | 4.0 | V | $V_{DS}=V_{GS}$, $I_D$= 250μA |
| $g_{fs}$ | Forward Transconductance | 6.9 | — | — | S | $V_{DS}$=50V, $I_D$=12A ④ |
| $I_{DSS}$ | Drain-to-Source Leakage Current | — | — | 25 | μA | $V_{DS}$=200V, $V_{GS}$=0V |
| | | — | — | 250 | | $V_{DS}$=160V, $V_{GS}$=0V, $T_J$=125°C |
| $I_{GSS}$ | Gate-to-Source Forward Leakage | — | — | 100 | nA | $V_{GS}$=20V |
| | Gate-to-Source Reverse Leakage | — | — | -100 | | $V_{GS}$=-20V |
| $Q_g$ | Total Gate Charge | — | — | 70 | nC | $I_D$=18A |
| $Q_{gs}$ | Gate-to-Source Charge | — | — | 13 | | $V_{DS}$=160V |
| $Q_{gd}$ | Gate-to-Drain ("Miller") Charge | — | — | 39 | | $V_{GS}$=10V See Fig. 6 and 13 ④ |
| $t_{d(on)}$ | Turn-On Delay Time | — | 14 | — | ns | $V_{DD}$=100V |
| $t_r$ | Rise Time | — | 51 | — | | $I_D$=18A |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 45 | — | | $R_G$=9.1Ω |
| $t_f$ | Fall Time | — | 36 | — | | $R_D$=5.4Ω See Figure 10 ④ |
| $L_D$ | Internal Drain Inductance | — | 5.0 | — | nH | Between lead, 6 mm (0.25in.) from package and center of die contact   |
| $L_S$ | Internal Source Inductance | — | 13 | — | | |
| $C_{iss}$ | Input Capacitance | — | 1300 | — | pF | $V_{GS}$=0V |
| $C_{oss}$ | Output Capacitance | — | 400 | — | | $V_{DS}$= 25V |
| $C_{rss}$ | Reverse Transfer Capacitance | — | 130 | — | | $f$=1.0MHz See Figure 5 |

## Source-Drain Ratings and Characteristics

| | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current (Body Diode) | — | — | 20 | A | MOSFET symbol showing the integral reverse p-n junction diode.   |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ① | — | — | 80 | | |
| $V_{SD}$ | Diode Forward Voltage | — | — | 2.0 | V | $T_J$=25°C, $I_S$=20A, $V_{GS}$=0V ④ |
| $t_{rr}$ | Reverse Recovery Time | — | 300 | 610 | ns | $T_J$=25°C, $I_F$=18A |
| $Q_{rr}$ | Reverse Recovery Charge | — | 3.4 | 7.1 | μC | di/dt=100A/μs ④ |
| $t_{on}$ | Forward Turn-On Time | Intrinsic turn-on time is neglegible (turn-on is dominated by $L_S+L_D$) | | | | |

Notes:

① Repetitive rating; pulse width limited by max. junction temperature (See Figure 11)

② $V_{DD}$=50V, starting $T_J$=25°C, L=1.9mH $R_G$=25Ω, $I_{AS}$=20A (See Figure 12)

③ $I_{SD}$≤18A, di/dt≤150A/μs, $V_{DD}$≤$V_{(BR)DSS}$, $T_J$≤150°C

④ Pulse width ≤ 300 μs; duty cycle ≤2%.