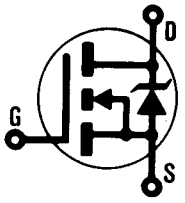
INTERNATIONAL RECTIFIER IOR

# REPETITIVE AVALANCHE RATED AND dv/dt RATED

# HEXFET® TRANSISTOR IRFV460




## N-CHANNEL

### 500 Volt, 0.27 Ohm HEXFET

The HEXFET® technology is the key to International Rectifier's advanced line of power MOSFET transistors. The efficient geometry design achieves very low on-state resistance combined with high transconductance.

The HEXFET transistors also feature all of the well established advantages of MOSFETs such as voltage control, very fast switching, ease of paralleling and temperature stability of the electrical parameters.

They are well suited for applications such as switching power supplies and virtually any application where military and/or high reliability is required.

### Product Summary

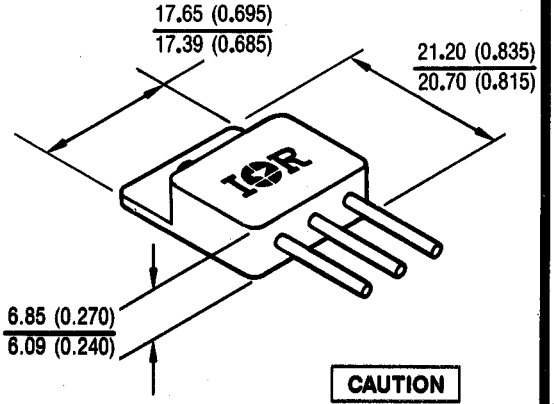
| Part Number | $BV_{DSS}$ | $R_{DS(on)}$ | $I_D$ |
|---|---|---|---|
| IRFV460 | 500V | 0.27Ω | 21A |

### FEATURES:

- Repetitive Avalanche Rating
- Dynamic dv/dt Rating
- Isolated and Hermetically Sealed
- Alternative to TO-3 Package
- Simple Drive Requirements
- Ease of Paralleling
- Ceramic Eyelets

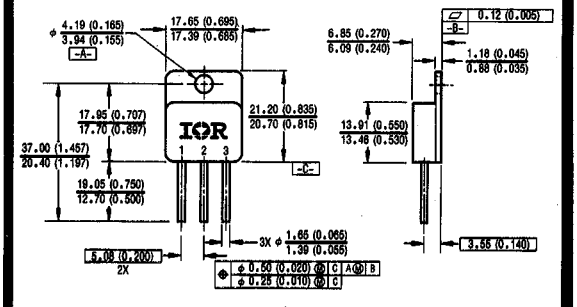
I

### CASE STYLE AND DIMENSIONS




CAUTION

BERYLLIA WARNING PER MIL-S-19500
SEE PAGE I-470




NOTES:
1 DIMENSIONING & TOLERANCING PER ANSI Y14.5M - 1982.
2 ALL DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).

LEGEND
1 DRAIN
2 SOURCE
3 GATE

*For optional leadforms see page I-470, fig. 15

**Conforms to JEDEC Outline TO-258AA***
Dimensions in Millimeters and (Inches)

## Absolute Maximum Ratings

| Parameter | | IRFV460 | Units |
|---|---|---|---|
| $I_D$ @ $V_{GS}$ = 0V, $T_C$ = 25°C | Continuous Drain Current | 21 | A |
| $I_D$ @ $V_{GS}$ = 0V, $T_C$ = 100°C | Continuous Drain Current | 13 | |
| $I_{DM}$ | Pulsed Drain Current ① | 84 | |
| $P_D$ @ $T_C$ = 25°C | Max. Power Dissipation | 300 | W |
| | Linear Derating Factor | 2.4 | W/K ⑤ |
| $V_{GS}$ | Gate-to-Source Voltage | ±20 | V |
| $E_{AS}$ | Single Pulse Avalanche Energy ② | 480 | mJ |
| $I_{AR}$ | Avalanche Current ① | 21 | A |
| $E_{AR}$ | Repetitive Avalanche Energy ① | 30 | mJ |
| dv/dt | Peak Diode Recovery dv/dt ③ | 3.5 | V/ns |
| $T_J$<br>$T_{STG}$ | Operating Junction<br>Storage Temperature Range | −55 to 150 | °C |
| | Lead Temperature | 300 (0.063 in. (1.6 mm) from case for 10s) | |
| | Weight | 10.9 (typical) | g |

## Electrical Characteristics @ $T_J$ = 25°C (Unless Otherwise Specified)

| Parameter | | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $BV_{DSS}$ | Drain-to-Source Breakdown Voltage | 500 | — | — | V | $V_{GS}$ = 0V, $I_D$ = 1.0 mA |
| $\Delta BV_{DSS}/\Delta T_J$ | Temperature Coefficient of Breakdown Voltage | — | 0.63 | — | V/°C | Reference to 25°C, $I_D$ = 1.0 mA |
| $R_{DS(on)}$ | Static Drain-to-Source On-State Resistance | — | — | 0.27 | Ω | $V_{GS}$ = 10V, $I_D$ = 13A ④ |
| | | — | — | 0.31 | | $V_{GS}$ = 10V, $I_D$ = 21A |
| $V_{GS(th)}$ | Gate Threshold Voltage | 2.0 | — | 4.0 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 μA |
| gfs | Forward Transconductance | 13 | — | — | S (℧) | $V_{DS}$ = 15V, $I_{DS}$ = 13A ④ |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | — | — | 25 | μA | $V_{DS}$ = Max. Rating, $V_{GS}$ = 0V |
| | | — | — | 250 | | $V_{DS}$ = 0.8 x Max. Rating<br>$V_{GS}$ = 0V, $T_J$ = 125°C |
| $I_{GSS}$ | Gate-to-Source Leakage Forward | — | — | 100 | nA | $V_{GS}$ = 20V |
| $I_{GSS}$ | Gate-to-Source Leakage Reverse | — | — | −100 | | $V_{GS}$ = −20V |
| $Q_g$ | Total Gate Charge | — | — | 190 | nC | $V_{GS}$ = 10V, $I_D$ = 21A |
| $Q_{gs}$ | Gate-to-Source Charge | — | — | 27 | | $V_{DS}$ = 0.5 x Max. Rating |
| $Q_{gd}$ | Gate-to-Drain ("Miller") Charge | — | — | 135 | | See Fig. 6 and 14 |
| $t_{d(on)}$ | Turn-On Delay Time | — | — | 35 | ns | $V_{DD}$ = 250V, $I_D$ = 21A, $R_G$ = 2.35Ω |
| $t_r$ | Rise Time | — | — | 120 | | |
| $t_{d(off)}$ | Turn-Off Delay Time | — | — | 130 | | See Fig. 11 |
| $t_f$ | Fall Time | — | — | 98 | | |
| $L_D$ | Internal Drain Inductance | — | 8.7 | — | nH | Measured from the drain lead, 6 mm (0.25 in.) from package to center of die. |
| $L_S$ | Internal Source Inductance | — | 8.7 | — | | Measured from the source lead, 6 mm (0.25 in.) from package to source bonding pad. |
| $C_{iss}$ | Input Capacitance | — | 4300 | — | pF | $V_{GS}$ = 0V, $V_{DS}$ = 25V |
| $C_{oss}$ | Output Capacitance | — | 1000 | — | | f = 1.0 MHz |
| $C_{rss}$ | Reverse Transfer Capacitance | — | 250 | — | | See Fig. 5 |

Modified MOSFET symbol showing the internal inductances.

## Source-Drain Diode Ratings and Characteristics

| | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current (Body Diode) | — | — | 21 | A | Modified MOSFET symbol showing the integral Reverse p-n junction rectifier.  |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ① | — | — | 84 | | |
| $V_{SD}$ | Diode Forward Voltage | — | — | 1.8 | V | $T_J$ = 25°C, $I_S$ = 21A, $V_{GS}$ = 0V ④ |
| $t_{rr}$ | Reverse Recovery Time | — | — | 580 | nS | $T_J$ = 25°C, $I_F$ = 21A, di/dt ≤ 100 A/μs ④ |
| $Q_{RR}$ | Reverse Recovery Charge | — | — | 8.1 | μC | $V_{DD}$ ≤ 50V |
| $t_{on}$ | Forward Turn-On Time | Intrinsic turn-on time is negligible. Turn-on speed is substantially controlled by $L_S$ + $L_D$. | | | | |

## Thermal Resistance

| | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $R_{thJC}$ | Junction-to-Case | — | — | 0.42 | K/W ⑤ | |
| $R_{thCS}$ | Case-to-Sink | — | 0.21 | — | | Mounting surface flat, smooth, and greased |
| $R_{thJA}$ | Junction-to-Ambient | — | — | 30 | | Typical socket mount |

① Repetitive Rating; Pulse width limited by maximum junction temperature (see figure 9) Refer to current HEXFET reliability report

② @ $V_{DD}$ = 50V, Starting $T_J$ = 25°C, L ≥ 2.0 mH, $R_G$ = 25Ω, Peak $I_L$ = 21A

③ $I_{SD}$ ≤ 21A, di/dt ≤ 160 A/μs, $V_{DD}$ ≤ $BV_{DSS}$, $T_J$ ≤ 150°C Suggested $R_G$ = 2.35Ω

④ Pulse width ≤ 300 μs; Duty Cycle ≤ 2%

⑤ K/W = °C/W W/K = W/°C

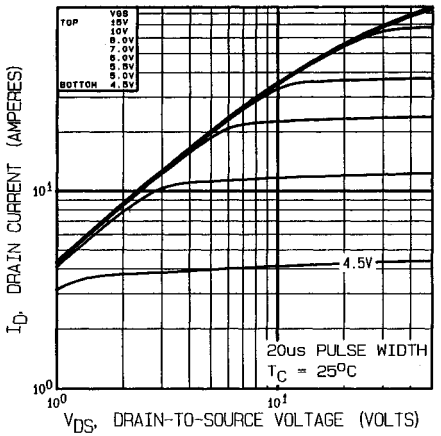



Fig. 1 — Typical Output Characteristics, $T_C$ = 25°C

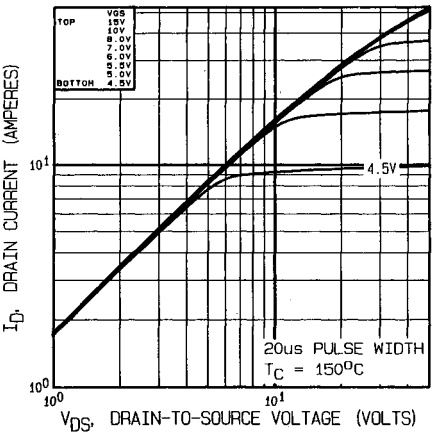



Fig. 2 — Typical Output Characteristics, $T_C$ = 150°C

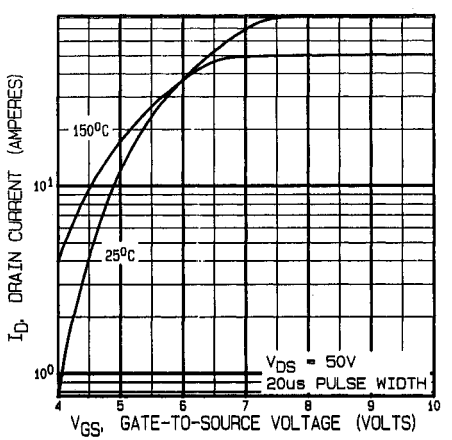



Fig. 3 — Typical Transfer Characteristics

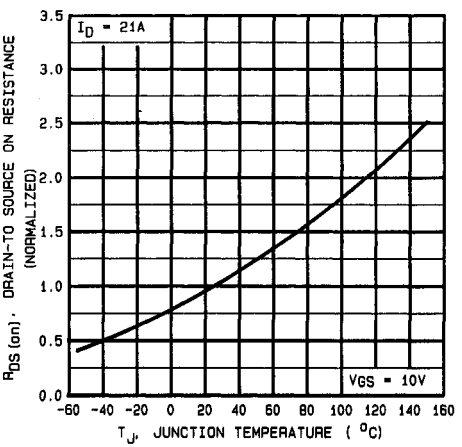



Fig. 4 — Normalized On-Resistance Vs. Temperature

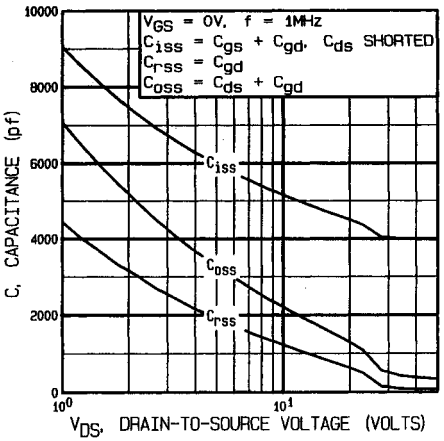



**Fig. 5 — Typical Capacitance Vs. Drain-to-Source Voltage**

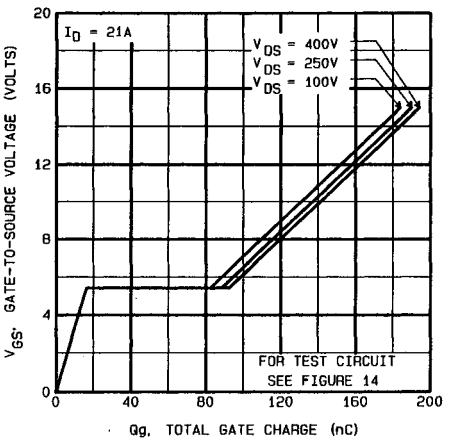



**Fig. 6 — Typical Gate Charge Vs. Gate-to-Source Voltage**

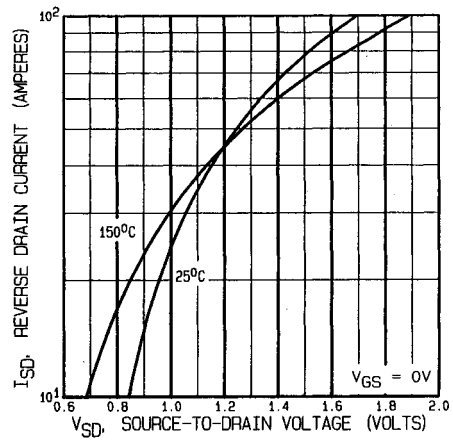



**Fig. 7 — Typical Source-Drain Diode Forward Voltage**

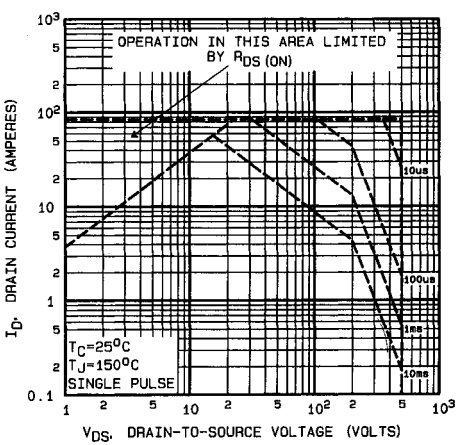



**Fig. 8 — Maximum Safe Operating Area**

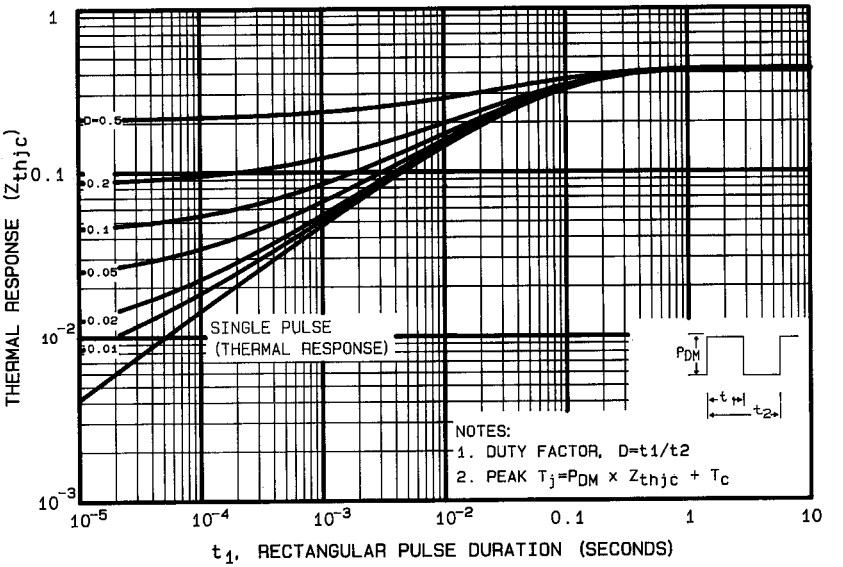



**Fig. 9 — Maximum Effective Transient Thermal Impedance, Junction-to-Case Vs. Pulse Duration**

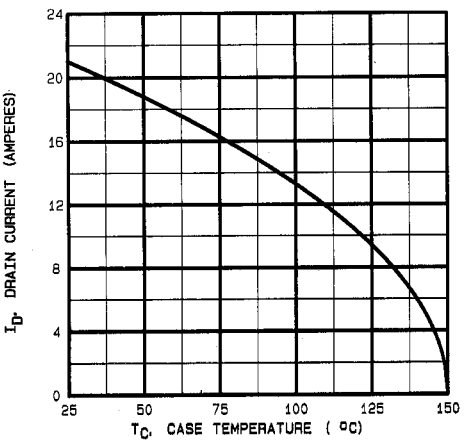



**Fig. 10 — Maximum Drain Current Vs. Case Temperature**

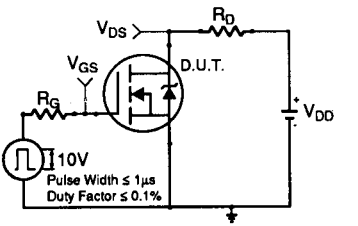



**Fig. 11a — Switching Time Test Circuit**

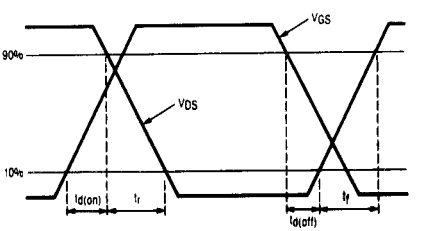



**Fig. 11b — Switching Time Waveforms**

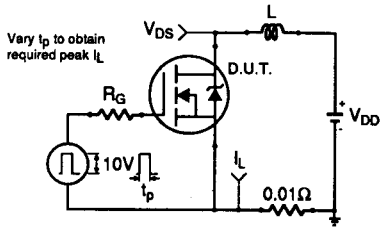



Fig. 12a — Unclamped Inductive Test Circuit

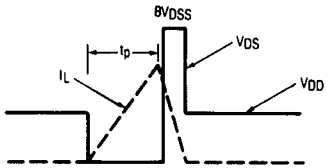



Fig. 12b — Unclamped Inductive Waveforms

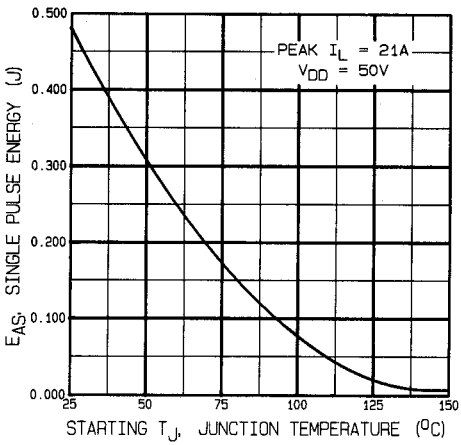
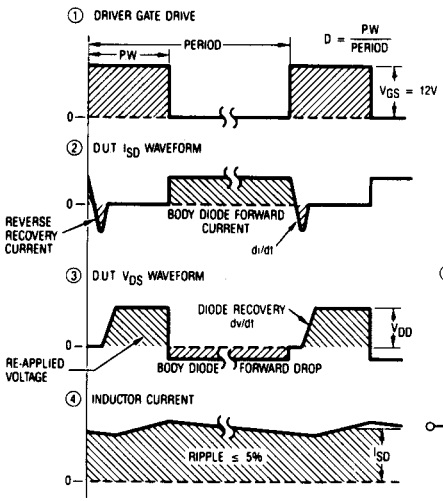



Fig. 12c — Maximum Avalanche Energy Vs. Starting Junction Temperature



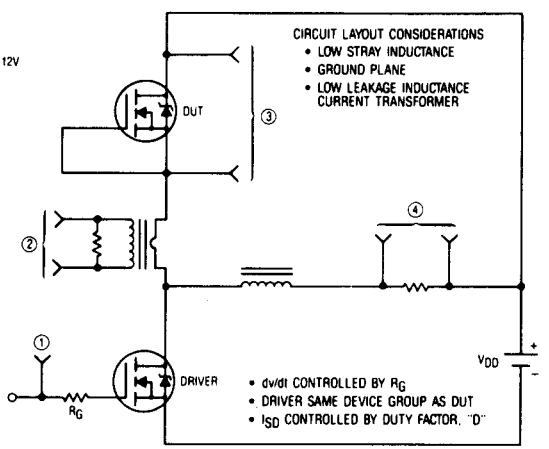




Fig. 13 — Peak Diode Recovery dv/dt Test Circuit

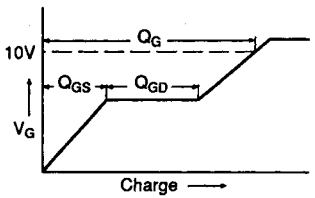



Fig. 14a — Basic Gate Charge Waveform

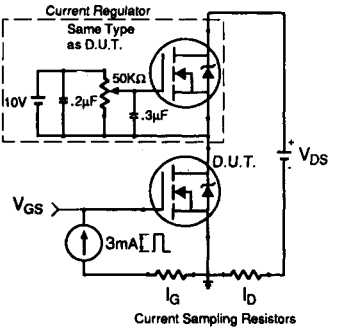



Fig. 14b — Gate Charge Test Circuit

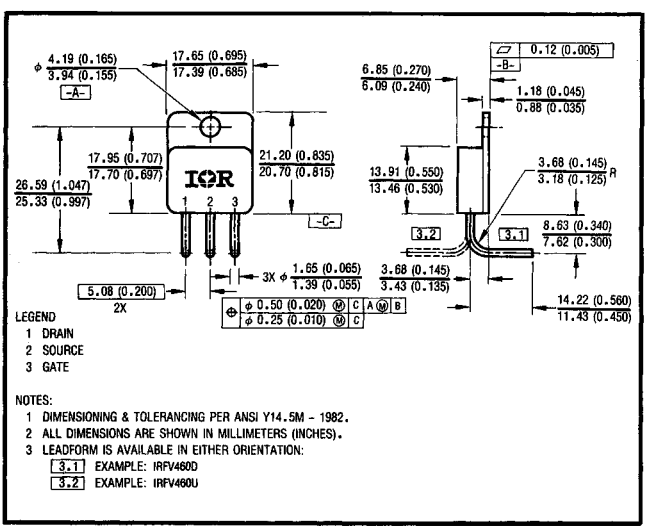



Fig. 15 – Optional Leadforms for Outline TO-258

**BERYLLIA WARNING PER MIL-S-19500**

**Packages containing beryllia shall not be ground, sandblasted, machined, or have other operations performed on them which will produce beryllia or beryllium dust. Furthermore, beryllium oxide packages shall not be placed in acids that will produce fumes containing beryllium.**

## IRFY Series Data Sheet

The IRFY Data Sheet describes 12 devices, 8 N-Channel and 4 P-Channel, all contained in the TO-257AB package. This data sheet is arranged to show common tabular and graphical information between devices.

Absolute maximum ratings and parametric data are presented in tabular format with devices grouped according to generically shared parameters. For each parametric rating, devices are categorized by N and P channel and listed in alpha-numeric order. The conditions specified for a given parametric test are provided in the right hand column of each table.

Graphical information is grouped by devices in alphabetical order. Where the information is device specific, we have assigned a numeric character for the graph type and an alpha character to a given device. (See Table A below). Where graphs are polarity specific as in figures 10, 12, 14 and 15, we have indicated N-Channel or P-Channel. The Thermal Impedance Graph (Fig. 11) is the only exception where a graph is common to both N-Channel and P-Channel devices since the thermal impedance is only dependent on the die size and package.

In Table A below, a legend is provided cross referencing the part number to its assigned alpha code. A given device will retain this alpha code for each device specific graph.

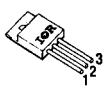
**Table A**

| DEVICE | ALPHA DESIGNATION |
|---|---|
| IRFY044 | a |
| IRFY120 | b |
| IRFY130 | c |
| IRFY140 | d |
| IRFY240 | e |
| IRFY340 | f |
| IRFY430 | g |
| IRFY440 | h |
| IRFY9120 | i |
| IRFY9130 | j |
| IRFY9140 | k |
| IRFY9240 | l |

# HEXFET, CECC Qualified — Europe

TO257/HEXFET/N-Channel

| Basic Type | $V_{DS}$ (V) | $R_{DS(on)}$ (Ohms) | CECC Specification | Issue No. | Issue Date | Level of Quality Assessment and CECC 50 000 Screen Level Options | Case Outline |
|---|---|---|---|---|---|---|---|
| IRFY044(M) | 60 | 0.03 | 50 012-062 | | | E-,EA,EB,EC,ED | **TO-257AA** Y-PAK |
| IRFY120(M) | 100 | 0.31 | 50 012-060 | | | E-,EA,EB,EC,ED | |
| IRFY130(M) | 100 | 0.19 | 50 012-061 | | | E-,EA,EB,EC,ED | |
| IRFY140(M) | 100 | 0.092 | 50 012-062 | | | E-,EA,EB,EC,ED | |
| IRFY240(M) | 200 | 0.19 | 50 012-062 | 1 | 10/91 | E-,EA,EB,EC,ED | |
| IRFY340(M) | 400 | 0.55 | 50 012-062 | | | E-,EA,EB,EC,ED | |
| IRFY430(M) | 500 | 1.50 | 50 012-061 | | | E-,EA,EB,EC,ED | |
| IRFY440(M) | 500 | 0.85 | 50 012-062 | | | E-,EA,EB,EC,ED | |
| TO257/HEXFET/P-Channel | | | | | | | |
| IRFY9120(M) | -100 | 0.60 | 50 012-063 | | | E-,EA,EB,EC,ED | |
| IRFY9130(M) | -100 | 0.31 | 50 012-064 | 1 | 10/91 | E-,EA,EB,EC,ED | |
| IRFY9140(M) | -100 | 0.21 | 50 012-065 | | | E-,EA,EB,EC,ED | |
| IRFY9240(M) | -200 | 0.50 | 50 012-065 | | | E-,EA,EB,EC,ED | |




| | 1 | 2 | 3 |
|---|---|---|---|
| IRFY | G | D | S |
| IRFY(M) | D | S | G |

FOR OTHER GOVERNMENT/SPACE QUALIFIED PRODUCTS SEE SECTION E.