

# HiPerFET™ Power MOSFETs

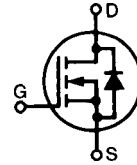
~~IXFH/IXFM15N60~~  
~~IXFH/IXFM20N60~~

| $V_{DSS}$ | $I_{D25}$ | $R_{DS(on)}$  |
|-----------|-----------|---------------|
| 600 V     | 15 A      | 0.50 $\Omega$ |
| 600 V     | 20 A      | 0.35 $\Omega$ |

$t_{rr} \leq 250$  ns

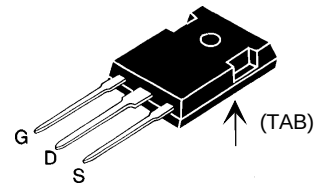
N-Channel Enhancement Mode  
High dv/dt, Low  $t_{rr}$ , HDMOS™ Family

Obsolete:  
~~IXFM15N60~~  
~~IXFM20N60~~



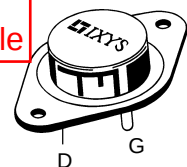
| Symbol    | Test Conditions                                                                                                                      | Maximum Ratings             |                  |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|------------------|
| $V_{DSS}$ | $T_J = 25^\circ\text{C}$ to $150^\circ\text{C}$                                                                                      | 600                         | V                |
| $V_{DGR}$ | $T_J = 25^\circ\text{C}$ to $150^\circ\text{C}$ ; $R_{GS} = 1$ M $\Omega$                                                            | 600                         | V                |
| $V_{GS}$  | Continuous                                                                                                                           | $\pm 20$                    | V                |
| $V_{GSM}$ | Transient                                                                                                                            | $\pm 30$                    | V                |
| $I_{D25}$ | $T_C = 25^\circ\text{C}$                                                                                                             | 15N60                       | 15 A             |
|           |                                                                                                                                      | 20N60                       | 20 A             |
| $I_{DM}$  | $T_C = 25^\circ\text{C}$ , pulse width limited by $T_{JM}$                                                                           | 15N60                       | 60 A             |
|           |                                                                                                                                      | 20N60                       | 80 A             |
| $I_{AR}$  | $T_C = 25^\circ\text{C}$                                                                                                             | 15N60                       | 15 A             |
|           |                                                                                                                                      | 20N60                       | 20 A             |
| $E_{AR}$  | $T_C = 25^\circ\text{C}$                                                                                                             | 30                          | mJ               |
| dv/dt     | $I_S \leq I_{DM}$ , $di/dt \leq 100$ A/ $\mu\text{s}$ , $V_{DD} \leq V_{DSS}$ ,<br>$T_J \leq 150^\circ\text{C}$ , $R_G = 2$ $\Omega$ | 5                           | V/ns             |
| $P_D$     | $T_C = 25^\circ\text{C}$                                                                                                             | 300                         | W                |
| $T_J$     |                                                                                                                                      | -55 ... +150                | $^\circ\text{C}$ |
| $T_{JM}$  |                                                                                                                                      | 150                         | $^\circ\text{C}$ |
| $T_{stg}$ |                                                                                                                                      | -55 ... +150                | $^\circ\text{C}$ |
| $T_L$     | 1.6 mm (0.062 in.) from case for 10 s                                                                                                | 300                         | $^\circ\text{C}$ |
| $M_d$     | Mounting torque                                                                                                                      | 1.13/10                     | Nm/lb.in.        |
| Weight    |                                                                                                                                      | TO-204 = 18 g, TO-247 = 6 g |                  |

TO-247 AD (IXFH)



~~TO-204 AE (IXFM)~~

Package  
unavailable



G = Gate, D = Drain,  
S = Source, TAB = Drain

## Features

- International standard packages
- Low  $R_{DS(on)}$  HDMOS™ process
- Rugged polysilicon gate cell structure
- Unclamped Inductive Switching (UIS) rated
- Low package inductance
  - easy to drive and to protect
- Fast intrinsic Rectifier

## Applications

- DC-DC converters
- Synchronous rectification
- Battery chargers
- Switched-mode and resonant-mode power supplies
- DC choppers
- AC motor control
- Temperature and lighting controls
- Low voltage relays

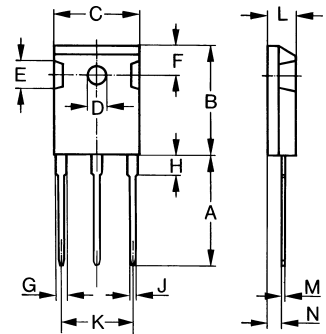
## Advantages

- Easy to mount with 1 screw (TO-247) (isolated mounting screw hole)
- Space savings
- High power density

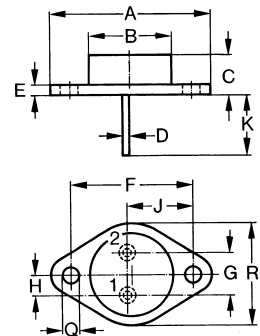
| Symbol       | Test Conditions                                                                                                | Characteristic Values<br>( $T_J = 25^\circ\text{C}$ , unless otherwise specified) |      |                   |
|--------------|----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------|-------------------|
|              |                                                                                                                | min.                                                                              | typ. | max.              |
| $V_{DSS}$    | $V_{GS} = 0$ V, $I_D = 250$ $\mu\text{A}$                                                                      | 600                                                                               |      | V                 |
| $V_{GS(th)}$ | $V_{DS} = V_{GS}$ , $I_D = 4$ mA                                                                               | 2.0                                                                               |      | 4.5 V             |
| $I_{GSS}$    | $V_{GS} = \pm 20$ V, $V_{DS} = 0$                                                                              |                                                                                   |      | $\pm 100$ nA      |
| $I_{DSS}$    | $V_{DS} = 0.8 \cdot V_{DSS}$<br>$V_{GS} = 0$ V                                                                 | $T_J = 25^\circ\text{C}$<br>$T_J = 125^\circ\text{C}$                             |      | 250 $\mu\text{A}$ |
|              |                                                                                                                |                                                                                   |      | 1 mA              |
| $R_{DS(on)}$ | $V_{GS} = 10$ V, $I_D = 0.5 \cdot I_{D25}$<br>Pulse test, $t \leq 300$ $\mu\text{s}$ , duty cycle $d \leq 2$ % | 15N60                                                                             |      | 0.50 $\Omega$     |
|              |                                                                                                                | 20N60                                                                             |      | 0.35 $\Omega$     |

| Symbol       | Test Conditions                                                                                             | Characteristic Values<br>( $T_J = 25^\circ\text{C}$ , unless otherwise specified) |      |          |
|--------------|-------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------|----------|
|              |                                                                                                             | min.                                                                              | typ. | max.     |
| $g_{fs}$     | $V_{DS} = 10\text{ V}; I_D = 0.5 \cdot I_{D25}$ , pulse test                                                | 11                                                                                | 18   | S        |
| $C_{iss}$    | $V_{GS} = 0\text{ V}, V_{DS} = 25\text{ V}, f = 1\text{ MHz}$                                               |                                                                                   | 4500 | pF       |
| $C_{oss}$    |                                                                                                             |                                                                                   | 420  | pF       |
| $C_{rss}$    |                                                                                                             |                                                                                   | 140  | pF       |
| $t_{d(on)}$  | $V_{GS} = 10\text{ V}, V_{DS} = 0.5 \cdot V_{DSS}, I_D = 0.5 \cdot I_{D25}$<br>$R_G = 2\ \Omega$ (External) |                                                                                   | 20   | 40 ns    |
| $t_r$        |                                                                                                             |                                                                                   | 43   | 60 ns    |
| $t_{d(off)}$ |                                                                                                             |                                                                                   | 70   | 90 ns    |
| $t_f$        |                                                                                                             |                                                                                   | 40   | 60 ns    |
| $Q_{g(on)}$  | $V_{GS} = 10\text{ V}, V_{DS} = 0.5 \cdot V_{DSS}, I_D = 0.5 \cdot I_{D25}$                                 |                                                                                   | 151  | 170 nC   |
| $Q_{gs}$     |                                                                                                             |                                                                                   | 29   | 40 nC    |
| $Q_{gd}$     |                                                                                                             |                                                                                   | 60   | 85 nC    |
| $R_{thJC}$   |                                                                                                             |                                                                                   | 0.25 | 0.42 K/W |
| $R_{thCK}$   |                                                                                                             |                                                                                   |      | K/W      |

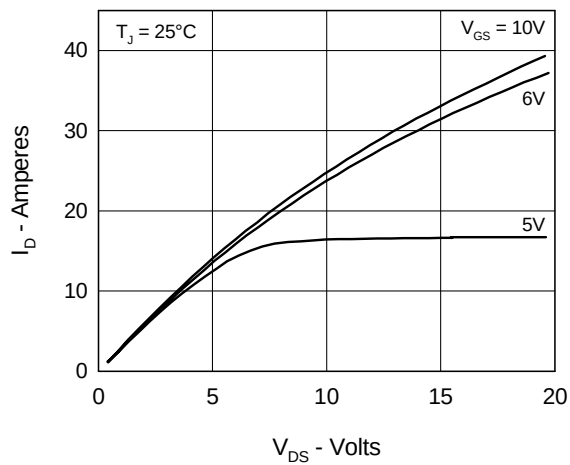
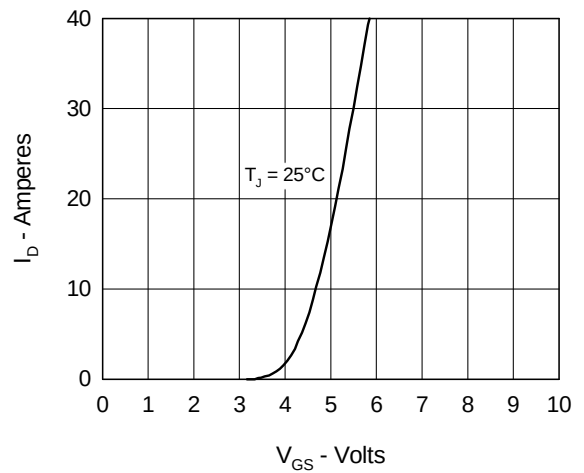
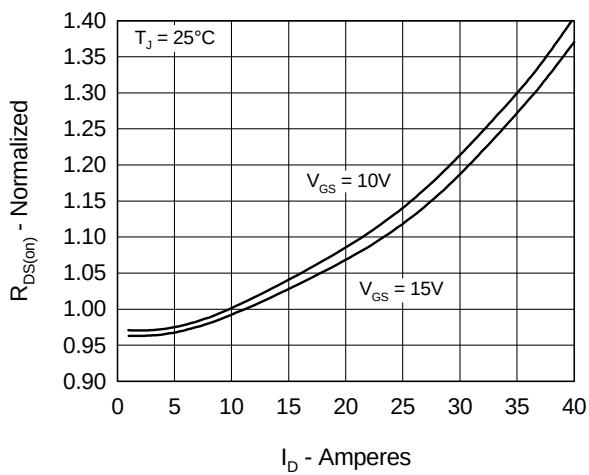
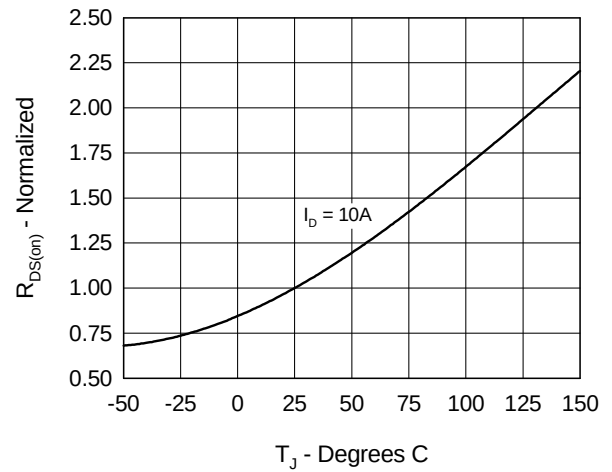
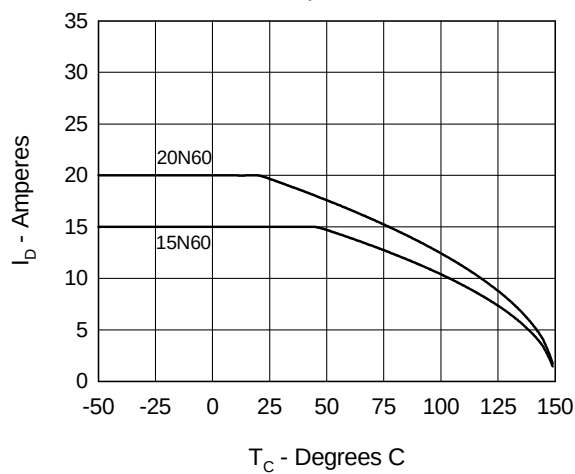
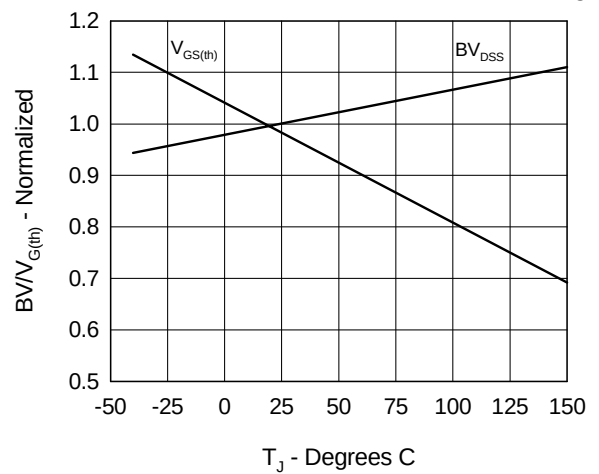
| Source-Drain Diode |                                                                                                      | Characteristic Values<br>( $T_J = 25^\circ\text{C}$ , unless otherwise specified) |      |                 |
|--------------------|------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------|-----------------|
| Symbol             | Test Conditions                                                                                      | min.                                                                              | typ. | max.            |
| $I_S$              | $V_{GS} = 0\text{ V}$                                                                                | 15N60<br>20N60                                                                    |      | 15 A<br>20 A    |
| $I_{SM}$           | Repetitive;<br>pulse width limited by $T_{JM}$                                                       | 15N60<br>20N60                                                                    |      | 60 A<br>80 A    |
| $V_{SD}$           | $I_F = I_S, V_{GS} = 0\text{ V},$<br>Pulse test, $t \leq 300\ \mu\text{s}$ , duty cycle $d \leq 2\%$ |                                                                                   |      | 1.5 V           |
| $t_{rr}$           | $I_F = I_S$<br>$-di/dt = 100\text{ A}/\mu\text{s},$<br>$V_R = 100\text{ V}$                          | $T_J = 25^\circ\text{C}$                                                          |      | 250 ns          |
|                    |                                                                                                      | $T_J = 125^\circ\text{C}$                                                         |      | 400 ns          |
| $Q_{RM}$           |                                                                                                      | $T_J = 25^\circ\text{C}$                                                          |      | 1 $\mu\text{C}$ |
|                    |                                                                                                      | $T_J = 125^\circ\text{C}$                                                         |      | 2 $\mu\text{C}$ |
| $I_{RM}$           |                                                                                                      | $T_J = 25^\circ\text{C}$                                                          |      | 10 A            |
|                    |                                                                                                      | $T_J = 125^\circ\text{C}$                                                         |      | 15 A            |

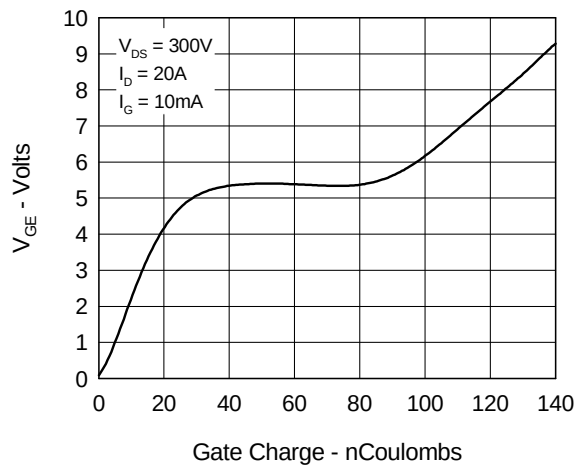
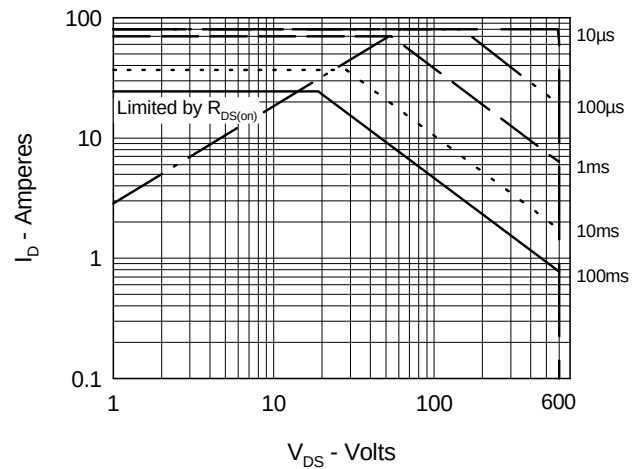
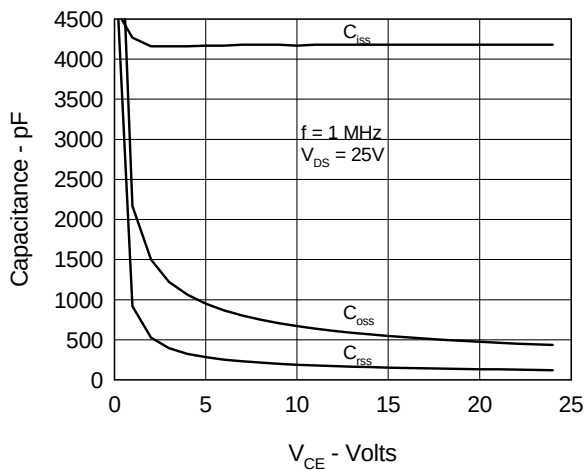
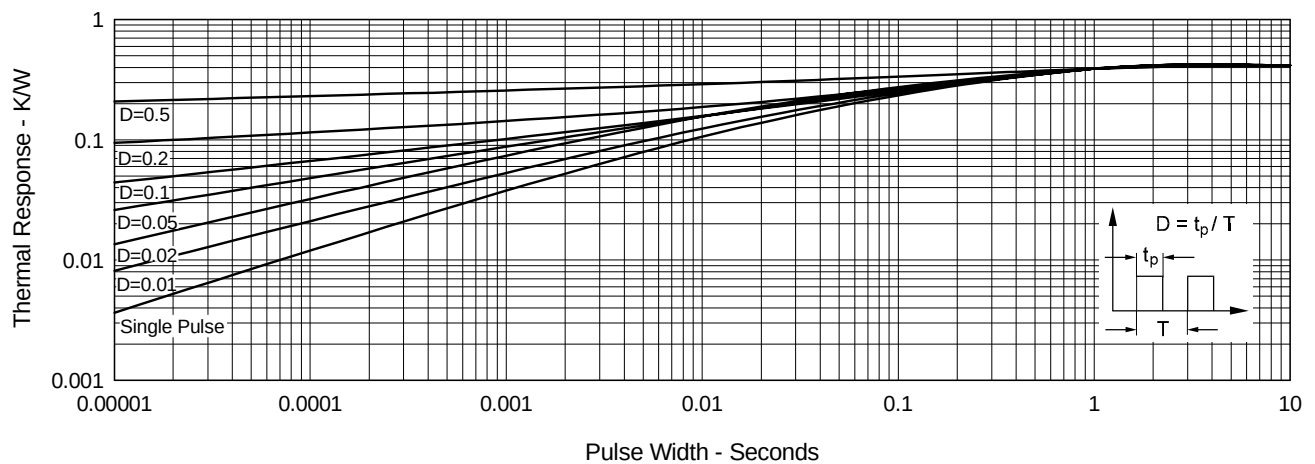
**TO-247 AD (IXFH) Outline**


| Dim. | Millimeter<br>Min. Max. | Inches<br>Min. Max. |
|------|-------------------------|---------------------|
| A    | 19.81 20.32             | 0.780 0.800         |
| B    | 20.80 21.46             | 0.819 0.845         |
| C    | 15.75 16.26             | 0.610 0.640         |
| D    | 3.55 3.65               | 0.140 0.144         |
| E    | 4.32 5.49               | 0.170 0.216         |
| F    | 5.4 6.2                 | 0.212 0.244         |
| G    | 1.65 2.13               | 0.065 0.084         |
| H    | - 4.5                   | - 0.177             |
| J    | 1.0 1.4                 | 0.040 0.055         |
| K    | 10.8 11.0               | 0.426 0.433         |
| L    | 4.7 5.3                 | 0.185 0.209         |
| M    | 0.4 0.8                 | 0.016 0.031         |
| N    | 1.5 2.49                | 0.087 0.102         |

**TO-204 AE (IXFM) Outline**


| Dim. | Millimeter<br>Min. Max. | Inches<br>Min. Max. |
|------|-------------------------|---------------------|
| A    | 38.61 39.12             | 1.520 1.540         |
| B    | - 22.22                 | - 0.875             |
| C    | 6.40 11.40              | 0.252 0.449         |
| D    | 1.45 1.60               | 0.057 0.063         |
| E    | 1.52 3.43               | 0.060 0.135         |
| F    | 30.15 BSC               | 1.187 BSC           |
| G    | 10.67 11.17             | 0.420 0.440         |
| H    | 5.21 5.71               | 0.205 0.225         |
| J    | 16.64 17.14             | 0.655 0.675         |
| K    | 11.18 12.19             | 0.440 0.480         |
| Q    | 3.84 4.19               | 0.151 0.165         |
| R    | 25.16 26.66             | 0.991 1.050         |

**Fig. 1 Output Characteristics**

**Fig. 2 Input Admittance**

**Fig. 3  $R_{DS(on)}$  vs. Drain Current**

**Fig. 4 Temperature Dependence of Drain to Source Resistance**

**Fig. 5 Drain Current vs. Case Temperature**

**Fig. 6 Temperature Dependence of Breakdown and Threshold Voltage**


**Fig.7 Gate Charge Characteristic Curve**

**Fig.8 Forward Bias Safe Operating Area**

**Fig.9 Capacitance Curves**

**Fig.10 Transient Thermal Impedance**




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