



## Description

The HIRFP450APBF uses advanced trench technology to provide excellent  $R_{DS(ON)}$ , low gate charge and operation with gate voltages as low as 4.5V. This device is suitable for use as a Battery protection or in other Switching application.

## General Features

$V_{DS} = 500V$   $I_D = 14A$

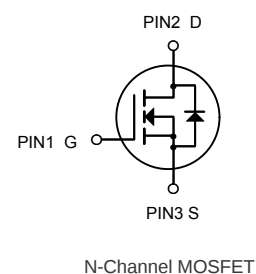
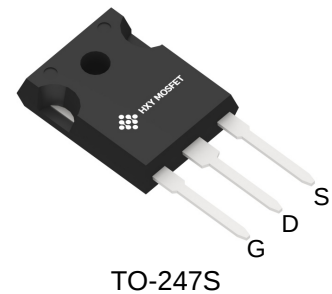
$R_{DS(ON)} < 0.5\Omega @ V_{GS}=10V$

## Application

Battery protection

Load switch

Uninterruptible power supply



## Package Marking and Ordering Information

| Product ID   | Pack    | Brand      | Qty(PCS) |
|--------------|---------|------------|----------|
| HIRFP450APBF | TO-247S | HXY MOSFET | 30       |

## Absolute Maximum Ratings $T_c=25^\circ\text{C}$ unless otherwise noted

| Symbol                        | Parameter                                  | Rating     | Units              |
|-------------------------------|--------------------------------------------|------------|--------------------|
| $V_{DS}$                      | Drain-Source Voltage                       | 500        | V                  |
| $V_{GS}$                      | Gate-Source Voltage                        | $\pm 20$   | V                  |
| $I_D @ T_c=25^\circ\text{C}$  | Continuous Drain Current, $V_{GS} @ 10V^1$ | 14         | A                  |
| $I_D @ T_c=100^\circ\text{C}$ | Continuous Drain Current, $V_{GS} @ 10V^1$ | 8.7        | A                  |
| $I_{DM}$                      | Pulsed Drain Current <sup>2</sup>          | 56         | A                  |
| EAS                           | Single Pulse Avalanche Energy <sup>3</sup> | 760        | mJ                 |
| $I_{AS}$                      | Avalanche Current                          | 8.7        | A                  |
| $P_D @ T_c=25^\circ\text{C}$  | Total Power Dissipation <sup>4</sup>       | 190        | W                  |
| $T_{STG}$                     | Storage Temperature Range                  | -55 to 150 | $^\circ\text{C}$   |
| $T_J$                         | Operating Junction Temperature Range       | -55 to 150 | $^\circ\text{C}$   |
| $R_{thJA}$                    | Maximum Junction-to-Ambient                | 40         | $^\circ\text{C/W}$ |
| $R_{thJC}$                    | Maximum Junction-to-Case (Drain)           | 0.65       | $^\circ\text{C/W}$ |



### Electrical Characteristics (TA=25°C unless otherwise noted)

| Parameter                                 | Symbol                           | Test Conditions                                                                                                                                                  |                                                                                   | Min. | Typ. | Max.  | Unit |
|-------------------------------------------|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------|------|-------|------|
| Static                                    |                                  |                                                                                                                                                                  |                                                                                   |      |      |       |      |
| Drain-Source Breakdown Voltage            | V <sub>DS</sub>                  | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA                                                                                                                   |                                                                                   | 500  | -    | -     | V    |
| V <sub>DS</sub> Temperature Coefficient   | ΔV <sub>DS</sub> /T <sub>J</sub> | Reference to 25 °C, I <sub>D</sub> = 1 mA                                                                                                                        |                                                                                   | -    | 0.63 | -     | V/°C |
| Gate-Source Threshold Voltage             | V <sub>GS(th)</sub>              | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA                                                                                                      |                                                                                   | 2.0  | -    | 4.0   | V    |
| Gate-Source Leakage                       | I <sub>GSS</sub>                 | V <sub>GS</sub> = ± 20 V                                                                                                                                         |                                                                                   | -    | -    | ± 100 | nA   |
| Zero Gate Voltage Drain Current           | I <sub>DSS</sub>                 | V <sub>DS</sub> = 500 V, V <sub>GS</sub> = 0 V                                                                                                                   |                                                                                   | -    | -    | 25    | μA   |
|                                           |                                  | V <sub>DS</sub> = 400 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 125 °C                                                                                          |                                                                                   | -    | -    | 250   |      |
| Drain-Source On-State Resistance          | R <sub>DS(on)</sub>              | V <sub>GS</sub> = 10 V                                                                                                                                           | I <sub>D</sub> = 8.4A <sup>b</sup>                                                | -    | 0.43 | 0.5   | Ω    |
| Forward Transconductance                  | g <sub>fs</sub>                  | V <sub>DS</sub> = 50 V, I <sub>D</sub> = 8.4 A <sup>b</sup>                                                                                                      |                                                                                   | 9.3  | -    | -     | S    |
| Dynamic                                   |                                  |                                                                                                                                                                  |                                                                                   |      |      |       |      |
| Input Capacitance                         | C <sub>iss</sub>                 | V <sub>GS</sub> = 0 V,<br>V <sub>DS</sub> = 25 V,<br>f = 1.0 MHz, see fig. 5                                                                                     |                                                                                   | -    | 2600 | -     | pF   |
| Output Capacitance                        | C <sub>oss</sub>                 |                                                                                                                                                                  |                                                                                   | -    | 720  | -     |      |
| Reverse Transfer Capacitance              | C <sub>rss</sub>                 |                                                                                                                                                                  |                                                                                   | -    | 340  | -     |      |
| Total Gate Charge                         | Q <sub>g</sub>                   | V <sub>GS</sub> = 10 V                                                                                                                                           | I <sub>D</sub> = 14 A, V <sub>DS</sub> = 400 V,<br>see fig. 6 and 13 <sup>b</sup> | -    | -    | 150   | nC   |
| Gate-Source Charge                        | Q <sub>gs</sub>                  |                                                                                                                                                                  |                                                                                   | -    | -    | 20    |      |
| Gate-Drain Charge                         | Q <sub>gd</sub>                  |                                                                                                                                                                  |                                                                                   | -    | -    | 80    |      |
| Turn-On Delay Time                        | t <sub>d(on)</sub>               | V <sub>DD</sub> = 250 V, I <sub>D</sub> = 14 A,<br>R <sub>G</sub> = 6.2 Ω, R <sub>D</sub> = 17 Ω, see fig. 10 <sup>b</sup>                                       |                                                                                   | -    | 17   | -     | ns   |
| Rise Time                                 | t <sub>r</sub>                   |                                                                                                                                                                  |                                                                                   | -    | 47   | -     |      |
| Turn-Off Delay Time                       | t <sub>d(off)</sub>              |                                                                                                                                                                  |                                                                                   | -    | 92   | -     |      |
| Fall Time                                 | t <sub>f</sub>                   |                                                                                                                                                                  |                                                                                   | -    | 44   | -     |      |
| Internal Drain Inductance                 | L <sub>D</sub>                   | Between lead,<br>6 mm (0.25") from<br>package and center of<br>die contact  |                                                                                   | -    | 5.0  | -     | nH   |
| Internal Source Inductance                | L <sub>S</sub>                   |                                                                                                                                                                  |                                                                                   | -    | 13   | -     |      |
| Drain-Source Body Diode Characteristics   |                                  |                                                                                                                                                                  |                                                                                   |      |      |       |      |
| Continuous Source-Drain Diode Current     | I <sub>S</sub>                   | MOSFET symbol<br>showing the<br>integral reverse<br>p - n junction diode    |                                                                                   | -    | -    | 14    | A    |
| Pulsed Diode Forward Current <sup>a</sup> | I <sub>SM</sub>                  |                                                                                                                                                                  |                                                                                   | -    | -    | 56    |      |
| Body Diode Voltage                        | V <sub>SD</sub>                  | T <sub>J</sub> = 25 °C, I <sub>S</sub> = 14 A, V <sub>GS</sub> = 0 V <sup>b</sup>                                                                                |                                                                                   | -    | -    | 1.4   | V    |
| Body Diode Reverse Recovery Time          | t <sub>rr</sub>                  | T <sub>J</sub> = 25 °C, I <sub>F</sub> = 14 A, dI/dt = 100 A/μs <sup>b</sup>                                                                                     |                                                                                   | -    | 540  | 810   | ns   |
| Body Diode Reverse Recovery Charge        | Q <sub>rr</sub>                  |                                                                                                                                                                  |                                                                                   | -    | 4.8  | 7.2   | μC   |
| Forward Turn-On Time                      | t <sub>on</sub>                  | Intrinsic turn-on time is negligible (turn-on is dominated by L <sub>S</sub> and L <sub>D</sub> )                                                                |                                                                                   |      |      |       |      |

### Notes

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).  
b. Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\%$ .



Typical Characteristics  $T_a = 25^\circ\text{C}$ , unless otherwise noted

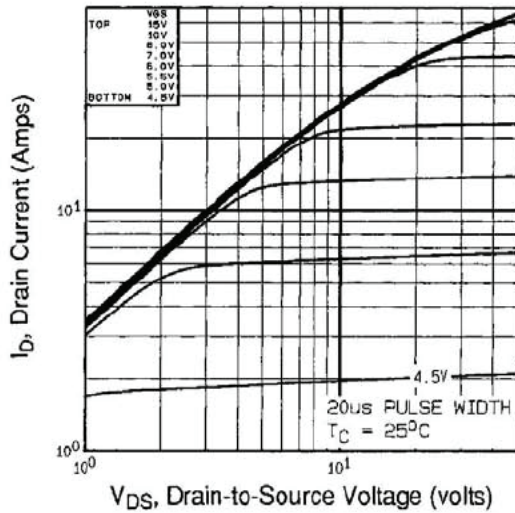


Fig. 1 - Typical Output Characteristics,  $T_C = 25^\circ\text{C}$

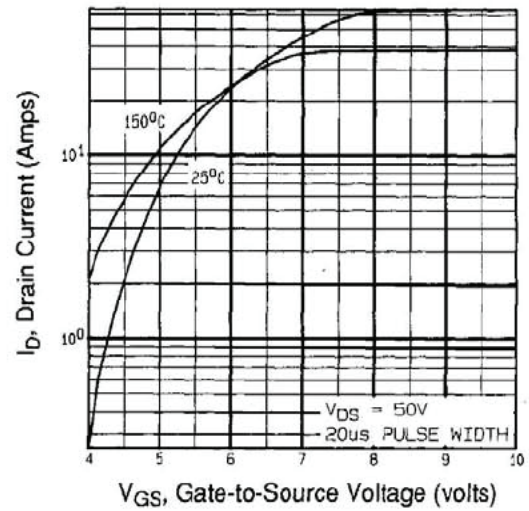


Fig. 3 - Typical Transfer Characteristics

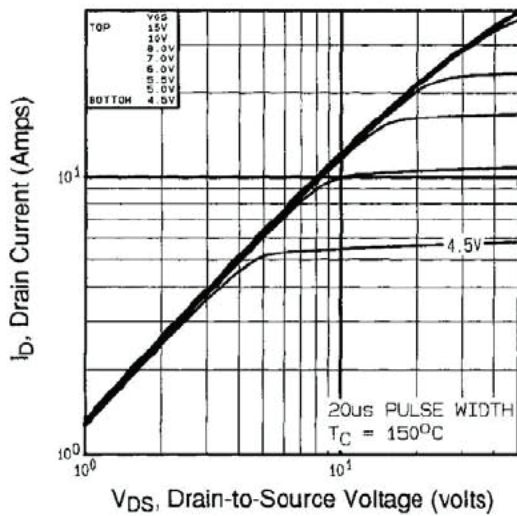


Fig. 2 - Typical Output Characteristics,  $T_C = 150^\circ\text{C}$

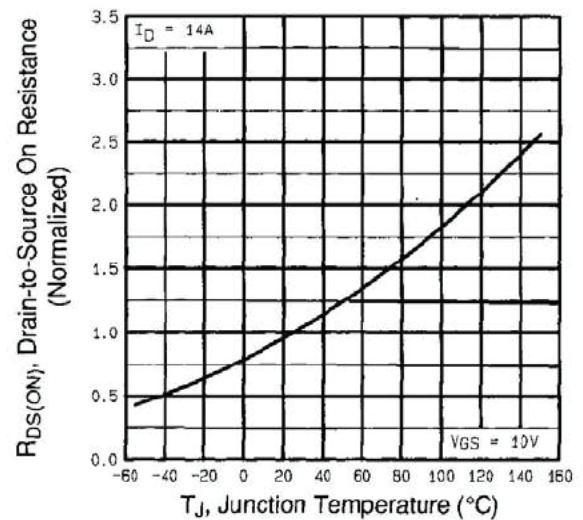


Fig. 4 - Normalized On-Resistance vs. Temperature

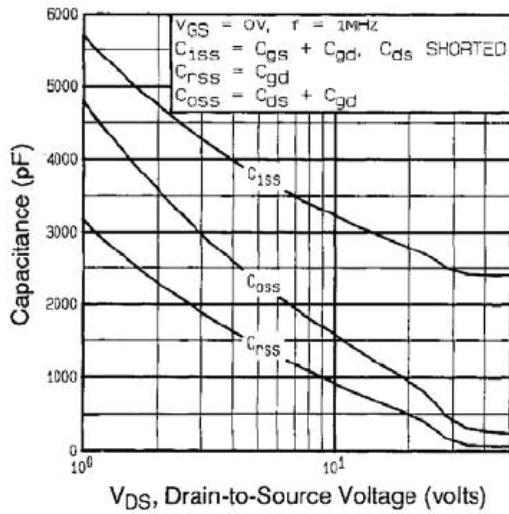


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

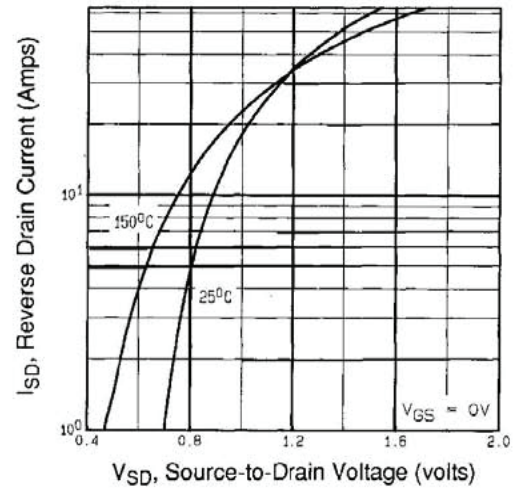


Fig. 7 - Typical Source-Drain Diode Forward Voltage

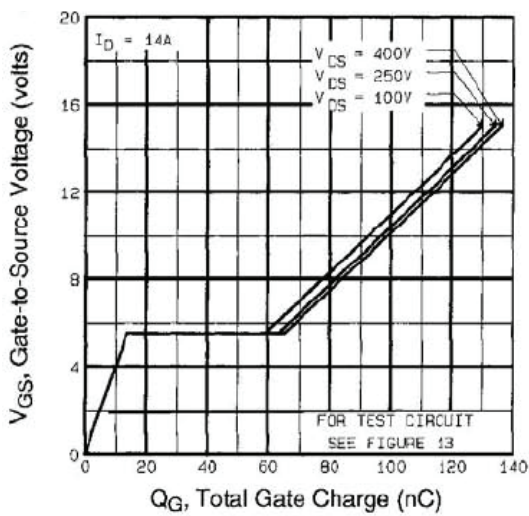


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

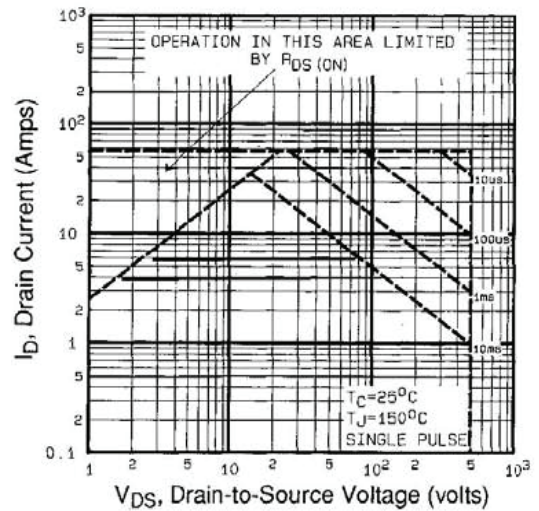


Fig. 8 - Maximum Safe Operating Area

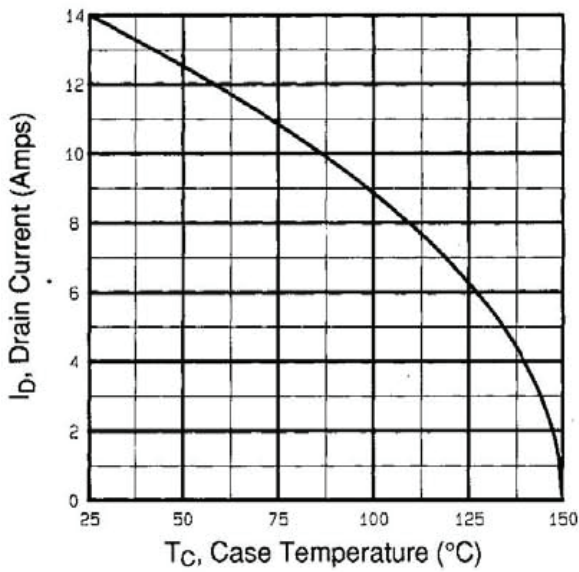


Fig. 9 - Maximum Drain Current vs. Case Temperature

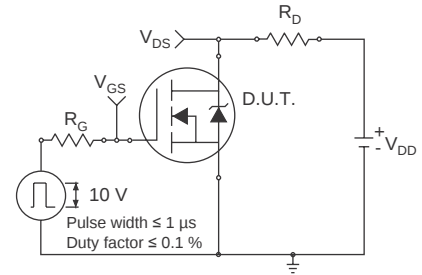


Fig. 10a - Switching Time Test Circuit

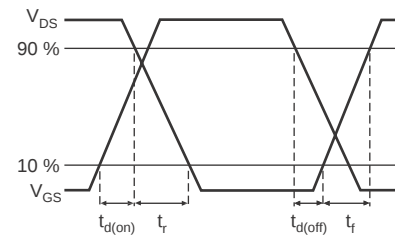


Fig. 10b - Switching Time Waveforms

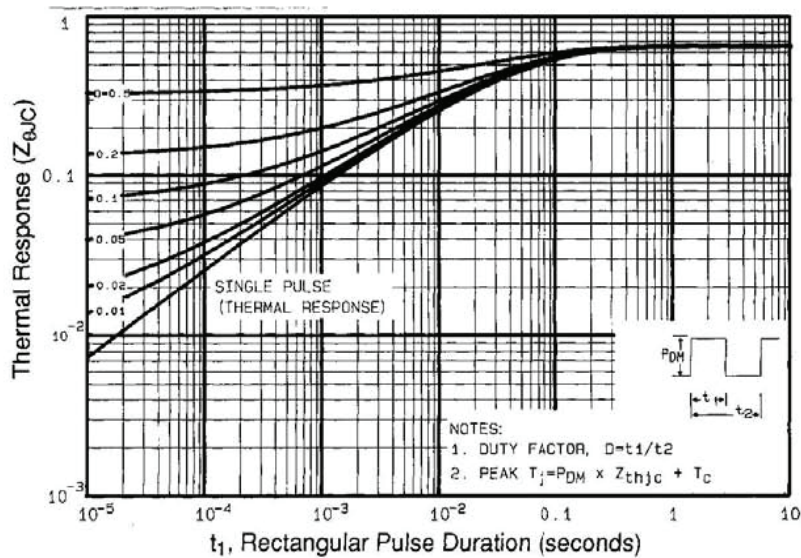


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

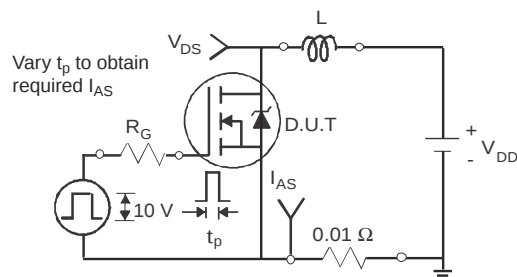


Fig. 12a - Unclamped Inductive Test Circuit

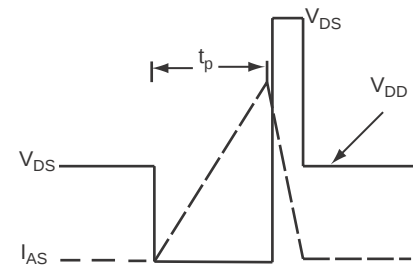
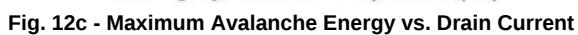


Fig. 12b - Unclamped Inductive Waveforms

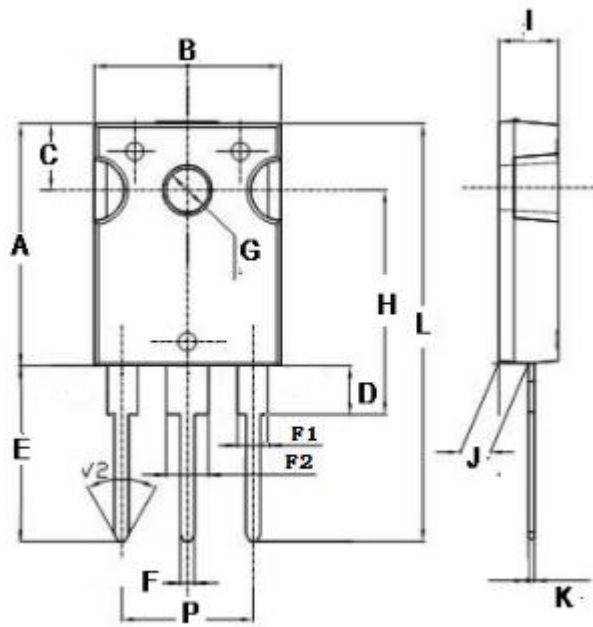


## N-Channel Enhancement Mode MOSFET





## TO-247S Package Information



| Dim | Min  | Max  |
|-----|------|------|
| A   | 20.0 | 22.0 |
| B   | 15.5 | 16.0 |
| C   | 5.7  | 6.3  |
| D   | 4.0  | 4.4  |
| E   | 19.0 | 21.0 |
| F   | 1.1  | 1.3  |
| G   | 3.5  | 3.8  |
| H   | 18.3 | 20.2 |
| I   | 4.9  | 5.2  |
| J   | 2.3  | 2.5  |
| K   | 0.55 | 0.65 |
| L   | 39.0 | 42.0 |
| P   | 10.7 | 10.9 |
| F1  | 1.9  | 2.1  |
| F2  | 2.9  | 3.1  |
| mm  |      |      |



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