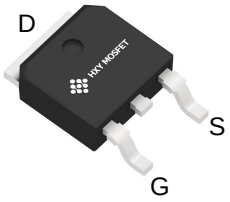
# IRFR9024NTRPBF

P-Channel Enhancement Mode MOSFET

## Description

The IRFR9024NTRPBF 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.

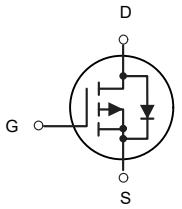



**TO-252-2L**
**(TO-252-2(DPAK))**

## General Features

$V_{DS}$ = -60V $I_D$ =-10 A

$R_{DS(ON)}$ < 140mΩ @ $V_{GS}$=10V




P-Channel MOSFET

## Application

Brushless motor

Load switch

Uninterruptible power supply

## Package Marking and Ordering Information

| Product ID | Pack | Marking | Qty(PCS) |
|---|---|---|---|
| IRFR9024NTRPBF | TO-252-2L(TO-252-2(DPAK)) | 10P06 XXYY | 2500 |

## Absolute Maximum Ratings ($T_C$=25℃unless otherwise noted)

| Symbol | Parameter | Rating | Units |
|---|---|---|---|
| $V_{DS}$ | Drain-Source Voltage | -60 | V |
| $V_{GS}$ | Gate-Source Voltage | ±20 | V |
| $I_D$@$T_C$=25℃ | Continuous Drain Current, $V_{GS}$ @ -10V[1] | -10 | A |
| $I_D$@$T_C$=100℃ | Continuous Drain Current, $V_{GS}$ @ -10V[1] | -8.3 | A |
| $I_D$@$T_A$=25℃ | Continuous Drain Current, $V_{GS}$ @ -10V[1] | -3.3 | A |
| $I_D$@$T_A$=70℃ | Continuous Drain Current, $V_{GS}$ @ -10V[1] | -2.7 | A |
| $I_{DM}$ | Pulsed Drain Current[2] | -26 | A |
| EAS | Single Pulse Avalanche Energy[3] | 29.8 | mJ |
| $I_{AS}$ | Avalanche Current | -24.4 | A |
| $P_D$@$T_C$=25℃ | Total Power Dissipation[4] | 31.3 | W |
| $P_D$@$T_A$=25℃ | Total Power Dissipation[4] | 2 | W |
| $T_{STG}$ | Storage Temperature Range | -55 to 150 | ℃ |
| $T_J$ | Operating Junction Temperature Range | -55 to 150 | ℃ |
| $R_{\theta JA}$ | Thermal Resistance Junction-Ambient [1] | 62 | ℃/W |
| $R_{\theta JC}$ | Thermal Resistance Junction-Case[1] | 4.0 | ℃/W |

## P-Channel Electrical Characteristics (TJ =25 ℃, unless otherwise noted)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| BVDSS | Drain-Source Breakdown Voltage | $V_{GS}$=0V , $I_D$=-250uA | -60 | --- | --- | V |
| △BVDSS/△TJ | $BV_{DSS}$ Temperature Coefficient | Reference to 25℃ , $I_D$=-1mA | --- | -0.03 | --- | V/℃ |
| RDS(ON) | Static Drain-Source On-Resistance[2] | $V_{GS}$=-10V , $I_D$=-3A | --- | 125 | 140 | mΩ |
| | | $V_{GS}$=-4.5V , $I_D$=-2A | --- | 185 | 200 | |
| VGS(th) | Gate Threshold Voltage | $V_{GS}$=$V_{DS}$ , $I_D$ =-250uA | -1.2 | 1.6 | -2.5 | V |
| IDSS | Drain-Source Leakage Current | $V_{DS}$=-48V , $V_{GS}$=0V , $T_J$=25℃ | --- | --- | 1 | uA |
| | | $V_{DS}$=-48V , $V_{GS}$=0V , $T_J$=55℃ | --- | --- | 5 | |
| IGSS | Gate-Source Leakage Current | $V_{GS}$=±20V , $V_{DS}$=0V | --- | --- | ±100 | nA |
| gfs | Forward Transconductance | $V_{DS}$=-5V , $I_D$=-3A | --- | 8.5 | --- | S |
| $Q_g$ | Total Gate Charge (-4.5V) | $V_{DS}$=-48V , $V_{GS}$=-4.5V , $I_D$=-3A | --- | 12.1 | --- | nC |
| Qgs | Gate-Source Charge | | --- | 2.2 | --- | |
| Qgd | Gate-Drain Charge | | --- | 6.3 | --- | |
| Td(on) | Turn-On Delay Time | $V_{DD}$=-15V , $V_{GS}$=-10V , $R_G$=3.3□, $I_D$=-1A | --- | 9.2 | --- | ns |
| $T_r$ | Rise Time | | --- | 20.1 | --- | |
| Td(off) | Turn-Off Delay Time | | --- | 46.7 | --- | |
| $T_f$ | Fall Time | | --- | 9.4 | --- | |
| Ciss | Input Capacitance | $V_{DS}$=-15V , $V_{GS}$=0V , f=1MHz | --- | 1137 | --- | pF |
| Coss | Output Capacitance | | --- | 76 | --- | |
| Crss | Reverse Transfer Capacitance | | --- | 50 | --- | |
| IS | Continuous Source Current[1,5] | $V_G$=$V_D$=0V , Force Current | --- | --- | -13 | A |
| VSD | Diode Forward Voltage[2] | $V_{GS}$=0V , $I_S$=-1A , $T_J$=25℃ | --- | --- | -1.2 | V |

Note :
1、The data tested by surface mounted on a 1 inch 2 FR-4 board with 2OZ copper.
2、The data tested by pulsed , pulse width ≦ 300us , duty cycle ≦ 2%
3、The EAS data shows Max. rating . The test condition is V DD =-25V,V GS =-10V,L=0.1mH,IAS =-24A
4、The power dissipation is limited by 150℃ junction temperature
5、The data is theoretically the same as I D and I DM , in real applications , should be limited by total power dissipation.

## P-Channel Typical Characteristics

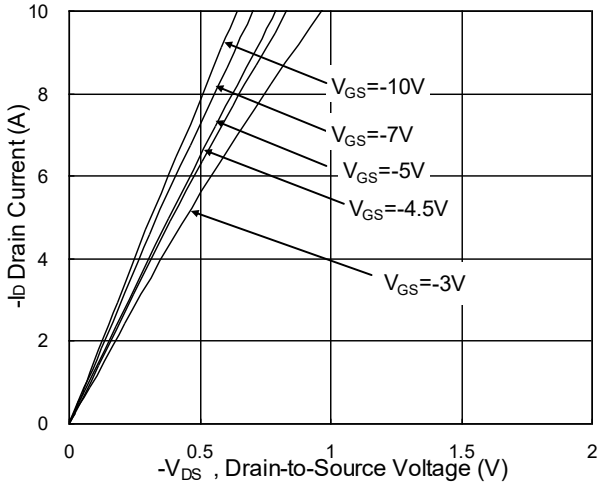



**Fig.1 Typical Output Characteristics**

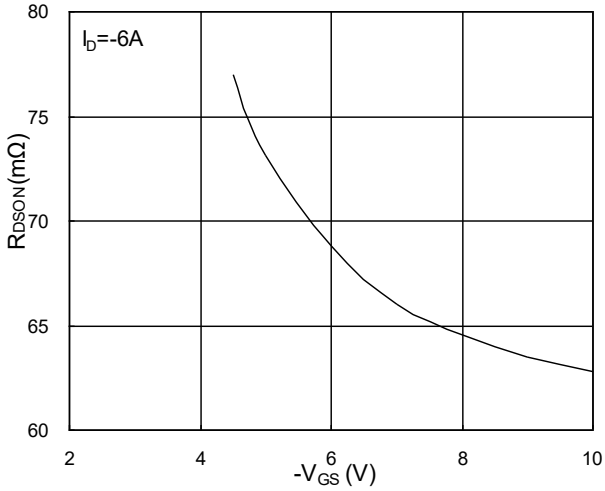



**Fig.2 On-Resistance v.s Gate-Source**

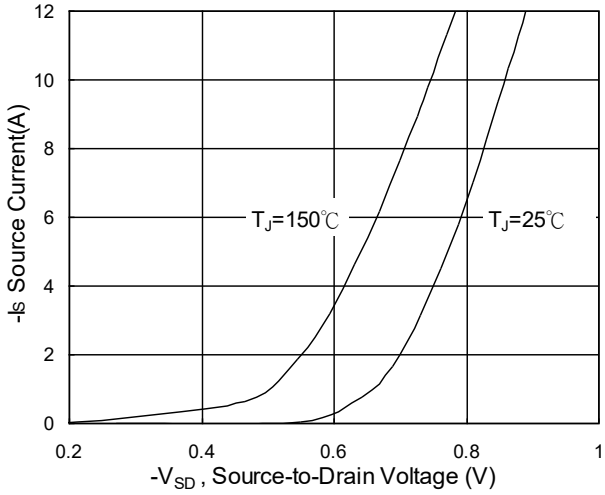



**Fig.3 Forward Characteristics of Reverse**

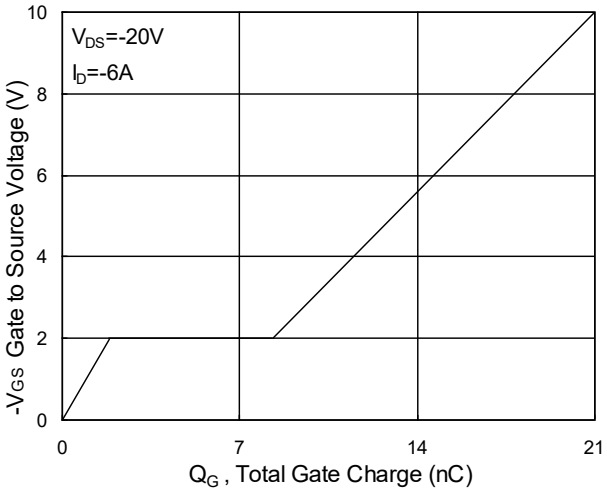



**Fig.4 Gate-Charge Characteristics**

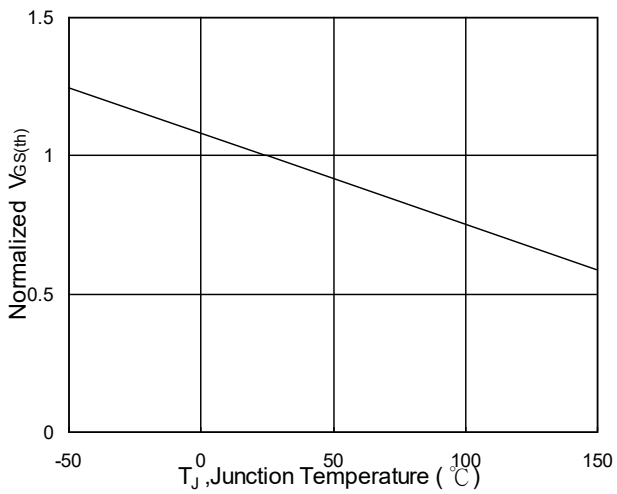



**Fig.5 Normalized $V_{GS(th)}$ v.s $T_J$**

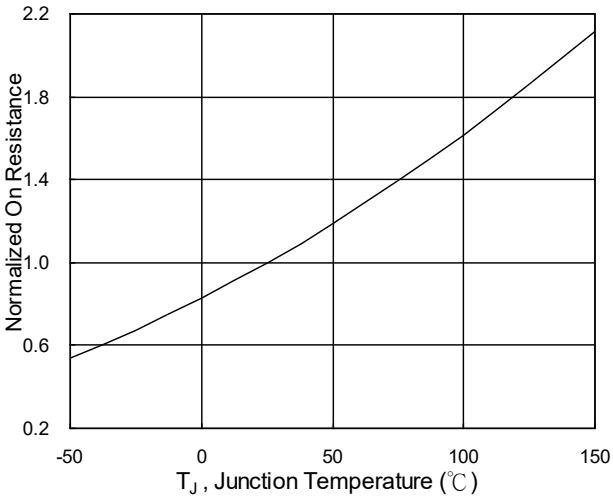



**Fig.6 Normalized $R_{DSON}$ v.s $T_J$**

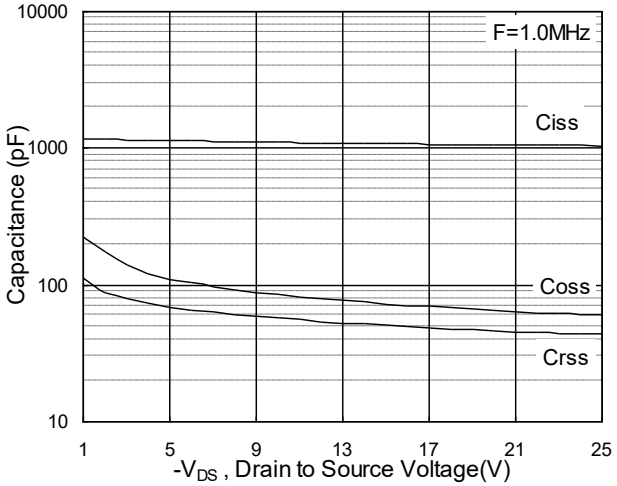



**Fig.7 Capacitance**

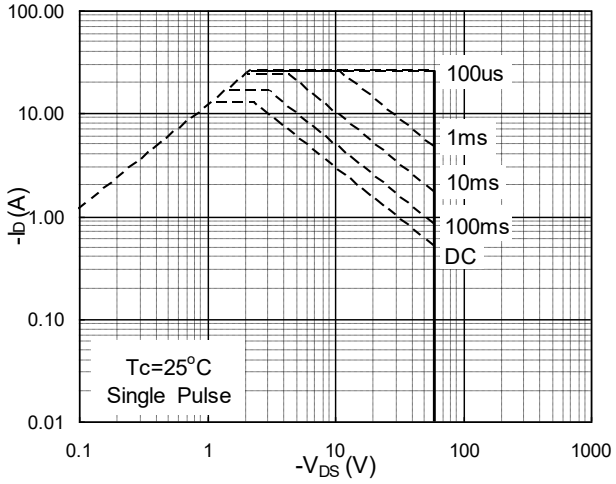



**Fig.8 Safe Operating Area**

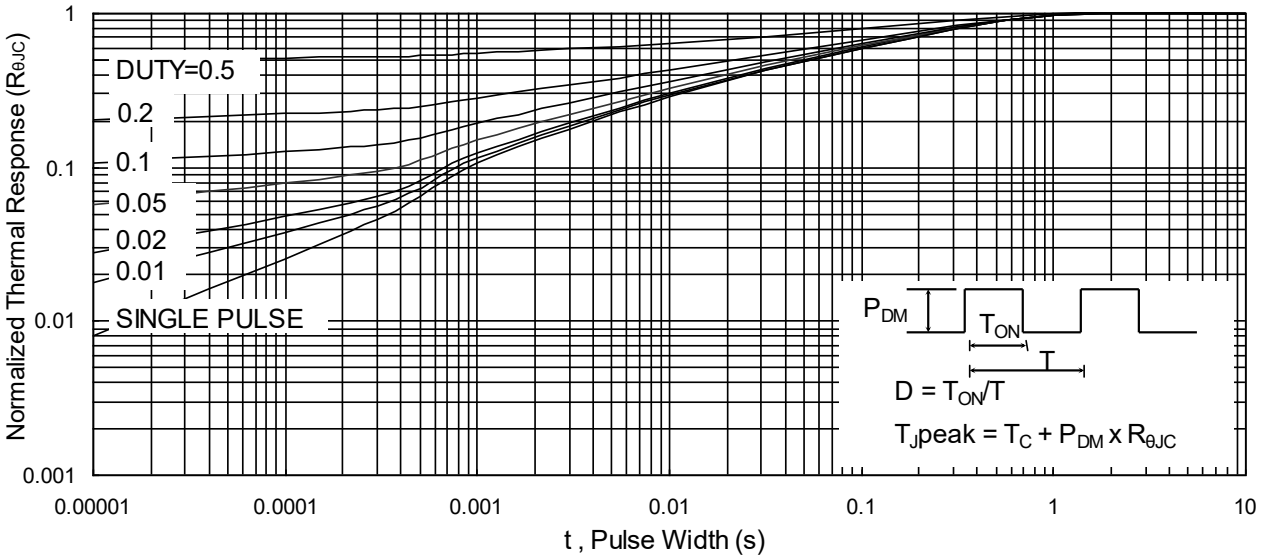



**Fig.9 Normalized Maximum Transient Thermal Impedance**

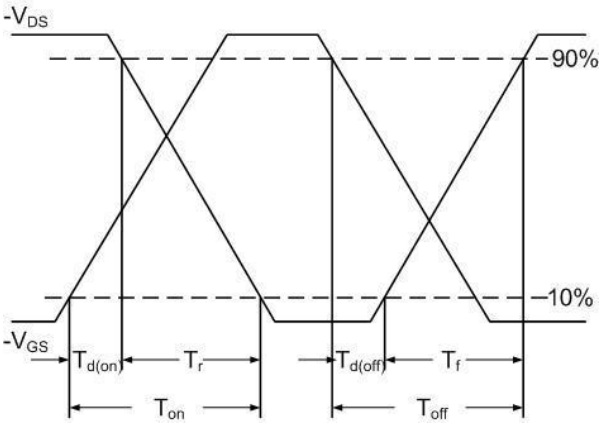



**Fig.10 Switching Time Waveform**

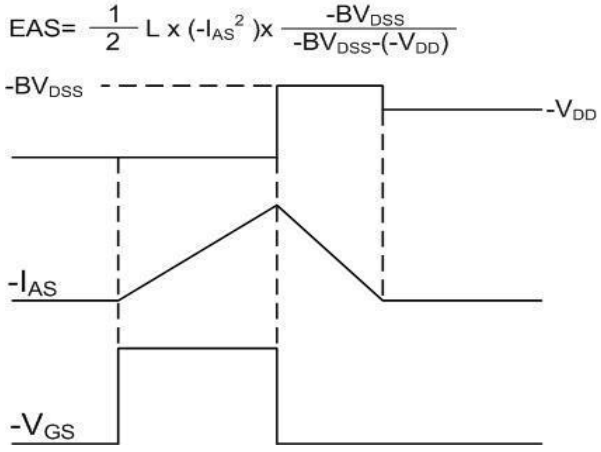
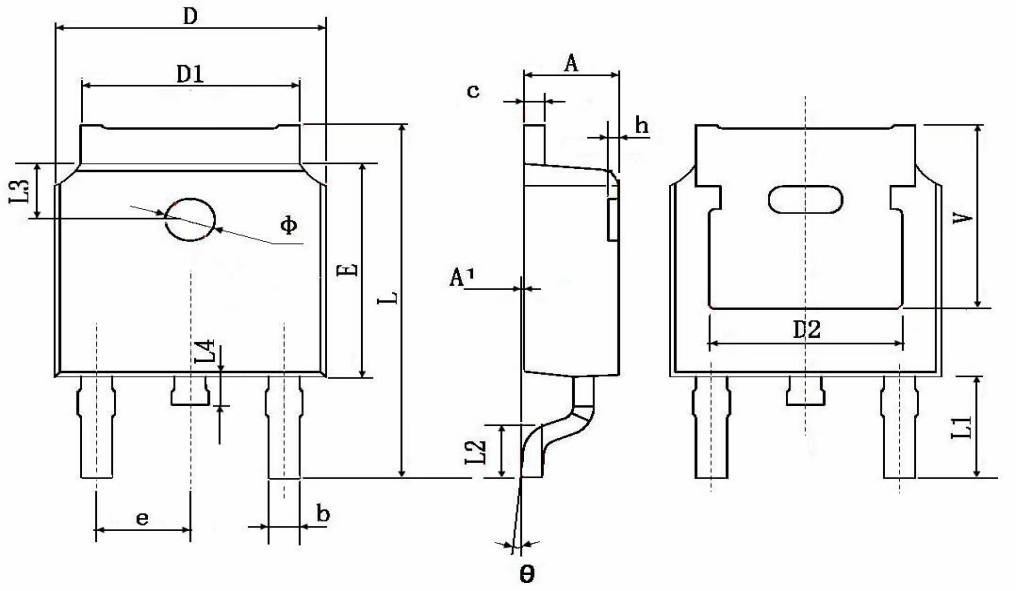



**Fig.11 Unclamped Inductive Switching Waveform**

## TO-252-2L(TO-252-2(DPAK)) Package Information




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min. | Max. | Min. | Max. |
| A | 2.200 | 2.400 | 0.087 | 0.094 |
| A1 | 0.000 | 0.127 | 0.000 | 0.005 |
| b | 0.660 | 0.860 | 0.026 | 0.034 |
| c | 0.460 | 0.580 | 0.018 | 0.023 |
| D | 6.500 | 6.700 | 0.256 | 0.264 |
| D1 | 5.100 | 5.460 | 0.201 | 0.215 |
| D2 | 4.830 TYP. | | 0.190 TYP. | |
| E | 6.000 | 6.200 | 0.236 | 0.244 |
| e | 2.186 | 2.386 | 0.086 | 0.094 |
| L | 9.800 | 10.400 | 0.386 | 0.409 |
| L1 | 2.900 TYP. | | 0.114 TYP. | |
| L2 | 1.400 | 1.700 | 0.055 | 0.067 |
| L3 | 1.600 TYP. | | 0.063 TYP. | |
| L4 | 0.600 | 1.000 | 0.024 | 0.039 |
| Φ | 1.100 | 1.300 | 0.043 | 0.051 |
| θ | 0° | 8° | 0° | 8° |
| h | 0.000 | 0.300 | 0.000 | 0.012 |
| V | 5.350 TYP. | | 0.211 TYP. | |

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HXY2101EI MAX487ESA P6SMB200A US2M HAD8542ARZ HMCP602-I/SN HXY8205ES SS1045
HC3D10170A HXY2300MI P6SMB33CA TPSMB100CA-VR BZT52C3V3S HESDNC5VB1AF-B