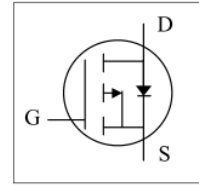


Description

The IRFR0924NTR 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

$V_{DS} = -60V$ $I_D = -20 A$

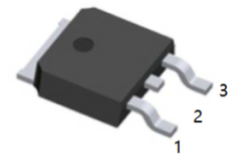
$R_{DS(ON)} < 75m\Omega @ V_{GS}=10V$

Application

Battery protection

Load switch

Uninterruptible power supply



1.G 2.D 3.S
TO-252(DPAK) top view

Absolute Maximum Ratings ($T_A=25^\circ C$ unless otherwise noted)

| Symbol | Parameter | Rating | Units |
|-----------------------|--|------------|--------------|
| V_{DS} | Drain-Source Voltage | -60 | V |
| V_{GS} | Gate-Source Voltage | ± 20 | V |
| $I_D@T_C=25^\circ C$ | Continuous Drain Current, $V_{GS} @ -10V^1$ | -20 | A |
| $I_D@T_C=100^\circ C$ | Continuous Drain Current, $V_{GS} @ -10V^1$ | -12 | A |
| $I_D@T_A=25^\circ C$ | Continuous Drain Current, $V_{GS} @ -10V^1$ | -4.3 | A |
| $I_D@T_A=70^\circ C$ | Continuous Drain Current, $V_{GS} @ -10V^1$ | -3.5 | A |
| I_{DM} | Pulsed Drain Current ² | -36 | A |
| EAS | Single Pulse Avalanche Energy ³ | 35.4 | mJ |
| I_{AS} | Avalanche Current | -26.6 | A |
| $P_D@T_C=25^\circ C$ | Total Power Dissipation ⁴ | 34.7 | W |
| $P_D@T_A=25^\circ C$ | Total Power Dissipation ⁴ | 2 | W |
| T_{STG} | Storage Temperature Range | -55 to 150 | $^\circ C$ |
| T_J | Operating Junction Temperature Range | -55 to 150 | $^\circ C$ |
| $R_{\theta JA}$ | Thermal Resistance Junction-Ambient ¹ | 62 | $^\circ C/W$ |
| $R_{\theta JC}$ | Thermal Resistance Junction-Case ¹ | 3.6 | $^\circ C/W$ |

60V P-Channel Enhancement Mode MOSFET

Electrical Characteristics (T_A=25°C unless otherwise noted)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|--------------------------------------|---|---|------|-------|------|-------|
| BV _{DSS} | Drain-Source Breakdown Voltage | V _{GS} =0V, I _D =-250uA | -60 | --- | --- | V |
| ΔBV _{DSS} / ΔT _J | BV _{DSS} Temperature Coefficient | Reference to 25°C, I _D =-1mA | --- | -0.03 | --- | V/°C |
| R _{DS(on)} | Static Drain-Source On-Resistance | V _{GS} =-10V, I _D =-12A | --- | 53 | 75 | mΩ |
| | | V _{GS} =-4.5V, I _D =-8A | --- | 64 | 105 | |
| V _{GS(th)} | Gate Threshold Voltage | V _{GS} =V _{DS} , I _D =-250uA | -1.2 | 1.5 | -2.5 | V |
| ΔV _{GS(th)} | V _{GS(th)} Temperature Coefficient | | --- | 4.56 | --- | mV/°C |
| I _{DSS} | Drain-Source Leakage Current | V _{DS} =-48V, V _{GS} =0V, T _J =25°C | --- | --- | 1 | uA |
| | | V _{DS} =-48V, V _{GS} =0V, T _J =55°C | --- | --- | 5 | |
| I _{GSS} | Gate-Source Leakage Current | V _{GS} =±20V, V _{DS} =0V | --- | --- | ±100 | nA |
| g _{fs} | Forward Transconductance | V _{DS} =-5V, I _D =-12A | --- | 15.4 | --- | S |
| R _g | Gate Resistance | V _{DS} =0V, V _{GS} =0V, f=1MHz | --- | 13.5 | --- | Ω |
| Q _g | Total Gate Charge (-4.5V) | V _{DS} =-48V, V _{GS} =-4.5V, I _D =-10A | --- | 9.86 | --- | nC |
| Q _{gs} | Gate-Source Charge | | --- | 3.08 | --- | |
| Q _{gd} | Gate-Drain Charge | | --- | 2.95 | --- | |
| T _{d(on)} | Turn-On Delay Time | V _{DD} =-15V, V _{GS} =-10V, R _G =3.3Ω, I _D =-1A | --- | 28.8 | --- | ns |
| T _r | Rise Time | | --- | 19.8 | --- | |
| T _{d(off)} | Turn-Off Delay Time | | --- | 60.8 | --- | |
| T _f | Fall Time | | --- | 7.2 | --- | |
| C _{iss} | Input Capacitance | V _{DS} =-15V, V _{GS} =0V, f=1MHz | --- | 1447 | --- | pF |
| C _{oss} | Output Capacitance | | --- | 97.3 | --- | |
| C _{rss} | Reverse Transfer Capacitance | | --- | 70 | --- | |
| I _S | Continuous Source Current ^{1,5} | V _G =V _D =0V, Force Current | --- | --- | -18 | A |
| I _{SM} | Pulsed Source Current ^{2,5} | | --- | --- | -36 | A |
| V _{SD} | Diode Forward Voltage ² | V _{GS} =0V, I _S =-1A, T _J =25°C | --- | --- | -1.2 | V |

Note :

- 1.The data tested by surface mounted on a 1 inch² 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, I_{AS}=-26.6A
- 4.The power dissipation is limited by 150°C 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.

60V P-Channel Enhancement Mode MOSFET

Typical Characteristics

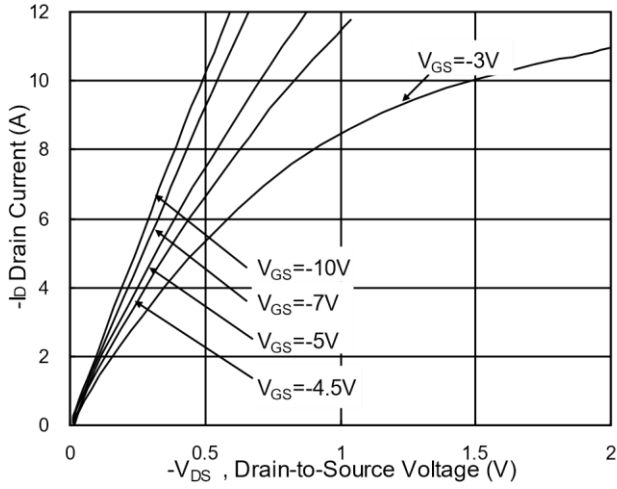


Fig.1 Typical Output Characteristics

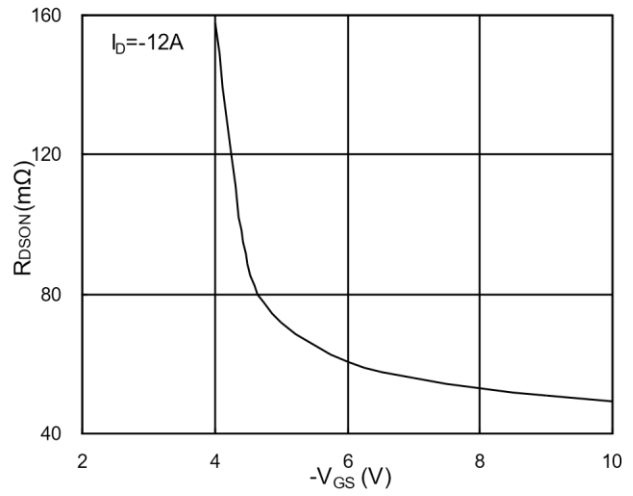


Fig.2 On-Resistance v.s Gate-Source

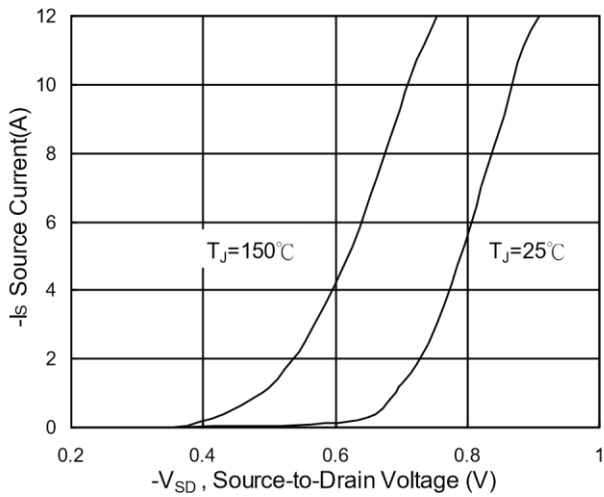


Fig.3 Forward Characteristics of Reverse

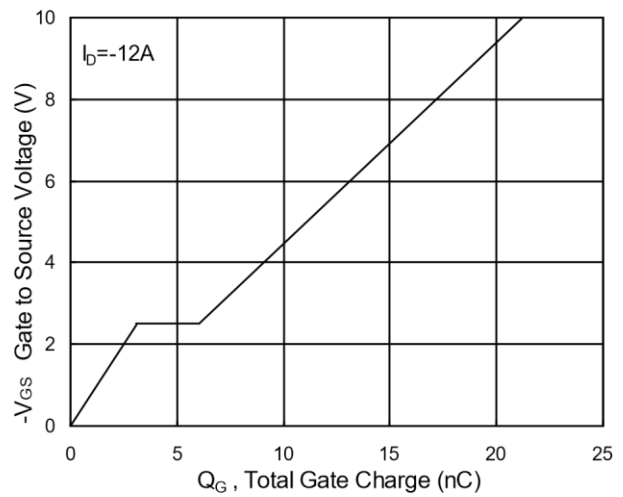


Fig.4 Gate-Charge Characteristics

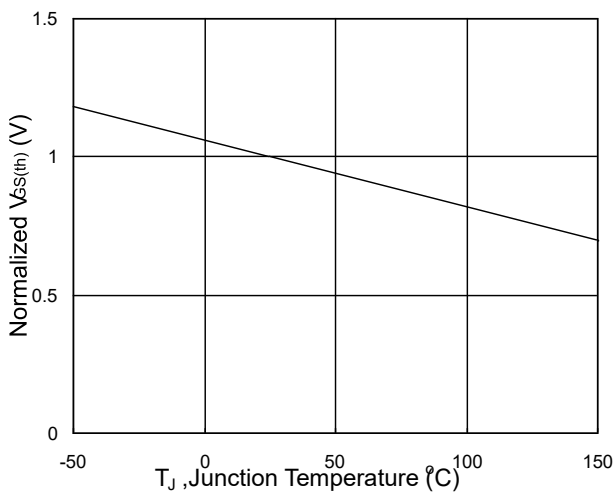


Fig.5 Normalized $V_{GS(th)}$ v.s T_J

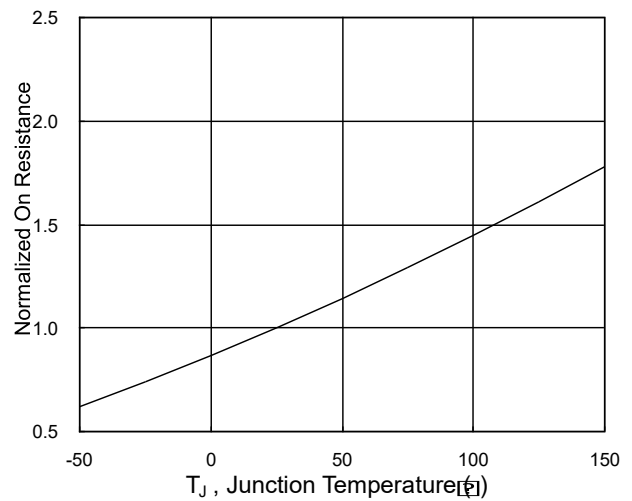


Fig.6 Normalized $R_{DS(on)}$ v.s T_J

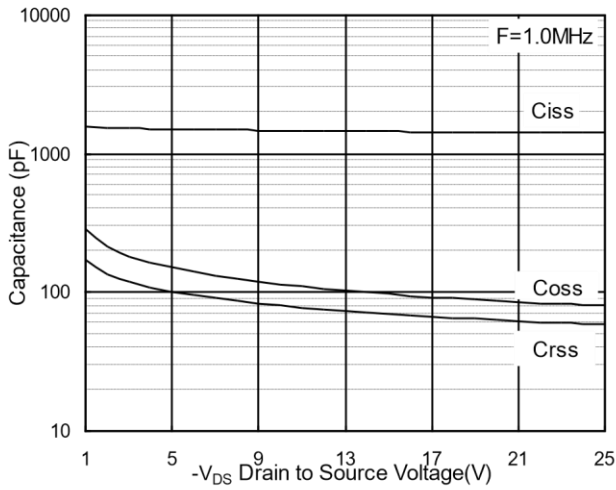


Fig.7 Capacitance

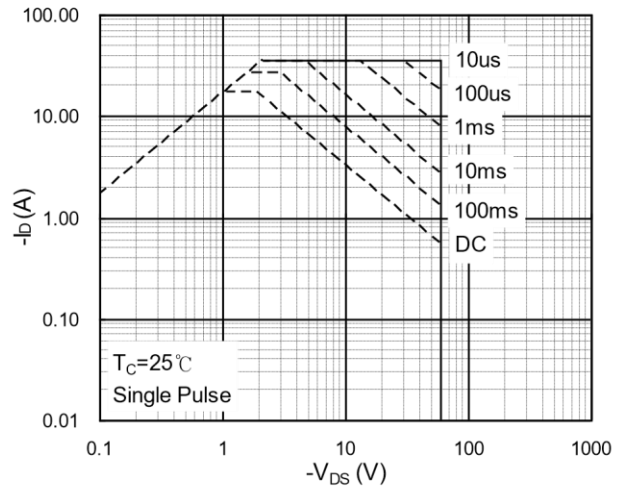


Fig.8 Safe Operating Area

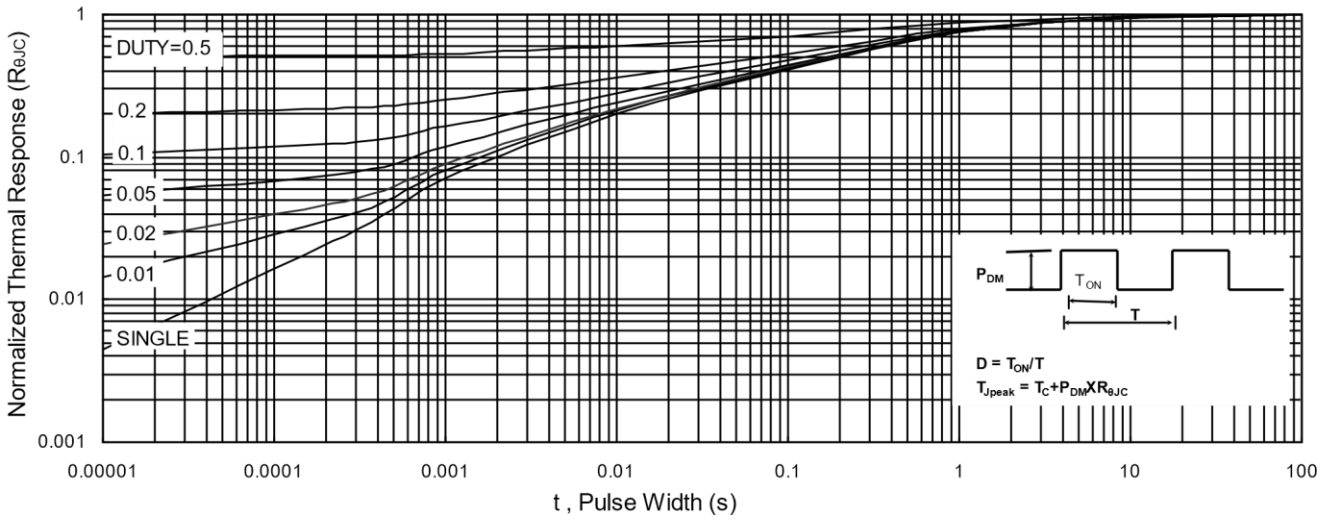


Fig.9 Normalized Maximum Transient Thermal Impedance

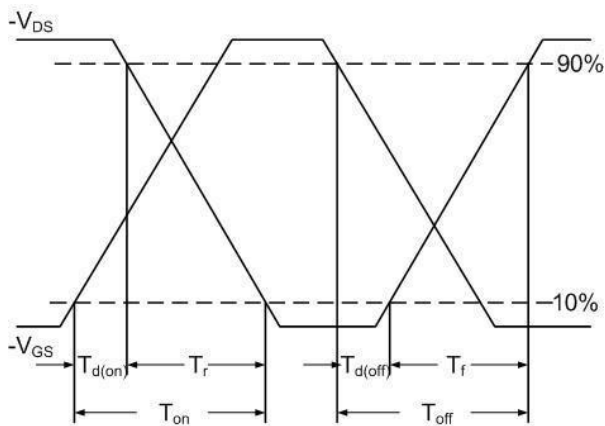


Fig.10 Switching Time Waveform

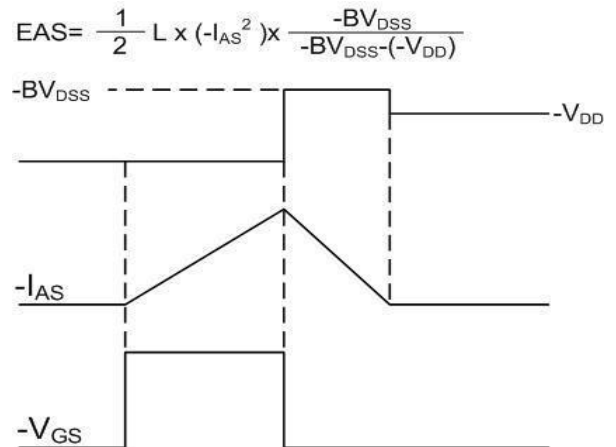
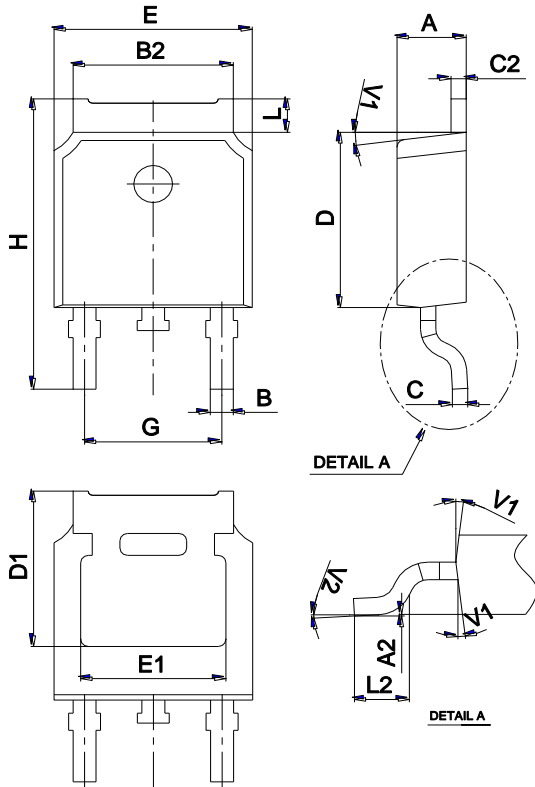


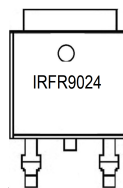
Fig.11 Unclamped Inductive Waveform

Package Mechanical Data TO-252



| Ref. | Dimensions | | | | | |
|------|-------------|------|-------|----------|------|-------|
| | Millimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 2.10 | | 2.50 | 0.083 | | 0.098 |
| A2 | 0 | | 0.10 | 0 | | 0.004 |
| B | 0.66 | | 0.86 | 0.026 | | 0.034 |
| B2 | 5.18 | | 5.48 | 0.202 | | 0.216 |
| C | 0.40 | | 0.60 | 0.016 | | 0.024 |
| C2 | 0.44 | | 0.58 | 0.017 | | 0.023 |
| D | 5.90 | | 6.30 | 0.232 | | 0.248 |
| D1 | 5.30REF | | | 0.209REF | | |
| E | 6.40 | | 6.80 | 0.252 | | 0.268 |
| E1 | 4.63 | | | 0.182 | | |
| G | 4.47 | | 4.67 | 0.176 | | 0.184 |
| H | 9.50 | | 10.70 | 0.374 | | 0.421 |
| L | 1.09 | | 1.21 | 0.043 | | 0.048 |
| L2 | 1.35 | | 1.65 | 0.053 | | 0.065 |
| V1 | | 7° | | | 7° | |
| V2 | 0° | | 6° | 0° | | 6° |

Marking



Ordering information

| Order code | Package | Baseqty | Deliverymode |
|-------------|---------|---------|---------------|
| IRFR9024NTR | TO-252 | 2500 | Tape and reel |