# UMW IRFL9014TR

-60V P-Channel MOSFET

## 1.Description

The SOT-223 package is designed for surface-mounting using vapor phase, infrared, or wave soldering techniques.Its unique package design allows for easy automatic pick and-place as with other SOT or SOP packages but has the added advantage of improved thermal performance due to an enlarged tab for heatsinking.

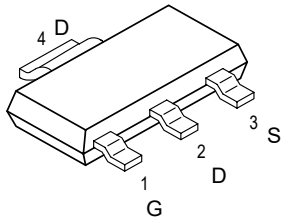
## 2.Features

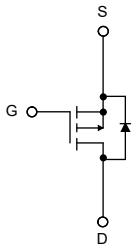
- $V_{DS\ (V)}$=-60V
- $I_D$=-1.8A
- $R_{DS(ON)}$<0.5Ω($V_{GS}$=-10V)

## 3.Pinning information

| Pin | Symbol | Description |
|---|---|---|
| 1 | G | GATE |
| 2,4 | D | DRAIN |
| 3 | S | SOURCE |

**SOT-223 top view**




## 4.Absolute Maximum Ratings $T_C$=25°C unless otherwise noted

| Parameter | | Symbol | Rating | Units |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | -60 | V |
| Gate-Source Voltage | | $V_{GS}$ | ±20 | V |
| Continuous Drain Current ($V_{GS}$ at - 10V, $T_C$=25°C) | | $I_D$ | -1.8 | A |
| Pulsed Drain Current [a] | | $I_{DM}$ | -14 | A |
| Linear Derating Factor | | | 0.025 | °C/W |
| Linear Derating Factor (PCB Mount) [e] | | | 0.017 | °C/W |
| Single Pulse Avalanche Energy [b] | | $E_{AS}$ | 140 | mJ |
| Repetitive Avalanche Current [a] | | $I_{AR}$ | -1.8 | A |
| Repetitive Avalanche Energy [a] | | $E_{AR}$ | 0.31 | mJ |
| Maximum Power Dissipation | $T_C$=25°C | $P_D$ | 3.1 | W |
| Maximum Power Dissipation (PCB Mount) [e] | $T_A$=25°C | | 2 | W |

| | | | | |
|---|---|---|---|---|
| Peak Diode Recovery dV/dt [c] | | dv/dt | -4.5 | V/nS |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{STG}$ | -55 to 150 | °C |
| Soldering Recommendations (Peak Temperature) [d] | for 10 s | | 300 | °C |

Notes:

a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).

b. $V_{DD}$=-25 V, starting $T_J$=25°C, L=50 mH, $R_g$ =25 Ω, $I_{AS}$=-1.8 A (see fig. 12).

c. $I_{SD}$ ≤ - 6.7 A, dI/dt ≤ 90 A/μs, $V_{DD}$ ≤ VDS, $T_J$≤ 150 °C.

d. 1.6 mm from case.

## 5.Thermal Resistance Rating

| Parameter | Symbol | Typ | Max | Units |
|---|---|---|---|---|
| Maximum Junction-to-Ambient (PCB Mount) [a] | $R_{thJA}$ | | 60 | °C/W |
| Maximum Junction-to-Case (Drain) | $R_{thJC}$ | | 40 | °C/W |

Notes:

a. When mounted on 1" square PCB (FR-4 or G-10 material).

## 6.Electrical Characteristics $T_J$=25°C

| Parameter | Symbol | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| Drain-Source Breakdown Voltage | $V_{DS}$ | $I_D$=250μA, $V_{GS}$=0V | -60 | | | V |
| $V_{DS}$ Temperature Coefficient | $\Delta V_{DS}/T_J$ | $I_D$=1mA,Reference to 25°C | | -0.059 | | V/°C |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$=$V_{GS}$, $I_D$=250μA | -2 | | -4 | V |
| Gate-Source Leakage | $I_{GSS}$ | $V_{GS}$=±20V | | | ±100 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$=-60V, $V_{GS}$=0V | | | -100 | μA |
| | | $V_{DS}$=-48V,$V_{GS}$=0V,$T_J$=125°C | | | -500 | μA |
| Drain-Source On-State Resistance | $R_{DS(ON)}$ | $V_{GS}$=-10V, $I_D$=1.1A [b] | | | 0.05 | Ω |
| Forward Transconductance | $g_{FS}$ | $V_{DS}$=-25V, $I_D$=1.1A [b] | 1.3 | | | S |
| Input Capacitance | $C_{iss}$ | $V_{GS}$=0V, $V_{DS}$=25V f=1MHz, see fig. 5 | | 270 | | pF |
| Output Capacitance | $C_{oss}$ | | | 170 | | pF |
| Reverse Transfer Capacitance | $C_{rss}$ | | | 31 | | pF |
| Total Gate Charge | $Q_g$ | $V_{GS}$=-10V, $I_D$=-6.7A $V_{DS}$=-48V see fig. 6 and 13 [b] | | | 12 | nC |
| Gate-Source Charge | $Q_{gs}$ | | | | 3.8 | nC |
| Gate-Drain Charge | $Q_{gd}$ | | | | 5.1 | nC |
| Turn-On Delay Time | $t_{D(on)}$ | $V_{DD}$=-30V, $I_D$=-6.7A $R_G$=24Ω, $R_D$=4Ω see fig. 10 [b] | | 11 | | ns |
| Rise Time | $t_r$ | | | 63 | | ns |
| Turn-Off Delay Time | $t_{D(off)}$ | | | 9.6 | | ns |
| Fall Time | $t_f$ | | | 31 | | ns |
| Internal Drain inductance | $L_D$ | Between lead,6mm (0.25in.) from package and centerof die contact | | 4 | | nH |
| Internal Source inductance | $L_S$ | | | 6 | | nH |

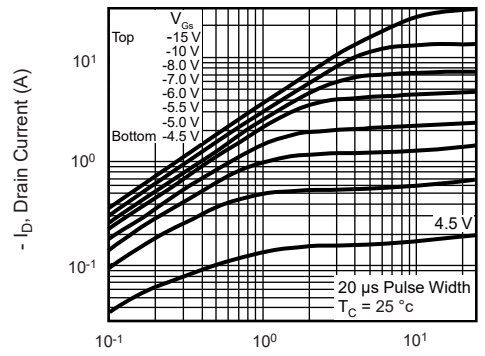
| Source-Drain Ratings and Characteristics | | | | | | |
|---|---|---|---|---|---|---|
| Continuous Source Current (Body Diode) | $I_S$ | MOSFET symbol showing the integral reverse p-n junction diode. | | | -1.8 | A |
| Pulsed Source Current (Body Diode) [a] | $I_{SM}$ | | | | -14 | |
| Diode Forward Voltage | $V_{SD}$ | $T_J$=25°C,$I_S$=-1.8A,$V_{GS}$=0V [b] | | | -5.5 | V |
| Reverse Recovery Time | $t_{rr}$ | $T_J$=25°C, $I_F$=-6.7A | | 80 | 160 | ns |
| Reverse Recovery Charge | $Q_{rr}$ | dI/dt=100A/μs [b] | | 0.096 | 0.19 | μC |
| Forward Turn-On Time | $t_{on}$ | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$+$L_D$) | | | | |

Notes:

a. Repetitive rating; pulse width limited by maximum junction temperature

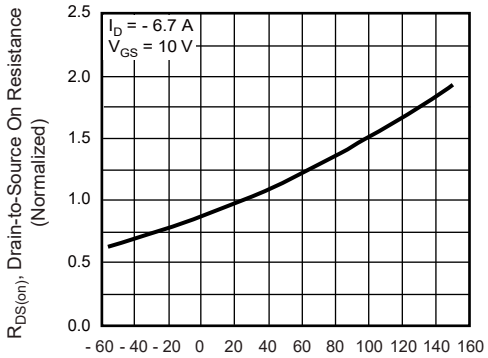
b. Pulse width ≤ 300 μs; duty cycle ≤ 2 %.

## 7.1Typical Characterisitics



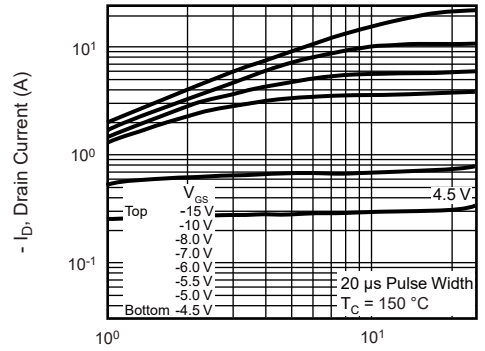

$-V_{DS}$,Drain-to-Source Voltage (V)

Figure 1: Typical Output Characteristics, $T_C$ = 25 °C



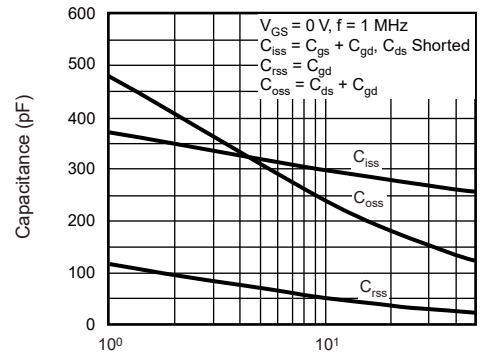

$T_J$,Junction Temperature (°C)

Figure 2: Normalized On-Resistance vs. Temperature



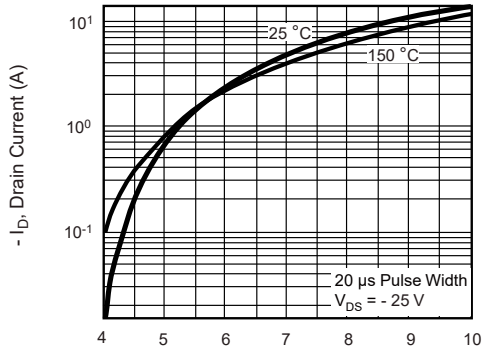

$-V_{DS}$,Drain-to-Source Voltage (V)

Figure 3: Typical Output Characteristics, $T_C$ = 150 °C



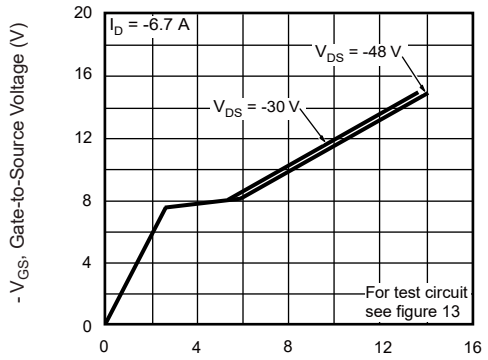

$-V_{DS}$,Drain-to-Source Voltage (V)

Figure 4: Typical Capacitance vs. Drain-to-Source Voltage




$-V_{GS}$,Gate-to-Source Voltage (V)

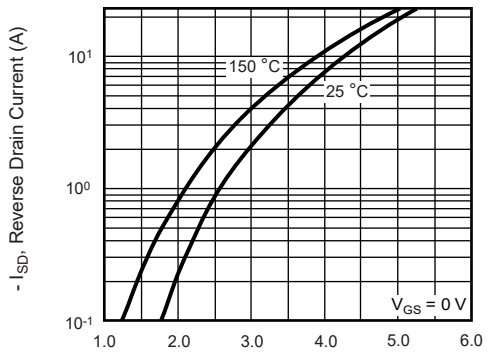
Figure 5: Typical Transfer Characteristics




$Q_G$, Total Gate Charge (nC)

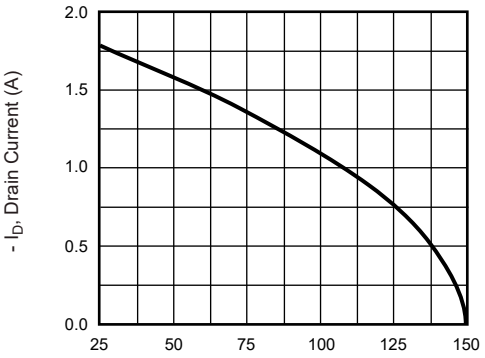
Figure 6: Typical Gate Charge vs. Gate-to-Source Voltage

## 7.2Typical Characterisitics



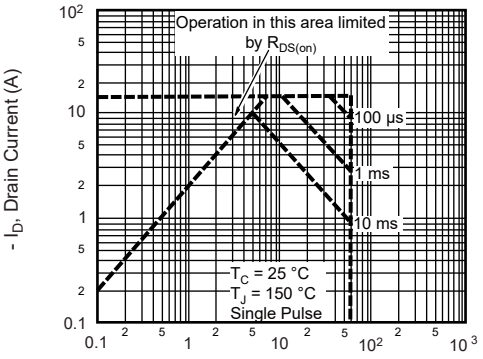

$-V_{SD}$,Source-to-Drain Voltage (V)

Figure 7: Typical Source-Drain Diode Forward Voltage



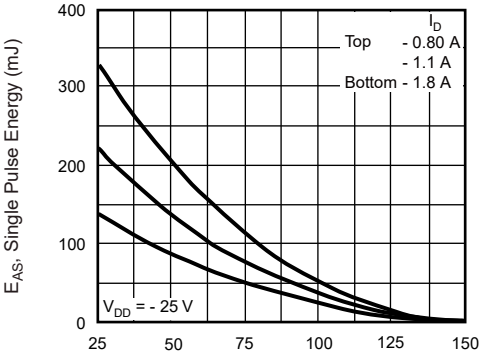

$T_C$,Case Temperature (°C)

Figure 8: Maximum Drain Current vs. Case Temperature



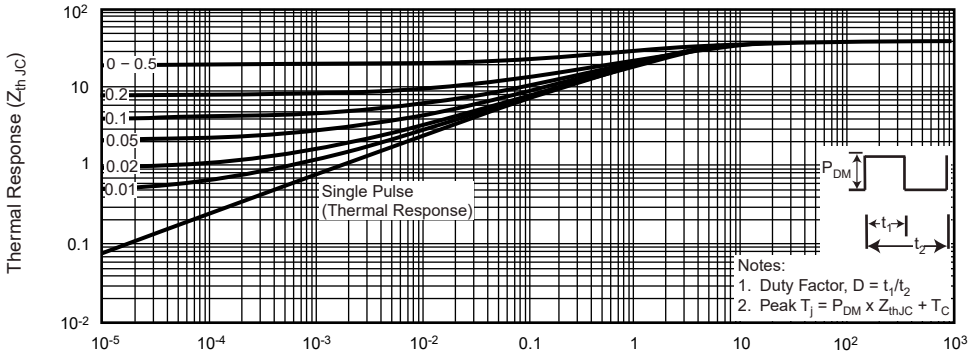

$-V_{DS}$,Drain-to-Source Voltage (V)

Figure 9: Maximum Safe Operating Area




Starting $T_J$ , Junction Temperature (°C)

Figure 10: Maximum Avalanche Energy vs. Drain Current




$t_1$, Rectangular Pulse Duration (s)

Figure 11: Maximum Effective Transient Thermal Impedance, Junction-to-Case

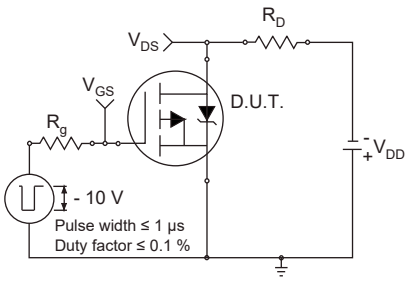



Figure 12a: Switching Time Test Circuit

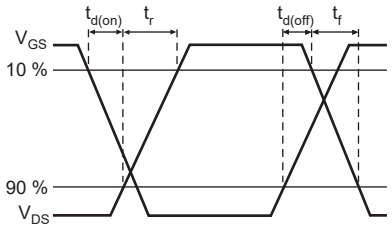



Figure 12b: Switching Time Waveforms

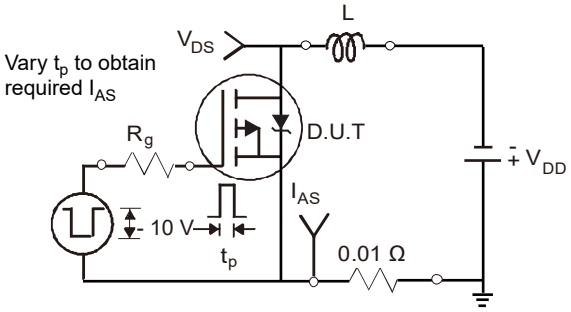



Figure 13a: Unclamped Inductive Test Circuit

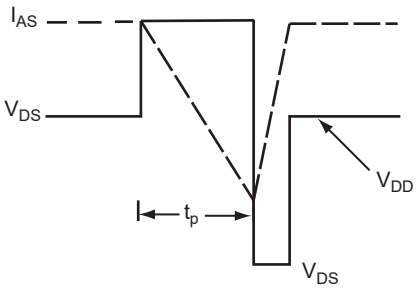



Figure 13b: Unclamped Inductive Waveforms

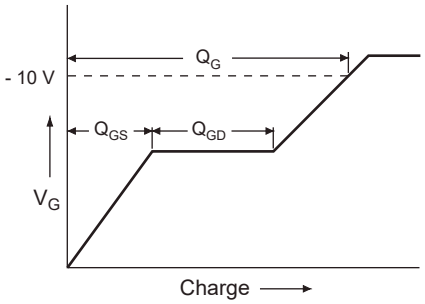



Figure 14a: Basic Gate Charge Waveform

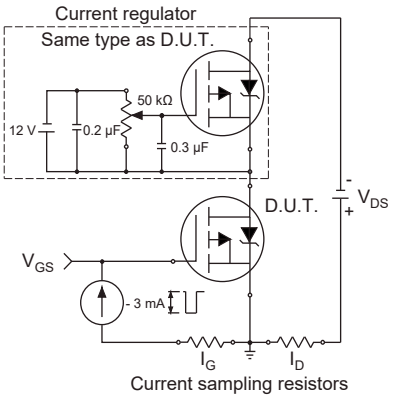
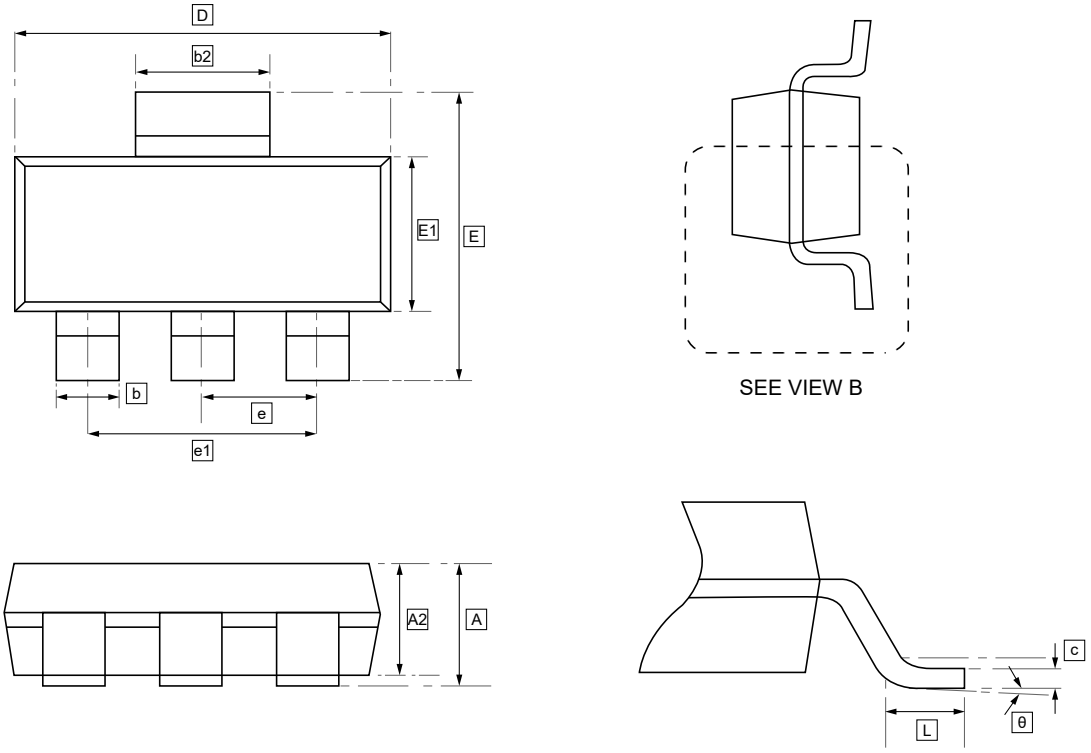



Figure 14b: Gate Charge Test Circuit

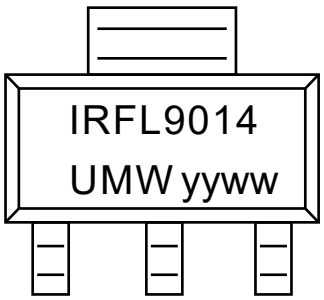
## 8.SOT-223 Package Outline Dimensions




**DIMENSIONS (mm are the original dimensions)**

| Symbol | A | A1 | A2 | b | b2 | c | D | E | E1 | e | e1 | L | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Min | 1.50 | 0.02 | 1.50 | 0.66 | 2.90 | 0.23 | 6.30 | 6.70 | 3.30 | 2.30 | 4.60 | 0.90 | 0° |
| Max | 1.80 | 0.10 | 1.70 | 0.84 | 3.10 | 0.33 | 6.70 | 7.30 | 3.70 | BSC | BSC | 1.10 | 8° |

## 9.Ordering information




yy: Year Code
ww: Week Code

| Order Code | Package | Base QTY | Delivery Mode |
|---|---|---|---|
| UMW IRFL9014TR | SOT-223 | 2500 | Tape and reel |

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