# UMW IRLML2060TR

60V N-Channel MOSFET

## 1.Description

The IRLML2060TR uses advanced trench technology to provide excellent $R_{DS(on)}$ with low gate charge. This device is suitable for use as a loads witch or in PWM applications.

## 2.Features

- $V_{DS\ (V)}$=60V
- $R_{DS(ON)}$<330mΩ($V_{GS}$=10V)
- $R_{DS(ON)}$<440mΩ($V_{GS}$=4.5V)

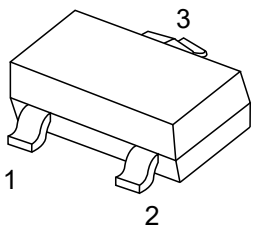
## 3.Benefits

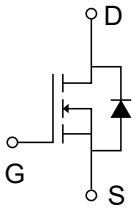
- Multi-vendor compatibility
- Easier manufacturing
- Environmentally friendly
- Increased reliability

## 4.Pinning information

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

**SOT-23**




## 5.Maximum ratings ($T_A$=25°C unless otherwise noted)

| Parameter | | Symbol | Value | Units |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | 60 | V |
| Continuous Drain Current, $V_{GS}$ @ 10V | $T_A$=25°C | $I_D$ | 1.2 | A |
| Continuous Drain Current, $V_{GS}$ @ 10V | $T_A$=70°C | | 0.93 | |
| Pulsed Drain Current | | $I_{DM}$ | 4.8 | |
| Maximum Power Dissipation | $T_A$=25°C | $P_D$ | 1.25 | W |
| Maximum Power Dissipation | $T_A$=70°C | | 0.8 | |
| Linear Derating Factor | | | 0.01 | W/°C |
| Gate-to-Source Voltage | | $V_{GS}$ | ±16 | V |
| Junction and Storage Temperature Range | | $T_J$,$T_{STG}$ | -55 to 150 | °C |

## 6.Thermal Resistance Rating

| Parameter | Symbol | Typ | Max | Units |
|---|---|---|---|---|
| Junction-to-Ambient ③ | $R_{\theta JA}$ | | 100 | °C/W |
| Junction-to-Ambient (t<10s) ④ | $R_{\theta JA}$ | | 99 | °C/W |

Notes:

① Repetitive rating; pulse width limited by max. junction temperature.

② Pulse width ≤ 400μs; duty cycle ≤ 2%.

③ Surface mounted on 1 in square Cu board.

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

| Parameter | Symbol | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| Drain-Source Breakdown Voltage | $V_{(BR)DSS}$ | $I_D$=250μA, $V_{GS}$=0V | 60 | | | V |
| Breakdown Voltage Temp. Coefficient | $\Delta V_{(BR)DSS}/\Delta T_J$ | $I_D$=5mA, Reference to 25°C | | 0.06 | | V/°C |
| Static Drain-to-Source On-Resistance | $R_{DS(ON)}$ | $V_{GS}$=10V, $I_D$=1.2A ② | | 240 | 330 | mΩ |
| | | $V_{GS}$=4.5V, $I_D$=0.96A ② | | 330 | 440 | |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$=$V_{GS}$, $I_D$=25μA | 1 | | 2.5 | V |
| Drain-to-Source Leakage Current | $I_{DSS}$ | $V_{DS}$=60V, $V_{GS}$=0V | | | 20 | μA |
| | | $V_{DS}$=60V, $V_{GS}$=0V, $T_J$=125°C | | | 150 | |
| Gate-to-Source Forward Leakage | $I_{GSS}$ | $V_{GS}$=16V | | | 100 | nA |
| Gate-to-Source Reverse Leakage | | $V_{GS}$=-16V | | | -100 | |
| Internal Gate Resistance | $R_G$ | | | 7.5 | | Ω |
| Forward Transconductance | $g_{fs}$ | $V_{DS}$=25V, $I_D$=1.2A | 1.6 | | | S |
| Total Gate Charge | $Q_g$ | $V_{DS}$=30V | | 0.67 | | nC |
| Gate-to-Source Charge | $Q_{gs}$ | $V_{GS}$=4.5V ② | | 0.18 | | |
| Gate-to-Drain ("Miller") Charge | $Q_{gd}$ | $I_D$=1.2A | | 0.4 | | |
| Turn-On Delay Time | $t_{D(on)}$ | $V_{DD}$=30V ② | | 4.9 | | ns |
| Rise Time | $t_r$ | $I_D$=1.2A | | 3.8 | | |
| Turn-Off Delay Time | $t_{D(off)}$ | $R_G$=6.8Ω | | 3.7 | | |
| Fall Time | $t_f$ | $V_{GS}$=4.5V | | 2.8 | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$=0V | | 64 | | pF |
| Output Capacitance | $C_{oss}$ | $V_{DS}$=25V | | 13 | | |
| Reverse Transfer Capacitance | $C_{rss}$ | $f$=1MHz | | 6.6 | | |

| Source-Drain Ratings and Characteristics | | | | | | |
|---|---|---|---|---|---|---|
| Continuous Source Current (Body Diode) | $I_S$ | MOSFET symbol showing the integral reverse p-n junction diode. | | | 1.2 | A |
| Pulsed Source Current (Body Diode) ① | $I_{SM}$ | | | | 4.8 | |
| Diode Forward Voltage | $V_{SD}$ | $T_J$=25°C,$I_S$=1.2A,$V_{GS}$=0V② | | | 1.2 | V |
| Reverse Recovery Time | $t_{rr}$ | $T_J$=25°C, $V_R$=30V, $I_F$=1.3A | | 14 | 21 | ns |
| Reverse Recovery Charge | $Q_{rr}$ | dI/dt=100A/μs ② | | 8.3 | 12 | nC |

## 8.1Typical Characterisitics

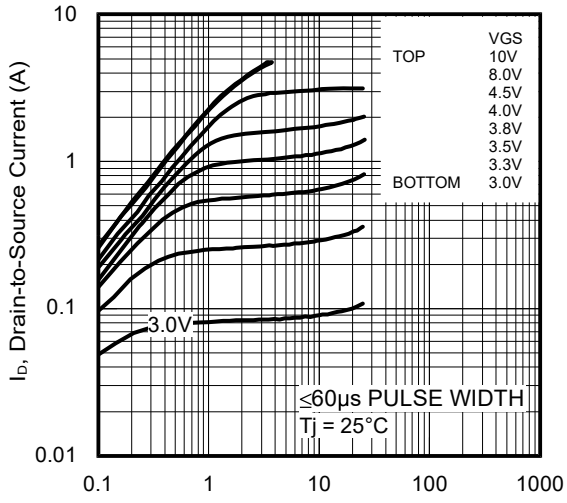



Fig 1. Typical Output Characteristics

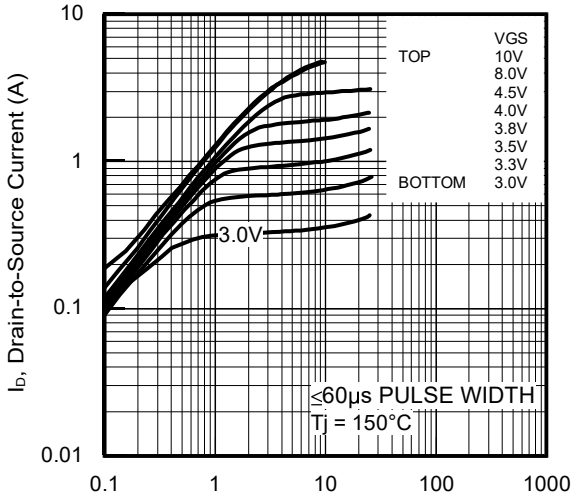



Fig 2. Typical Output Characteristics

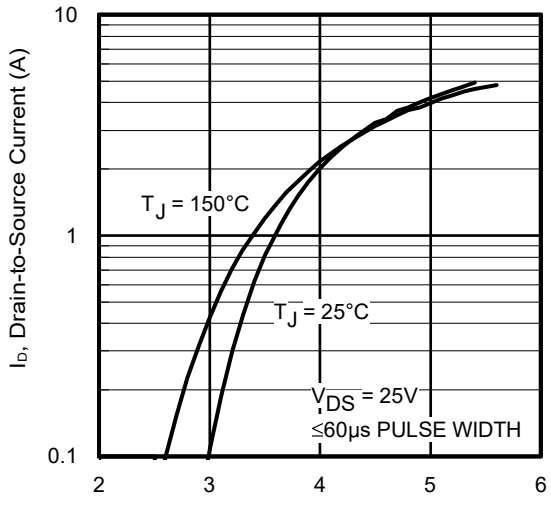



Fig 3. Typical Transfer Characteristics

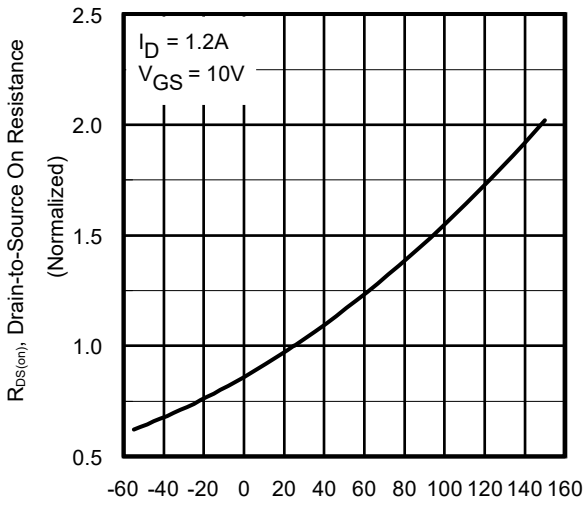
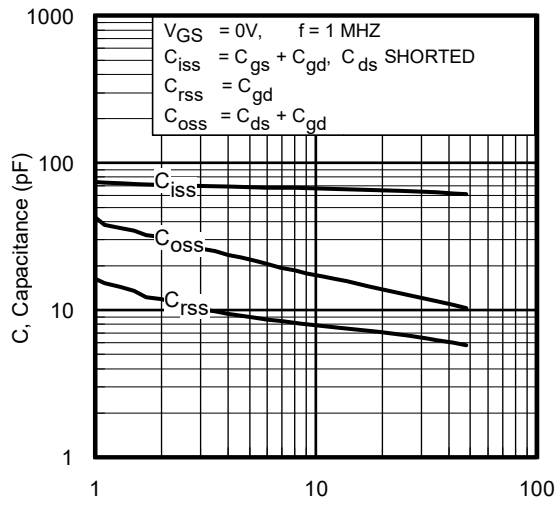


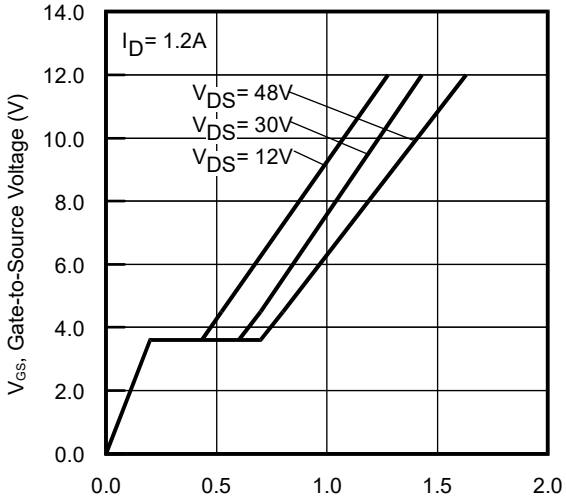

Fig 4. Nomalized On-ResistanceVs. Temperature

## 8.2Typical Characterisitics



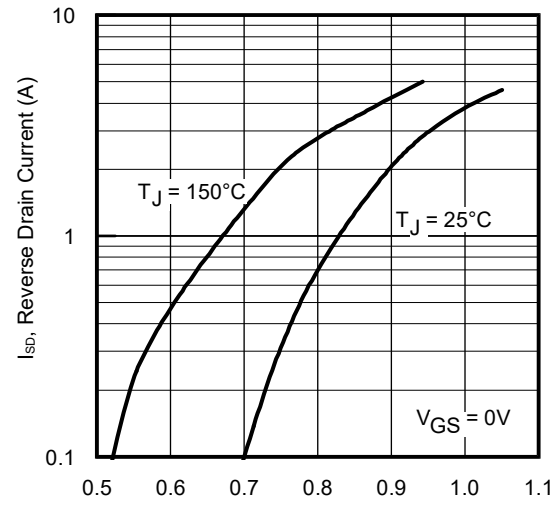

$V_{DS}$ ,Drain-to-Source Voltage (V)

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



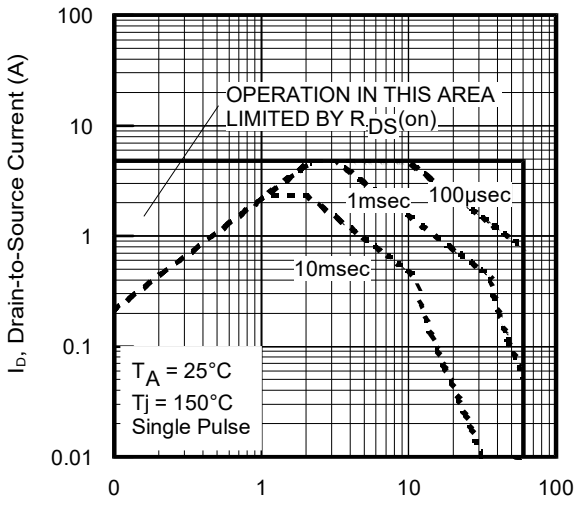

$Q_G$, Total Gate Charge (nC)

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




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

Fig 7. Typical Source-Drain Diode Forward Voltage




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

Fig 8. Maximum Safe Operating Area

## 8.3Typical Characterisitics

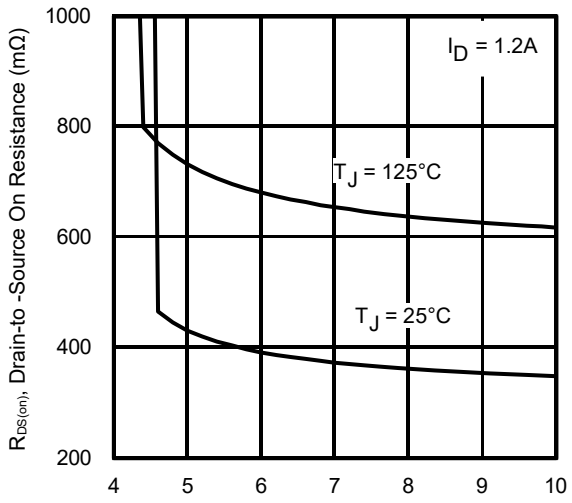



Fig 9. Typical On-Resistance vs. Gate Voltage

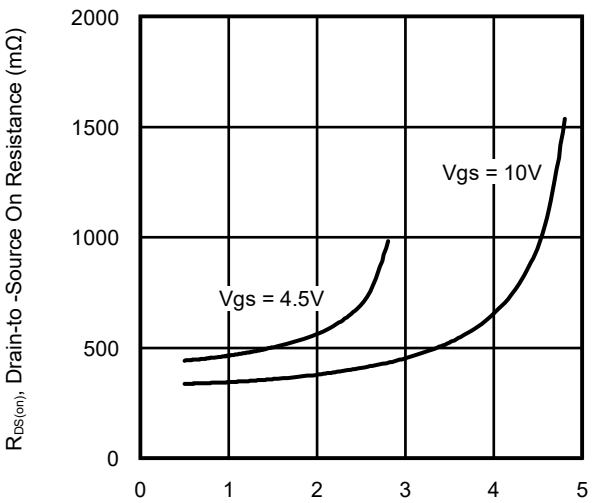



Fig 10. Typical On-Resistance vs. Drain Current

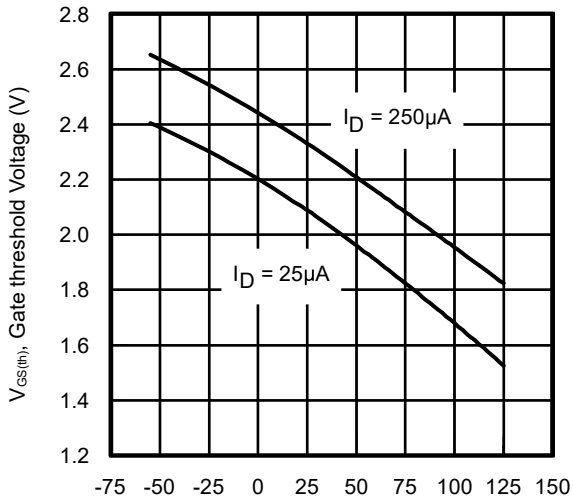



Fig 11. Typical Threshold Voltage vs. Junction Temperature

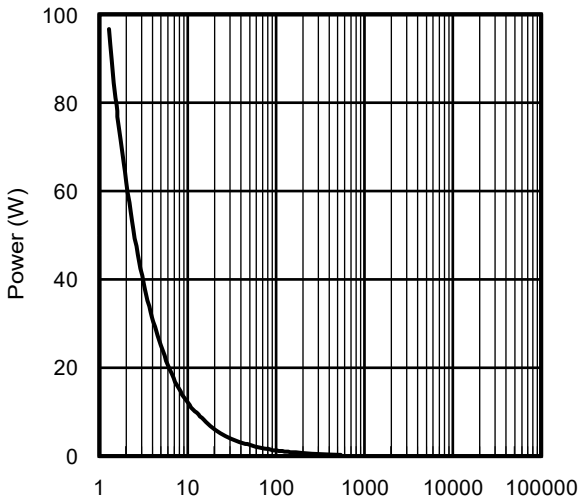



Fig 12. Typical Power vs. Time

## 8.4Typical Characterisitics

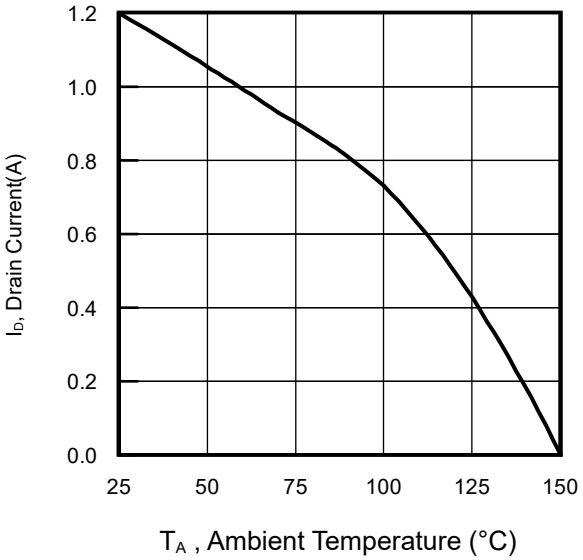



Fig 13. Maximum Drain Current vs. Ambient Temperature

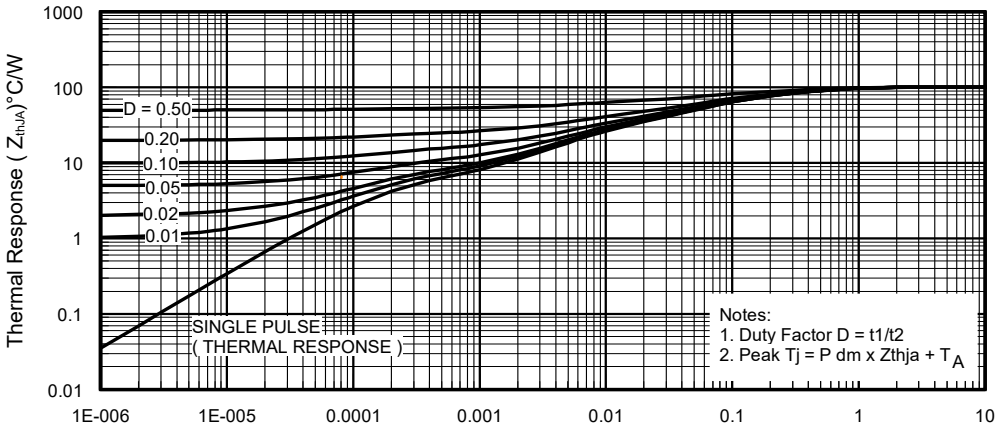



Fig 14. Typical Effective Transient Thermal Impedance, Junction-to-Ambient

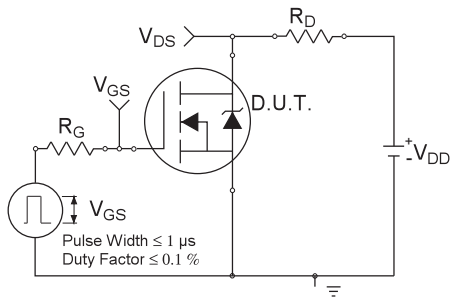



Fig 15a. Switching Time Test Circuit

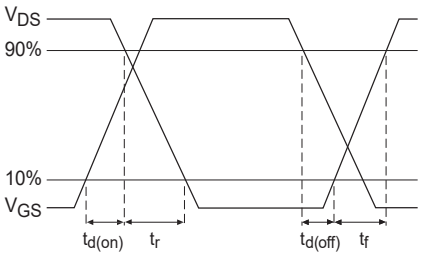



Fig 15b. Switching Time Waveforms

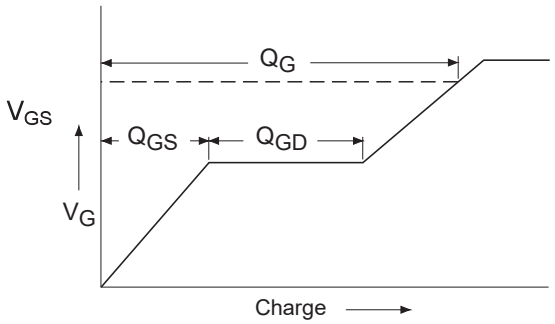



Fig 16a. Basic Gate Charge Waveform

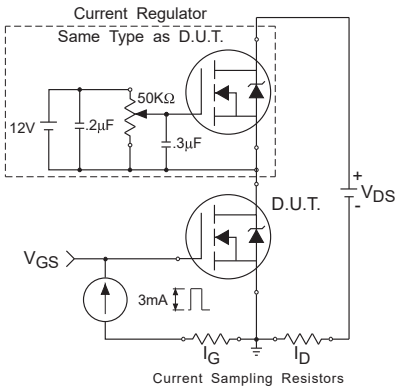
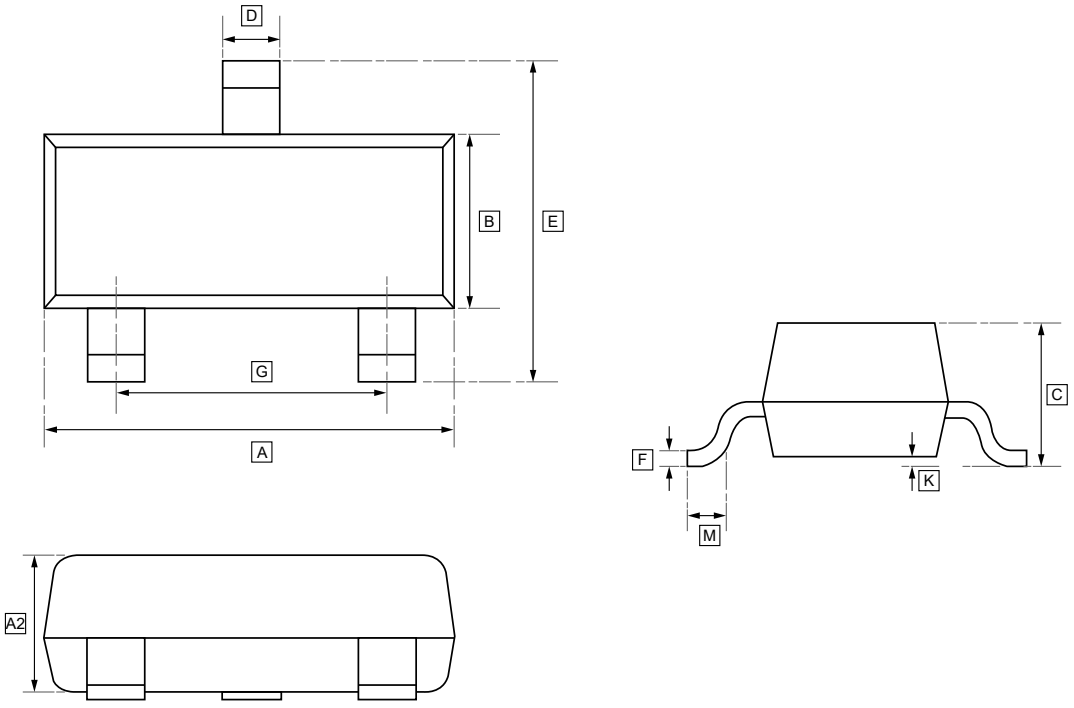



Fig 16b. Gate Charge Test Circuit

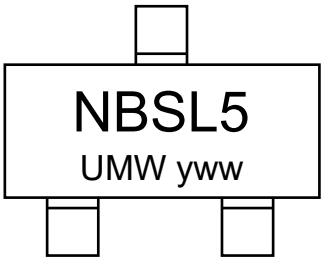
## 9.SOT-23 Package Outline Dimensions




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

| Symbol | A | B | C | D | E | G | K | M | A2 | F |
|---|---|---|---|---|---|---|---|---|---|---|
| **Min** | 2.80 | 1.20 | 0.90 | 0.32 | 2.25 | 1.80 | 0.00 | 0.30 | 0.95 | 0.095 |
| **Max** | 3.04 | 1.40 | 1.10 | 0.55 | 2.55 | 2.00 | 0.10 | - | 1.05 | 0.115 |

## 10.Ordering information




yww: Batch Code

| Order Code | Package | Base QTY | Delivery Mode |
|---|---|---|---|
| UMW IRLML2060TR | SOT-23 | 3000 | Tape and reel |

## 11.Disclaimer

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