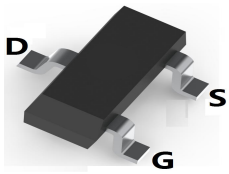
HKT Hottech Electronic

# IRLML6402

P-Channel Power MOSFET

## FEATURES

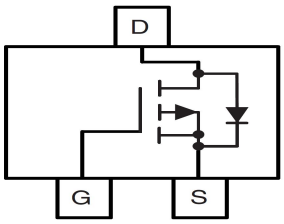
- $V_{DS}$=-20V,$R_{DS(ON)}$≤65mΩ@$V_{GS}$=-4.5V,$I_D$=-3.7A
- Ultra Low On-Resistance
- P-Channel MOSFET
- Fast Switching




SOT-23

## MECHANICAL DATA

- Case: SOT-23
- Case Material: Molded Plastic. UL flammability
- Classification Rating: 94V-0
- Weight: 0.008 grams (approximate)




## Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---|---|---|---|
| $V_{DS}$ | Drain- Source Voltage | -20 | V |
| $I_D$ @ $T_A$ = 25°C | Continuous Drain Current, $V_{GS}$ @ -4.5V | -3.7 | A |
| $I_D$ @ $T_A$= 70°C | Continuous Drain Current, $V_{GS}$ @ -4.5V | -2.2 | |
| $I_{DM}$ | Pulsed Drain Current ① | -22 | |
| $P_D$ @$T_A$ = 25°C | Power Dissipation | 1.3 | W |
| $P_D$ @$T_A$ = 70°C | Power Dissipation | 0.8 | |
| | Linear Derating Factor | 0.01 | W/°C |
| $E_{AS}$ | Single Pulse Avalanche Energy④ | 11 | mJ |
| $V_{GS}$ | Gate-to-Source Voltage | ± 12 | V |
| $T_J$, $T_{STG}$ | Junction and Storage Temperature Range | -55 to + 150 | °C |

## Thermal Resistance

| | Parameter | Typ. | Max. | Units |
|---|---|---|---|---|
| $R_{\theta JA}$ | Maximum Junction-to-Ambient③ | 75 | 100 | °C/W |

## Electrical Characteristics @ $T_J$ = 25°C (unless otherwise specified)

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-to-Source Breakdown Voltage | -20 | —— | —— | V | $V_{GS}$ = 0V, $I_D$ = -250μA |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient | —— | -0.009 | —— | V/°C | Reference to 25°C, $I_D$ = -1mA ② |
| $R_{DS(on)}$ | Static Drain-to-Source On-Resistance | —— | 0.050 | 0.065 | Ω | $V_{GS}$ = -4.5V, $I_D$ = -3.7A ② |
| | | —— | 0.080 | 0.135 | | $V_{GS}$ = -2.5V, $I_D$ = -3.1A ② |
| $V_{GS(th)}$ | Gate Threshold Voltage | -0.40 | -0.55 | -1.2 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = -250μA |
| $g_{fs}$ | Forward Transconductance | 6.0 | —— | —— | S | $V_{DS}$ = -10V, $I_D$ = -3.7A ② |
| $I_{DSS}$ | Drain-to-Source Leakage Current | —— | —— | -1.0 | μA | $V_{DS}$ = -20V, $V_{GS}$ = 0V |
| | | —— | —— | -25 | | $V_{DS}$ = -20V, $V_{GS}$ = 0V, $T_J$ = 70°C |
| $I_{GSS}$ | Gate-to-Source Forward Leakage | —— | —— | -100 | nA | $V_{GS}$ = -12V |
| | Gate-to-Source Reverse Leakage | —— | —— | 100 | | $V_{GS}$ = 12V |
| $Q_g$ | Total Gate Charge | —— | 8.0 | 12 | nC | $I_D$ = -3.7A |
| $Q_{gs}$ | Gate-to-Source Charge | —— | 1.2 | 1.8 | | $V_{DS}$ = -10V |
| $Q_{gd}$ | Gate-to-Drain ("Miller") Charge | —— | 2.8 | 4.2 | | $V_{GS}$ = -5.0V ② |
| $t_{d(on)}$ | Turn-On Delay Time | —— | 350 | —— | ns | $V_{DD}$ = -10V |
| $t_r$ | Rise Time | —— | 48 | —— | | $I_D$ = -3.7A |
| $t_{d(off)}$ | Turn-Off Delay Time | —— | 588 | —— | | $R_G$ = 89Ω |
| $t_f$ | Fall Time | —— | 381 | —— | | $R_D$ = 2.7Ω |
| $C_{iss}$ | Input Capacitance | —— | 633 | —— | pF | $V_{GS}$ = 0V |
| $C_{oss}$ | Output Capacitance | —— | 145 | —— | | $V_{DS}$ = -10V |
| $C_{rss}$ | Reverse Transfer Capacitance | —— | 110 | —— | | $f$ = 1.0MHz |

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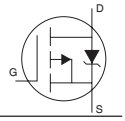
## Source-Drain Ratings and Characteristics

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current (Body Diode) | — | — | -1.3 | A | MOSFET symbol showing the integral reverse p-n junction diode.  |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ① | — | — | -22 | | |
| $V_{SD}$ | Diode Forward Voltage | — | — | -1.2 | V | $T_J$ = 25°C, $I_S$ = -1.0A, $V_{GS}$ = 0V ② |
| $t_{rr}$ | Reverse Recovery Time | — | 29 | 43 | ns | $T_J$ = 25°C, $I_F$ = -1.0A |
| $Q_{rr}$ | Reverse RecoveryCharge | — | 11 | 17 | nC | di/dt = -100A/μs ② |

**Notes:**

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

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

③ Surface mounted on 1" square single layer 1oz. copper FR4 board, steady state.

④ Starting $T_J$ = 25°C, L = 1.65mH $R_G$ = 25Ω, $I_{AS}$ = -3.7A.

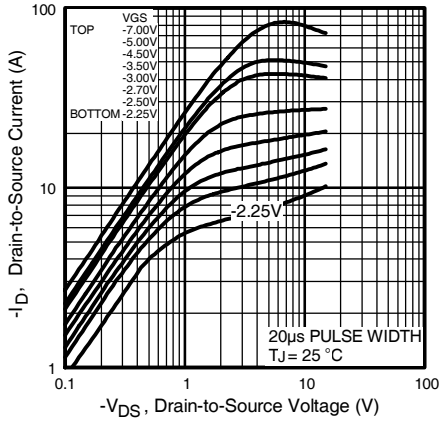



**Fig 1.** Typical Output Characteristics

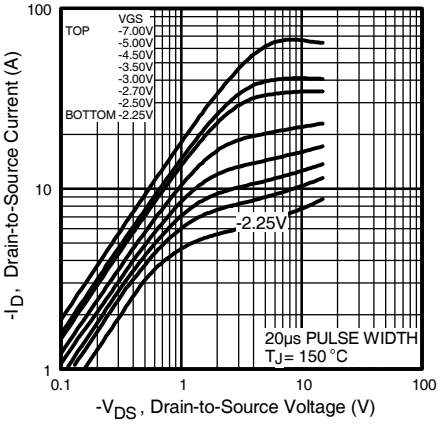



**Fig 2.** Typical Output Characteristics

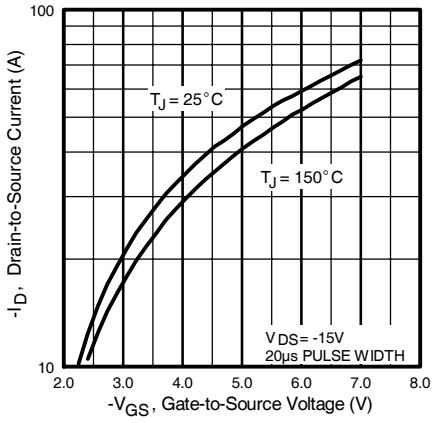



**Fig 3.** Typical Transfer Characteristics

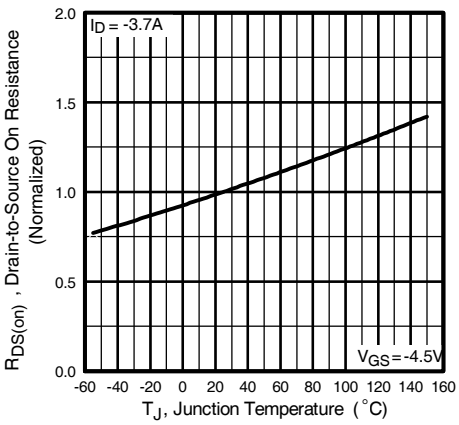



**Fig 4.** Normalized On-Resistance Vs. Temperature

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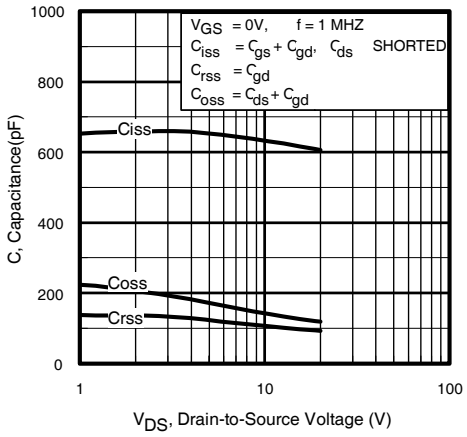


**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage

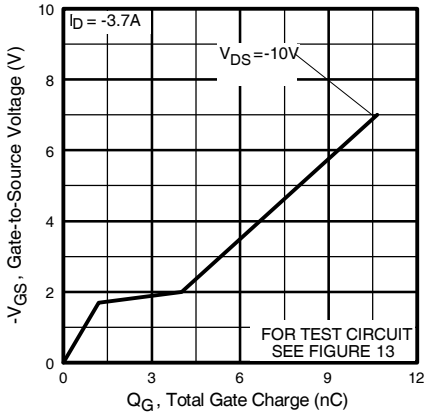


**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage

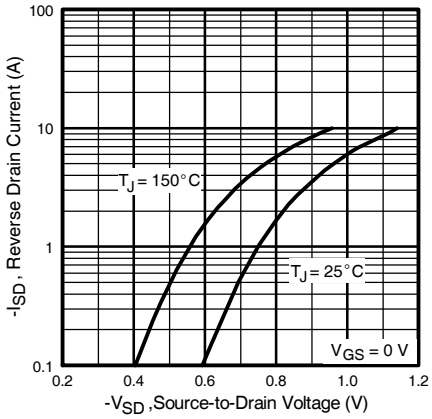


**Fig 7.** Typical Source-Drain Diode Forward Voltage

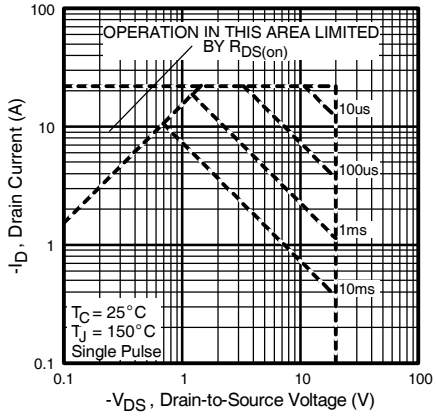


**Fig 8.** Maximum Safe Operating Area

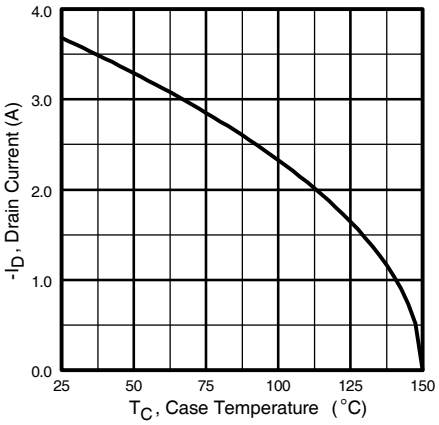


**Fig 9.** Maximum Drain Current Vs. Case Temperature

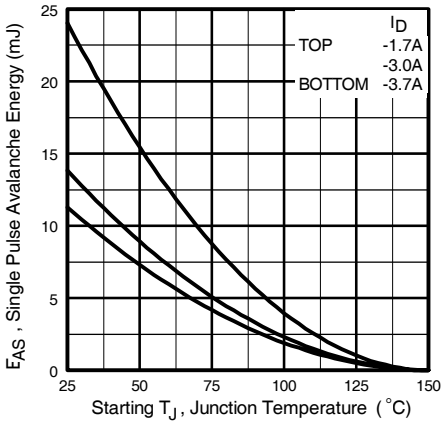


**Fig 10.** Maximum Avalanche Energy Vs. Drain Current

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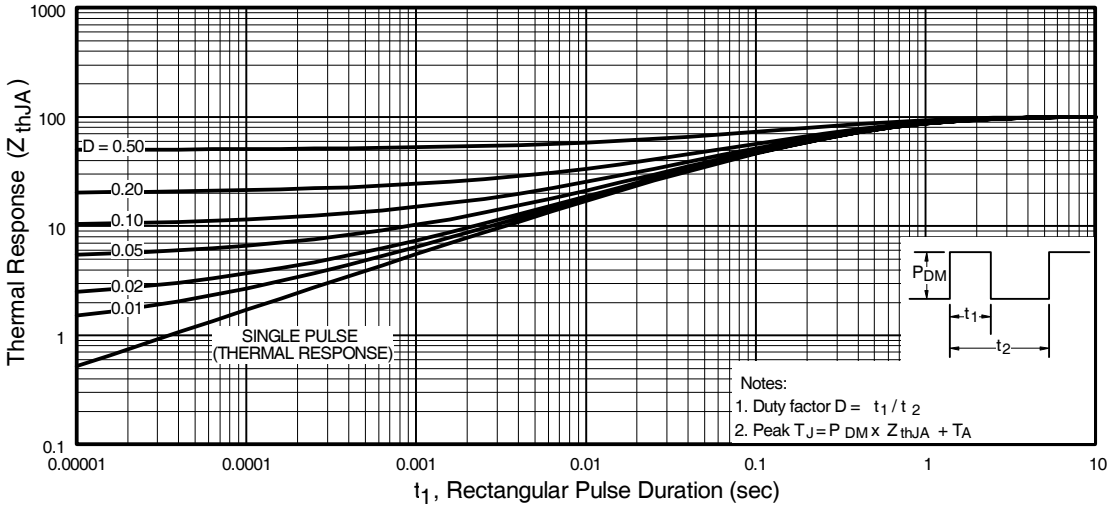



**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Ambient

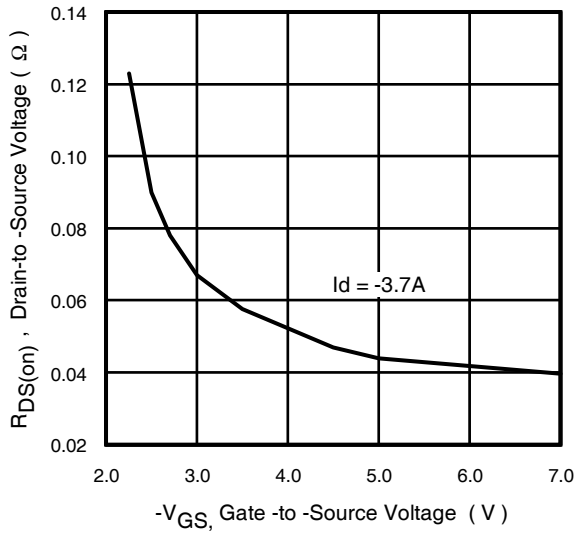



**Fig 12.** Typical On-Resistance Vs. Gate Voltage

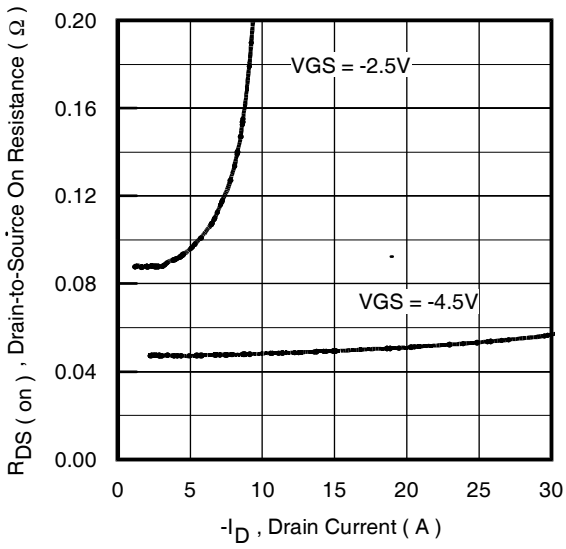
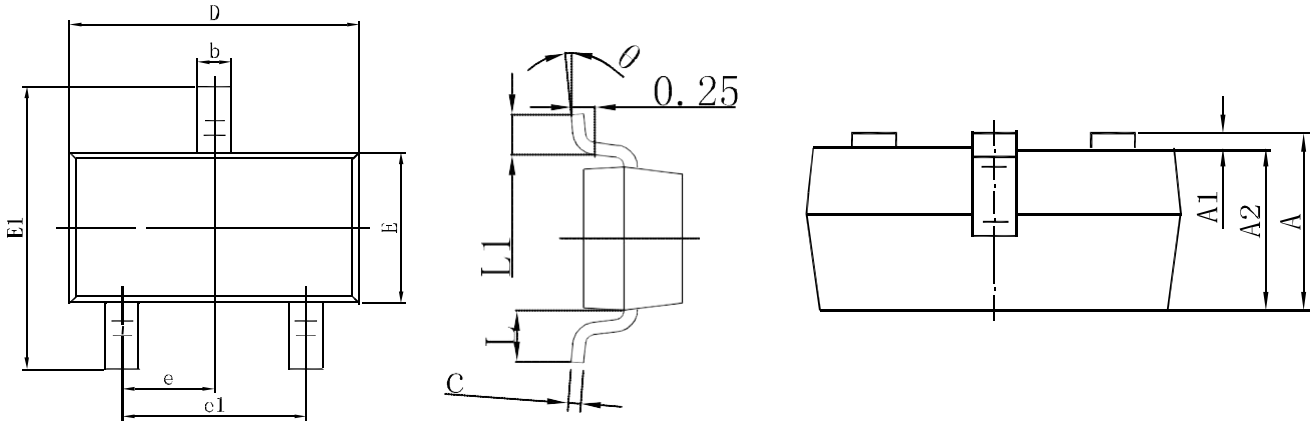


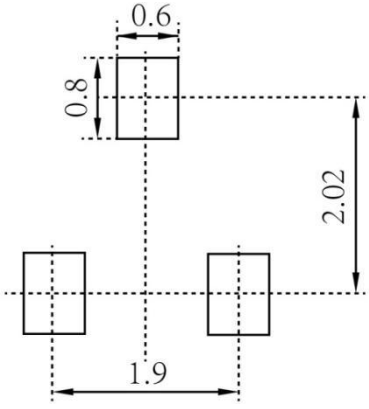

**Fig 13.** Typical On-Resistance Vs. Drain Current

## SOT-23 Package Outline Dimensions




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min. | Max. | Min. | Max. |
| A | 0.900 | 1.150 | 0.035 | 0.045 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| A2 | 0.900 | 1.050 | 0.035 | 0.041 |
| b | 0.300 | 0.500 | 0.012 | 0.020 |
| c | 0.080 | 0.150 | 0.003 | 0.006 |
| D | 2.800 | 3.000 | 0.110 | 0.118 |
| E | 1.200 | 1.400 | 0.047 | 0.055 |
| E1 | 2.250 | 2.550 | 0.089 | 0.100 |
| e | 0.950 TYP | | 0.037 TYP | |
| e1 | 1.800 | 2.000 | 0.071 | 0.079 |
| L | 0.550 REF | | 0.022 REF | |
| L1 | 0.300 | 0.500 | 0.012 | 0.020 |
| θ | 0° | 8° | 0° | 8° |

## SOT-23 Suggested Pad Layout




**Note:**

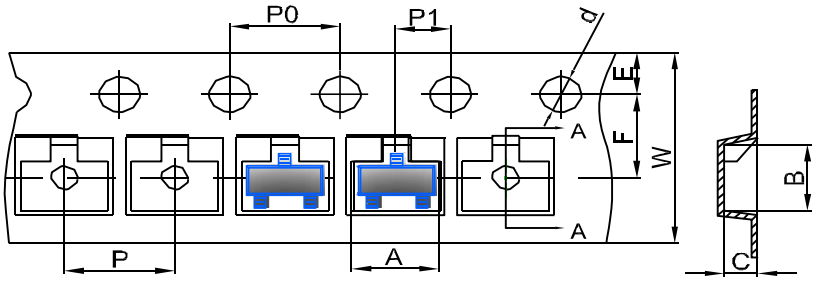
1.Controlling dimension: in millimeters

2.General tolerance: ±0.05mm

3.The pad layout is for reference purposes only

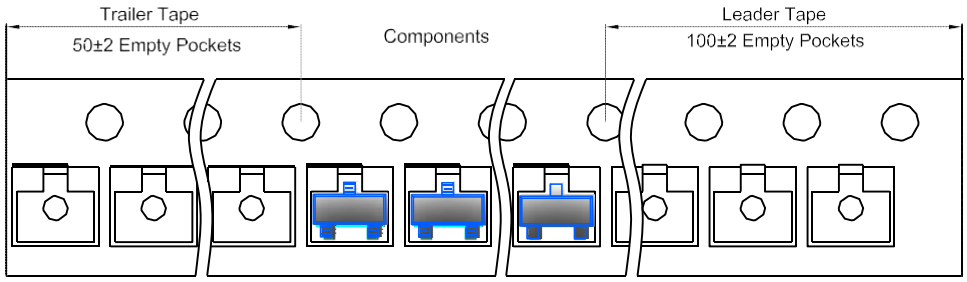
# SOT-23 Tape and Reel

## SOT-23 Embossed Carrier Tape

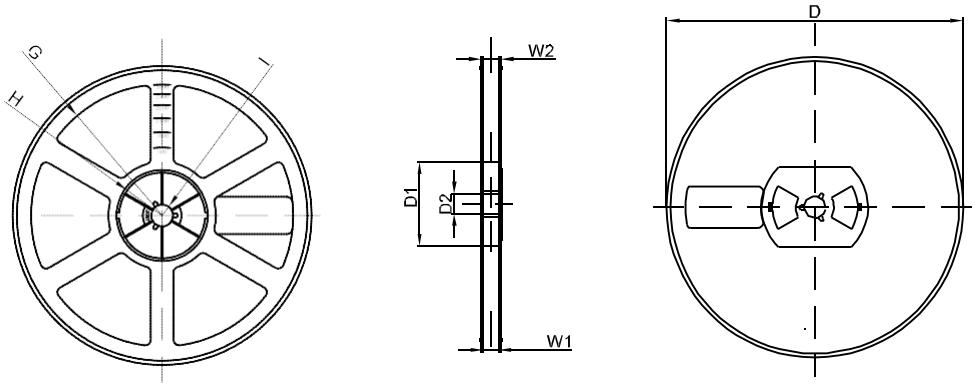



| | DIMENSIONS ARE IN MILLIMETER | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| TYPE | A | B | C | d | E | F | P0 | P | P1 | W |
| SOT-23 | 3.15 | 2.77 | 1.22 | Ø1.50 | 1.75 | 3.50 | 4.00 | 4.00 | 2.00 | 8.00 |
| TOLERANCE | ±0.1 | ±0.1 | ±0.1 | ±0.1 | ±0.1 | ±0.1 | ±0.1 | ±0.1 | ±0.1 | ±0.1 |

## SOT-23 Tape Leader and Trailer




## SOT-23 Reel




| | DIMENSIONS ARE IN MILLIMETER | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| REEL OPTION | D | D1 | D2 | G | H | I | W1 | W2 |
| 7" DIA | Ø178 | 54.40 | 13.00 | R78 | R25.60 | R6.50 | 9.50 | 12.30 |
| TOLERANCE | ±2 | ±1 | ±1 | ±1 | ±1 | ±1 | ±1 | ±1 |

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