# N+P Channel Enhancement Mode MOSFET
# BL2038-6L

## Features

HF

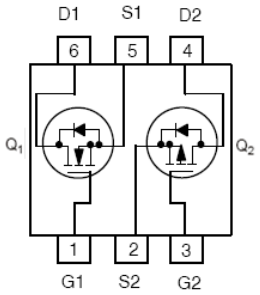
- Low on-resistance
- Low input capacitance
- Fast switching speed
- Low input/output leakage
- Fast switching speed

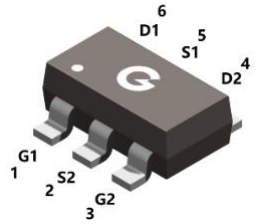
## Typical Applications

- Motor control
- Power Management Functions
- DC-DC Converters
- Backlighting

## Mechanical Data

- Case: SOT-23-6L
- Molding Compound: UL Flammability Classification Rating 94V-0
- Terminals: Matte tin-plated leads; solderability-per MIL-STD-202, Method 208




SOT-23-6L

## Ordering Information

| Part Number | Package | Shipping Quantity | Marking Code |
|---|---|---|---|
| BL2038-6L | SOT-23-6L | 3000 pcs / Tape & Reel | 2038 |

## Maximum Ratings (@ $T_A$ = 25°C unless otherwise specified)

| Parameter | Symbol | Q1 | Q2 | Unit |
|---|---|---|---|---|
| Drain-to-Source Voltage | $V_{DSS}$ | 20 | -20 | V |
| Gate-to-Source Voltage | $V_{GSS}$ | ±12 | ±12 | V |
| Continuous Drain Current ($T_A$ = 25°C) *1 | $I_D$ | 4.5 | -3.2 | A |
| Continuous Drain Current ($T_A$ = 70°C) *1 | | 3.6 | -2.6 | A |
| Pulsed Drain Current ($t_p$ = 10μs, $T_A$ = 25°C) | $I_{DM}$ | 25 | -20 | A |
| Single Pulse Avalanche Energy *4 | $E_{AS}$ | 5 | 5 | mJ |
| Power Dissipation ($T_A$ = 25°C) *1 | $P_D$ | 1.1 | | W |
| Power Dissipation ($T_A$ = 25°C) *2 | | 0.7 | | W |
| Operating Junction Temperature Range | $T_J$ | -55 ~ +150 | | °C |
| Storage Temperature Range | $T_{STG}$ | -55 ~ +150 | | °C |

## Thermal Characteristics

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Thermal Resistance Junction-to-Air *1 | $R_{\theta JA}$ | - | 100 | 110 | °C/W |
| Thermal Resistance Junction-to-Air *2 | | - | - | 180 | °C/W |

Notes:

1. The data tested by surface mounted on a 1 inch$^2$ FR-4 board with 2OZ copper
2. The data tested by surface mounted on a minimum recommended FR-4 board

## Electrical Characteristics-$Q_1$ (@ $T_A$ = 25°C unless otherwise specified)

| Symbol | Parameter | Test Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Static Characteristics** | | | | | | |
| $V_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$ = 0V, $I_D$ = 250μA | 20 | - | - | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 20V, $V_{GS}$ = 0V | - | - | 1 | μA |
| $I_{GSS}$ | Gate-Body Leakage Current | $V_{GS}$ = ±12V, $V_{DS}$ = 0V | - | - | ±100 | nA |
| **On Characteristics** | | | | | | |
| $R_{DS(ON)}$ | Drain-Source On-resistance *3 | $V_{GS}$ = 4.5V, $I_D$ = 4A | - | 23 | 35 | mΩ |
| | | $V_{GS}$ = 2.5V, $I_D$ = 2.5A | - | 29 | 43 | |
| | | $V_{GS}$ = 1.8V, $I_D$ = 1A | - | 51 | 75 | |
| $V_{GS(TH)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250uA | 0.4 | 0.8 | 1 | V |
| $R_G$ | Gate Resistance | $V_{GS}$ = 0V, f = 1MHz | - | 9 | - | Ω |
| **Dynamic Characteristics** | | | | | | |
| $C_{ISS}$ | Input Capacitance | $V_{GS}$ = 0V<br>$V_{DS}$ = 10V<br>f = 1.0MHz | - | 426 | - | pF |
| $C_{OSS}$ | Output Capacitance | | - | 76 | - | |
| $C_{RSS}$ | Reverse Transfer Capacitance | | - | 66 | - | |
| **Switching Characteristics** | | | | | | |
| $t_{d(ON)}$ | Turn-on Delay Time *5 | $V_{DD}$ = 10V<br>$V_{GS}$ = 4.5V<br>$I_D$ = 3.6A<br>$R_G$ = 6Ω | - | 9 | - | ns |
| $t_r$ | Turn-on Rise Time *5 | | - | 23 | - | |
| $t_{d(OFF)}$ | Turn-Off Delay Time *5 | | - | 38 | - | |
| $t_f$ | Turn-Off Fall Time *5 | | - | 3 | - | |
| $Q_G$ | Total Gate-Charge | $V_{DD}$ = 10V<br>$V_{GS}$ = 4.5V<br>$I_D$ = 3.6A | - | 6.4 | - | nC |
| $Q_{GS}$ | Gate to Source Charge | | - | 1.1 | - | |
| $Q_{GD}$ | Gate to Drain (Miller) Charge | | - | 1.8 | - | |
| **Source-Drain Diode Characteristics** | | | | | | |
| $V_{SD}$ | Diode Forward Voltage *3 | $I_{SD}$ = 1A,$V_{GS}$ = 0V | - | 0.7 | 1.1 | V |

## Electrical Characteristics-$Q_2$ (@ $T_A$ = 25°C unless otherwise specified)

| Symbol | Parameter | Test Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Static Characteristics** | | | | | | |
| $V_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$ = 0V, $I_D$ = -250μA | -20 | - | - | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = -16V, $V_{GS}$ = 0V | - | - | -1 | μA |
| $I_{GSS}$ | Gate-Body Leakage Current | $V_{GS}$ = ±12V, $V_{DS}$ = 0V | - | - | ±100 | nA |
| **On Characteristics** | | | | | | |
| $R_{DS(ON)}$ | Drain-Source On-resistance *3 | $V_{GS}$ = -4.5V, $I_D$ = -3A | - | 56 | 74 | mΩ |
| | | $V_{GS}$ = -2.5V, $I_D$ = -1.5A | - | 77 | 110 | |
| | | $V_{GS}$ = -1.8V, $I_D$ = -1A | - | 96 | 168 | |
| $V_{GS(TH)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = -250uA | -0.4 | -0.7 | -1.0 | V |
| $R_G$ | Gate Resistance | $V_{GS}$ = 0V, f = 1MHz | - | 27 | - | Ω |
| **Dynamic Characteristics** | | | | | | |
| $C_{ISS}$ | Input Capacitance | $V_{GS}$ = 0V<br>$V_{DS}$ = -10V<br>f = 1.0MHz | - | 550 | - | pF |
| $C_{OSS}$ | Output Capacitance | | - | 70 | - | |
| $C_{RSS}$ | Reverse Transfer Capacitance | | - | 61 | - | |
| **Switching Characteristics** | | | | | | |
| $t_{d(ON)}$ | Turn-on Delay Time *5 | $V_{DD}$ = -10V<br>$V_{GS}$ = -4.5V<br>$I_D$ = -1A<br>$R_G$ = 10Ω | - | 11 | - | ns |
| $t_r$ | Turn-on Rise Time *5 | | - | 35 | - | |
| $t_{d(OFF)}$ | Turn-Off Delay Time *5 | | - | 30 | - | |
| $t_f$ | Turn-Off Fall Time *5 | | - | 10 | - | |
| $Q_G$ | Total Gate-Charge | $V_{DD}$ = -10V<br>$V_{GS}$ = -4.5V<br>$I_D$ = -3.6A | - | 6.5 | - | nC |
| $Q_{GS}$ | Gate to Source Charge | | - | 1.6 | - | |
| $Q_{GD}$ | Gate to Drain (Miller) Charge | | - | 1.4 | - | |
| **Source-Drain Diode Characteristics** | | | | | | |
| $V_{SD}$ | Diode Forward Voltage *3 | $I_{SD}$ = -0.6A,$V_{GS}$ = 0V | - | -0.7 | -1.0 | V |

Notes:

3. The data tested by pulsed, pulse width ≤ 300μs, duty cycle ≤ 2%
4. The $E_{AS}$ data shows Max. rating. N: The test condition is $V_{DD}$ = 10V, $V_{GS}$ = 6V, L = 0.1mH;
   P: The test condition is $V_{DD}$ = -10V, $V_{GS}$ = -6V, L = 0.1mH
5. Guaranteed by design, not subject to production

## Ratings and Characteristics Curves-$Q_1$ (@ $T_A$ = 25°C unless otherwise specified)

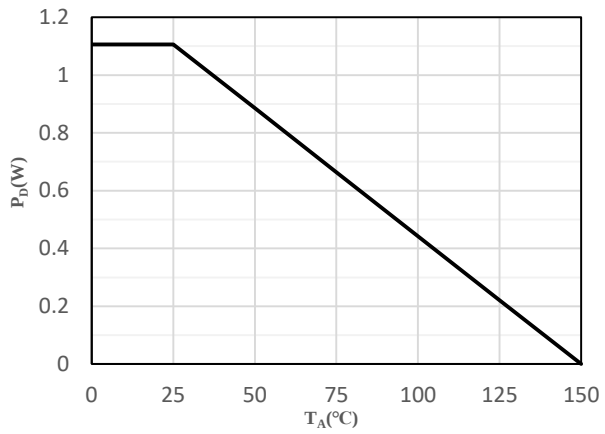



Fig 1 Power Dissipation

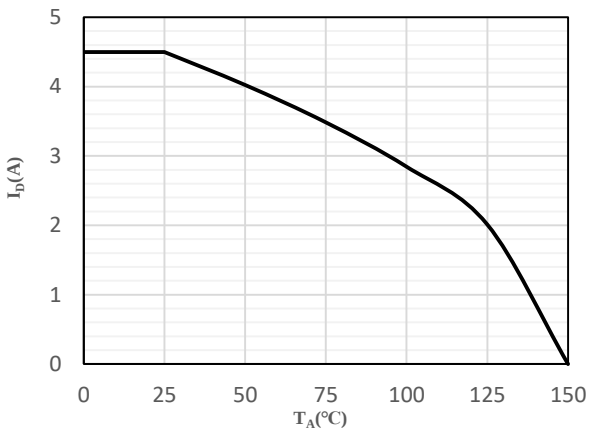



Fig 2 Drain Current

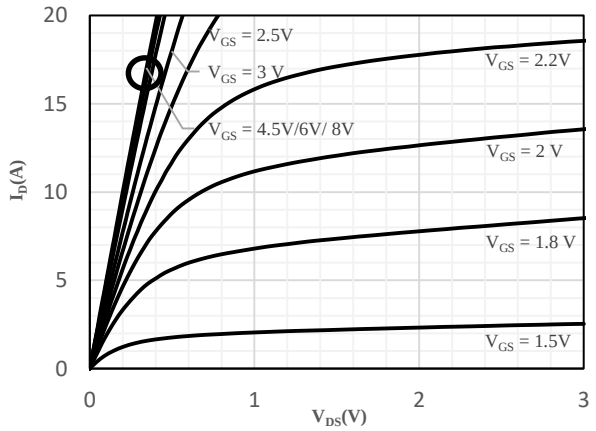



Fig 3 Typical Output Characteristics

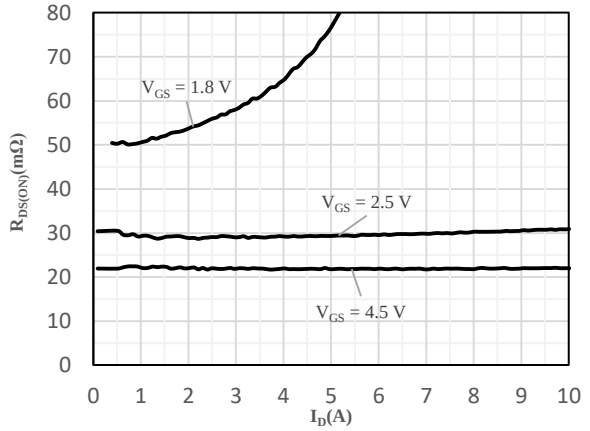



Fig 4 On-Resistance vs. Drain Current and Gate Voltage

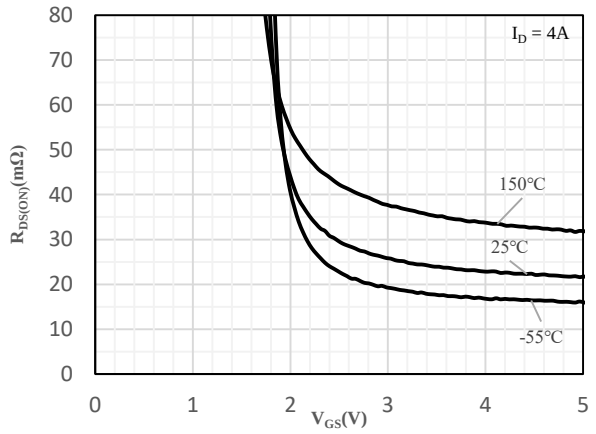



Fig 5 On-Resistance vs. Gate-Source Voltage

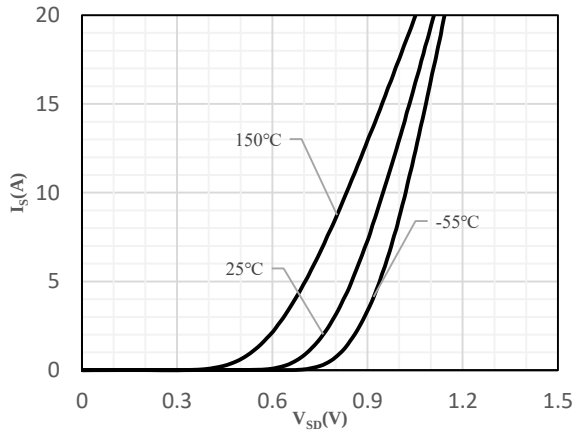



Fig 6 Body-Diode Characteristics

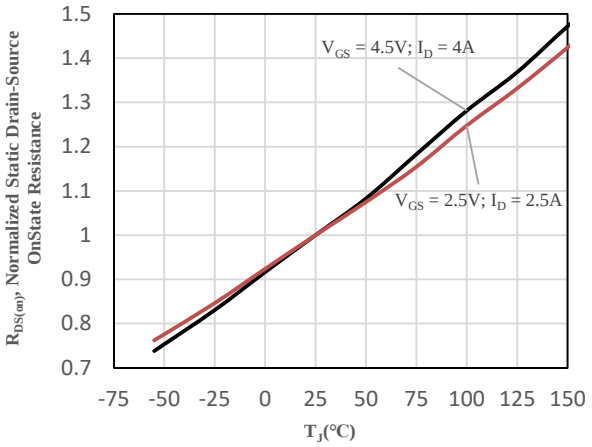



Fig 7 Normalized On-Resistance vs. Junction Temperature

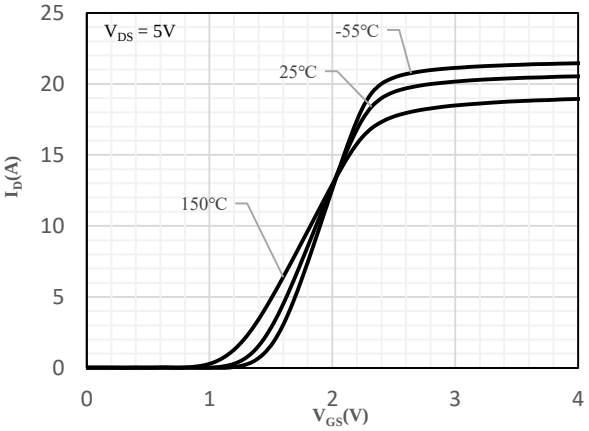



Fig 8 Transfer Characteristics

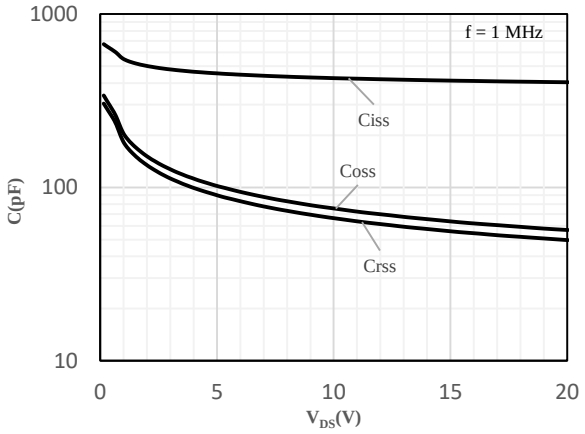



Fig 9 Capacitance Characteristics

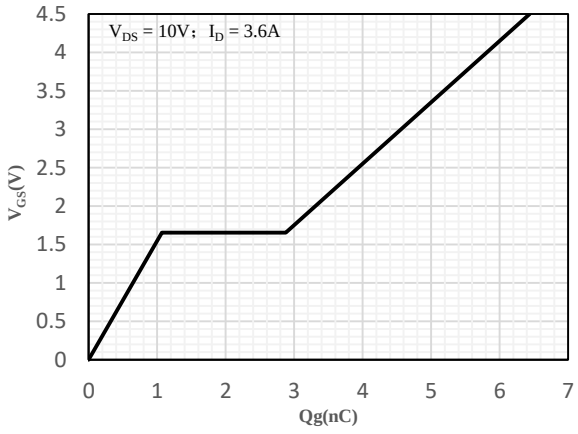



Fig 10 Gate-Charge Characteristics

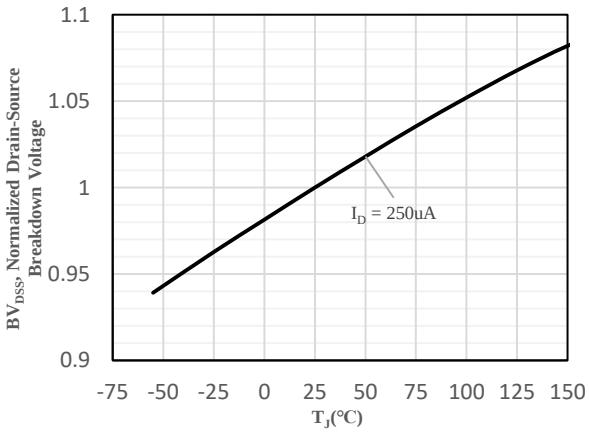



Fig 11 Normalized Breakdown Voltage vs. Junction Temperature

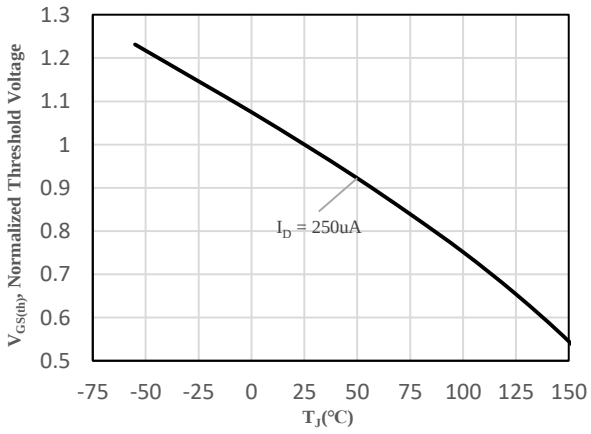



Fig 12 Normalized $V_{GS(th)}$ vs. Junction Temperature

## Ratings and Characteristics Curves-$Q_2$ (@ $T_A$ = 25°C unless otherwise specified)

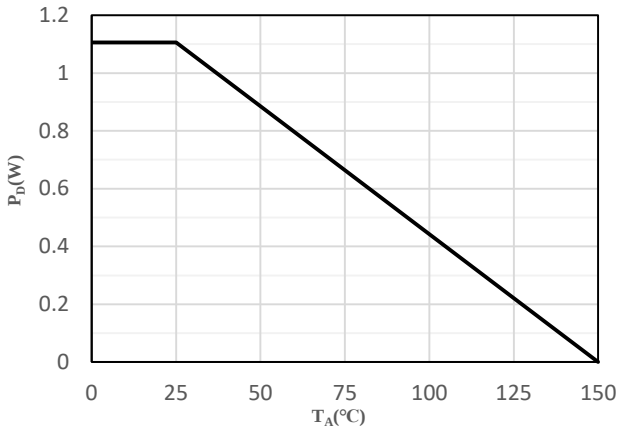



Fig 1 Power Dissipation

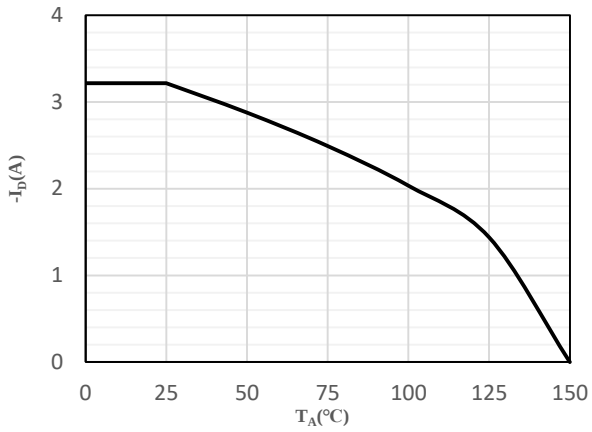



Fig 2 Drain Current

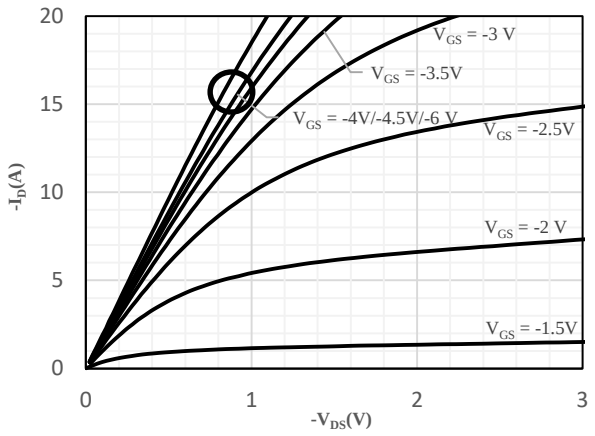



Fig 3 Typical Output Characteristics

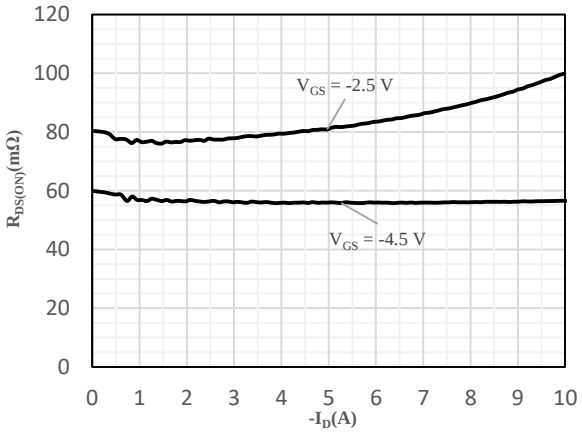



Fig 4 On-Resistance vs. Drain Current and Gate Voltage

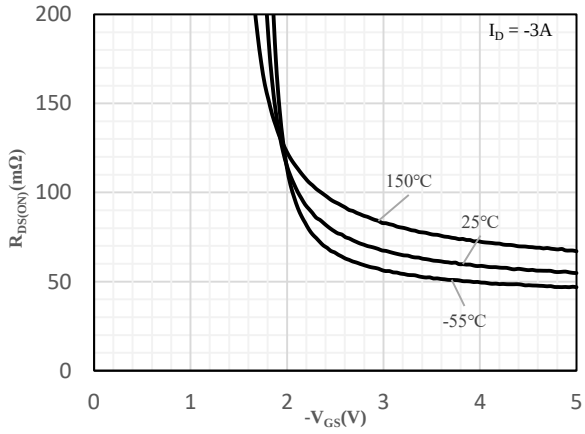



Fig 5 On-Resistance vs. Gate-Source Voltage

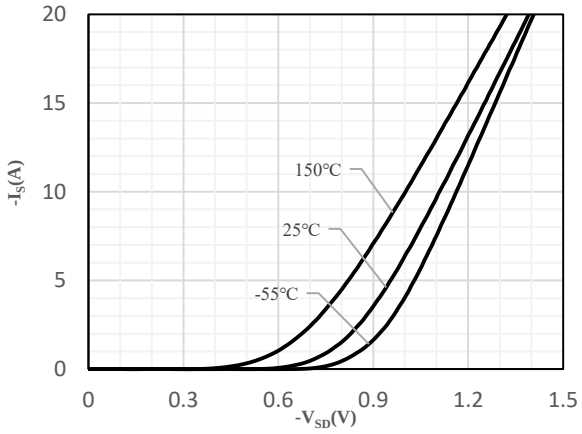



Fig 6 Body-Diode Characteristics

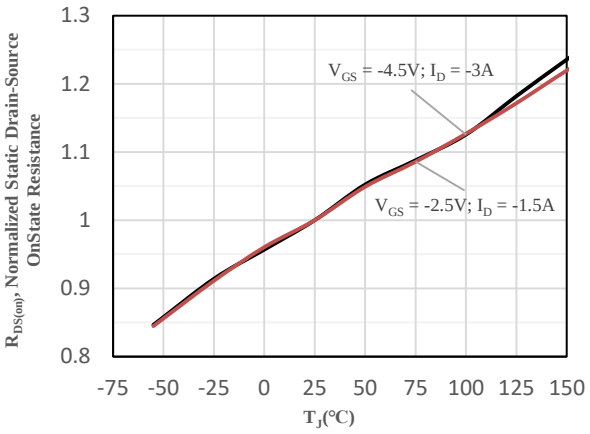



Fig 7 Normalized On-Resistance vs. Junction Temperature

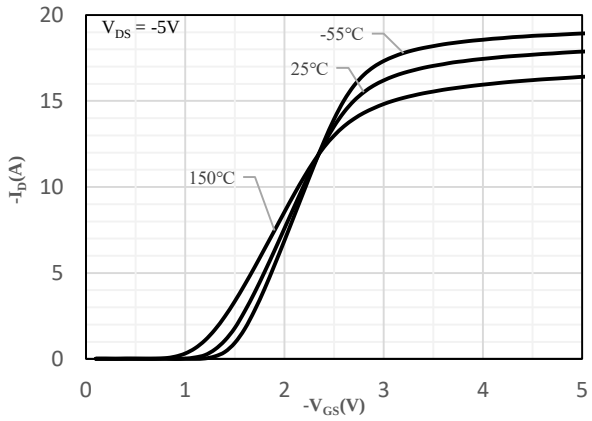



Fig 8 Transfer Characteristics

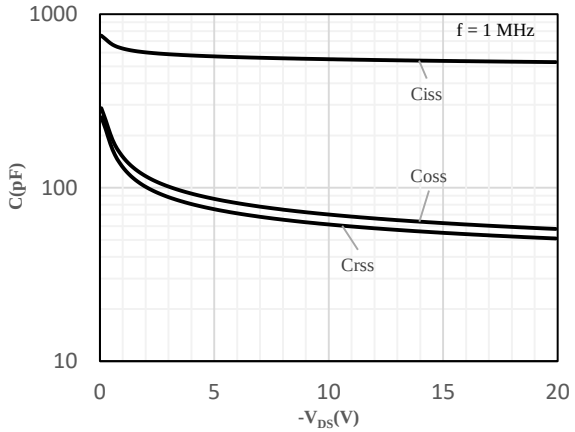



Fig 9 Capacitance Characteristics

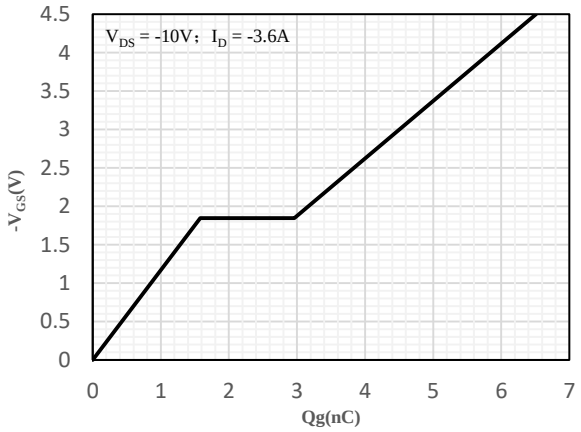



Fig 10 Gate-Charge Characteristics

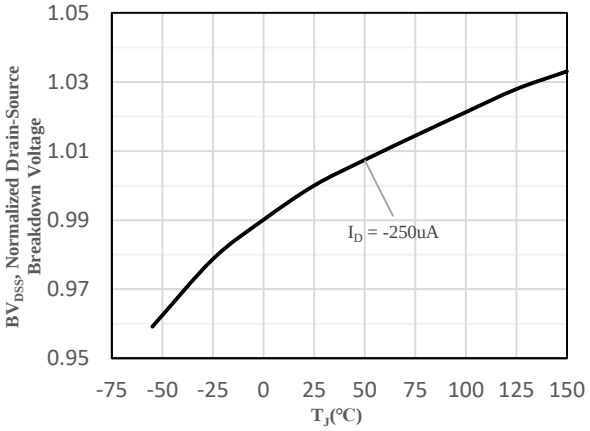



Fig 11 Normalized Breakdown Voltage vs. Junction Temperature

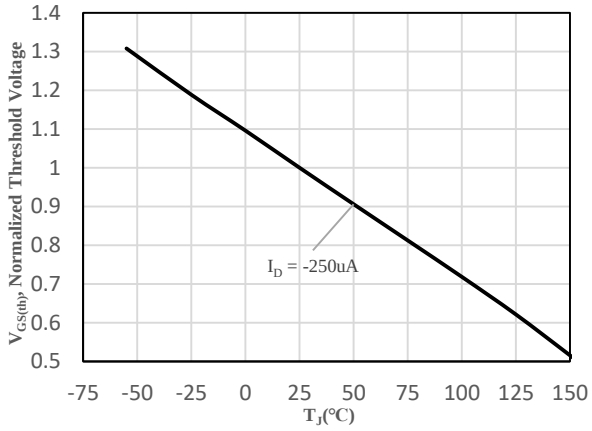
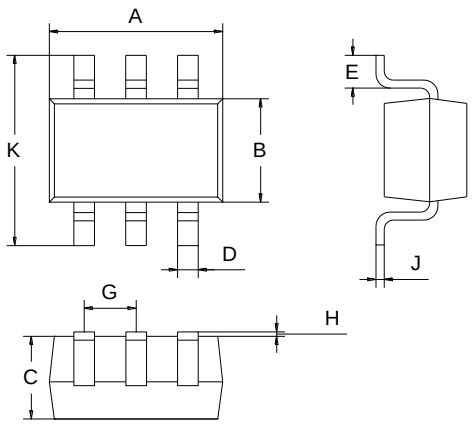



Fig 12 Normalized $V_{GS(th)}$ vs. Junction Temperature

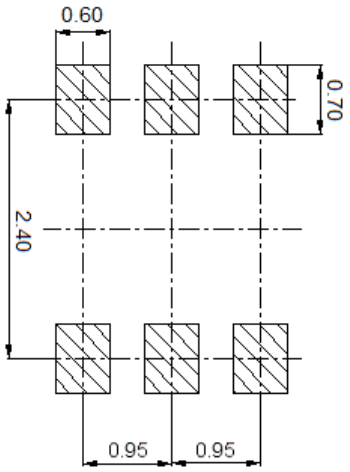
## Package Outline Dimensions (Unit: mm)




| SOT-23-6L | | |
|---|---|---|
| **Dimension** | **Min.** | **Max.** |
| A | 2.80 | 3.00 |
| B | 1.50 | 1.70 |
| C | 1.00 | 1.20 |
| D | 0.35 | 0.45 |
| E | 0.35 | 0.55 |
| G | 0.90 | 1.00 |
| H | 0.02 | 0.10 |
| J | 0.10 | 0.20 |
| K | 2.60 | 3.00 |

## Package Outline Dimensions (Unit: mm)

### SOT-23-6L




## IMPORTANT NOTICE

Changzhou Galaxy Century Microelectronics (GME) reserves the right to make changes without further notice to any product information (copyrighted) herein to make corrections, modifications, improvements, or other changes. GME does not assume any liability arising out of the application or use of any product described herein; neither does it convey any license under its patent rights, nor the rights of others.