# P＋N-Channel Enhancement Mode MOSFET

# GBLH4405-5DL8

## Features

- Advanced trench technology
- Reliable and Rugged
- HBM: JESD22-A114-B: 1B
- RoHS compliant with Halogen-free

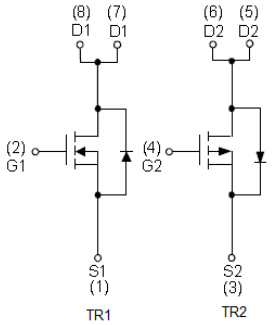
HF

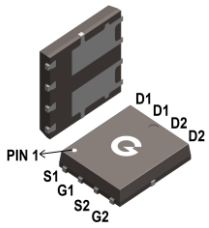
## Applications

- Synchronous Rectification
- Motor Control
- Portable equipment application

## Mechanical Data

- Case: PDFN5×6-8LC
- Molding Compound: UL Flammability Classification Rating 94V-0
- Terminals: Matte tin-plated leads; solderability-per MIL-STD-202, Method 208




PDFN5×6-8LC

## Ordering Information

| Part Number | Package | Shipping Quantity | Marking Code |
|---|---|---|---|
| GBLH4405-5DL8 | PDFN5×6-8LC | 5000 pcs / Tape & Reel | GBLH4405 |

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

| Parameter | Symbol | N | P | Unit |
|---|---|---|---|---|
| Drain-to-Source Voltage | $V_{DSS}$ | 40 | -40 | V |
| Gate-to-Source Voltage | $V_{GSS}$ | ±20 | ±20 | V |
| Continuous Drain Current ($T_C$ = 25°C) | $I_D$ | 44 | -40 | A |
| Continuous Drain Current ($T_C$ = 100°C) | | 28 | -25 | A |
| Continuous Drain Current ($T_A$ = 25°C) *1 | | 11.6 | -10.8 | A |
| Continuous Drain Current ($T_A$ = 100°C) *1 | | 7.3 | -6.8 | A |
| Pulsed Drain Current ($t_p$ = 10μs, $T_C$ = 25°C) | $I_{DM}$ | 176 | -160 | A |
| Single Pulse Avalanche Energy *3 | $E_{AS}$ | 50 | 100 | mJ |
| Power Dissipation ($T_C$ = 25°C) | $P_D$ | 36 | | 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-Case | $R_{\theta JC}$ | - | - | 3.5 | °C/W |
| Thermal Resistance Junction-to-Air *1 | $R_{\theta JA}$ | - | - | 50 | °C/W |

## Electrical Characteristics-N (@ $T_A$ = 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 | 40 | - | - | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 32V, $V_{GS}$ = 0V | - | - | 1 | μA |
| $I_{GSS}$ | Gate-Body Leakage Current | $V_{GS}$ = ±20V, $V_{DS}$ = 0V | - | - | ±100 | nA |
| **On Characteristics** | | | | | | |
| $R_{DS(ON)}$ | Drain-Source On-resistance *2 | $V_{GS}$ = 10V,$I_D$ = 5A | - | 8 | 10 | mΩ |
| | | $V_{GS}$ = 4.5V,$I_D$ = 4A | - | 10 | 15 | mΩ |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250μA | 1 | 1.8 | 2.5 | V |
| $R_G$ | Gate Resistance | $V_{GS}$ = 0V, f = 1MHz | - | 3.2 | - | Ω |
| **Dynamic Characteristics** | | | | | | |
| $C_{ISS}$ | Input Capacitance | $V_{GS}$ = 0V<br>$V_{DS}$ = 20V<br>f = 1.0MHz | - | 1703 | - | pF |
| $C_{OSS}$ | Output Capacitance | | - | 161 | - | |
| $C_{RSS}$ | Reverse Transfer Capacitance | | - | 145 | - | |
| **Switching Characteristics** | | | | | | |
| $t_{d(ON)}$ | Turn-on Delay Time | $V_{DD}$ = 30V<br>$V_{GS}$ = 15V<br>$I_D$ = 10A<br>$R_G$ = 2Ω | - | 5 | - | ns |
| $t_r$ | Turn-on Rise Time | | - | 26 | - | |
| $t_{d(OFF)}$ | Turn-Off Delay Time | | - | 39 | - | |
| $t_f$ | Turn-Off Fall Time | | - | 30 | - | |
| $Q_G$ | Total Gate-Charge ($V_{GS}$ = 4.5V) | $V_{DD}$ = 20V<br>$V_{GS}$ = 10V<br>$I_D$ = 20A | | 19.3 | | nC |
| | Total Gate-Charge ($V_{GS}$ = 10V) | | - | 37.5 | - | |
| $Q_{GS}$ | Gate to Source Charge | | - | 5.4 | - | |
| $Q_{GD}$ | Gate to Drain (Miller) Charge | | - | 9.2 | - | |
| **Source-Drain Diode Characteristics** | | | | | | |
| $V_{SD}$ | Diode Forward Voltage *2 | $I_{SD}$ = 5A, $V_{GS}$ = 0V | - | 0.8 | 1.2 | V |
| trr | Reverse Recovery Time | $I_{SD}$ = 12A, $V_{GS}$ = 0V<br>$d_{ISD}/d_t$ = 100A/μs | - | 35 | - | ns |
| Qrr | Reverse Recovery Charge | | - | 18 | - | nC |

## Electrical Characteristics-P (@ $T_A$ = 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 | -40 | - | - | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = -32V, $V_{GS}$ = 0V | - | - | -1 | μA |
| $I_{GSS}$ | Gate-Body Leakage Current | $V_{GS}$ = ±20V, $V_{DS}$ = 0V | - | - | ±100 | nA |
| **On Characteristics** | | | | | | |
| $R_{DS(ON)}$ | Drain-Source On-resistance *2 | $V_{GS}$ = -10V,$I_D$ = -5A | - | 11 | 13 | mΩ |
| | | $V_{GS}$ = -4.5V,$I_D$ = -4A | - | 14 | 20 | mΩ |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = -250 μA | -1 | -1.5 | -2.5 | V |
| $R_G$ | Gate Resistance | $V_{GS}$ = 0V, f = 1MHz | - | 10.8 | - | Ω |
| **Dynamic Characteristics** | | | | | | |
| $C_{ISS}$ | Input Capacitance | $V_{GS}$ = 0V<br>$V_{DS}$ = -20V<br>f = 1.0MHz | - | 3020 | - | pF |
| $C_{OSS}$ | Output Capacitance | | - | 262 | - | |
| $C_{RSS}$ | Reverse Transfer Capacitance | | - | 213 | - | |
| **Switching Characteristics** | | | | | | |
| $t_{d(ON)}$ | Turn-on Delay Time *4 | $V_{DD}$ =-15V<br>$V_{GS}$ = -10V<br>$R_G$ = 3.3Ω<br>$R_L$ = 15Ω<br>$I_D$ = -1A | - | 40 | - | ns |
| $t_r$ | Turn-on Rise Time *4 | | - | 35 | - | |
| $t_{d(OFF)}$ | Turn-Off Delay Time *4 | | - | 100 | - | |
| $t_f$ | Turn-Off Fall Time *4 | | - | 9.6 | - | |
| $Q_G$ | Total Gate-Charge ($V_{GS}$ = -4.5V) | $V_{DD}$ = -32V<br>$V_{GS}$ = -10V<br>$I_D$ = -50A | | 30 | | nC |
| | Total Gate-Charge ($V_{GS}$ = -10V) | | - | 60.7 | - | |
| $Q_{GS}$ | Gate to Source Charge | | - | 16 | - | |
| $Q_{GD}$ | Gate to Drain (Miller) Charge | | - | 9 | - | |
| **Source-Drain Diode Characteristics** | | | | | | |
| $V_{SD}$ | Diode Forward Voltage *2 | $I_{SD}$ = -5A, $V_{GS}$ = 0V | - | -0.8 | -1.2 | V |
| trr | Reverse Recovery Time | $I_{SD}$ = -15A, $V_{GS}$ = 0V<br>$d_I/d_t$ = 100A/μs | - | 65 | - | ns |
| Qrr | Reverse Recovery Charge | | - | 48 | - | nC |

Notes:

1. The data tested by surface mounted on a 1 inch$^2$ FR-4 board with 2OZ copper
2. The data tested by pulsed, pulse width ≤ 300μs, duty cycle ≤ 2%
3. The $E_{AS}$ data shows Max. rating. The test condition is N: $V_{DD}$ = 25V, $V_{GS}$ = 10V, L = 0.5mH
   P: $V_{DD}$ = -25V, $V_{GS}$ = -10V, L = 0.5mH
4. Guaranteed by design, not subject to production

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

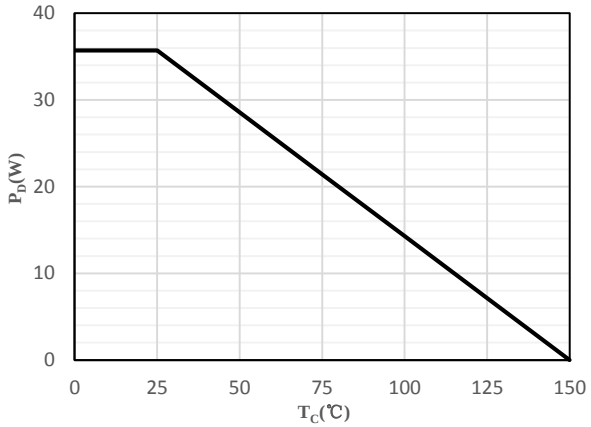



Fig 1 Power Dissipation

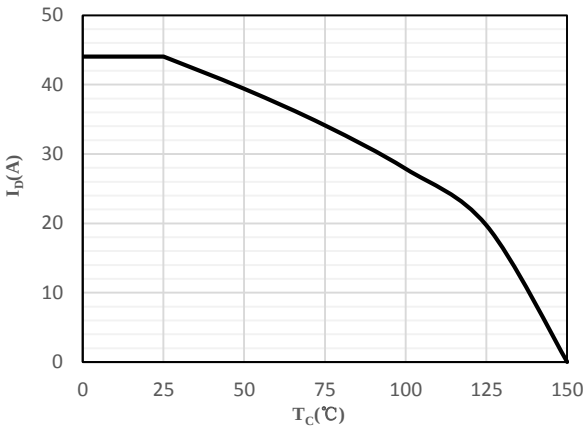



Fig 2 Drain Current

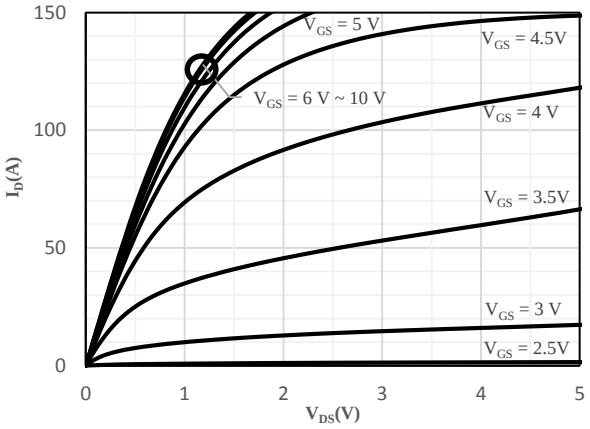



Fig 3 Typical Output Characteristics

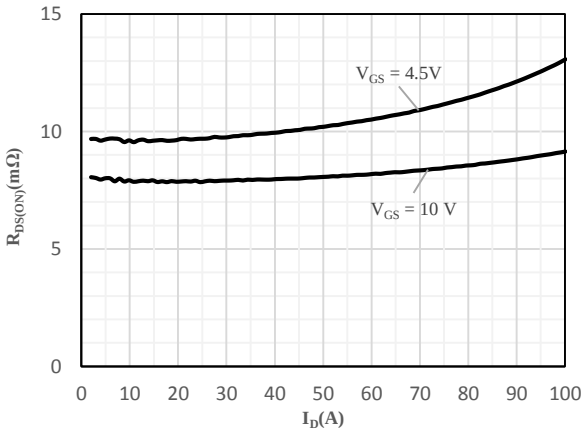



Fig 4 On-Resistance vs. Drain Current and Gate Voltage

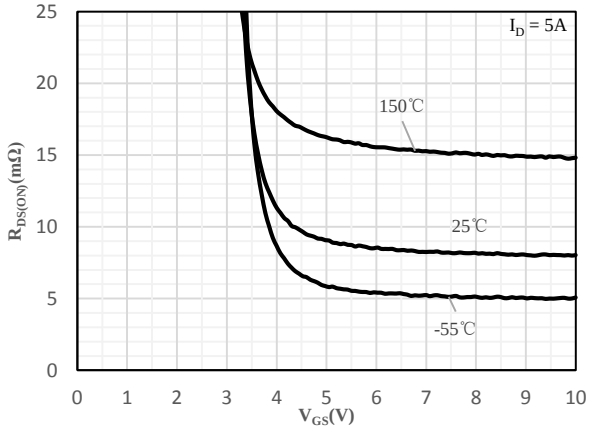



Fig 5 On-Resistance vs. Gate-Source Voltage

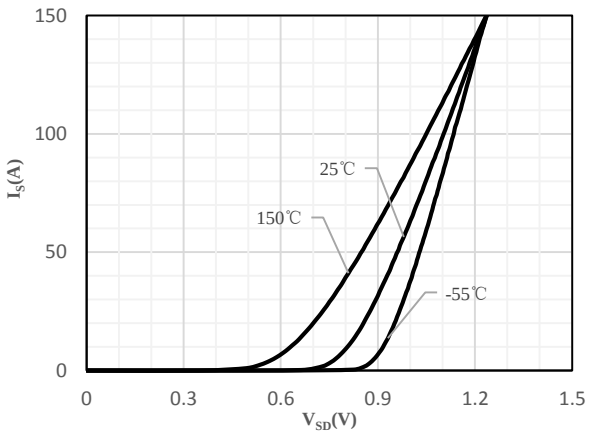



Fig 6 Body-Diode Characteristics

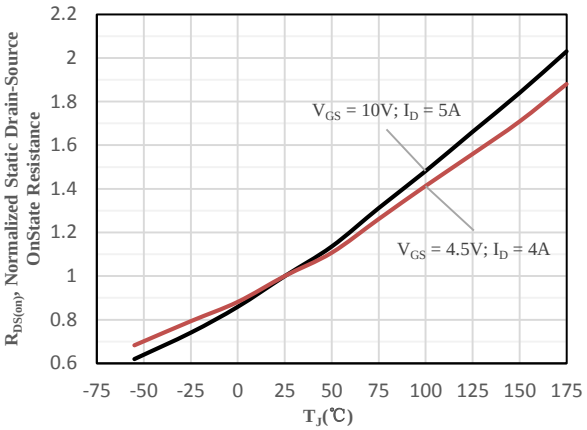



Fig 7 Normalized On-Resistance vs. Junction Temperature

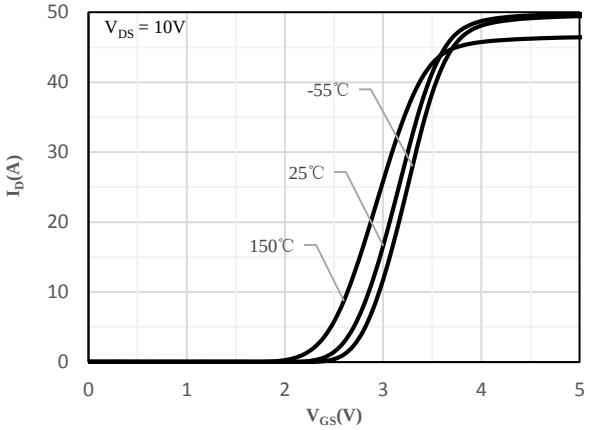



Fig 8 Transfer Characteristics

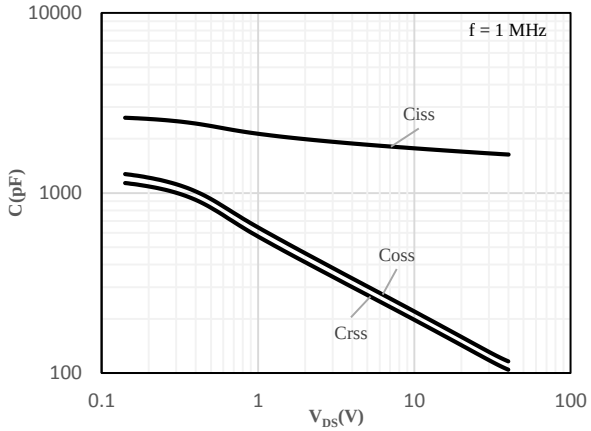



Fig 9 Capacitance Characteristics

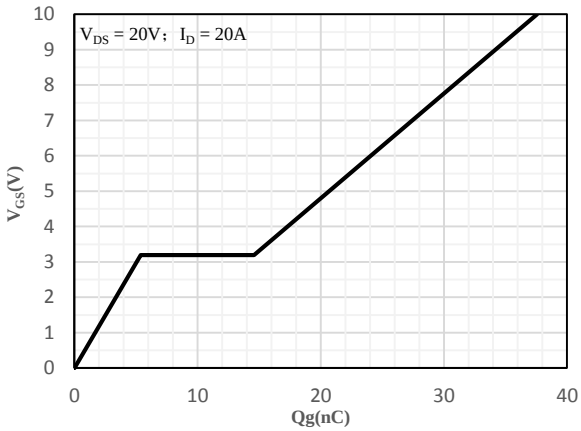



Fig 10 Gate-Charge Characteristics

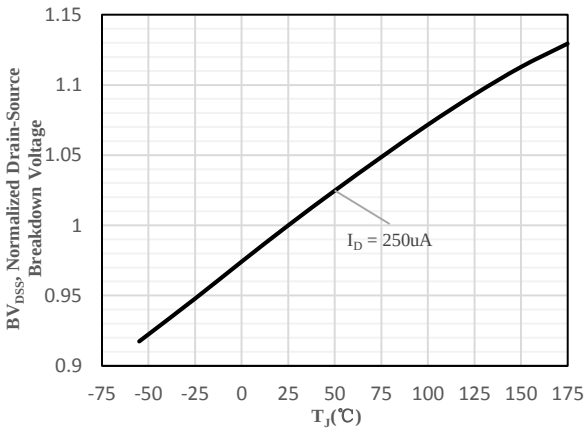



Fig 11 Normalized Breakdown Voltage vs. Junction Temperature

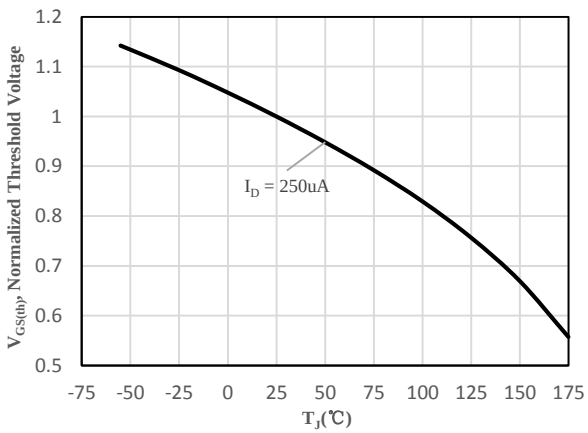



Fig 12 Normalized $V_{GS(th)}$ vs. Junction Temperature

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

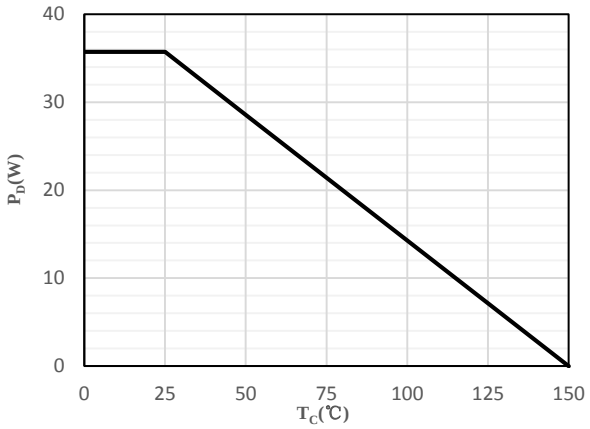



Fig 1 Power Dissipation

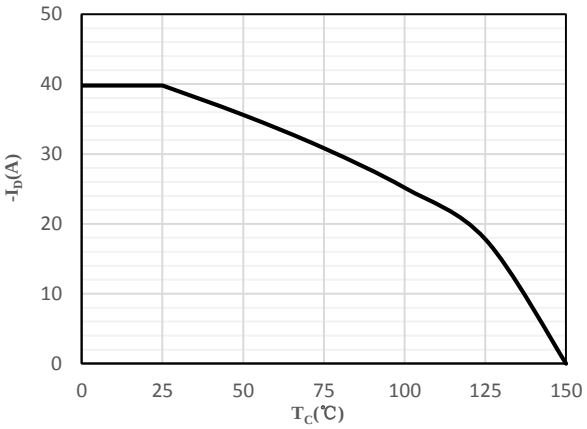



Fig 2 Drain Current

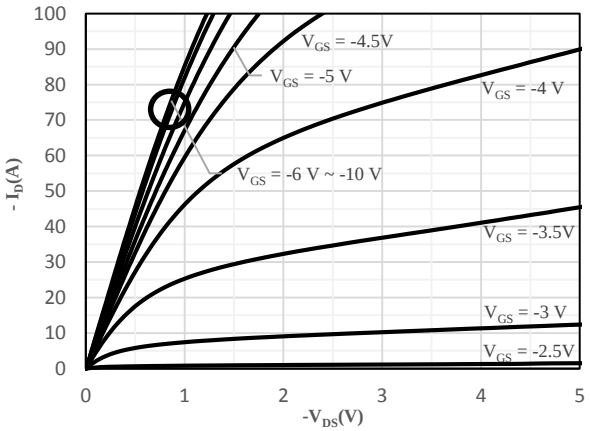



Fig 3 Typical Output Characteristics

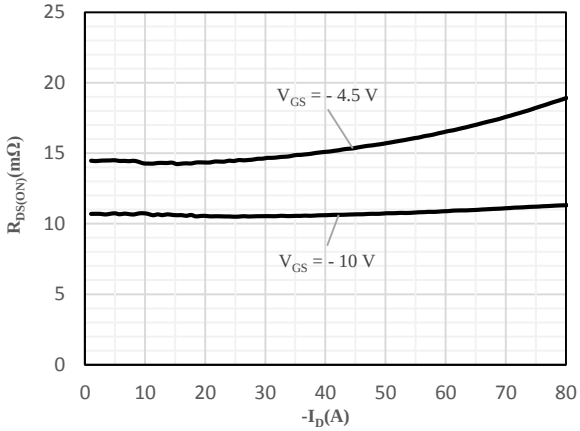



Fig 4 On-Resistance vs. Drain Current and Gate Voltage

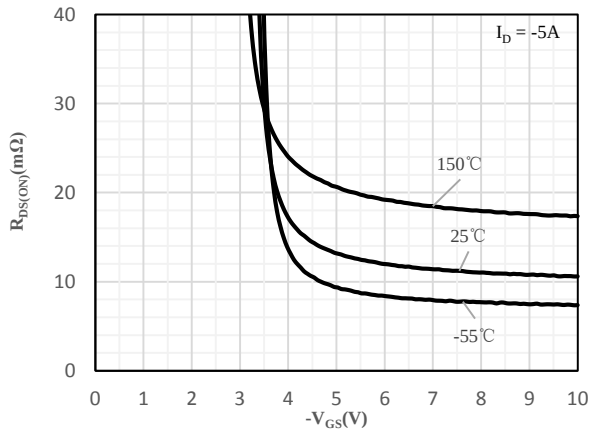



Fig 5 On-Resistance vs. Gate-Source Voltage

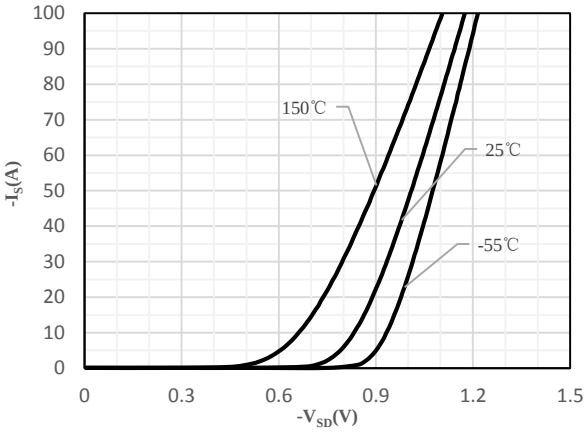



Fig 6 Body-Diode Characteristics

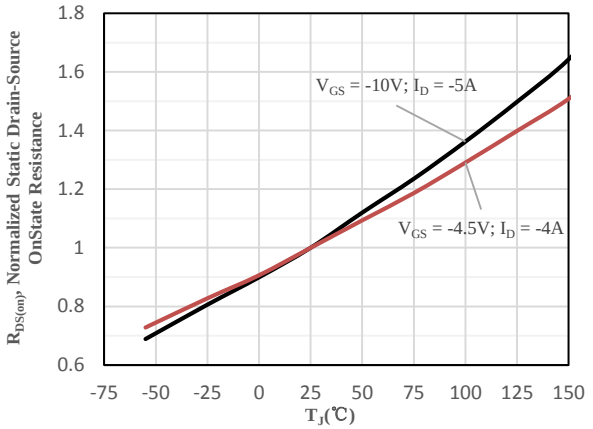



Fig 7 Normalized On-Resistance vs. Junction Temperature

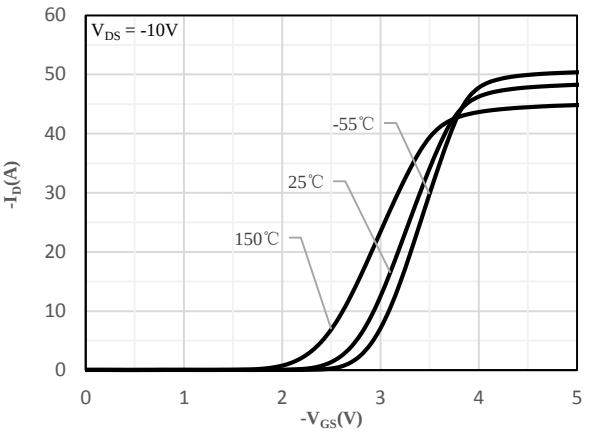



Fig 8 Transfer Characteristics

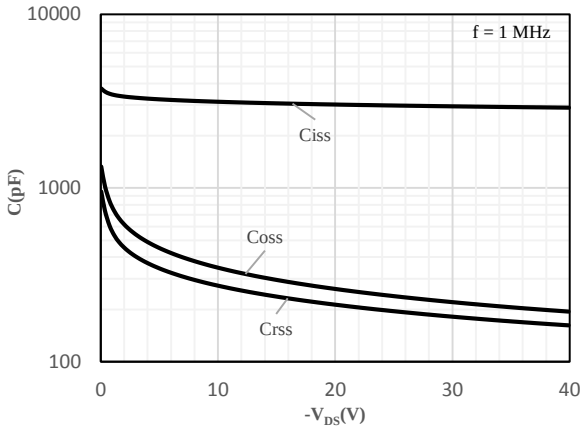



Fig 9 Capacitance Characteristics

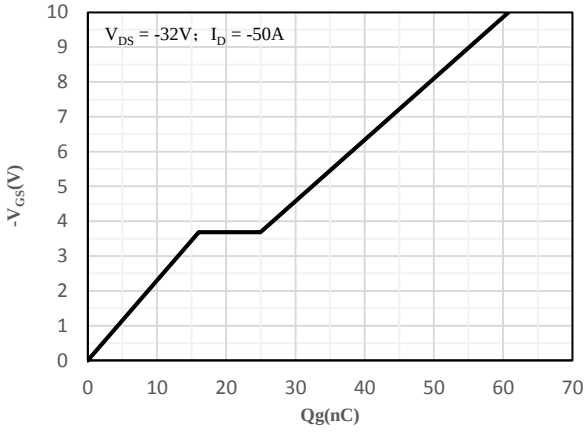



Fig 10 Gate-Charge Characteristics

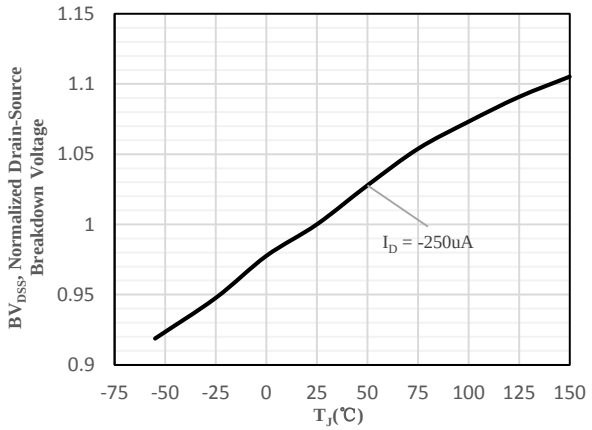



Fig 11 Normalized Breakdown Voltage vs. Junction Temperature

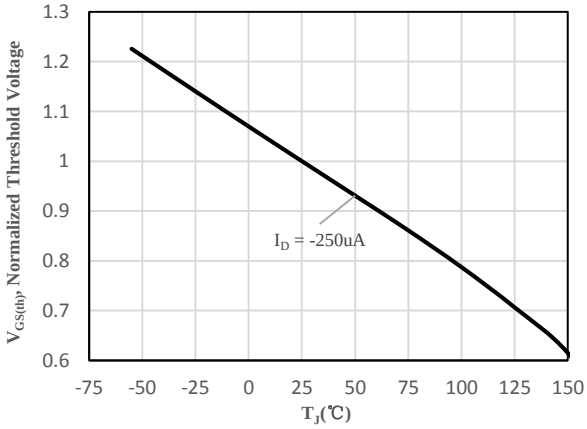
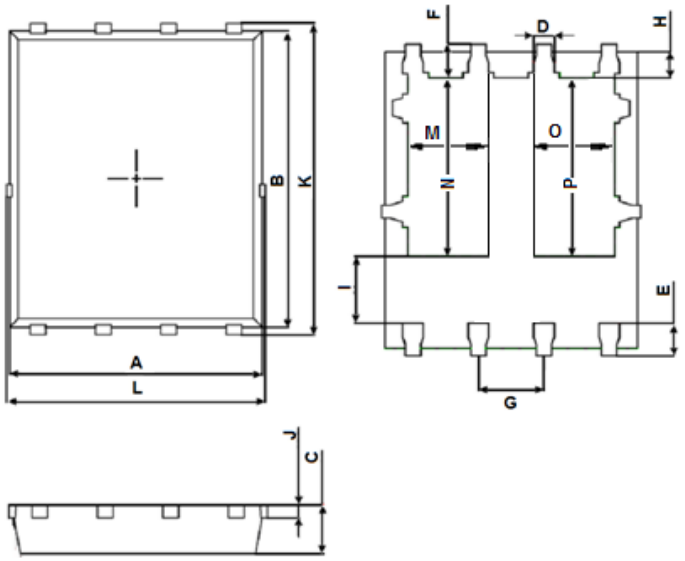



Fig 12 Normalized $V_{GS(th)}$ vs. Junction Temperature

## Package Outline Dimensions (Unit: mm)




| PDFN5×6-8LC | | |
|---|---|---|
| **Dimension** | **Min.** | **Max.** |
| A | 4.824 | 4.976 |
| B | 5.674 | 5.826 |
| C | 0.900 | 1.000 |
| D | 0.350 | 0.450 |
| E | 0.559 | 0.711 |
| F | 0.574 | 0.726 |
| G | 1.250 | 1.290 |
| H | 0.424 | 0.576 |
| I | 1.190 | 1.390 |
| J | 0.154 | 0.354 |
| K | 5.974 | 6.126 |
| L | 4.944 | 5.096 |
| M/O | 1.595 | 1.795 |
| N/P | 3.375 | 3.575 |

## Mounting Pad Layout (Unit: mm)

### PDFN5×6-8LC