

## N-Channel Power MOSFET

40V, 170A, 2.0mΩ

### FEATURES

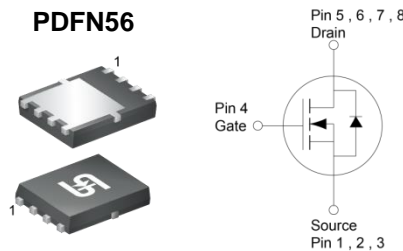
- Low  $R_{DS(on)}$  to minimize conductive losses
- Logic level
- Low gate charge for fast power switching
- 100% UIS and  $R_g$  tested
- Compliant to RoHS directive 2011/65/EU and in accordance to WEEE 2002/96/EC
- Halogen-free according to IEC 61249-2-21

### KEY PERFORMANCE PARAMETERS

| PARAMETER             | VALUE           | UNIT |
|-----------------------|-----------------|------|
| $V_{DS}$              | 40              | V    |
| $R_{DS(on)}$<br>(max) | $V_{GS} = 10V$  | 2.0  |
|                       | $V_{GS} = 4.5V$ | 2.6  |
| $Q_g$                 | 76              | nC   |

### APPLICATIONS

- BLDC Motor Control
- Battery Power Management
- DC-DC converter
- Secondary Synchronous Rectification



Note: MSL 1 (Moisture Sensitivity Level) per J-STD-020

### ABSOLUTE MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

| PARAMETER                                          | SYMBOL         | LIMIT                     | UNIT             |
|----------------------------------------------------|----------------|---------------------------|------------------|
| Drain-Source Voltage                               | $V_{DS}$       | 40                        | V                |
| Gate-Source Voltage                                | $V_{GS}$       | $\pm 20$                  | V                |
| Continuous Drain Current <sup>(Note 1)</sup>       | $I_D$          | $T_C = 25^\circ\text{C}$  | 170              |
|                                                    |                | $T_A = 25^\circ\text{C}$  | 27               |
| Pulsed Drain Current                               | $I_{DM}$       | 680                       | A                |
| Single Pulse Avalanche Current <sup>(Note 2)</sup> | $I_{AS}$       | 43                        | A                |
| Single Pulse Avalanche Energy <sup>(Note 2)</sup>  | $E_{AS}$       | 277                       | mJ               |
| Total Power Dissipation                            | $P_D$          | $T_C = 25^\circ\text{C}$  | 104              |
|                                                    |                | $T_C = 125^\circ\text{C}$ | 21               |
| Total Power Dissipation                            | $P_D$          | $T_A = 25^\circ\text{C}$  | 2.6              |
|                                                    |                | $T_A = 125^\circ\text{C}$ | 0.5              |
| Operating Junction and Storage Temperature Range   | $T_J, T_{STG}$ | - 55 to +150              | $^\circ\text{C}$ |

### THERMAL PERFORMANCE

| PARAMETER                              | SYMBOL          | LIMIT | UNIT               |
|----------------------------------------|-----------------|-------|--------------------|
| Junction to Case Thermal Resistance    | $R_{\theta JC}$ | 1.2   | $^\circ\text{C/W}$ |
| Junction to Ambient Thermal Resistance | $R_{\theta JA}$ | 48    | $^\circ\text{C/W}$ |

**Thermal Performance Note:**  $R_{\theta JA}$  is the sum of the junction-to-case and case-to-ambient thermal resistances. The case-thermal reference is defined at the solder mounting surface of the drain pins.  $R_{\theta JA}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.

| <b>ELECTRICAL SPECIFICATIONS</b> ( $T_A = 25^\circ\text{C}$ unless otherwise noted) |                                                                                   |              |     |      |           |               |
|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------|-----|------|-----------|---------------|
| PARAMETER                                                                           | CONDITIONS                                                                        | SYMBOL       | MIN | TYP  | MAX       | UNIT          |
| <b>Static</b>                                                                       |                                                                                   |              |     |      |           |               |
| Drain-Source Breakdown Voltage                                                      | $V_{GS} = 0\text{V}, I_D = 250\mu\text{A}$                                        | $BV_{DSS}$   | 40  | --   | --        | V             |
| Gate Threshold Voltage                                                              | $V_{GS} = V_{DS}, I_D = 250\mu\text{A}$                                           | $V_{GS(TH)}$ | 1   | 1.5  | 2.5       | V             |
| Gate-Source Leakage Current                                                         | $V_{GS} = \pm 20\text{V}, V_{DS} = 0\text{V}$                                     | $I_{GSS}$    | --  | --   | $\pm 100$ | nA            |
| Drain-Source Leakage Current                                                        | $V_{GS} = 0\text{V}, V_{DS} = 40\text{V}$                                         | $I_{DSS}$    | --  | --   | 1         | $\mu\text{A}$ |
|                                                                                     | $V_{GS} = 0\text{V}, V_{DS} = 40\text{V}$<br>$T_J = 125^\circ\text{C}$            |              | --  | --   | 100       |               |
| Drain-Source On-State Resistance<br>(Note 3)                                        | $V_{GS} = 10\text{V}, I_D = 27\text{A}$                                           | $R_{DS(on)}$ | --  | 1.5  | 2.0       | m $\Omega$    |
|                                                                                     | $V_{GS} = 4.5\text{V}, I_D = 27\text{A}$                                          |              | --  | 1.8  | 2.6       |               |
| Forward Transconductance (Note 3)                                                   | $V_{DS} = 5\text{V}, I_D = 27\text{A}$                                            | $g_{fs}$     | --  | 43   | --        | S             |
| <b>Dynamic</b> (Note 4)                                                             |                                                                                   |              |     |      |           |               |
| Total Gate Charge                                                                   | $V_{GS} = 10\text{V}, V_{DS} = 20\text{V},$<br>$I_D = 27\text{A}$                 | $Q_g$        | --  | 150  | --        | nC            |
| Total Gate Charge                                                                   | $V_{GS} = 4.5\text{V}, V_{DS} = 20\text{V},$<br>$I_D = 27\text{A}$                | $Q_g$        | --  | 76   | --        |               |
| Gate-Source Charge                                                                  |                                                                                   | $Q_{gs}$     | --  | 21   | --        |               |
| Gate-Drain Charge                                                                   |                                                                                   | $Q_{gd}$     | --  | 32   | --        |               |
| Input Capacitance                                                                   | $V_{GS} = 0\text{V}, V_{DS} = 20\text{V}$<br>$f = 1.0\text{MHz}$                  | $C_{iss}$    | --  | 7942 | --        | pF            |
| Output Capacitance                                                                  |                                                                                   | $C_{oss}$    | --  | 768  | --        |               |
| Reverse Transfer Capacitance                                                        |                                                                                   | $C_{rss}$    | --  | 498  | --        |               |
| Gate Resistance                                                                     | $f = 1.0\text{MHz}$                                                               | $R_g$        | 0.4 | 1.2  | 2.4       | $\Omega$      |
| <b>Switching</b> (Note 4)                                                           |                                                                                   |              |     |      |           |               |
| Turn-On Delay Time                                                                  | $V_{GS} = 10\text{V}, V_{DS} = 20\text{V},$<br>$I_D = 27\text{A}, R_G = 2\Omega,$ | $t_{d(on)}$  | --  | 7.6  | --        | ns            |
| Turn-On Rise Time                                                                   |                                                                                   | $t_r$        | --  | 8.8  | --        |               |
| Turn-Off Delay Time                                                                 |                                                                                   | $t_{d(off)}$ | --  | 67   | --        |               |
| Turn-Off Fall Time                                                                  |                                                                                   | $t_f$        | --  | 31   | --        |               |
| <b>Source-Drain Diode</b>                                                           |                                                                                   |              |     |      |           |               |
| Forward Voltage (Note 3)                                                            | $V_{GS} = 0\text{V}, I_S = 27\text{A}$                                            | $V_{SD}$     | --  | --   | 1.2       | V             |
| Reverse Recovery Time                                                               | $I_S = 27\text{A},$<br>$di/dt = 100\text{A}/\mu\text{s}$                          | $t_{rr}$     | --  | 43   | --        | ns            |
| Reverse Recovery Charge                                                             |                                                                                   | $Q_{rr}$     | --  | 35   | --        | nC            |

**Notes:**

- Silicon limited current only.
- $L = 0.3\text{mH}, V_{GS} = 10\text{V}, V_{DD} = 25\text{V}, R_G = 25\Omega, I_{AS} = 43\text{A},$  Starting  $T_J = 25^\circ\text{C}$
- Pulse test: Pulse Width  $\leq 300\mu\text{s}$ , duty cycle  $\leq 2\%$ .
- Switching time is essentially independent of operating temperature.

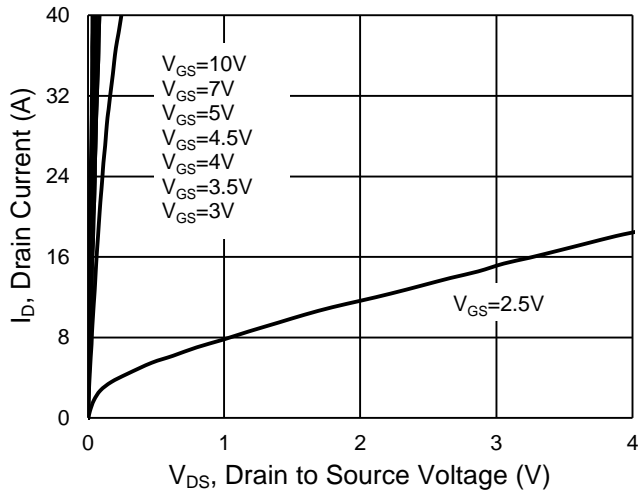
**ORDERING INFORMATION**

| PART NO.         | PACKAGE | PACKING            |
|------------------|---------|--------------------|
| TSM020N04LCR RLG | PDFN56  | 2,500pcs / 13"Reel |

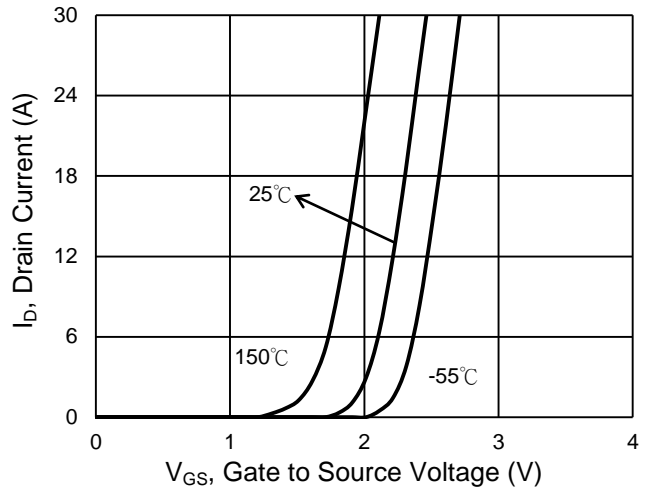
**CHARACTERISTICS CURVES**

( $T_A = 25^\circ\text{C}$  unless otherwise noted)

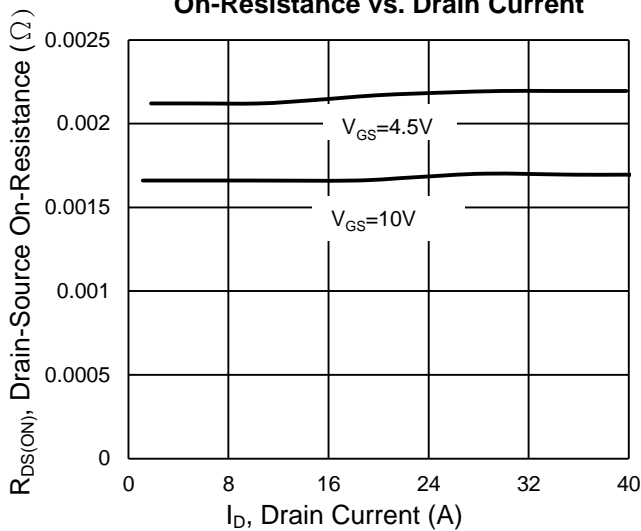
**Output Characteristics**



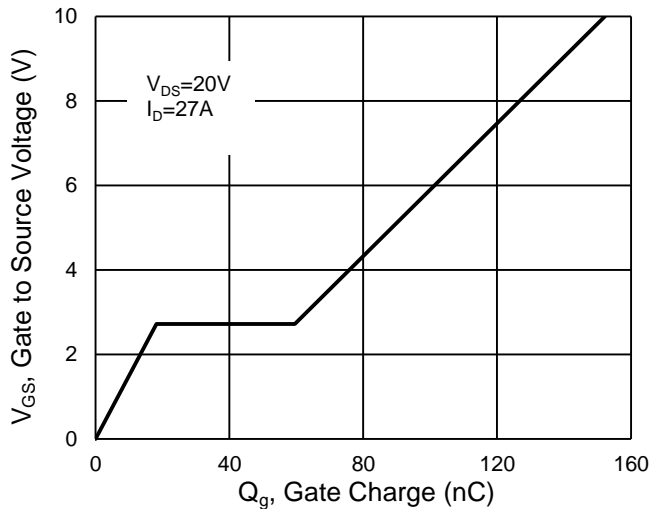
**Transfer Characteristics**



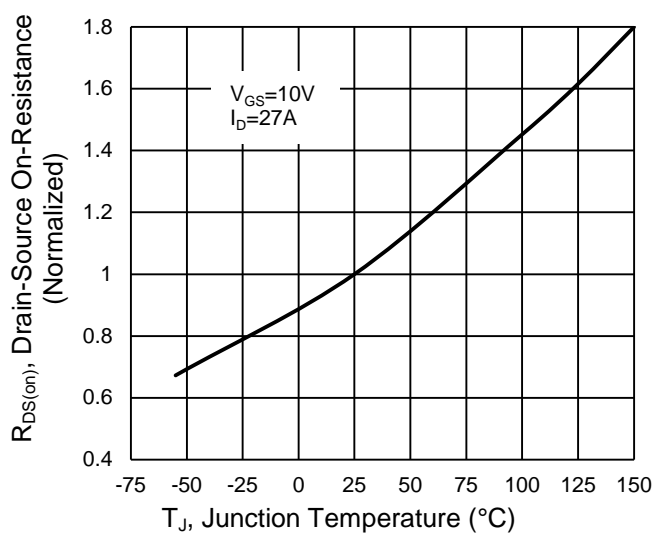
**On-Resistance vs. Drain Current**



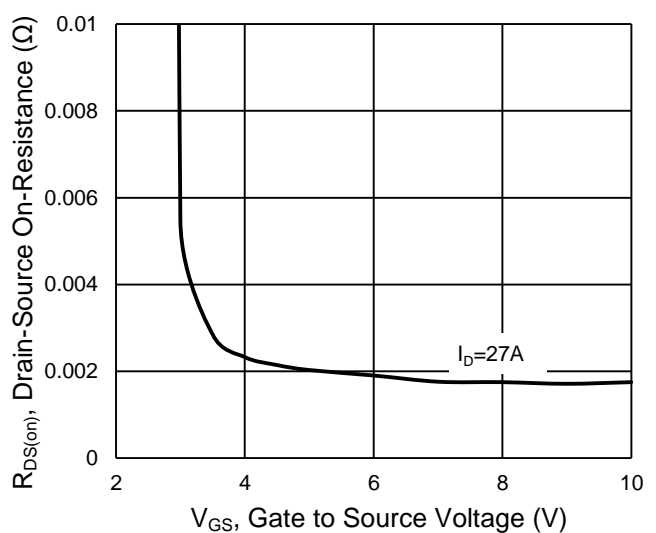
**Gate-Source Voltage vs. Gate Charge**



**On-Resistance vs. Junction Temperature**

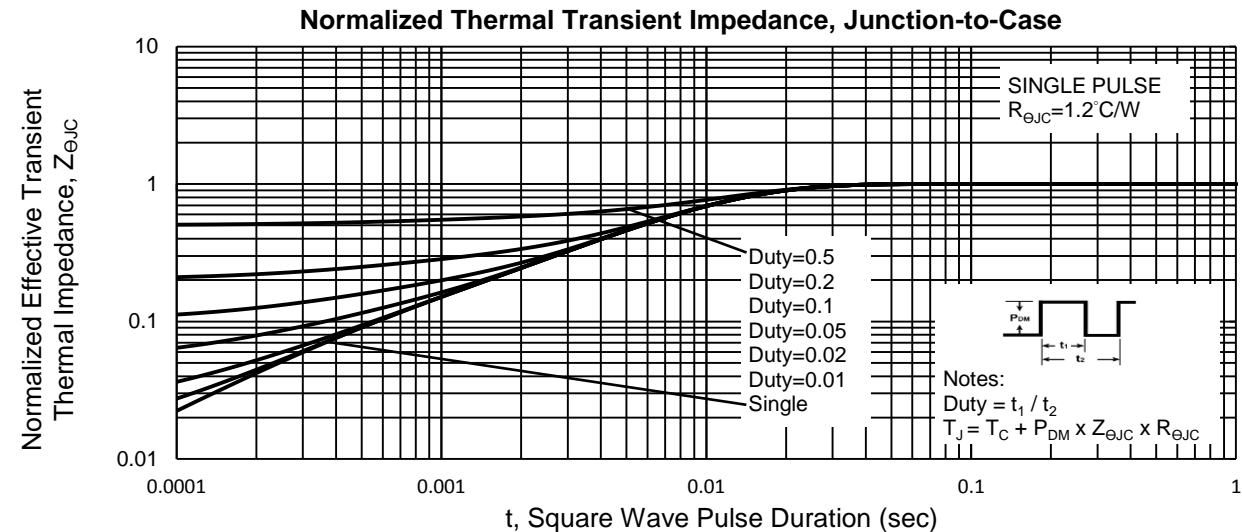
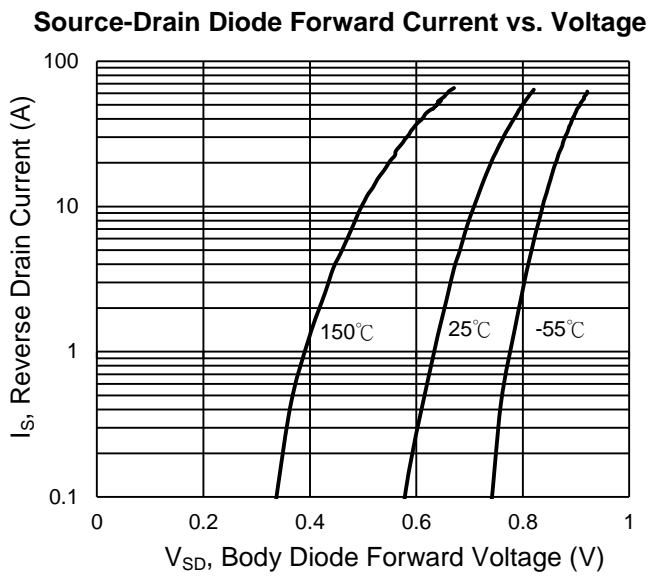
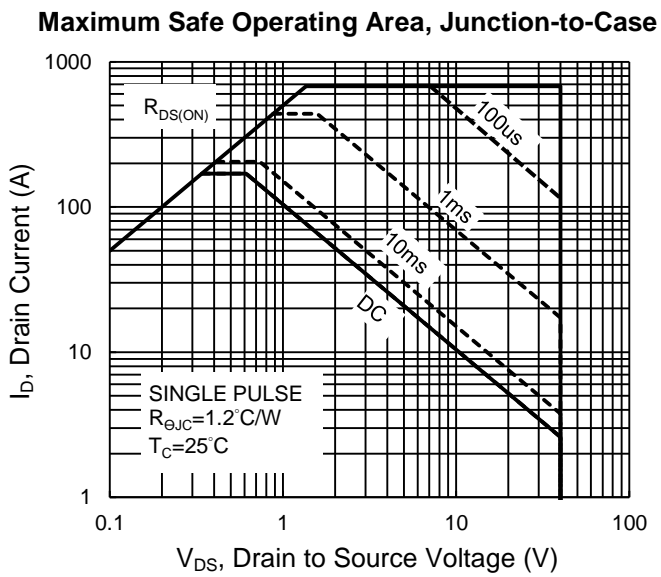
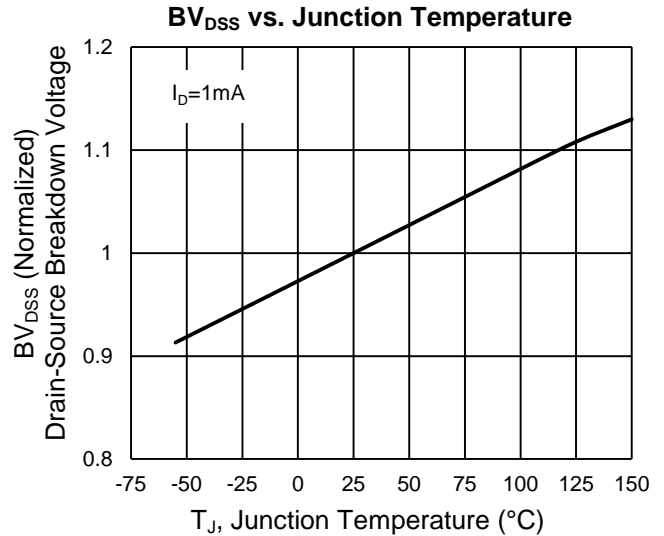
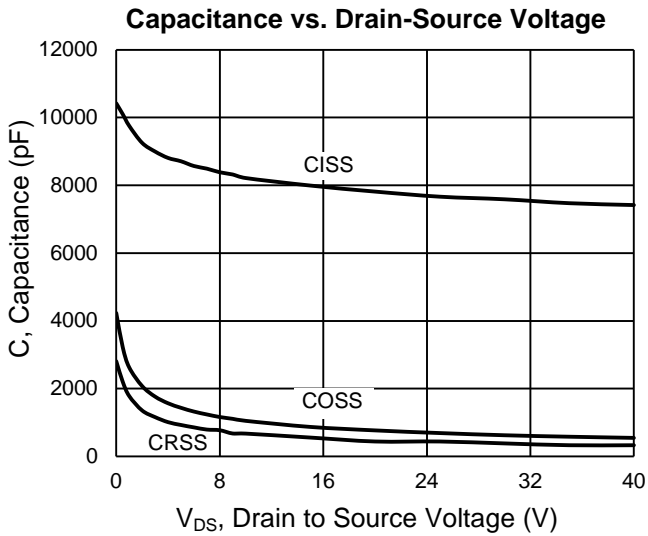


**On-Resistance vs. Gate-Source Voltage**



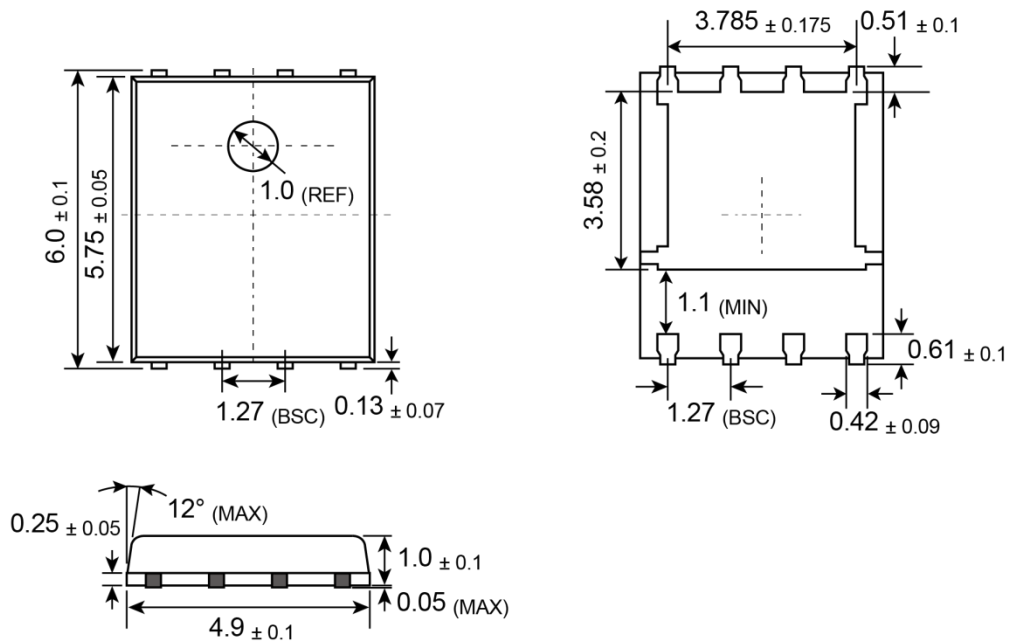
**CHARACTERISTICS CURVES**

( $T_A = 25^\circ\text{C}$  unless otherwise noted)

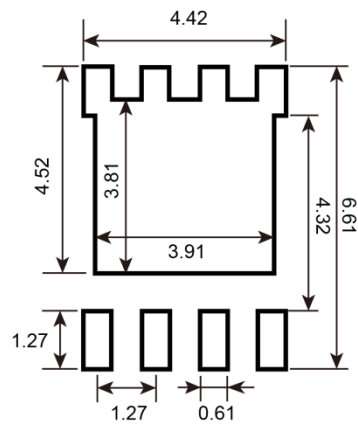


**PACKAGE OUTLINE DIMENSIONS** (Unit: Millimeters)

**PDFN56**



**SUGGESTED PAD LAYOUT** (Unit: Millimeters)



**MARKING DIAGRAM**



- G** = Halogen Free
- Y** = Year Code
- WW** = Week Code (01~52)
- F** = Factory Code

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