# PerFET™ Power Transistor

## FEATURES

- Excellent FOM
- AEC-Q101 Qualified
- Wettable Flank leads for Enhanced AOI
- 100% UIS and Rg tested
- 175°C Operating Junction Temperature
- RoHS Compliant
- Halogen-Free

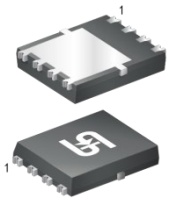
| PRODUCT SUMMARY | | | |
|---|---|---|---|
| **PARAMETER** | | **VALUE** | **UNIT** |
| $V_{DS}$ | | 40 | V |
| $R_{DS(on)}$ (max) | $V_{GS}$ = 10V | 1.1 | mΩ |
| | $V_{GS}$ = 4.5V | 1.5 | |
| $Q_g$ | $V_{GS}$ = 4.5V | 67 | nC |

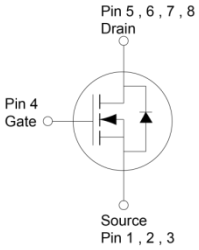
## APPLICATIONS

- Automotive Applications
- Solenoid and Motor Drivers
- DC-DC Converters

Pb-Free RoHS COMPLIANT HALOGEN FREE

**PDFN56U**






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

| **ABSOLUTE MAXIMUM RATINGS** ($T_A$ = 25°C unless otherwise noted) | | | | |
|---|---|---|---|---|
| **PARAMETER** | | **SYMBOL** | **LIMIT** | **UNIT** |
| Drain-Source Voltage | | $V_{DS}$ | 40 | V |
| Gate-Source Voltage | | $V_{GS}$ | ±16 | V |
| Continuous Drain Current, Silicon limited | $T_C$ = 25°C | $I_D$ | 321 | A |
| Continuous Drain Current (Note 1) | $T_C$ = 25°C | $I_D$ | 175 | A |
| | $T_C$ = 100°C | | 175 | |
| | $T_A$ = 25°C | | 38 | |
| Pulsed Drain Current (Note 2,6) | | $I_{DM}$ | 700 | A |
| Single Pulse Avalanche Current (Note 3) | | $I_{AS}$ | 59 | A |
| Single Pulse Avalanche Energy (Note 3) | | $E_{AS}$ | 522 | mJ |
| Total Power Dissipation | $T_C$ = 25°C | $P_D$ | 214 | W |
| | $T_C$ = 125°C | | 71 | |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{STG}$ | - 55 to +175 | °C |

| **THERMAL RESISTANCE** | | | |
|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **MAXIMUM** | **UNIT** |
| Thermal Resistance – Junction to Case | $R_{\Theta JC}$ | 0.7 | °C/W |
| Thermal Resistance – Junction to Ambient (Note 4) | $R_{\Theta JA}$ | 45 | °C/W |

**Notes:**

1. Package current limit.
2. Pulse Width ≤ 100μs.
3. L = 0.3mH, VGS = 10V, RG = 25Ω, Starting TJ = 25°C.
4. Device on a PCB FR4 with 1 $in^2$ (single layer, 2 oz thick) copper area for drain connection.

| ELECTRICAL CHARACTERISTICS ($T_A$ = 25°C unless otherwise noted) | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **CONDITIONS** | **SYMBOL** | **MIN** | **TYP** | **MAX** | **UNIT** |
| **Static** | | | | | | |
| Drain-Source Breakdown Voltage | $V_{GS}$ = 0V, $I_D$ = 1mA | $BV_{DSS}$ | 40 | -- | -- | V |
| Gate Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 250μA | $V_{GS(TH)}$ | 1.4 | 1.6 | 2.2 | V |
| Gate-Source Leakage Current | $V_{GS}$ = ±16V, $V_{DS}$ = 0V | $I_{GSS}$ | -- | -- | ±100 | nA |
| Drain-Source Leakage Current | $V_{GS}$ = 0V, $V_{DS}$ = 40V | $I_{DSS}$ | -- | -- | 1 | μA |
| | $V_{GS}$ = 0V, $V_{DS}$ = 40V<br>$T_J$ = 125°C | | -- | -- | 100 | |
| Drain-Source On-State Resistance (Note 5) | $V_{GS}$ = 10V, $I_D$ = 50A | $R_{DS(on)}$ | -- | 0.8 | 1.1 | mΩ |
| | $V_{GS}$ = 4.5V, $I_D$ = 50A | | -- | 1 | 1.5 | |
| Forward Transconductance (Note 5) | $V_{DS}$ = 10V, $I_D$ = 12.5A | $g_{fs}$ | -- | 117 | -- | S |
| **Dynamic** (Note 6) | | | | | | |
| Total Gate Charge | $V_{GS}$ = 4.5V, $V_{DS}$ = 20V, $I_D$ = 38A | $Q_g$ | -- | 67 | -- | nC |
| Total Gate Charge | $V_{GS}$ = 10V, $V_{DS}$ = 20V, $I_D$ = 38A | $Q_g$ | -- | 142 | -- | |
| Gate-Source Charge | | $Q_{gs}$ | -- | 22 | -- | |
| Gate-Drain Charge | | $Q_{gd}$ | -- | 21 | -- | |
| Input Capacitance | $V_{DS}$ = 20V, $V_{GS}$ = 0V, f = 1.0MHz | $C_{iss}$ | -- | 8693 | -- | pF |
| Output Capacitance | | $C_{oss}$ | -- | 1743 | -- | |
| Reverse Transfer Capacitance | | $C_{rss}$ | -- | 127 | -- | |
| Gate Resistance | f = 1.0MHz | $R_g$ | -- | 1.3 | -- | Ω |
| **Switching** (Note 7) | | | | | | |
| Turn-On Delay Time | $V_{GS}$ = 10V, $V_{DS}$ = 20V, $I_D$ = 38A, $R_G$ = 6Ω | $t_{d(on)}$ | -- | 17 | -- | ns |
| Rise Time | | $t_r$ | -- | 141 | -- | |
| Turn-Off Delay Time | | $t_{d(off)}$ | -- | 160 | -- | |
| Fall Time | | $t_f$ | -- | 120 | -- | |
| **Source-Drain Diode** | | | | | | |
| Diode Forward Voltage (Note 5) | $V_{GS}$ = 0V, $I_S$ = 50A | $V_{SD}$ | -- | -- | 1.1 | V |
| Reverse Recovery Time | $I_S$ = 38A, di/dt = 100A/μs | $t_{rr}$ | -- | 63 | -- | ns |
| Reverse Recovery Charge | | $Q_{rr}$ | -- | 94 | -- | nC |

**Notes:**

5. Pulse test: Pulse Width ≤ 300μs, duty cycle ≤ 2%.
6. Defined by design. Not subject to production test.
7. Switching time is essentially independent of operating temperature.

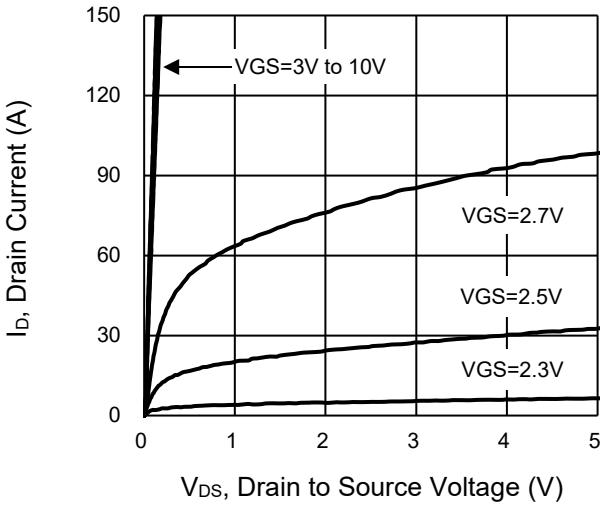
## ORDERING INFORMATION

| ORDERING CODE | PACKAGE | PACKING |
|---|---|---|
| TQM011NH04LCR RLG | PDFN56U | 2,500pcs / 13” Reel |

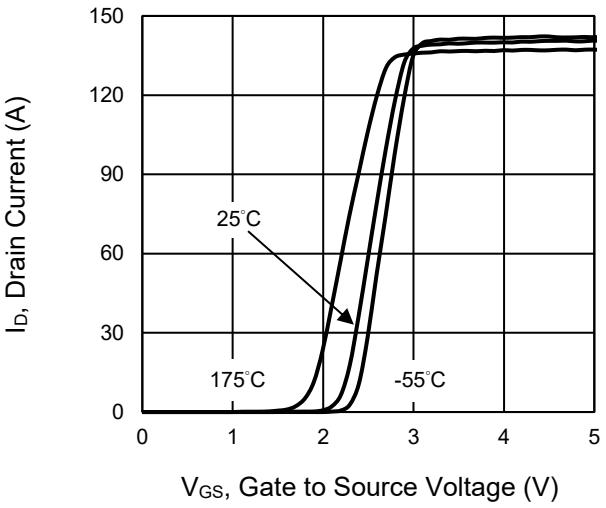
## CHARACTERISTICS CURVES

($T_A$ = 25°C unless otherwise noted)

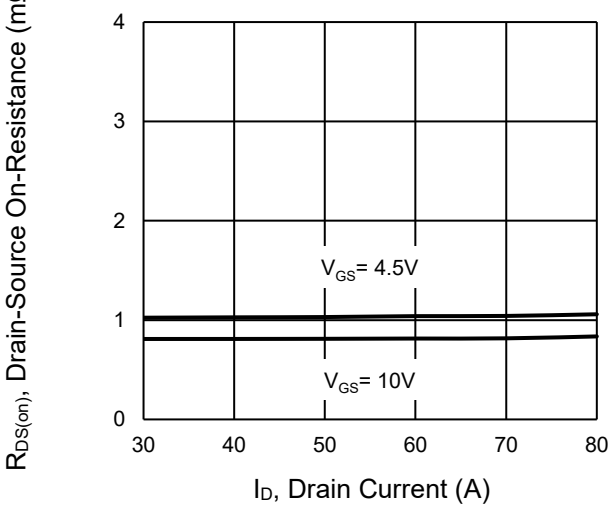
**Output Characteristics**



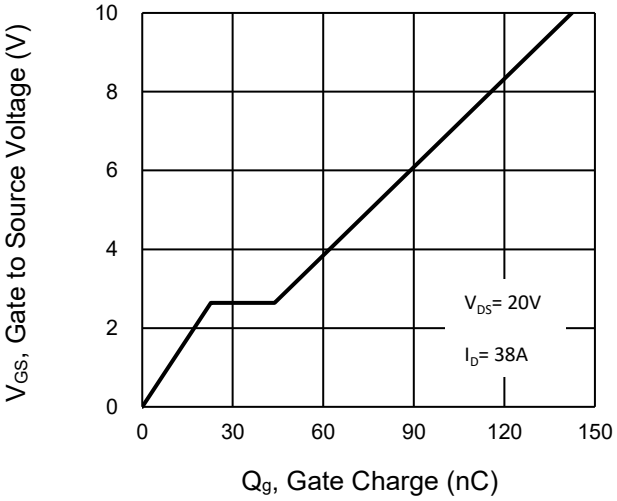

**Transfer Characteristics**



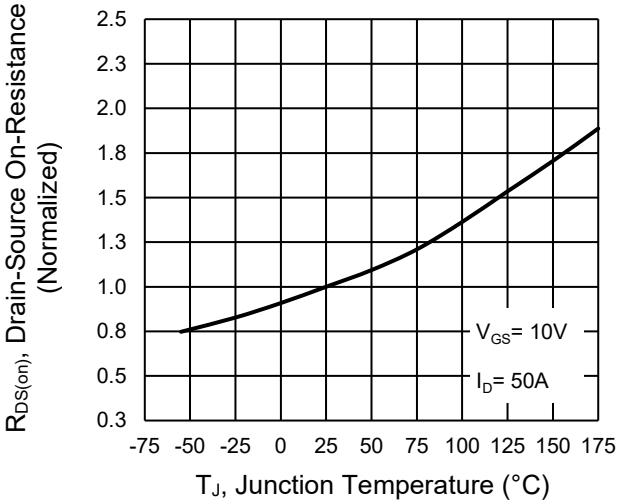

**On-Resistance vs. Drain Current**



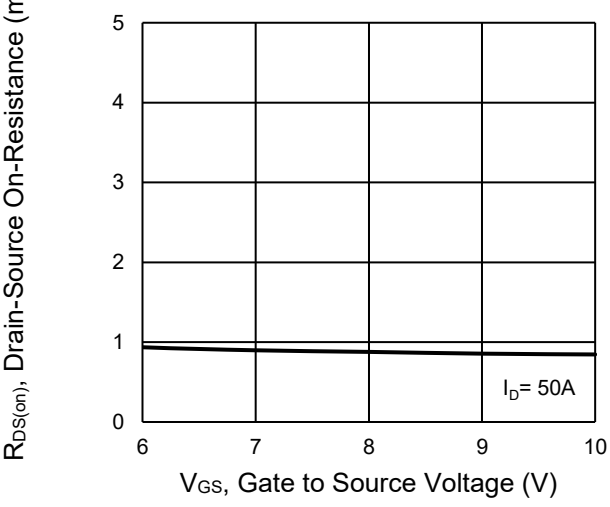

**Gate-Source Voltage vs. Gate Charge**




**On-Resistance vs. Junction Temperature**



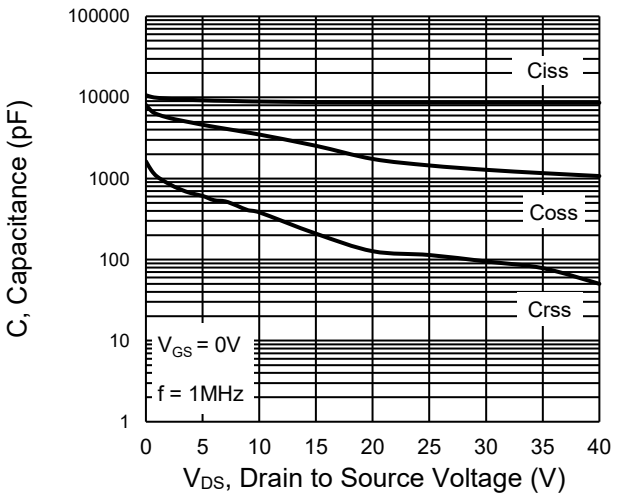

**On-Resistance vs. Gate-Source Voltage**



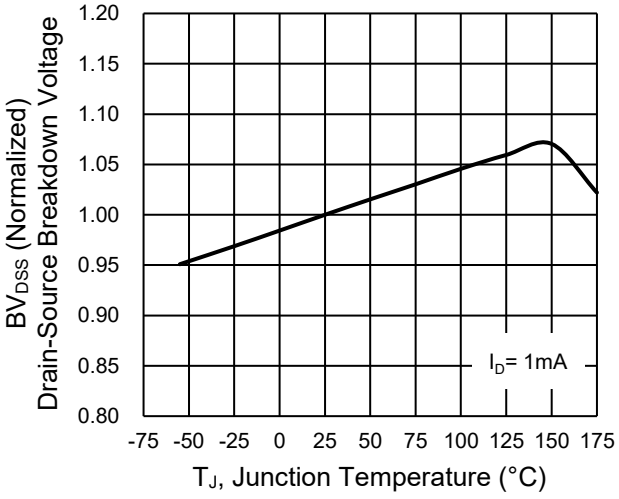
## CHARACTERISTICS CURVES

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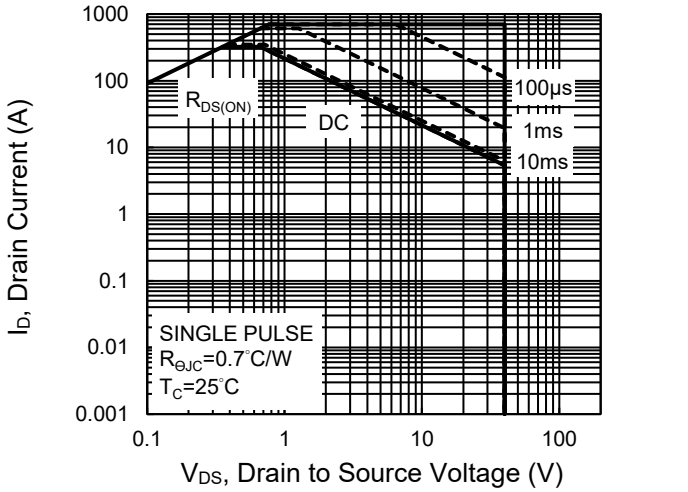
### Capacitance vs. Drain-Source Voltage



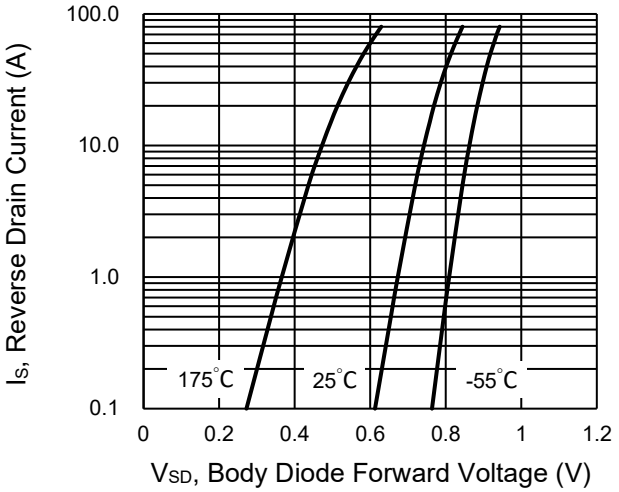

### $BV_{DSS}$ vs. Junction Temperature



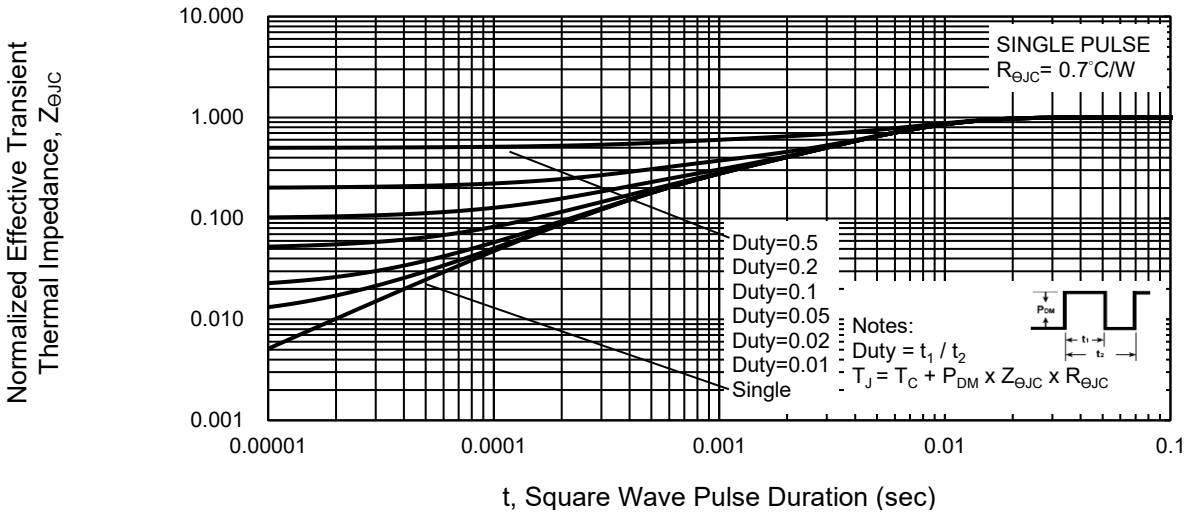

### Maximum Safe Operating Area, Junction-to-Case




### Source-Drain Diode Forward Current vs. Voltage



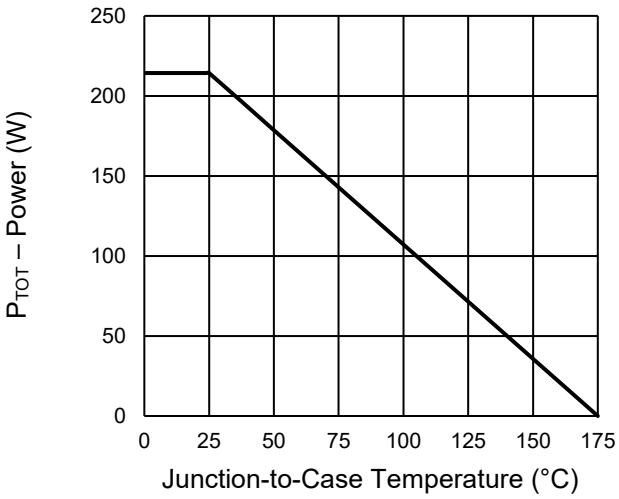

### Normalized Thermal Transient Impedance, Junction-to-Case



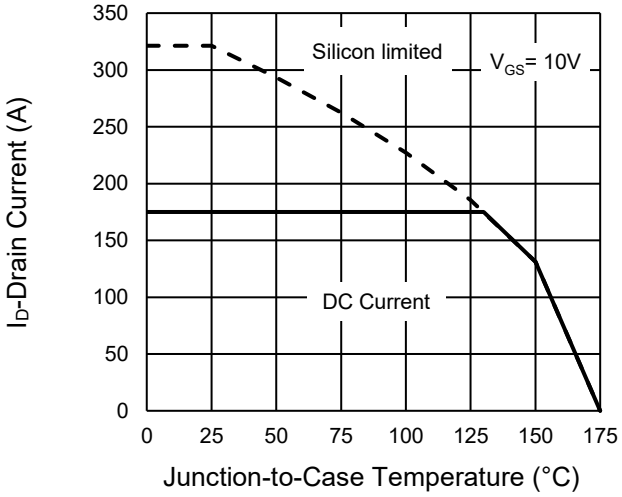
## CHARACTERISTICS CURVES

($T_A$ = 25°C unless otherwise noted)

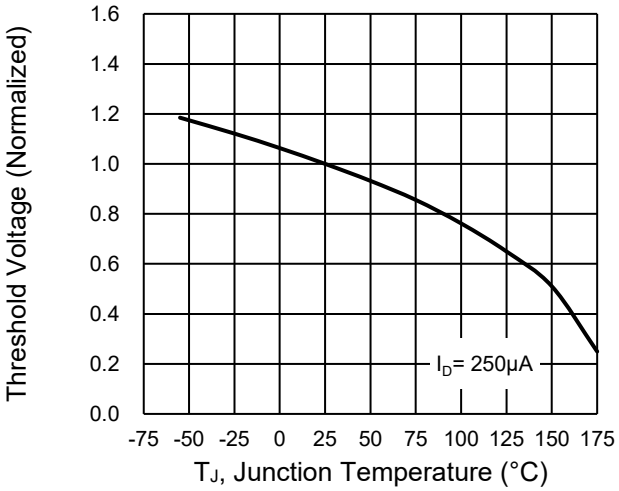
**Power Dissipation**




**Drain Current**

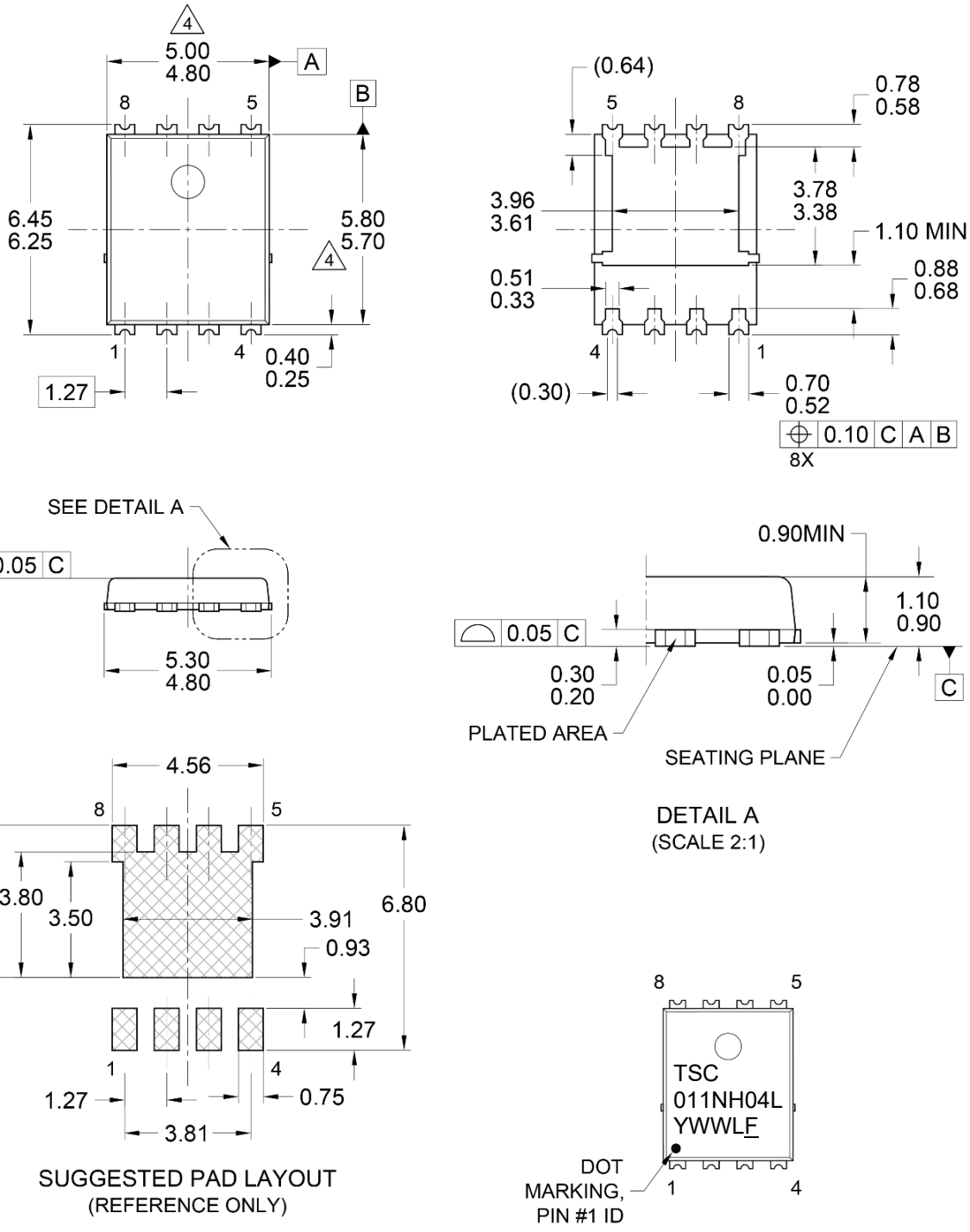



**Normalized gate threshold voltage vs Temperature**



## PACKAGE OUTLINE DIMENSIONS (Unit: Millimeters)

**PDFN56U**




NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994.
3. PACKAGE OUTLINE REFERENCE: JEITA ED-7500B, EIAJ SC-111BB.
4. MOLDED PLASTIC BODY DIMENSIONS DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.
5. DWG NO. REF: HQ2SD07-PDFN56U-023 REV B.

| | |
|---|---|
| 011NH04L | = Device marking |
| Y | = Year code |
| WW | = Week code (01~52) |
| L | = Lot code (1~9,A~Z) |
| F | = Factory code |
| _ | = AEC-Q101 qualified |

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