# AUTOMOTIVE N-Channel 60V 175°C MOSFET

## FEATURES

- AEC-Q101 Qualified
- 100% UIS and $R_g$ Tested
- 175°C Operating Junction Temperature
- Wettable Flank Package
- RoHS Compliant
- Halogen-free according to IEC 61249-2-21

## APPLICATIONS

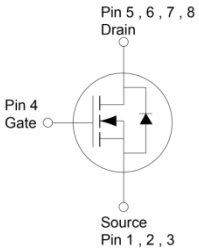
- 12V Automotive Systems
- Solenoid and Motor Control
- Automotive Transmission Control
- DC-DC Converters

| PRODUCT SUMMARY | | | |
|---|---|---|---|
| **PARAMETER** | | **VALUE** | **UNIT** |
| $V_{DS}$ | | 60 | V |
| $R_{DS(on)}$ (max) | $V_{GS}$ = 10V | 30 | mΩ |
| | $V_{GS}$ = 7V | 42.3 | |
| $Q_g$ | | 20 | nC |

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 | | $V_{DS}$ | 60 | V |
| Gate-Source Voltage | | $V_{GS}$ | ±20 | V |
| Continuous Drain Current (Note 1) | $T_C$ = 25°C | $I_D$ | 27 | A |
| | $T_A$ = 25°C | | 6 | |
| Pulsed Drain Current | | $I_{DM}$ | 108 | A |
| Single Pulse Avalanche Current (Note 2) | | $I_{AS}$ | 12 | A |
| Single Pulse Avalanche Energy (Note 2) | | $E_{AS}$ | 21.6 | mJ |
| Total Power Dissipation | $T_C$ = 25°C | $P_D$ | 56 | W |
| | $T_C$ = 125°C | | 19 | |
| Total Power Dissipation | $T_A$ = 25°C | $P_D$ | 3.1 | W |
| | $T_A$ = 125°C | | 1 | |
| 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 | $R_{\Theta JC}$ | 2.7 | °C/W |
| Thermal Resistance – Junction to Ambient | $R_{\Theta JA}$ | 48 | °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. $R_{\Theta JC}$ is guaranteed by design while $R_{\Theta CA}$ is determined by the user's board design. The $R_{\Theta JA}$ limit presented here is based on mounting on a 1 $in^2$ pad of 2 oz copper.

| ELECTRICAL CHARACTERISTICS ($T_A$ = 25°C unless otherwise noted) | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **CONDITIONS** | **SYMBOL** | **MIN** | **TYP** | **MAX** | **UNIT** |
| **Static** | | | | | | |
| Drain-Source Breakdown Voltage | $V_{GS}$ = 0V, $I_D$ = 250μA | $BV_{DSS}$ | 60 | -- | -- | V |
| Gate Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 250μA | $V_{GS(TH)}$ | 1.8 | 2.6 | 3.8 | V |
| Gate-Source Leakage Current | $V_{GS}$ = ±20V, $V_{DS}$ = 0V | $I_{GSS}$ | -- | -- | ±100 | nA |
| Drain-Source Leakage Current | $V_{GS}$ = 0V, $V_{DS}$ = 60V | $I_{DSS}$ | -- | -- | 1 | μA |
| | $V_{GS}$ = 0V, $V_{DS}$ = 60V $T_J$ = 125°C | | -- | -- | 100 | |
| | $V_{GS}$ = 0V, $V_{DS}$ = 60V $T_J$ = 175°C | | -- | -- | 500 | |
| Drain-Source On-State Resistance **(Note 3)** | $V_{GS}$ = 10V, $I_D$ = 6A | $R_{DS(on)}$ | -- | 25 | 30 | mΩ |
| | $V_{GS}$ = 10V, $I_D$ = 6A, $T_J$ = 125°C | | -- | 49.3 | 59.1 | |
| | $V_{GS}$ = 10V, $I_D$ = 6A, $T_J$ = 175°C | | -- | 65 | 78 | |
| | $V_{GS}$ = 7V, $I_D$ = 5A | | -- | 26 | 42.3 | |
| Forward Transconductance **(Note 3)** | $V_{DS}$ = 10V, $I_D$ = 6A | $g_{fs}$ | -- | 30 | -- | S |
| **Dynamic** **(Note 4)** | | | | | | |
| Total Gate Charge | $V_{GS}$ = 10V, $V_{DS}$ = 30V, $I_D$ = 6A | $Q_g$ | -- | 20 | -- | nC |
| Total Gate Charge | $V_{GS}$ = 7V, $V_{DS}$ = 30V, $I_D$ = 5A | $Q_g$ | -- | 14 | -- | |
| Gate-Source Charge | | $Q_{gs}$ | -- | 5 | -- | |
| Gate-Drain Charge | | $Q_{gd}$ | -- | 6 | -- | |
| Input Capacitance | $V_{GS}$ = 0V, $V_{DS}$ = 30V, f = 1.0MHz | $C_{iss}$ | -- | 1009 | -- | pF |
| Output Capacitance | | $C_{oss}$ | -- | 74 | -- | |
| Reverse Transfer Capacitance | | $C_{rss}$ | -- | 23 | -- | |
| Gate Resistance | f = 1.0MHz | $R_g$ | 0.7 | 2.2 | 4.4 | Ω |
| **Switching** **(Note 4)** | | | | | | |
| Turn-On Delay Time | $V_{GS}$ = 10V, $V_{DS}$ = 30V, $I_D$ = 6A, $R_G$ = 2Ω | $t_{d(on)}$ | -- | 3 | -- | ns |
| Rise Time | | $t_r$ | -- | 21 | -- | |
| Turn-Off Delay Time | | $t_{d(off)}$ | -- | 10 | -- | |
| Fall Time | | $t_f$ | -- | 15 | -- | |
| **Source-Drain Diode** | | | | | | |
| Diode Forward Voltage **(Note 3)** | $V_{GS}$ = 0V, $I_S$ = 6A | $V_{SD}$ | -- | -- | 1.2 | V |
| Reverse Recovery Time | $I_S$ = 6A, di/dt = 100A/μs | $t_{rr}$ | -- | 17 | -- | ns |
| Reverse Recovery Charge | | $Q_{rr}$ | -- | 13 | -- | nC |

**Notes:**

1. Silicon limited current only.
2. L = 0.3mH, $V_{GS}$ = 10V, $V_{DD}$ = 30V, $R_G$ = 50Ω, $I_{AS}$ = 12A, Starting $T_J$ = 25°C
3. Pulse test: Pulse Width ≤ 300μs, duty cycle ≤ 2%.
4. Switching time is essentially independent of operating temperature.

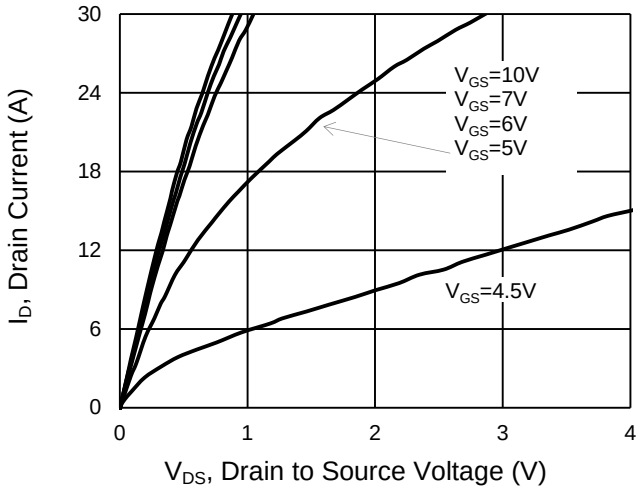
## ORDERING INFORMATION

| ORDERING CODE | PACKAGE | PACKING |
|---|---|---|
| TQM300NB06CR RLG | PDFN56U | 2,500pcs / 13” Reel |

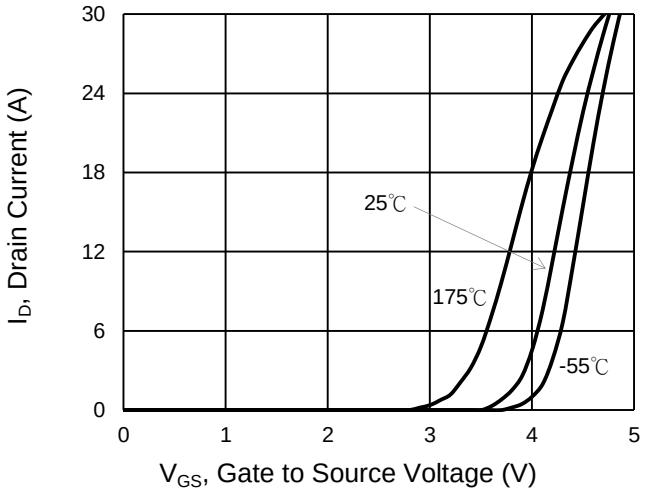
## CHARACTERISTICS CURVES

($T_A$ = 25°C unless otherwise noted)

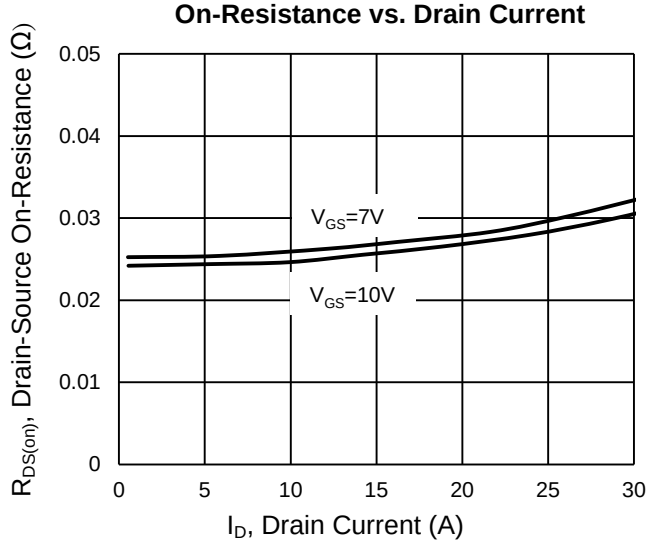
**Output Characteristics**



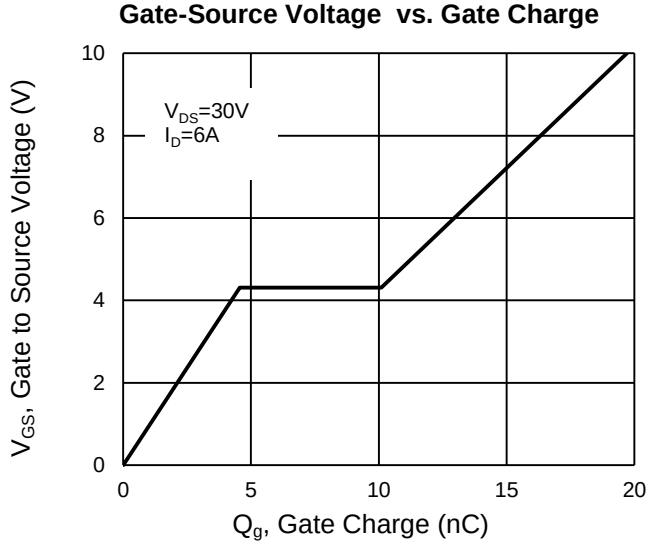

**Transfer Characteristics**



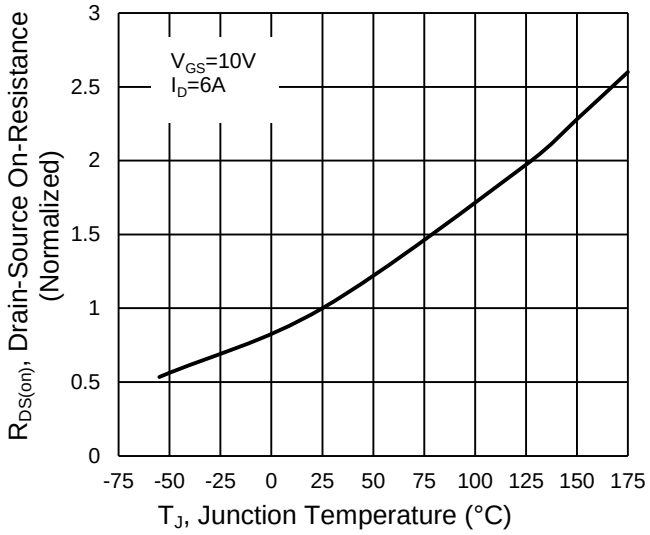

**On-Resistance vs. Drain Current**



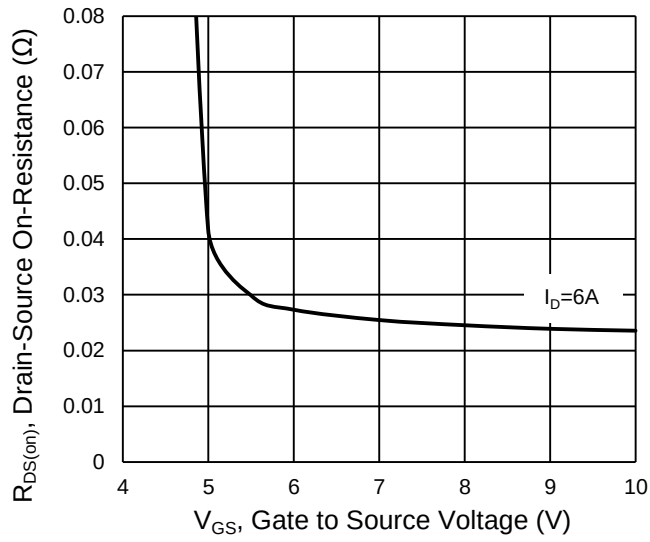

**Gate-Source Voltage vs. Gate Charge**




**On-Resistance vs. Junction Temperature**



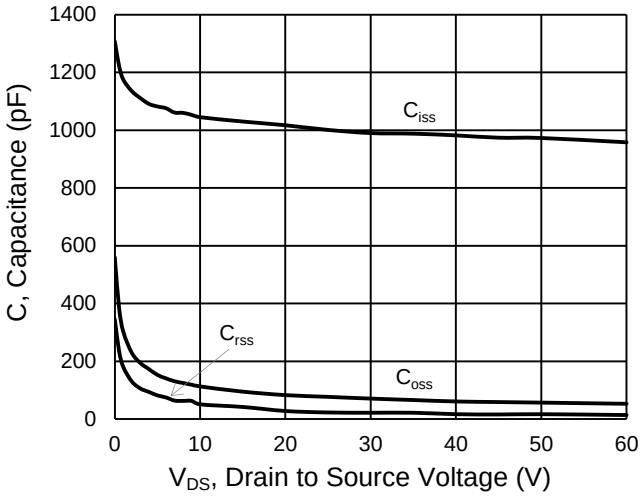

**On-Resistance vs. Gate-Source Voltage**



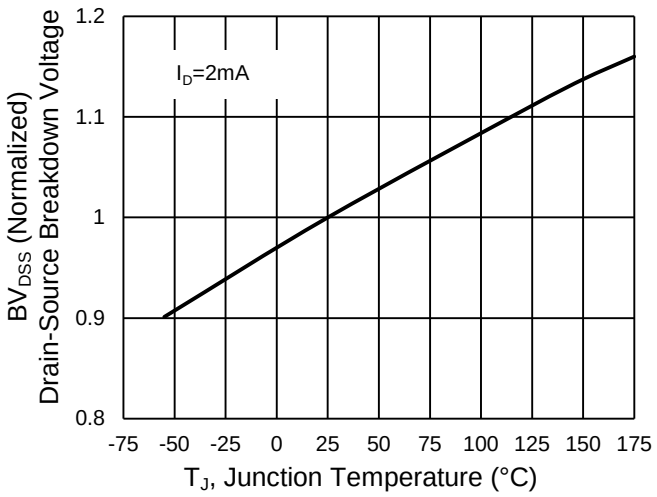
## CHARACTERISTICS CURVES

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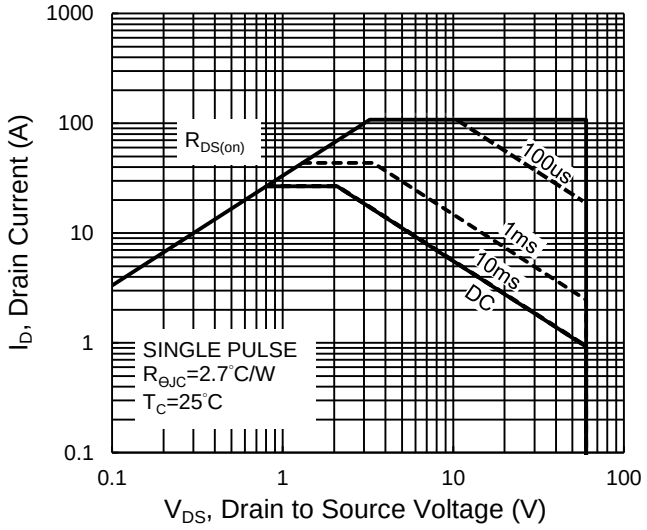
**Capacitance vs. Drain-Source Voltage**



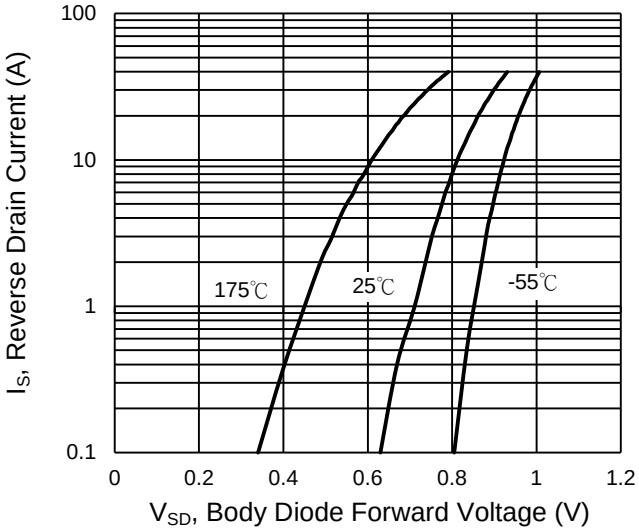

**$BV_{DSS}$ vs. Junction Temperature**



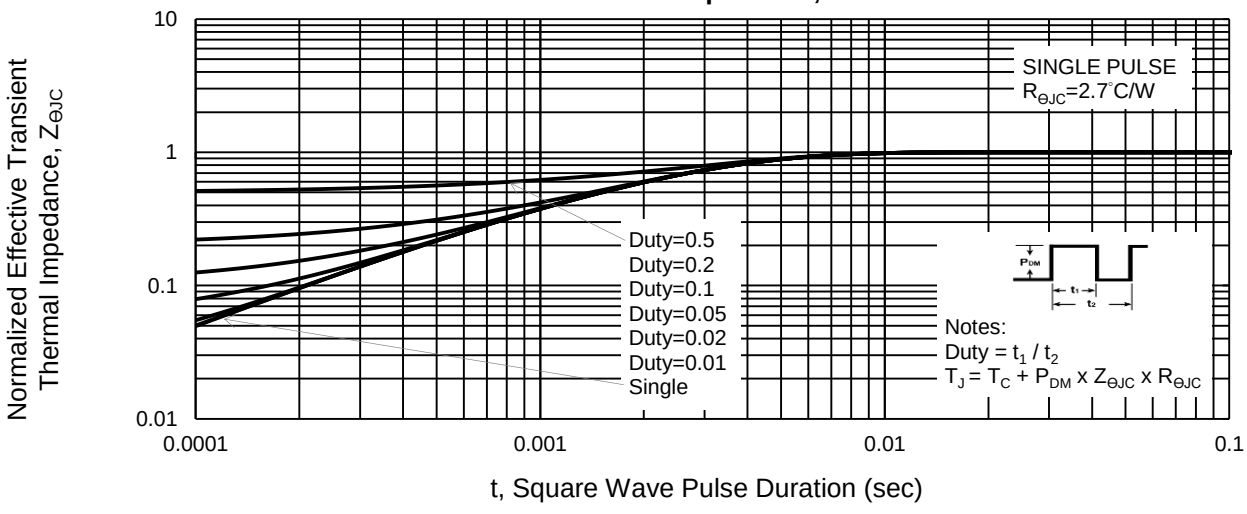

**Maximum Safe Operating Area, Junction-to-Case**




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

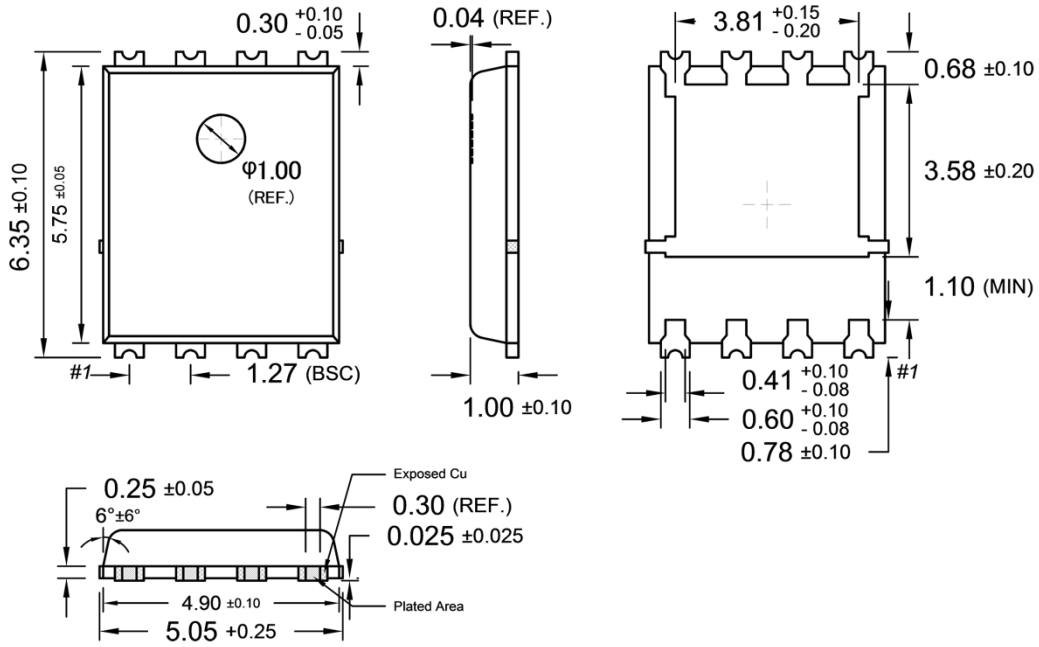



**Normalized Thermal Transient Impedance, Junction-to-Case**

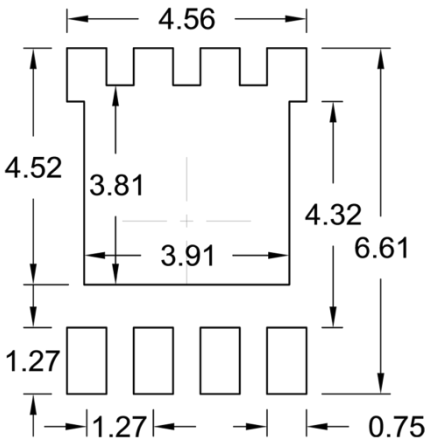


## PACKAGE OUTLINE DIMENSIONS (Unit: Millimeters)

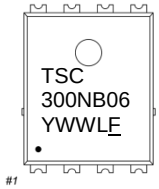
**PDFN56U**




## SUGGESTED PAD LAYOUT (Unit: Millimeters)




## MARKING DIAGRAM




**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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