

# MOSFET – Power, N-Channel

## 60 V, 0.95 mΩ



ON Semiconductor®

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## PCFA86561F

### Features

- Typical  $R_{DS(on)}$  = 0.75 mΩ at  $V_{GS} = 10$  V
- Typical  $Q_{g(tot)}$  = 170 nC at  $V_{GS} = 10$  V
- AEC-Q101 Qualified and PPAP Capable
- RoHS Compliant

### DIMENSION (μm)

|                    |                     |
|--------------------|---------------------|
| Die Size           | 6604 x 3683         |
| Die Size (Sawn)    | 6584 ±15 x 3663 ±15 |
| Source Attach Area | 6405 x 3455         |
| Gate Attach Area   | 446.3 x 715         |
| Die Thickness      | 101.6 ±19.1         |

Gate and Source: AlSiCu  
 Drain: Ti-NiV-Ag (back side of die)  
 Passivation: Polyimide  
 Wafer Diameter: 8 inch  
 Wafer sawn on UV Tape  
 Bad dice identified in inking  
 Gross Die Counts: 1038

The Chip is 100% Probed to Meet the Conditions and Limits Specified at  $T_J = 25^\circ\text{C}$ .



### ORDERING INFORMATION

| Device     | Package               |
|------------|-----------------------|
| PCFA86561F | Wafer<br>Sawn on Foil |

### RECOMMENDED STORAGE CONDITIONS

|             |            |
|-------------|------------|
| Temperature | 22 to 28°C |
| RH          | 40 to 66%  |

| Symbol         | Parameter                              | Condition                                   | Min | Typ  | Max  | Unit |
|----------------|--|---|-----|------|------|------|
| $BV_{DSS}$     | Drain to Source Breakdown Voltage      | $I_D = 250 \mu\text{A}$ , $V_{GS} = 0$ V    | 60  | -    | -    | V    |
| $I_{DSS}$      | Drain to Source Leakage Current        | $V_{DS} = 60$ V, $V_{GS} = 0$ V             | -   | -    | 1    | μA   |
| $I_{GSS}$      | Gate to Source Leakage Current         | $V_{GS} = \pm 20$ V, $V_{DS} = 0$ V         | -   | -    | ±100 | nA   |
| $V_{GS(th)}$   | Gate to Source Threshold Voltage       | $V_{GS} = V_{DS}$ , $I_D = 250 \mu\text{A}$ | 2.0 | -    | 4.0  | V    |
| * $R_{DS(on)}$ | Bare Die Drain to Source On Resistance | $I_D = 5$ A, $V_{GS} = 10$ V                | -   | 0.75 | 0.95 | mΩ   |
| $V_{SD}$       | Source to Drain Diode Voltage          | $I_{SD} = 5$ A, $V_{GS} = 0$ V              | -   | -    | 1.25 | V    |

\*Accurate  $R_{DS(on)}$  test at die level is not feasible as limited by the test contact precision attainable in a die form. The max  $R_{DS(on)}$  specification is defined from the historical performance of the die in package but is not guaranteed by test in production. The die  $R_{DS(on)}$  performance depends on the Source wire/ribbon bonding layout.

# PCFA86561F

**ABSOLUTE MAXIMUM RATINGS** in Reference to the FDBL86561–F085 electrical data in TOLL ( $T_J = 25^\circ\text{C}$  unless otherwise noted)

| Symbol          | Parameter  | Ratings                   | Unit                      |   |
|-----------------|--|---------------------------|---------------------------|---|
| $V_{DSS}$       | Drain to Source Voltage  | 60                        | V                         |   |
| $V_{GS}$        | Gate to Source Voltage   | $\pm 20$                  | V                         |   |
| $I_D$           | Continuous Drain Current $R_{\theta JC}$ ( $V_{GS} = 10\text{ V}$ ) (Note 1) | $T_C = 25^\circ\text{C}$  | 441                       | A |
|                 |  | $T_C = 100^\circ\text{C}$ | 312                       | A |
| $E_{AS}$        | Single Pulse Avalanche Energy (Note 2)                                       | 1167                      | mJ                        |   |
| $P_D$           | Power Dissipation $R_{\theta JC}$  | 429                       | W                         |   |
|                 | Derate above $25^\circ\text{C}$  | 2.86                      | W/ $^\circ\text{C}$       |   |
| $T_J, T_{STG}$  | Operating and Storage Temperature  | $-55$ to $+175$           | $^\circ\text{C}$          |   |
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case   | 0.35                      | $^\circ\text{C}/\text{W}$ |   |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 3)                             | 43                        | $^\circ\text{C}/\text{W}$ |   |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

- Current is limited by silicon.
- Starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.57\text{ mH}$ ,  $I_{AS} = 64\text{ A}$
- $R_{\theta JA}$  is the sum of the junction-to-case and case-to-ambient thermal resistance, where the case thermal reference is defined as the solder mounting surface of the drain pins.  $R_{\theta JC}$  is guaranteed by design, while  $R_{\theta JA}$  is determined by the board design. The maximum rating presented here is based on mounting on a  $1\text{ in}^2$  pad of 2oz copper.

**ELECTRICAL CHARACTERISTICS** in Reference to the FDBL86561–F085 electrical data in TOLL ( $T_J = 25^\circ\text{C}$  unless otherwise noted)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------|-----------|-----------------|------|------|------|------|
|--------|-----------|-----------------|------|------|------|------|

### OFF CHARACTERISTICS

|            |                                   |   |                                    |   |           |    |               |
|------------|-----------------------------------|---|------------------------------------|---|-----------|----|---------------|
| $BV_{DSS}$ | Drain to Source Breakdown Voltage | $I_D = 250\ \mu\text{A}$ , $V_{GS} = 0\text{ V}$  | 60                                 | – | –         | V  |               |
| $I_{DSS}$  | Drain to Source Leakage Current   | $V_{DS} = 60\text{ V}$ ,<br>$V_{GS} = 0\text{ V}$ | $T_J = 25^\circ\text{C}$           | – | –         | 1  | $\mu\text{A}$ |
|            |                                   |   | $T_J = 175^\circ\text{C}$ (Note 4) | – | –         | 3  | mA            |
| $I_{GSS}$  | Gate to Source Leakage Current    | $V_{GS} = \pm 20\text{ V}$                        | –                                  | – | $\pm 100$ | nA |               |

### ON CHARACTERISTICS

|              |                                  |   |                                    |     |      |     |            |
|--------------|----------------------------------|---|------------------------------------|-----|------|-----|------------|
| $V_{GS(th)}$ | Gate to Source Threshold Voltage | $V_{GS} = V_{DS}$ , $I_D = 250\ \mu\text{A}$    | 2.0                                | 3.0 | 4.0  | V   |            |
| $R_{DS(on)}$ | Drain to Source On-Resistance    | $I_D = 80\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$ | $T_J = 25^\circ\text{C}$           | –   | 0.85 | 1.1 | m $\Omega$ |
|              |                                  |   | $T_J = 175^\circ\text{C}$ (Note 4) | –   | 1.5  | 2.2 | m $\Omega$ |

### DYNAMIC CHARACTERISTICS

|              |                               |  |   |       |   |          |
|--------------|-------------------------------|--|---|-------|---|----------|
| $C_{iss}$    | Input Capacitance             | $V_{DS} = 30\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1\text{ MHz}$          | – | 13650 | – | pF       |
| $C_{oss}$    | Output Capacitance            |  | – | 3375  | – | pF       |
| $C_{rss}$    | Reverse Transfer Capacitance  |  | – | 255   | – | pF       |
| $R_g$        | Gate Resistance               | $f = 1\text{ MHz}$   | – | 2.3   | – | $\Omega$ |
| $Q_{g(ToT)}$ | Total Gate Charge             | $V_{GS} = 0$ to $10\text{ V}$ , $V_{DD} = 48\text{ V}$ , $I_D = 80\text{ A}$ | – | 170   | – | nC       |
| $Q_{g(th)}$  | Threshold Gate Charge         | $V_{GS} = 0$ to $2\text{ V}$ , $V_{DD} = 48\text{ V}$ , $I_D = 80\text{ A}$  | – | 24    | – | nC       |
| $Q_{gs}$     | Gate to Source Gate Charge    | $V_{DD} = 48\text{ V}$ , $I_D = 80\text{ A}$                                 | – | 56    | – | nC       |
| $Q_{gd}$     | Gate to Drain “Miller” Charge |  | – | 24    | – | nC       |

### SWITCHING CHARACTERISTICS

|              |                     |  |   |    |   |    |
|--------------|---------------------|--|---|----|---|----|
| $t_{d(on)}$  | Turn-On Delay Time  | $V_{DD} = 30\text{ V}$ , $I_D = 80\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$ , $R_{GEN} = 6\ \Omega$ | – | 45 | – | ns |
| $t_r$        | Rise Time           |  | – | 61 | – | ns |
| $t_{d(off)}$ | Turn-Off Delay Time |  | – | 80 | – | ns |
| $t_f$        | Fall Time           |  | – | 41 | – | ns |

# PCFA86561F

**ELECTRICAL CHARACTERISTICS** in Reference to the FDBL86561-F085 electrical data in TOLL ( $T_J = 25^\circ\text{C}$  unless otherwise noted)

| Symbol                                   | Parameter                     | Test Conditions   | Min. | Typ. | Max. | Unit |
|--|-------------------------------|---|------|------|------|------|
| <b>DRAIN-SOURCE DIODE CHARACTERISTIC</b> |                               |   |      |      |      |      |
| $V_{SD}$                                 | Source to Drain Diode Voltage | $I_{SD} = 80\text{ A}, V_{GS} = 0\text{ V}$   | -    | -    | 1.25 | V    |
|  |                               | $I_{SD} = 40\text{ A}, V_{GS} = 0\text{ V}$   | -    | -    | 1.2  | V    |
| $t_{rr}$                                 | Reverse Recovery Time         | $I_F = 80\text{ A}, dI_{SD}/dt = 100\text{ A}/\mu\text{s},$<br>$V_{DD} = 48\text{ V}$ | -    | 107  | -    | ns   |
| $Q_{rr}$                                 | Reverse Recovery Charge       |   | -    | 183  | -    | nC   |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

4. The maximum value is specified by design at  $T_J = 175^\circ\text{C}$ . Product is not tested to this condition in production.

TYPICAL CHARACTERISTICS

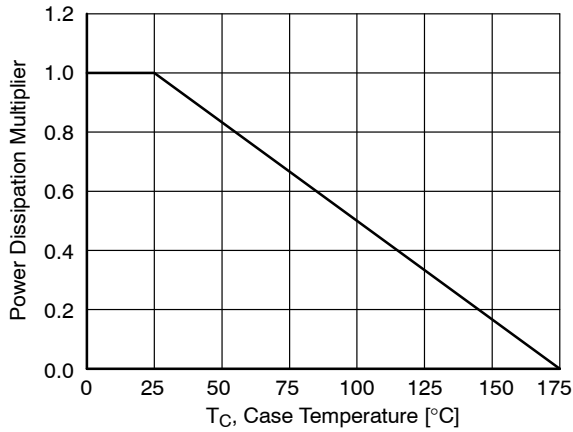


Figure 1. Normalized Power Dissipation vs. Case Temperature

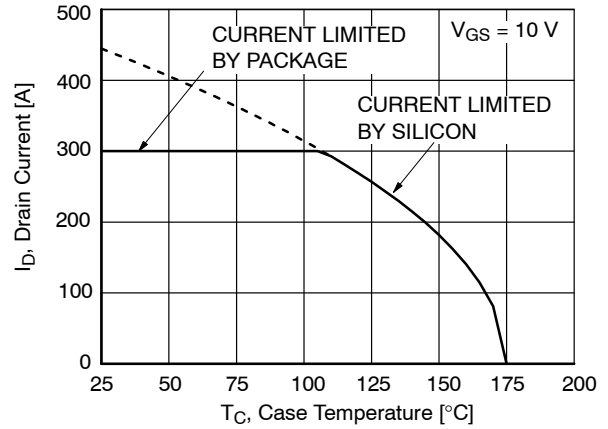


Figure 2. Maximum Continuous Drain Current vs. Case Temperature

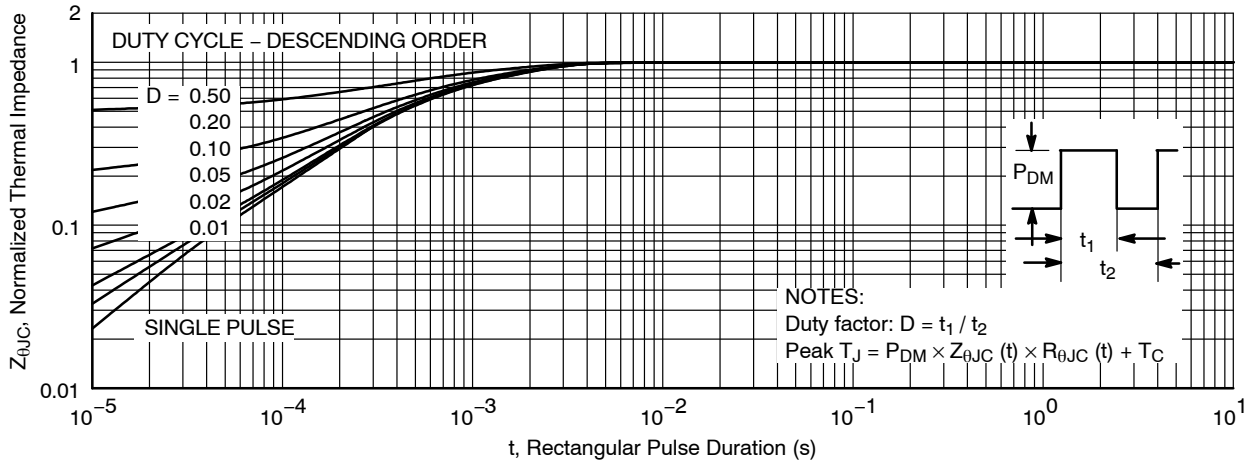


Figure 3. Normalized Maximum Transient Thermal Impedance

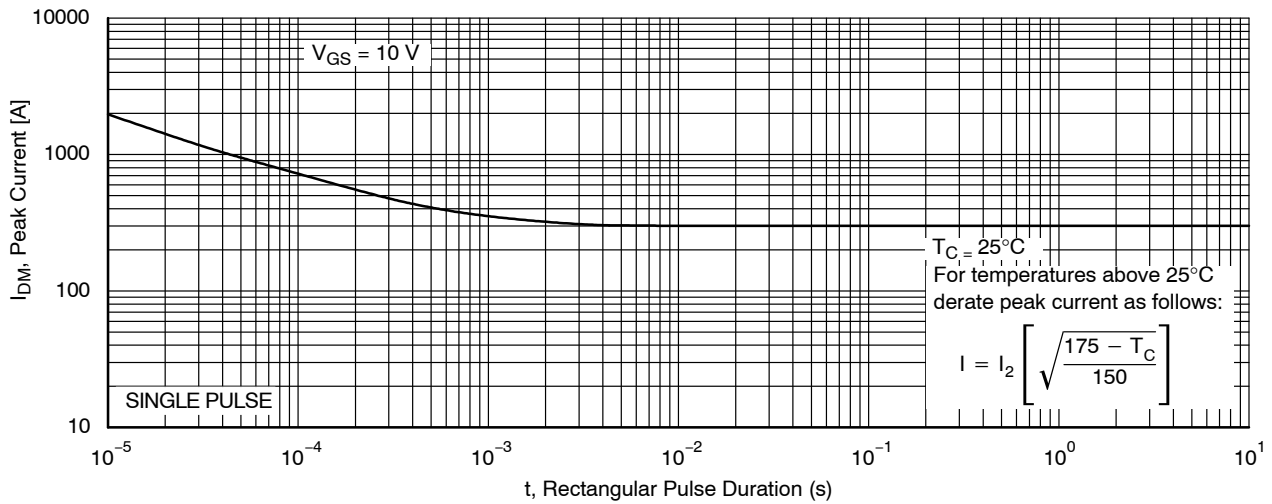


Figure 4. Peak Current Capability

TYPICAL CHARACTERISTICS (continued)

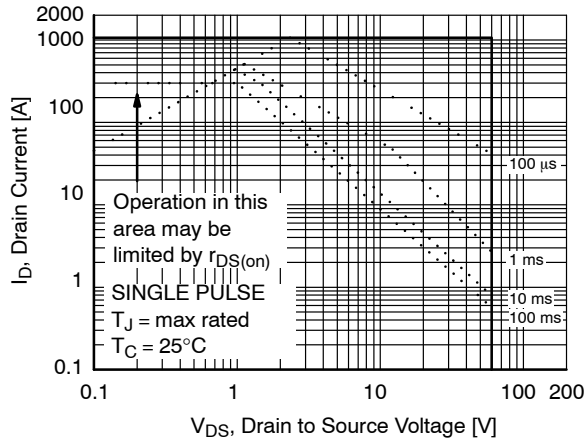
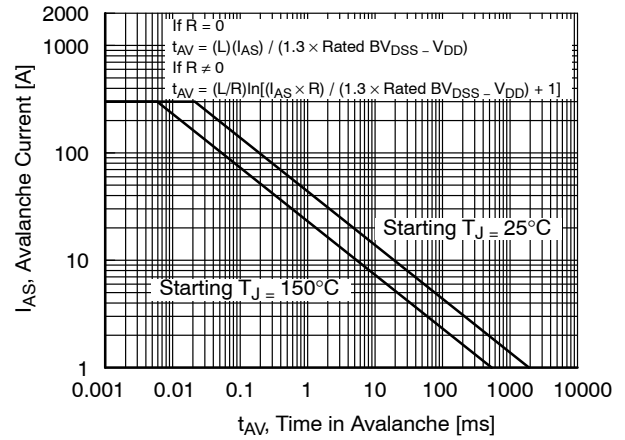


Figure 5. Forward Bias Safe Operating Area



NOTE: Refer to ON Semiconductor Application Notes [AN7514](#) and [AN7515](#).

Figure 6. Unclamped Inductive Switching Capability

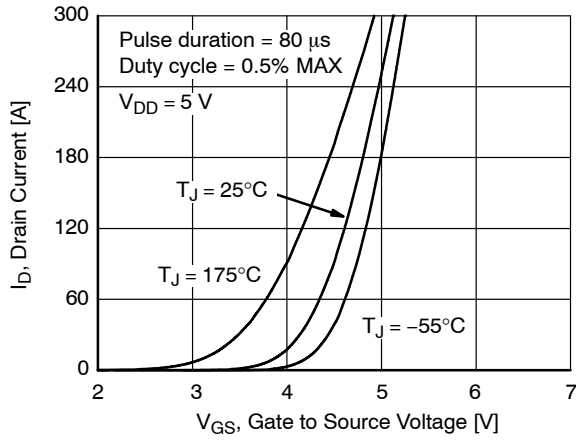


Figure 7. Transfer Characteristics

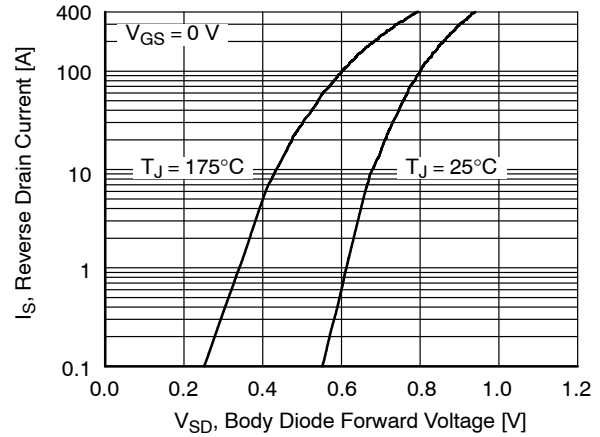


Figure 8. Forward Diode Characteristics

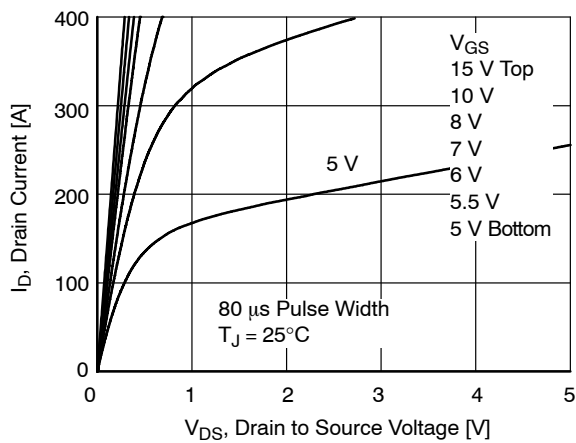


Figure 9. Saturation Characteristics

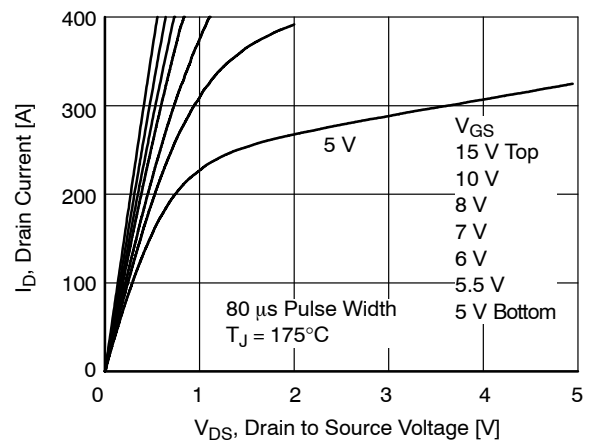


Figure 10. Saturation Characteristics

TYPICAL CHARACTERISTICS (continued)

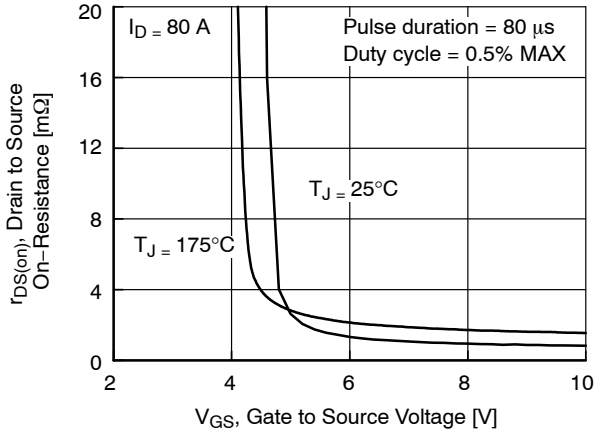


Figure 11.  $R_{DS(on)}$  vs. Gate Voltage

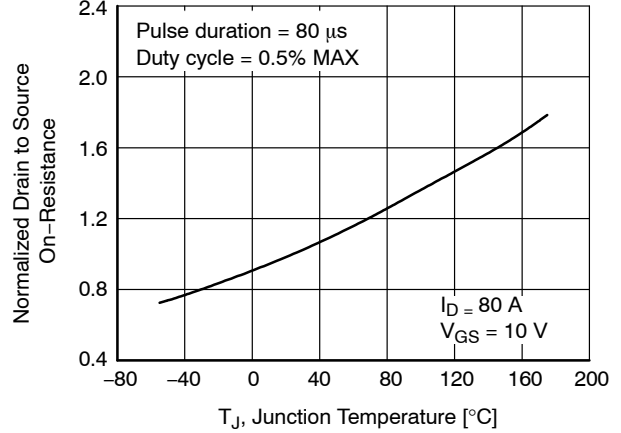


Figure 12. Normalized  $R_{DS(on)}$  vs. Junction Temperature

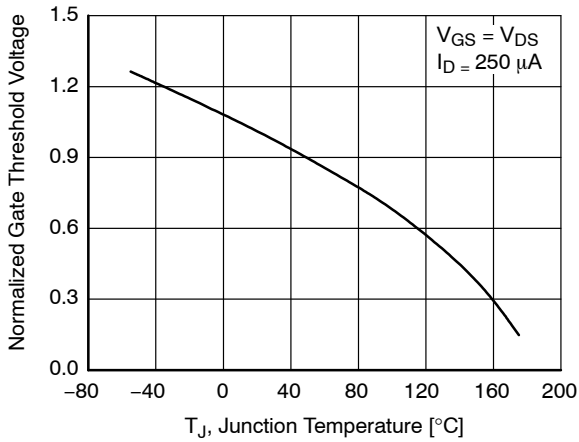


Figure 13. Normalized Gate Threshold Voltage vs. Temperature

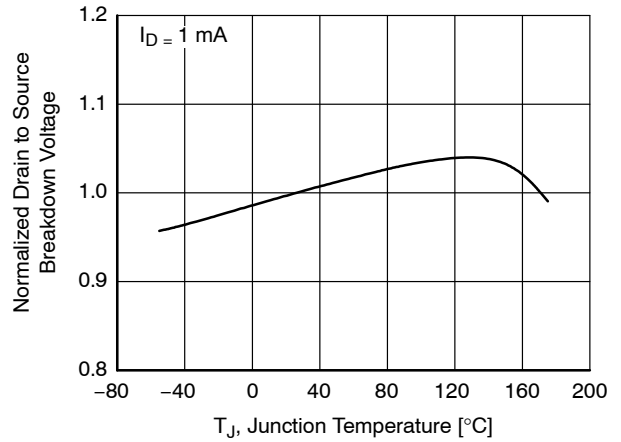


Figure 14. Normalized Drain to Source Breakdown Voltage vs. Junction Temperature

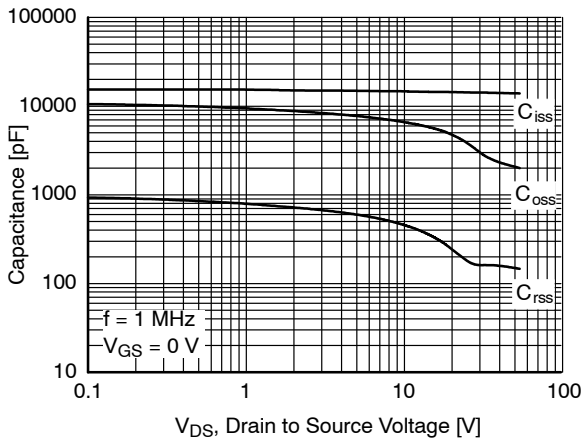


Figure 15. Capacitance vs. Drain to Source Voltage

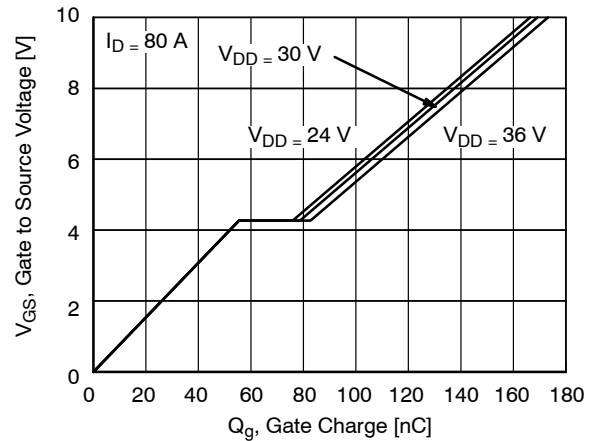


Figure 16. Gate Charge vs. Gate to Source Voltage

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