



FDY4001CZ

Complementary N & P-Channel PowerTrench® MOSFET

Features

Q1: N-Channel

- Max $r_{DS(on)}$ = 5Ω at $V_{GS} = 4.5V$, $I_D = 200mA$
- Max $r_{DS(on)}$ = 7Ω at $V_{GS} = 2.5V$, $I_D = 175mA$
- Max $r_{DS(on)}$ = 9Ω at $V_{GS} = 1.8V$, $I_D = 150mA$

Q2: P-Channel

- Max $r_{DS(on)}$ = 8Ω at $V_{GS} = -4.5V$, $I_D = -150mA$
- Max $r_{DS(on)}$ = 12Ω at $V_{GS} = -2.5V$, $I_D = -125mA$
- Max $r_{DS(on)}$ = 15Ω at $V_{GS} = -1.8V$, $I_D = -100mA$
- ESD protection diode (note 3)
- RoHS Compliant

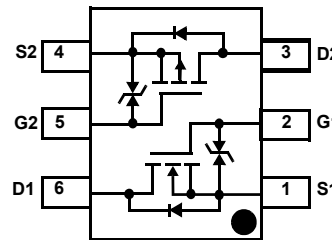
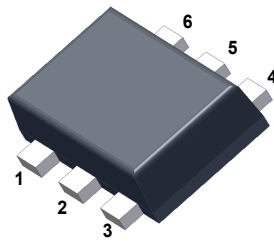


General Description

This Complementary N & P-Channel MOSFET has been designed using Fairchild Semiconductor's advanced PowerTrench® process to optimize the $r_{DS(on)}$ @ $V_{GS}=2.5V$ and specify the $r_{DS(on)}$ @ $V_{GS} = 1.8V$.

Applications

- Level shifting
- Power Supply Converter Circuits
- Load/Power Switching Cell Phones, Pagers



MOSFET Maximum Ratings $T_C = 25^\circ C$ unless otherwise noted

| Symbol | Parameter | Q1 | Q2 | Units |
|----------------|---|------------|---------|------------|
| V_{DS} | Drain to Source Voltage | 20 | -20 | V |
| V_{GS} | Gate to Source Voltage | ± 12 | ± 8 | V |
| I_D | Drain Current -Continuous (Note 1a) | 200 | -150 | mA |
| | -Pulsed | 1000 | -1000 | |
| P_D | Power Dissipation (Steady State) (Note 1a) (Note 1b) | 625 | | mW |
| | | 446 | | |
| T_J, T_{STG} | Operating and Storage Junction Temperature Range | -55 to 150 | | $^\circ C$ |

Thermal Characteristics

| | | | |
|-----------------|---|-----|--------------|
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1a) | 200 | $^\circ C/W$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1b) | 280 | |

Package Marking and Ordering Information

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|----------------|-----------|---------|-----------|------------|-----------|
| F | FDY4001CZ | SC89-6 | 7" | 8mm | 3000units |

Electrical Characteristics $T_J = 25^\circ\text{C}$ unless otherwise noted

| Symbol | Parameter | Test Conditions | Type | Min | Typ | Max | Units |
|--------|-----------|-----------------|------|-----|-----|-----|-------|
|--------|-----------|-----------------|------|-----|-----|-----|-------|

Off Characteristics

| | | | | | | | |
|--------------------------------------|---|---|----------------|-----------|-----------|---------------------------------|----------------------|
| B_{VDSS} | Drain to Source Breakdown Voltage | $I_D = 250\mu\text{A}, V_{GS} = 0\text{V}$ $I_D = -250\mu\text{A}, V_{GS} = 0\text{V}$ | Q1 Q2 | 20 -20 | | | V |
| $\frac{\Delta B_{VDSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\mu\text{A}$, referenced to 25°C $I_D = -250\mu\text{A}$, referenced to 25°C | Q1 Q2 | | 14 -15 | | mV/ $^\circ\text{C}$ |
| I_{DSS} | Zero Gate Voltage Drain Current | $V_{DS} = 16\text{V}, V_{GS} = 0\text{V}$ $V_{DS} = -16\text{V}, V_{GS} = 0\text{V}$ | Q1 Q2 | | | 1 -3 | μA |
| I_{GSS} | Gate-Body Leakage | $V_{GS} = \pm 12\text{V}, V_{DS} = 0\text{V}$ $V_{GS} = \pm 4.5\text{V}, V_{DS} = 0\text{V}$ $V_{GS} = \pm 8\text{V}, V_{DS} = 0\text{V}$ | Q1 Q1 Q2 | | | ± 10 ± 1 ± 10 | μA |

On Characteristics (note 2)

| | | | | | | | |
|--|--|--|----------------------|--------------|------------|---|----------------------|
| $V_{GS(th)}$ | Gate to Source Threshold Voltage | $V_{GS} = V_{DS}, I_D = 250\mu\text{A}$ $V_{GS} = V_{DS}, I_D = -250\mu\text{A}$ | Q1 Q2 | 0.6 -0.65 | -1.0 | 1.5 -1.5 | V |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate to Source Threshold Voltage Temperature Coefficient | $I_D = 250\mu\text{A}$, referenced to 25°C $I_D = -250\mu\text{A}$, referenced to 25°C | Q1 Q2 | | 2.8 -3 | | mV/ $^\circ\text{C}$ |
| $r_{DS(on)}$ | Drain to Source On Resistance | $V_{GS} = 4.5\text{V}, I_D = 200\text{mA}$ $V_{GS} = 2.5\text{V}, I_D = 175\text{mA}$ $V_{GS} = 1.8\text{V}, I_D = 150\text{mA}$ $V_{GS} = 1.5\text{V}, I_D = 20\text{mA}$ $V_{GS} = 4.5\text{V}, I_D = 200\text{mA}, T_J = 125^\circ\text{C}$ $V_{GS} = -4.5\text{V}, I_D = -150\text{mA}$ $V_{GS} = -2.5\text{V}, I_D = -125\text{mA}$ $V_{GS} = -1.8\text{V}, I_D = -100\text{mA}$ $V_{GS} = -1.5\text{V}, I_D = -30\text{mA}$ $V_{GS} = -4.5\text{V}, I_D = -150\text{mA}, T_J = 125^\circ\text{C}$ | Q1 Q2 | | | 5 7 9 10 7 8 12 15 20 12 | Ω |
| g_{FS} | Forward Transconductance | $V_{DS} = 5\text{V}, I_D = 200\text{mA}$ $V_{DS} = -5\text{V}, I_D = -150\text{mA}$ | Q1 Q2 | | 1.1 0.7 | | S |

Dynamic Characteristics

| | | | | | | | |
|------------|------------------------------|--|----------|--|-----------|--|----|
| C_{iss} | Input Capacitance | Q1 $V_{DS} = 10\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$ | Q1 Q2 | | 60 100 | | pF |
| C_{oss} | Output Capacitance | Q2 | Q1 Q2 | | 20 30 | | pF |
| C_{riss} | Reverse Transfer Capacitance | $V_{DS} = -10\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$ | Q1 Q2 | | 10 15 | | pF |

Switching Characteristics

| | | | | | | | |
|--------------|-------------------------------|--|----------|--|-------------|------------|----|
| $t_{d(on)}$ | Turn-On Delay Time | Q1 $V_{DD} = 10\text{V}, I_D = 1\text{A}$ | Q1 Q2 | | 6 6 | 12 12 | ns |
| t_r | Rise Time | $V_{GS} = 4.5\text{V}, R_g = 6\Omega$ | Q1 Q2 | | 8 13 | 16 23 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | Q2 $V_{DD} = -10\text{V}, I_D = -0.5\text{A}$ | Q1 Q2 | | 8 8 | 16 16 | ns |
| t_f | Fall Time | $V_{GS} = -4.5\text{V}, R_g = 6\Omega$ | Q1 Q2 | | 2.4 1 | 4.8 2 | ns |
| Q_g | Total Gate Charge | Q1 $V_{DS} = 10\text{V}, I_D = 200\text{mA}, V_{GS} = 4.5\text{V}$ | Q1 Q2 | | 0.8 1.0 | 1.1 1.4 | nC |
| Q_{gs} | Gate to Source Gate Charge | Q1 Q2 | Q1 Q2 | | 0.16 0.2 | | nC |
| Q_{gd} | Gate to Drain "Miller" Charge | Q1 Q2 $V_{DS} = -10\text{V}, I_D = -150\text{mA}, V_{GS} = -4.5\text{V}$ | Q1 Q2 | | 0.26 0.3 | | nC |

Electrical Characteristics $T_J = 25^\circ\text{C}$ unless otherwise noted

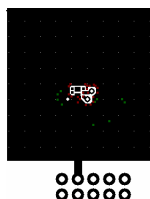
| Symbol | Parameter | Test Conditions | Type | Min | Typ | Max | Units |
|--------|-----------|-----------------|------|-----|-----|-----|-------|
|--------|-----------|-----------------|------|-----|-----|-----|-------|

Drain-Source Diode Characteristics

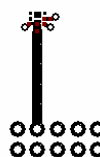
| | | | | | | | |
|----------|---------------------------------------|--|----|--|------|------|----|
| V_{SD} | Source to Drain Diode Forward Voltage | $V_{GS} = 0\text{V}, I_S = 150\text{mA}$ (Note 2) | Q1 | | 0.7 | 1.2 | V |
| | | $V_{GS} = 0\text{V}, I_S = -150\text{mA}$ (Note 2) | Q2 | | -0.8 | -1.2 | |
| t_{rr} | Reverse Recovery Time | $I_F = 200\text{mA}, di/dt = 100\text{A}/\mu\text{s}$ | Q1 | | 12 | | ns |
| | | | Q2 | | 11 | | |
| Q_{rr} | Reverse Recovery Charge | $I_F = -150\text{mA}, di/dt = 100\text{A}/\mu\text{s}$ | Q1 | | 3 | | nC |
| | | | Q2 | | 2 | | |

Notes:

1: $R_{\theta JA}$ 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 user's board design.



a) $200^\circ\text{C}/\text{W}$ when mounted on a 1 in^2 pad of 2 oz copper



b) $280^\circ\text{C}/\text{W}$ when mounted on a minimum pad of 2 oz copper

Scale 1:1 on letter size paper

2: Pulse Test : Pulse Width < 300us, Duty Cycle < 2.0%

3: The diode connected between the gate and source serves only as protection against ESD. No gate overvoltage rating is implied.

Typical Characteristics Q1 (N-Channel)

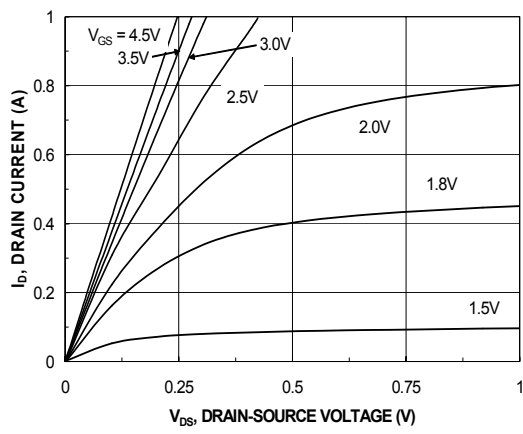


Figure 1. On-Region Characteristics.

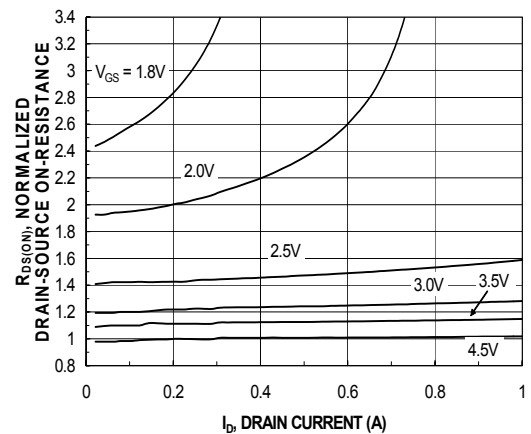


Figure 2. Normalized on-Resistance vs. Drain Current and Gate Voltage.

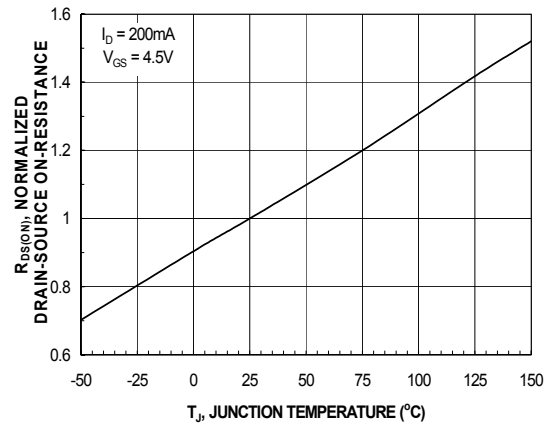


Figure 3. Normalized on-Resistance vs. Temperature.

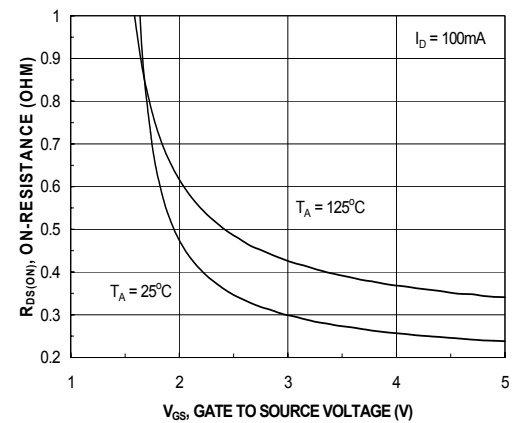


Figure 4. On-Resistance vs. Gate-to-Source Voltage.

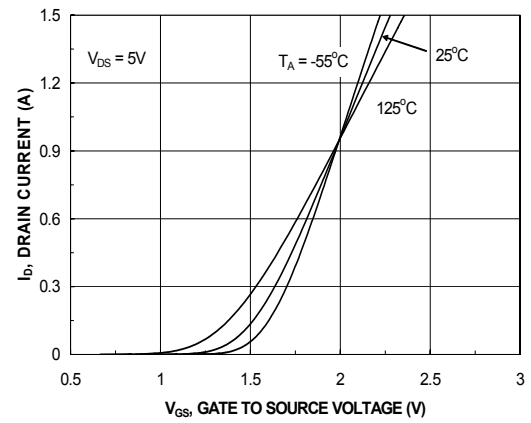


Figure 5. Transfer Characteristics.

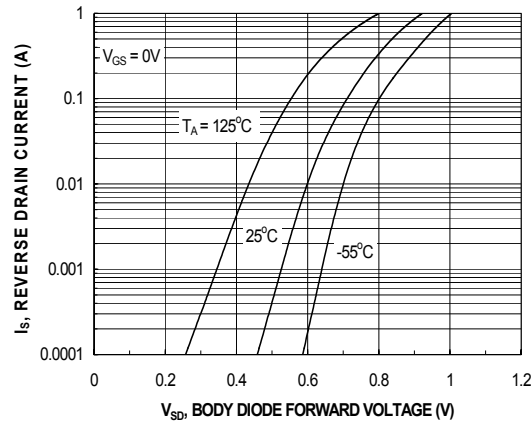


Figure 6. Source to Drain Diode Forward Voltage vs. Source Current and Temperature.

Typical Characteristics Q1 (N-Channel)

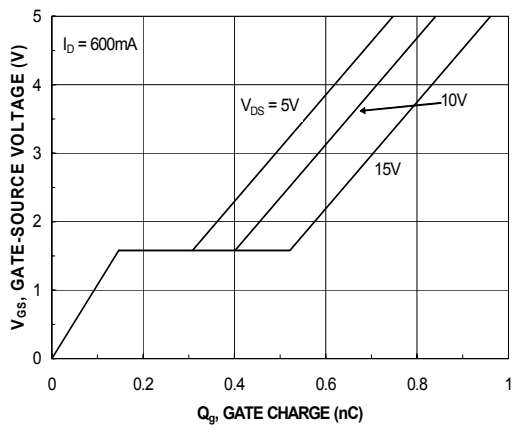


Figure 7. Gate Charge Characteristics.

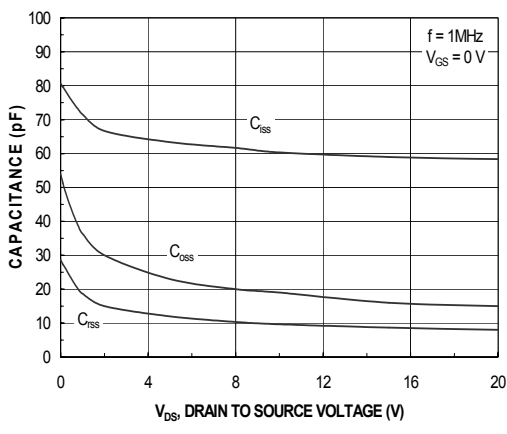


Figure 8. Capacitance vs. Drain to source voltage.

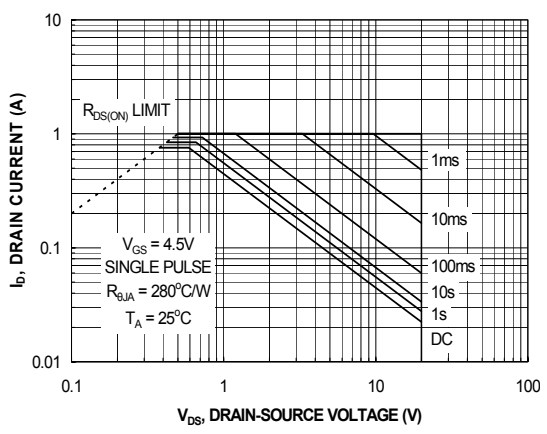


Figure 9. Maximum Safe Operating Area.

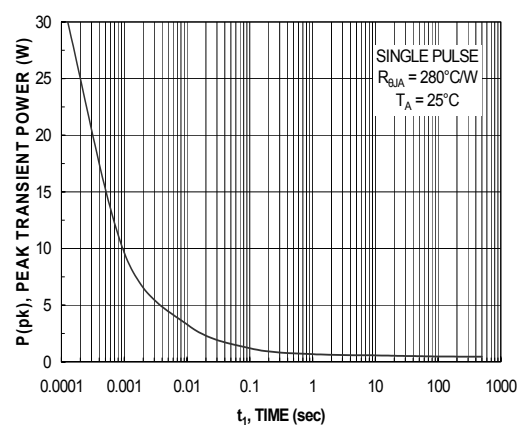


Figure 10. Single Pulse Maximum Power Dissipation.

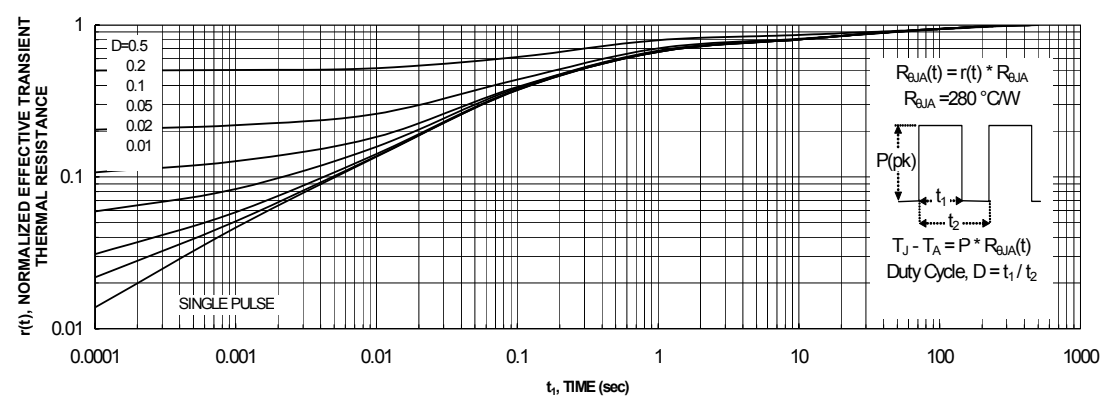


Figure 11. Transient Thermal Response Curve.
 Thermal characterization performed using the conditions described in Note 1b.
 Transient thermal response will change depending on the circuit board design.

Typical Characteristics Q2 (P-Channel)

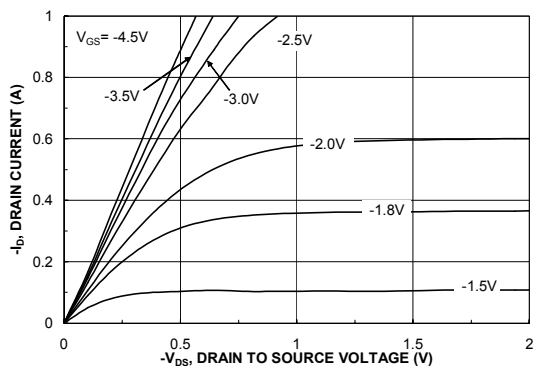


Figure 1. On-Region Characteristics.

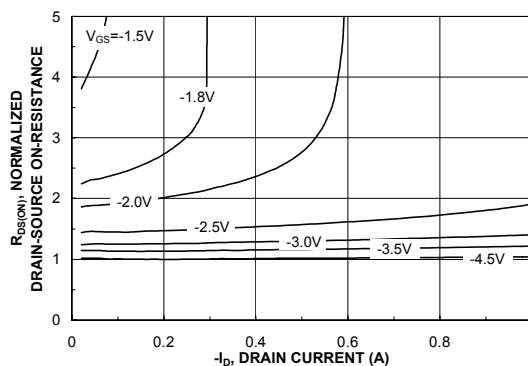


Figure 2. Normalized on-Resistance vs. Drain Current and Gate Voltage.

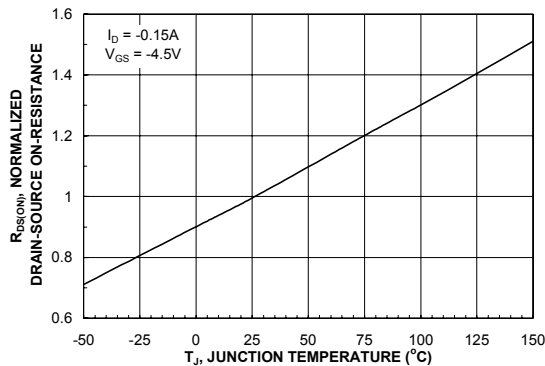


Figure 3. Normalized on-Resistance vs. Temperature.

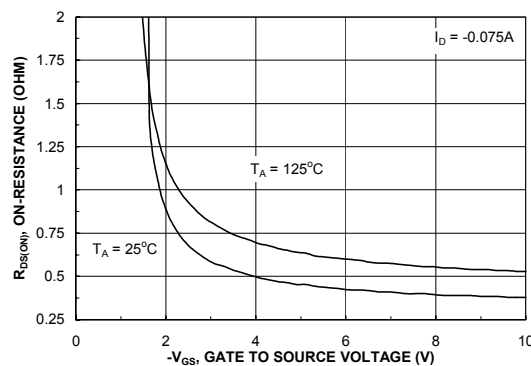


Figure 4. On-Resistance vs. Gate-to-Source Voltage.

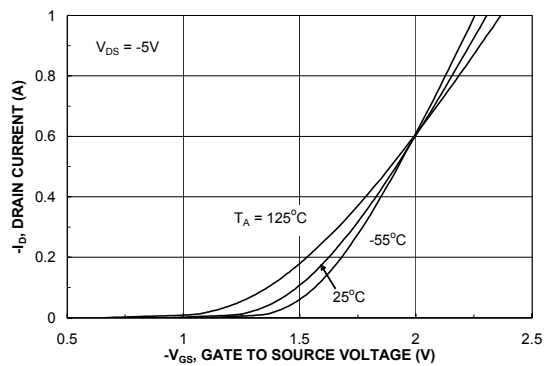


Figure 5. Transfer Characteristics.

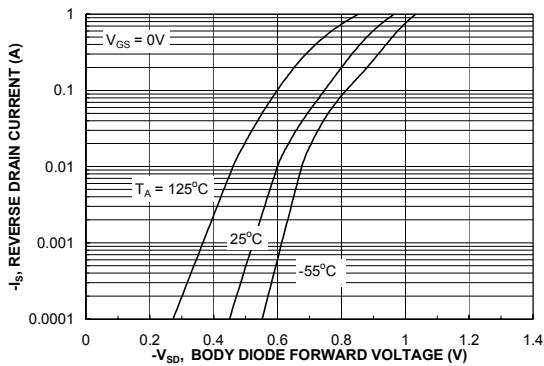


Figure 6. Source to Drain Diode Forward Voltage vs. Source Current and Temperature.

Typical Characteristics Q2 (P-Channel)

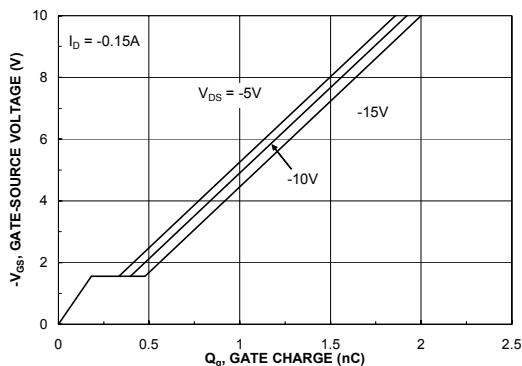


Figure 7. Gate Charge Characteristics.

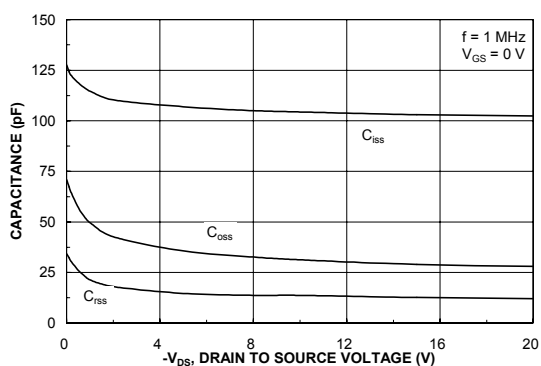


Figure 8. Capacitance vs. Drain to source voltage.

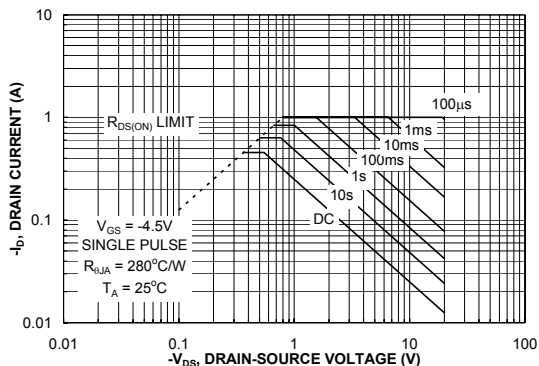


Figure 9. Maximum Safe Operating Area.

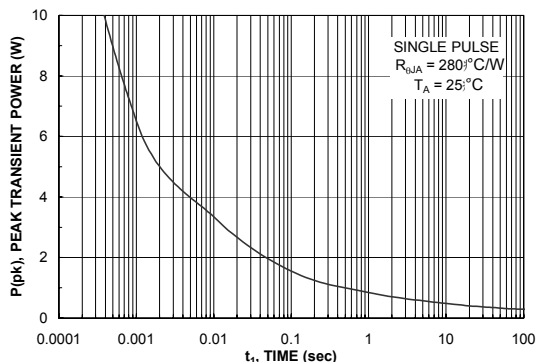


Figure 10. Single Pulse Maximum Power Dissipation.

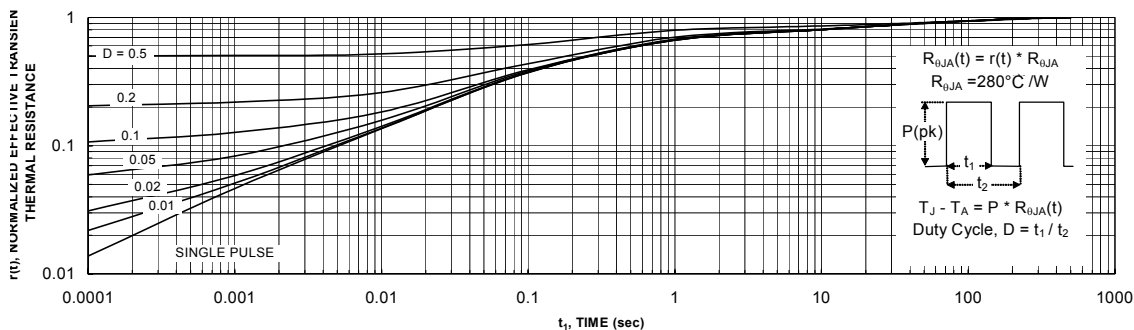
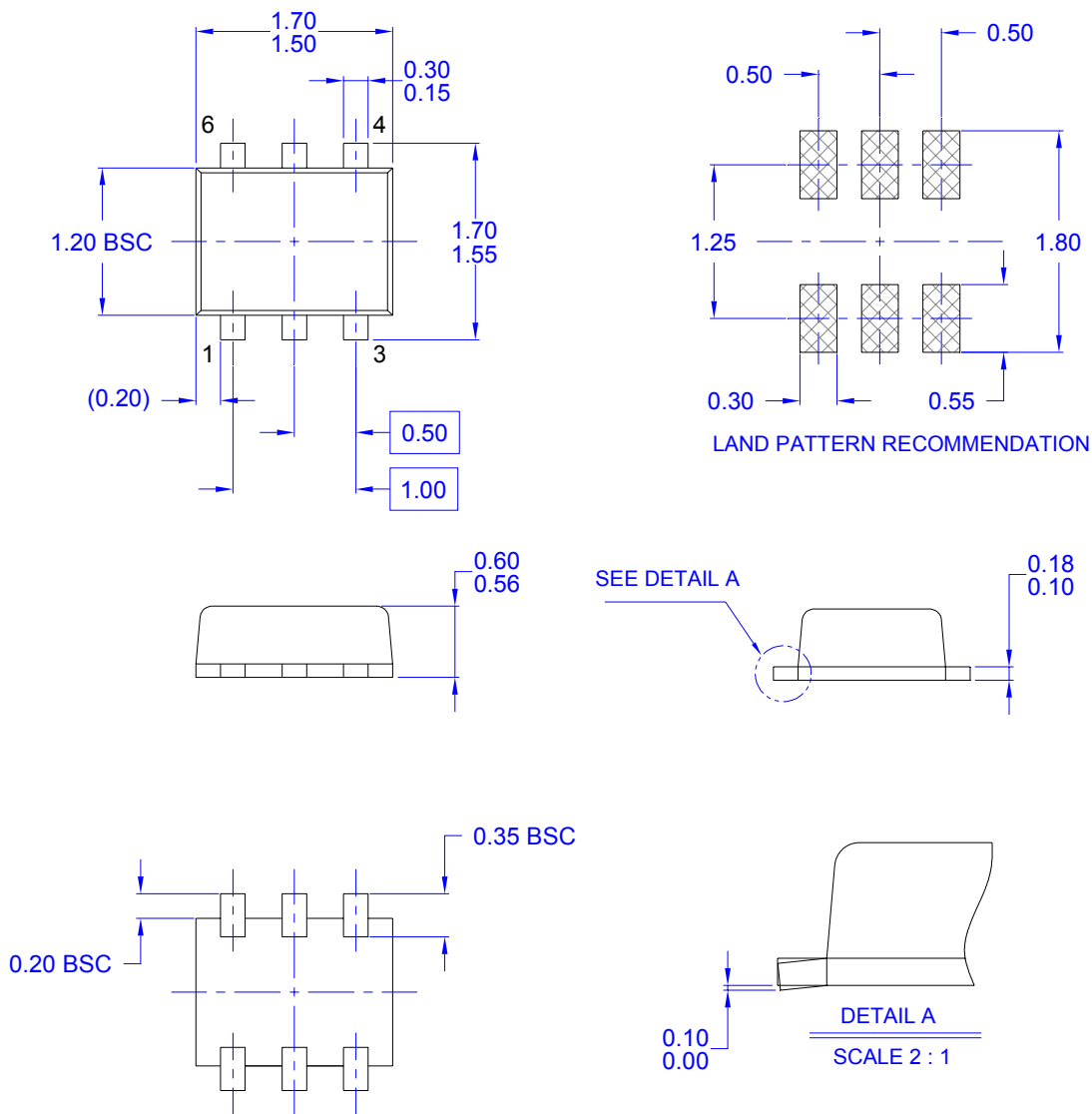


Figure 11. Transient Thermal Response Curve.

Thermal characterization performed using the conditions described in Note 1b. Transient thermal response will change depending on the circuit board design.

Dimensional Outline and Pad Layout



- NOTES: UNLESS OTHERWISE SPECIFIED
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 B) ALL DIMENSIONS ARE IN MILLIMETERS.
 C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

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