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# FDD8424H\_F085A

## Dual N & P-Channel PowerTrench<sup>®</sup> MOSFET N-Channel: 40V, 20A, 24mΩ P-Channel: -40V, -20A, 54mΩ

### Features

Q1: N-Channel

- Max  $r_{DS(on)}$  = 24mΩ at  $V_{GS} = 10V$ ,  $I_D = 9.0A$
- Max  $r_{DS(on)}$  = 30mΩ at  $V_{GS} = 4.5V$ ,  $I_D = 7.0A$

Q2: P-Channel

- Max  $r_{DS(on)}$  = 54mΩ at  $V_{GS} = -10V$ ,  $I_D = -6.5A$
- Max  $r_{DS(on)}$  = 70mΩ at  $V_{GS} = -4.5V$ ,  $I_D = -5.6A$
- Fast switching speed
- Qualified to AEC Q101
- RoHS Compliant

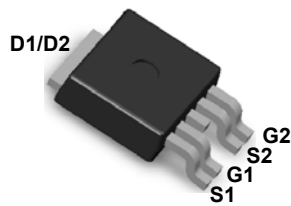


### General Description

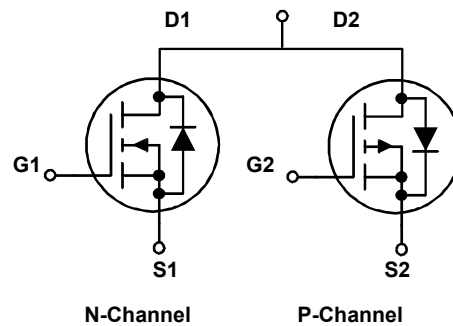
These dual N and P-Channel enhancement mode Power MOSFETs are produced using Fairchild Semiconductor's advanced PowerTrench process that has been especially tailored to minimize on-state resistance and yet maintain superior switching performance.

### Application

- Inverter
- H-Bridge



Dual DPAK 4L



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

| Symbol         | Parameter                                                          | Q1          | Q2       | Units      |
|----------------|--------------------------------------------------------------------|-------------|----------|------------|
| $V_{DS}$       | Drain to Source Voltage                                            | 40          | -40      | V          |
| $V_{GS}$       | Gate to Source Voltage                                             | $\pm 20$    | $\pm 20$ | V          |
| $I_D$          | Drain Current - Continuous (Package Limited)                       | 20          | -20      | A          |
|                | - Continuous (Silicon Limited) $T_C = 25^\circ C$                  | 26          | -20      |            |
|                | - Continuous $T_A = 25^\circ C$                                    | 9.0         | -6.5     |            |
|                | - Pulsed                                                           | 55          | -40      |            |
| $P_D$          | Power Dissipation for Single Operation $T_C = 25^\circ C$ (Note 1) | 30          | 35       | W          |
|                | $T_A = 25^\circ C$ (Note 1a)                                       | 3.1         |          |            |
|                | $T_A = 25^\circ C$ (Note 1b)                                       | 1.3         |          |            |
| $E_{AS}$       | Single Pulse Avalanche Energy (Note 3)                             | 29          | 33       | mJ         |
| $T_J, T_{STG}$ | Operating and Storage Junction Temperature Range                   | -55 to +150 |          | $^\circ C$ |

### Thermal Characteristics

|                 |                                                                        |     |              |
|-----------------|------------------------------------------------------------------------|-----|--------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Single Operation for Q1 (Note 1) | 4.1 | $^\circ C/W$ |
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Single Operation for Q2 (Note 1) | 3.5 |              |

### Package Marking and Ordering Information

| Device Marking | Device         | Package   | Reel Size | Tape Width | Quantity   |
|----------------|----------------|-----------|-----------|------------|------------|
| FDD8424H       | FDD8424H_F085A | TO-252-4L | 13"       | 12mm       | 2500 units |

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

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

### Off Characteristics

|                                      |                                           |                                                                                                                         |          |           |           |                        |                      |
|--------------------------------------|-------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|----------|-----------|-----------|------------------------|----------------------|
| $BV_{DSS}$                           | Drain to Source Breakdown Voltage         | $I_D = 250\mu\text{A}, V_{GS} = 0\text{V}$<br>$I_D = -250\mu\text{A}, V_{GS} = 0\text{V}$                               | Q1<br>Q2 | 40<br>-40 |           |                        | V                    |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\mu\text{A}$ , referenced to $25^\circ\text{C}$<br>$I_D = -250\mu\text{A}$ , referenced to $25^\circ\text{C}$ | Q1<br>Q2 |           | 34<br>-32 |                        | mV/ $^\circ\text{C}$ |
| $I_{DSS}$                            | Zero Gate Voltage Drain Current           | $V_{DS} = 32\text{V}, V_{GS} = 0\text{V}$<br>$V_{DS} = -32\text{V}, V_{GS} = 0\text{V}$                                 | Q1<br>Q2 |           |           | 1<br>-1                | $\mu\text{A}$        |
| $I_{GSS}$                            | Gate to Source Leakage Current            | $V_{GS} = \pm 20\text{V}, V_{DS} = 0\text{V}$                                                                           | Q1<br>Q2 |           |           | $\pm 100$<br>$\pm 100$ | nA<br>nA             |

### On Characteristics

|                                        |                                                          |                                                                                                                                                                  |          |         |                |                |                      |
|----------------------------------------|----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---------|----------------|----------------|----------------------|
| $V_{GS(th)}$                           | Gate to Source Threshold Voltage                         | $V_{GS} = V_{DS}, I_D = 250\mu\text{A}$<br>$V_{GS} = V_{DS}, I_D = -250\mu\text{A}$                                                                              | Q1<br>Q2 | 1<br>-1 | 1.7<br>-1.6    | 3<br>-3        | V                    |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate to Source Threshold Voltage Temperature Coefficient | $I_D = 250\mu\text{A}$ , referenced to $25^\circ\text{C}$<br>$I_D = -250\mu\text{A}$ , referenced to $25^\circ\text{C}$                                          | Q1<br>Q2 |         | -5.3<br>4.8    |                | mV/ $^\circ\text{C}$ |
| $r_{DS(on)}$                           | Static Drain to Source On Resistance                     | $V_{GS} = 10\text{V}, I_D = 9.0\text{A}$<br>$V_{GS} = 4.5\text{V}, I_D = 7.0\text{A}$<br>$V_{GS} = 10\text{V}, I_D = 9.0\text{A}, T_J = 125^\circ\text{C}$       | Q1       |         | 19<br>23<br>29 | 24<br>30<br>37 | m $\Omega$           |
|                                        |                                                          | $V_{GS} = -10\text{V}, I_D = -6.5\text{A}$<br>$V_{GS} = -4.5\text{V}, I_D = -5.6\text{A}$<br>$V_{GS} = -10\text{V}, I_D = -6.5\text{A}, T_J = 125^\circ\text{C}$ | Q2       |         | 42<br>58<br>62 | 54<br>70<br>80 |                      |
| $g_{FS}$                               | Forward Transconductance                                 | $V_{DS} = 5\text{V}, I_D = 9.0\text{A}$<br>$V_{DS} = -5\text{V}, I_D = -6.5\text{A}$                                                                             | Q1<br>Q2 |         | 29<br>13       |                | S                    |

### Dynamic Characteristics

|           |                              |                                                                  |          |  |             |              |          |
|-----------|------------------------------|------------------------------------------------------------------|----------|--|-------------|--------------|----------|
| $C_{iss}$ | Input Capacitance            | Q1<br>$V_{DS} = 20\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$ | Q1<br>Q2 |  | 750<br>1000 | 1000<br>1330 | pF       |
| $C_{oss}$ | Output Capacitance           | Q2                                                               | Q1<br>Q2 |  | 115<br>140  | 155<br>185   | pF       |
| $C_{rss}$ | Reverse Transfer Capacitance | $V_{DS} = -20\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$      | Q1<br>Q2 |  | 75<br>75    | 115<br>115   | pF       |
| $R_g$     | Gate Resistance              | $f = 1\text{MHz}$                                                | Q1<br>Q2 |  | 1.1<br>3.3  |              | $\Omega$ |

### Switching Characteristics

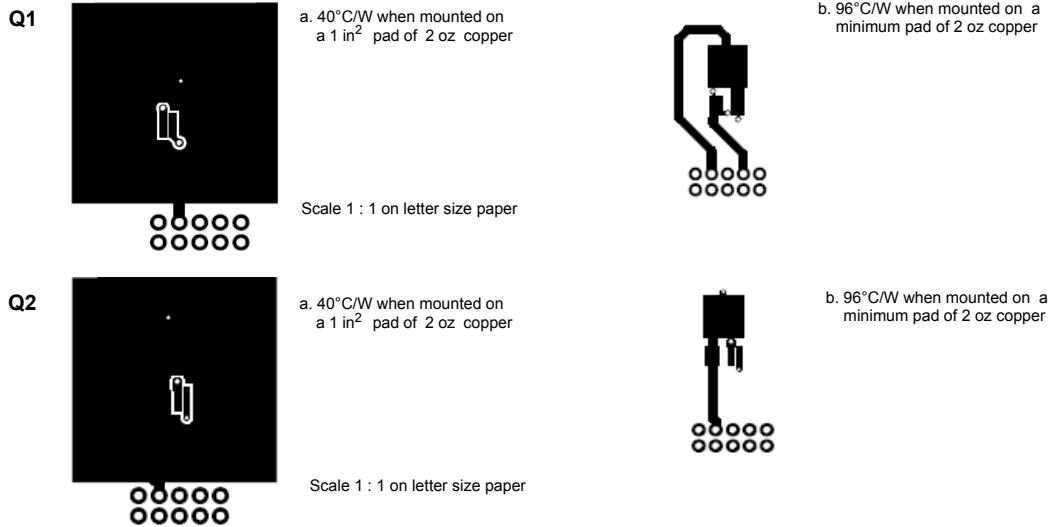
|              |                               |                                                                                                |          |  |        |          |    |
|--------------|-------------------------------|------------------------------------------------------------------------------------------------|----------|--|--------|----------|----|
| $t_{d(on)}$  | Turn-On Delay Time            | Q1                                                                                             | Q1<br>Q2 |  | 7<br>7 | 14<br>14 | ns |
| $t_r$        | Rise Time                     | $V_{DD} = 20\text{V}, I_D = 9.0\text{A},$<br>$V_{GS} = 10\text{V}, R_{GEN} = 6\Omega$          | Q1       |  | 13     | 24       | ns |
|              |                               |                                                                                                | Q2       |  | 3      | 10       |    |
| $t_{d(off)}$ | Turn-Off Delay Time           | Q2<br>$V_{DD} = -20\text{V}, I_D = -6.5\text{A},$<br>$V_{GS} = -10\text{V}, R_{GEN} = 6\Omega$ | Q1       |  | 17     | 31       | ns |
|              |                               |                                                                                                | Q2       |  | 20     | 36       |    |
| $t_f$        | Fall Time                     | $V_{GS} = -10\text{V}, R_{GEN} = 6\Omega$                                                      | Q1       |  | 6      | 12       | ns |
|              |                               |                                                                                                | Q2       |  | 3      | 10       |    |
| $Q_{g(TOT)}$ | Total Gate Charge             | Q1<br>$V_{GS} = 10\text{V}, V_{DD} = 20\text{V}, I_D = 9.0\text{A}$                            | Q1       |  | 14     | 20       | nC |
|              |                               |                                                                                                | Q2       |  | 17     | 24       |    |
| $Q_{gs}$     | Gate to Source Charge         | Q2                                                                                             | Q1       |  | 2.3    |          | nC |
|              |                               |                                                                                                | Q2       |  | 3.0    |          |    |
| $Q_{gd}$     | Gate to Drain "Miller" Charge | $V_{GS} = -10\text{V}, V_{DD} = -20\text{V}, I_D = -6.5\text{A}$                               | Q1       |  | 3.2    |          | nC |
|              |                               |                                                                                                | Q2       |  | 3.6    |          |    |

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

| Symbol   | Parameter                             | Test Conditions                     | Type | Min | Typ  | Max  | Units |
|----------|---------------------------------------|-------------------------------------|------|-----|------|------|-------|
| $V_{SD}$ | Source to Drain Diode Forward Voltage | $V_{GS} = 0V, I_S = 9.0A$ (Note 2)  | Q1   |     | 0.87 | 1.2  | V     |
|          |                                       | $V_{GS} = 0V, I_S = -6.5A$ (Note 2) | Q2   |     | 0.88 | -1.2 |       |
| $t_{rr}$ | Reverse Recovery Time                 | $I_F = 9.0A, di/dt = 100A/s$        | Q1   |     | 25   | 38   | ns    |
|          |                                       |                                     | Q2   |     | 29   | 44   |       |
| $Q_{rr}$ | Reverse Recovery Charge               | $I_F = -6.5A, di/dt = 100A/s$       | Q1   |     | 19   | 29   | nC    |
|          |                                       |                                     | Q2   |     | 29   | 44   |       |

**Notes:**

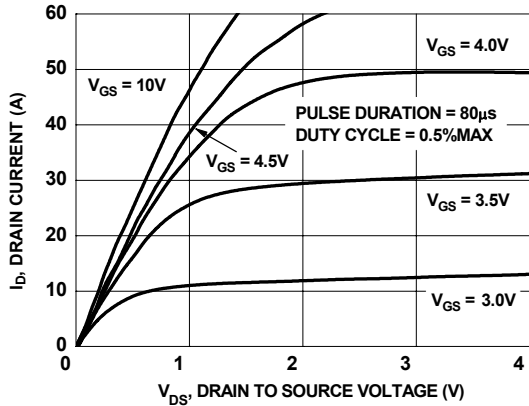
- $R_{\theta JA}$  is determined with the device mounted on a  $1\text{in}^2$  pad 2 oz copper pad on a  $1.5 \times 1.5\text{in.}$  board of FR-4 material.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.



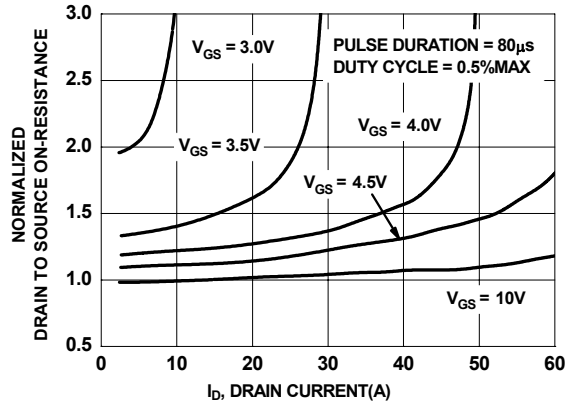
- Pulse Test: Pulse Width <  $300\mu\text{s}$ , Duty cycle < 2.0%.

- Starting  $T_J = 25^\circ\text{C}$ , N-ch:  $L = 0.3\text{mH}$ ,  $I_{AS} = 14A$ ,  $V_{DD} = 40V$ ,  $V_{GS} = 10V$ ; P-ch:  $L = 0.3\text{mH}$ ,  $I_{AS} = -15A$ ,  $V_{DD} = -40V$ ,  $V_{GS} = -10V$ .

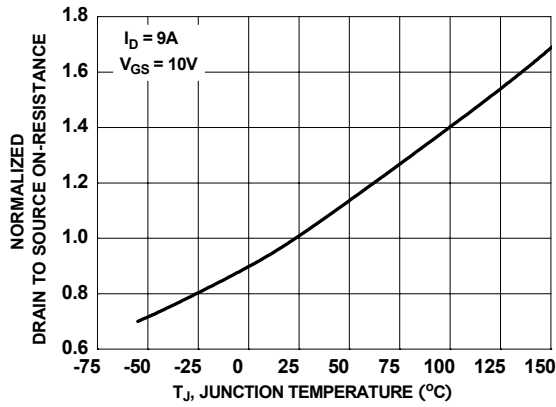
**Typical Characteristics (Q1 N-Channel)**  $T_J = 25^\circ\text{C}$  unless otherwise noted



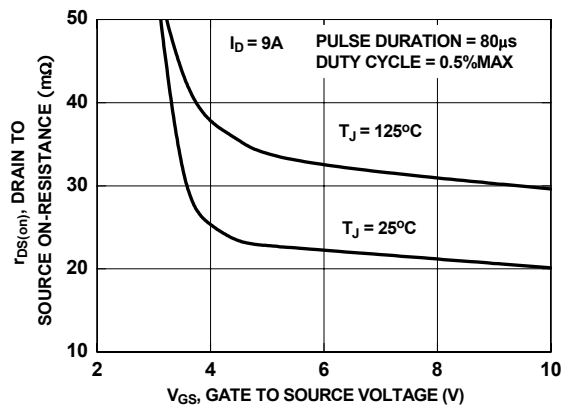
**Figure 1. On-Region Characteristics**



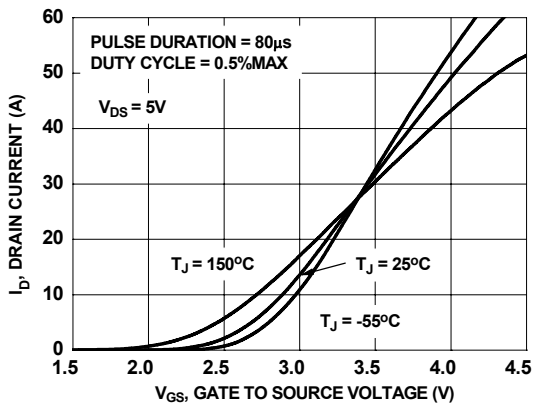
**Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage**



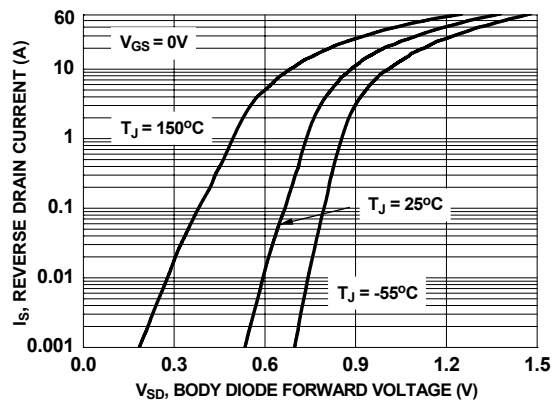
**Figure 3. Normalized On-Resistance vs Junction Temperature**



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

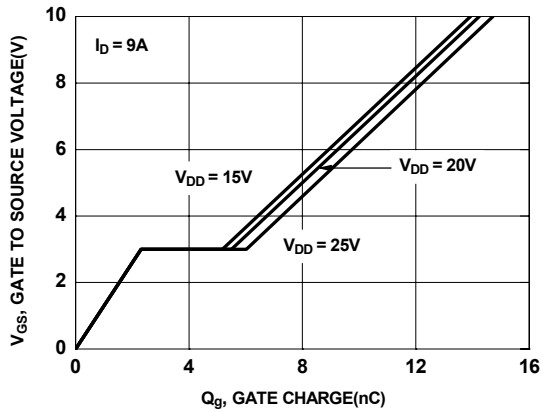


**Figure 5. Transfer Characteristics**

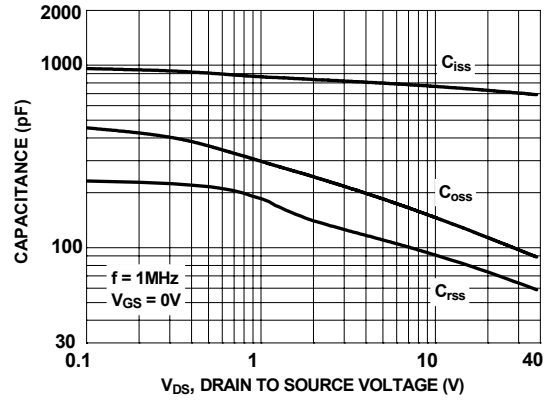


**Figure 6. Source to Drain Diode Forward Voltage vs Source Current**

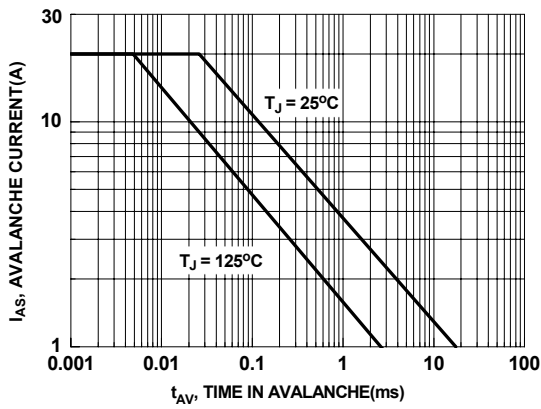
**Typical Characteristics (Q1 N-Channel)**  $T_J = 25^\circ\text{C}$  unless otherwise noted



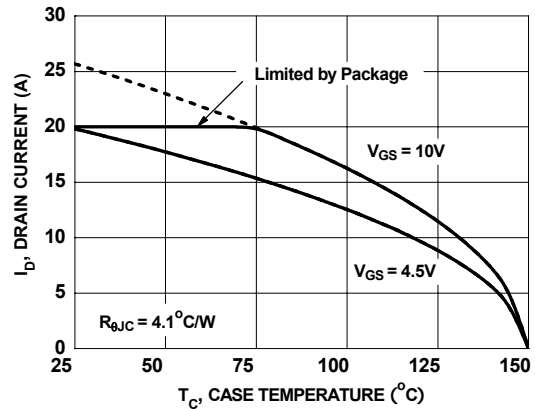
**Figure 7. Gate Charge Characteristics**



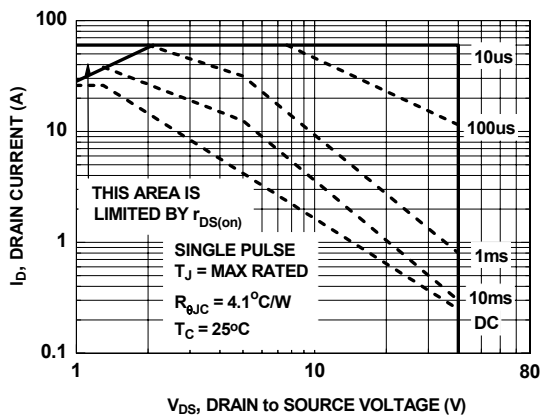
**Figure 8. Capacitance vs Drain to Source Voltage**



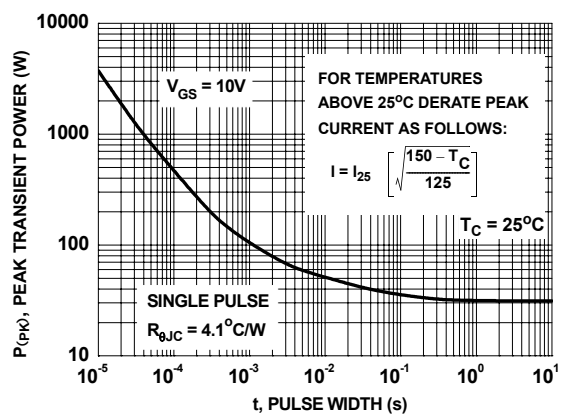
**Figure 9. Unclamped Inductive Switching Capability**



**Figure 10. Maximum Continuous Drain Current vs Case Temperature**

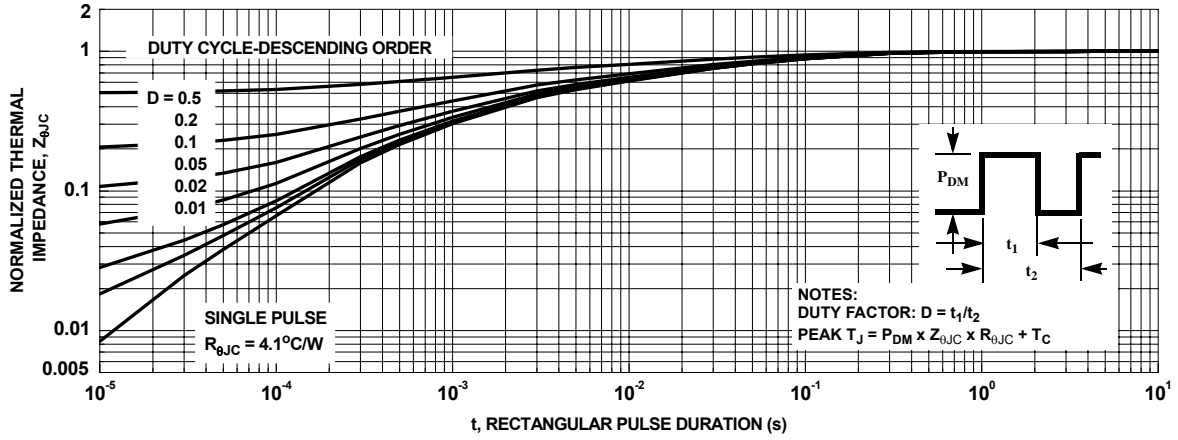


**Figure 11. Forward Bias Safe Operating Area**



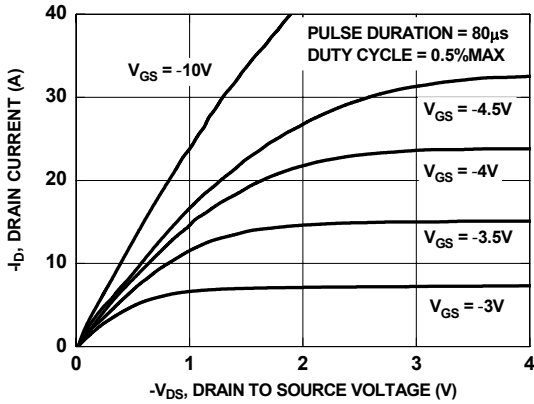
**Figure 12. Single Pulse Maximum Power Dissipation**

**Typical Characteristics (Q1 N-Channel)**  $T_J = 25^\circ\text{C}$  unless otherwise noted

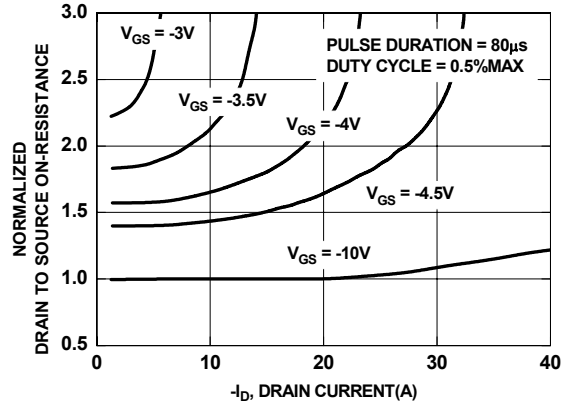


**Figure 13. Transient Thermal Response Curve**

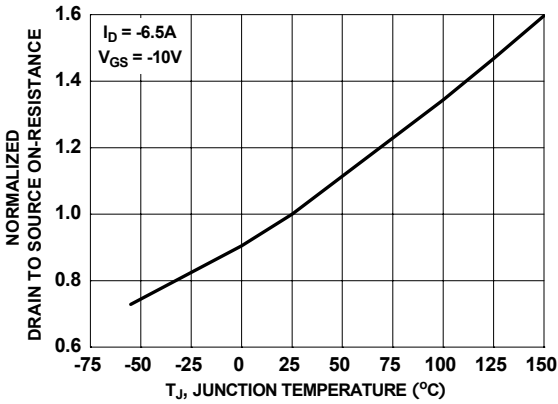
**Typical Characteristics (Q2 P-Channel)**  $T_J = 25^\circ\text{C}$  unless otherwise noted



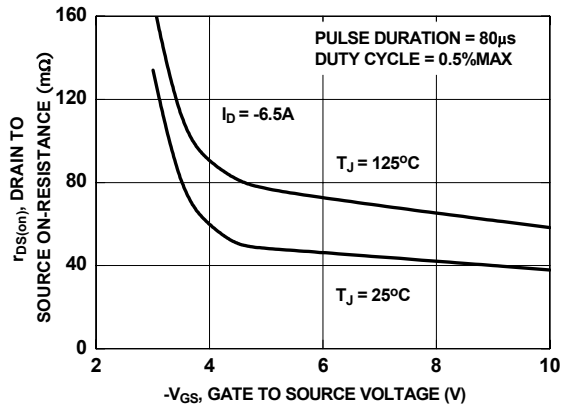
**Figure 14. On-Region Characteristics**



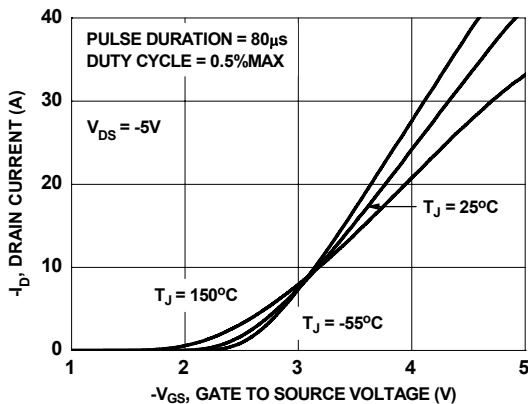
**Figure 15. Normalized on-Resistance vs Drain Current and Gate Voltage**



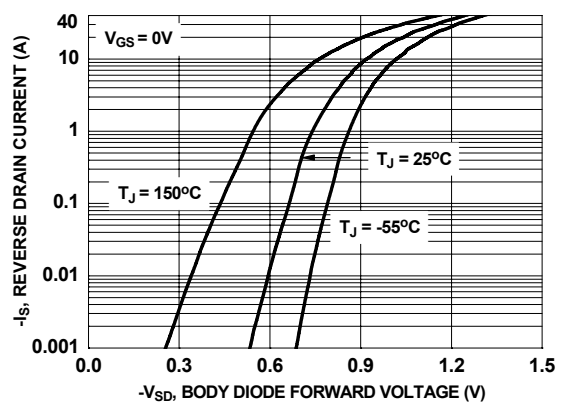
**Figure 16. Normalized On-Resistance vs Junction Temperature**



**Figure 17. On-Resistance vs Gate to Source Voltage**



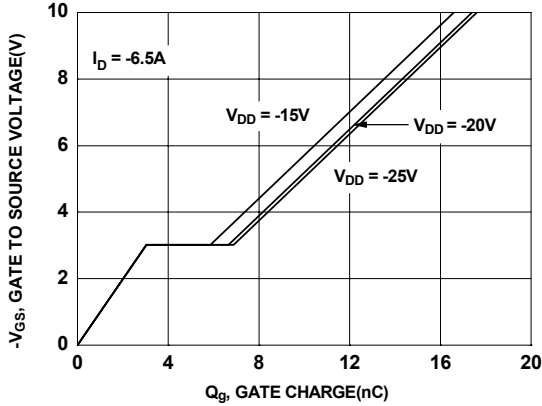
**Figure 18. Transfer Characteristics**



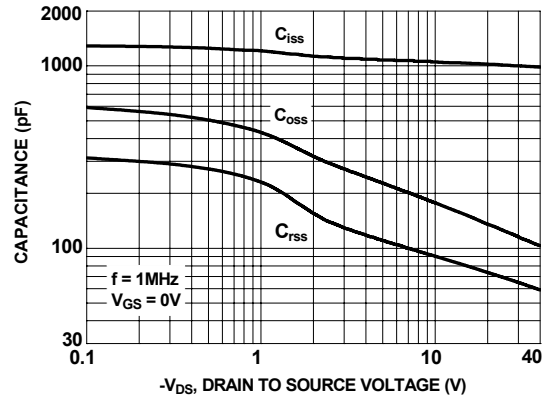
**Figure 19. Source to Drain Diode Forward Voltage vs Source Current**



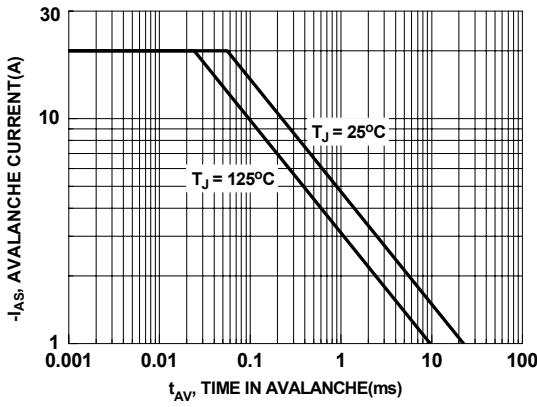
**Typical Characteristics (Q2 P-Channel)**  $T_J = 25^\circ\text{C}$  unless otherwise noted



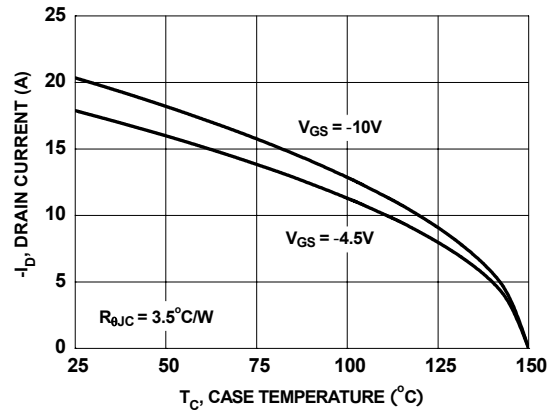
**Figure 20. Gate Charge Characteristics**



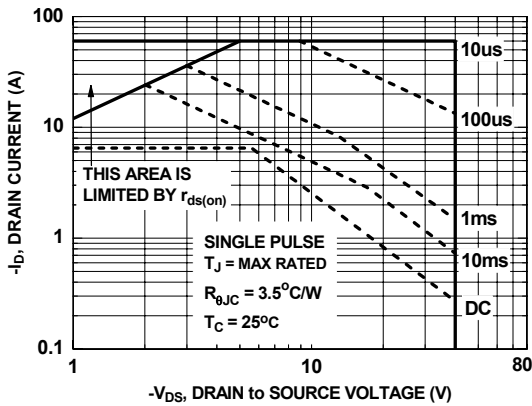
**Figure 21. Capacitance vs Drain to Source Voltage**



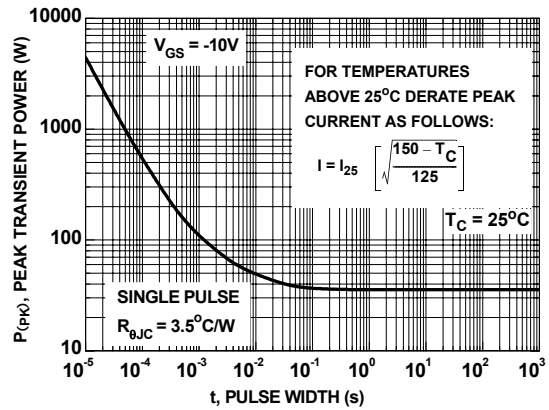
**Figure 22. Unclamped Inductive Switching Capability**



**Figure 23. Maximum Continuous Drain Current vs Case Temperature**

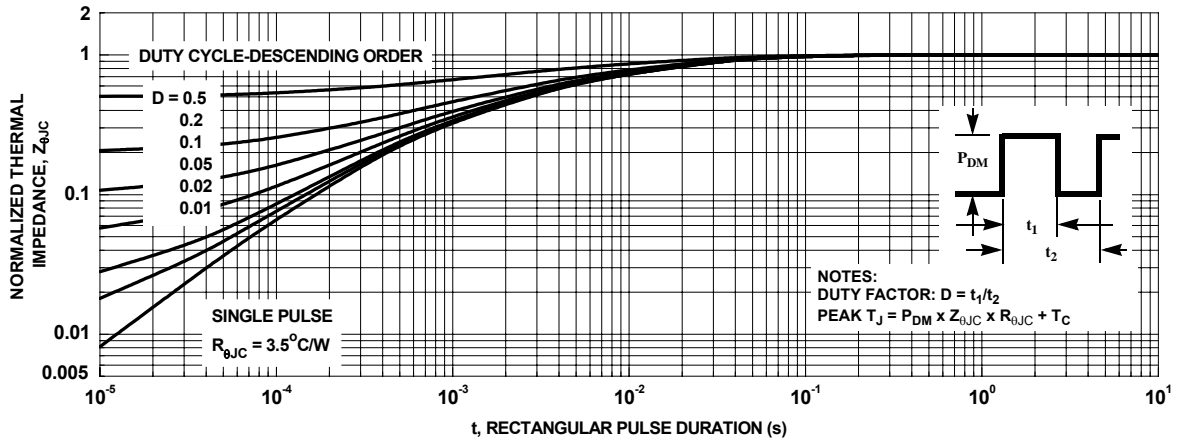


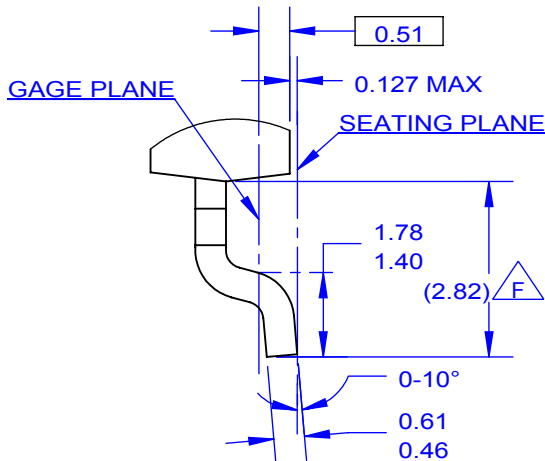
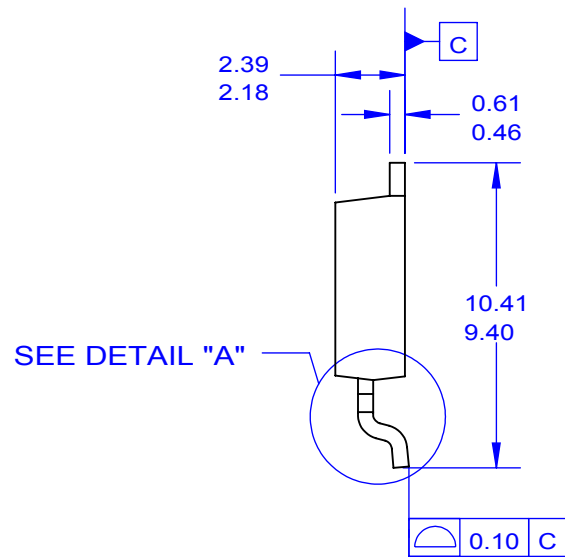
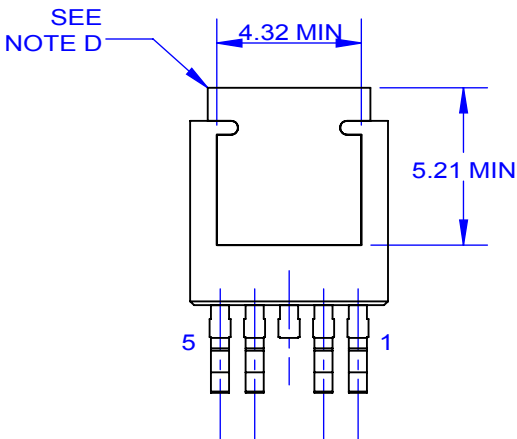
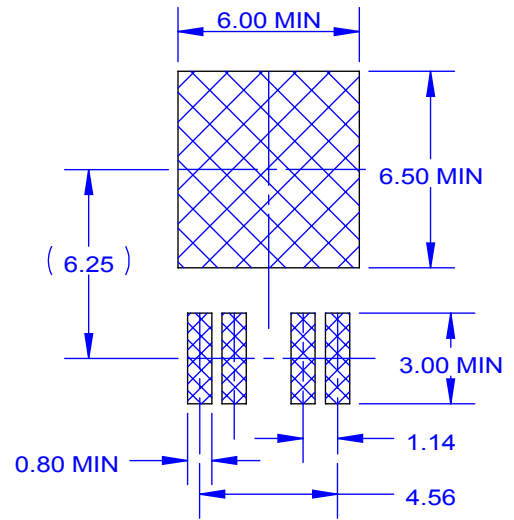
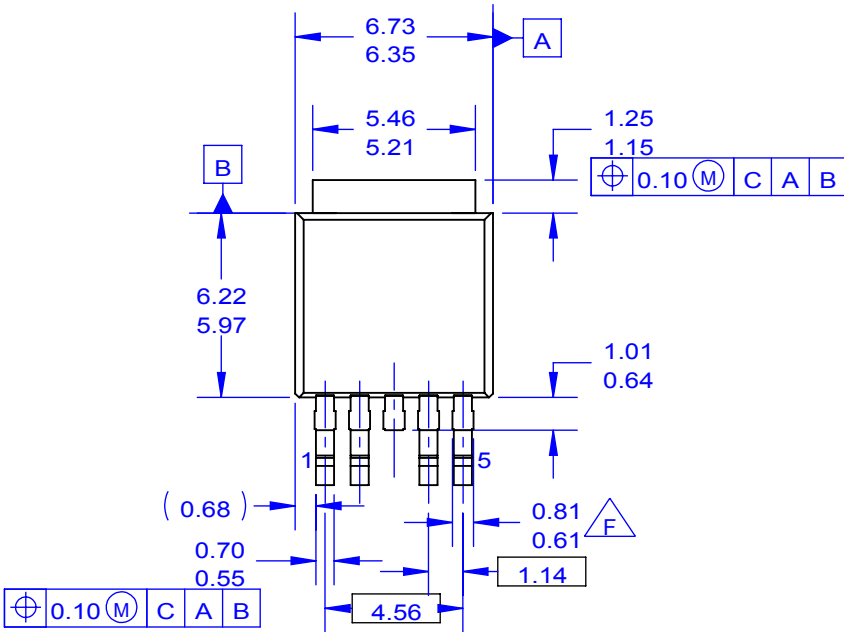
**Figure 24. Forward Bias Safe Operating Area**



**Figure 25. Single Pulse Maximum Power Dissipation**

**Typical Characteristics (Q2 P-Channel)**  $T_J = 25^\circ\text{C}$  unless otherwise noted





DETAIL A  
SCALE 2:1

NOTES: UNLESS OTHERWISE SPECIFIED

- A. THIS PACKAGE CONFORMS TO JEDEC, TO252 VARIATION AD.
- B. ALL DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS
- D. HEATSINK TOP EDGE COULD BE IN CHAMFERED CORNERS OR EDGE PROTRUSION.
- E. DIMENSIONS AND TOLERANCES AS PER ASME Y14.5-2009.
- F. EXCEPTION TO TO-252 STANDARD.
- G. FILE NAME: TO252B05REV3
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