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# FDMS7600AS

## Dual N-Channel PowerTrench® MOSFET

N-Channel: 30 V, 30 A, 7.5 mΩ N-Channel: 30 V, 40 A, 2.8 mΩ

### Features

Q1: N-Channel

- Max  $r_{DS(on)}$  = 7.5 mΩ at  $V_{GS}$  = 10 V,  $I_D$  = 12 A
- Max  $r_{DS(on)}$  = 12 mΩ at  $V_{GS}$  = 4.5 V,  $I_D$  = 10 A

Q2: N-Channel

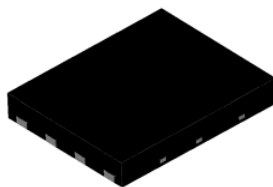
- Max  $r_{DS(on)}$  = 2.8 mΩ at  $V_{GS}$  = 10 V,  $I_D$  = 20 A
- Max  $r_{DS(on)}$  = 3.3 mΩ at  $V_{GS}$  = 4.5 V,  $I_D$  = 18 A
- RoHS Compliant

### General Description

This device includes two specialized N-Channel MOSFETs in a dual MLP package. The switch node has been internally connected to enable easy placement and routing of synchronous buck converters. The control MOSFET (Q1) and synchronous SyncFET™ (Q2) have been designed to provide optimal power efficiency.

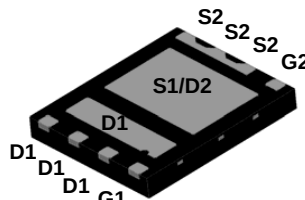
### Applications

- Computing
- Communications
- General Purpose Point of Load
- Notebook  $V_{CORE}$

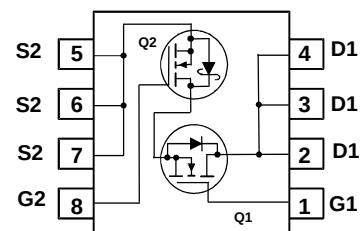


Top

Power 56



Bottom



### MOSFET Maximum Ratings $T_A = 25^\circ\text{C}$ unless otherwise noted

| Symbol         | Parameter                                                       | Q1                | Q2                | Units            |
|----------------|-----------------------------------------------------------------|-------------------|-------------------|------------------|
| $V_{DS}$       | Drain to Source Voltage                                         | 30                | 30                | V                |
| $V_{GS}$       | Gate to Source Voltage (Note 3)                                 | $\pm 20$          | $\pm 20$          | V                |
| $I_D$          | Drain Current -Continuous $T_C = 25^\circ\text{C}$              | 30                | 40                | A                |
|                | -Continuous $T_A = 25^\circ\text{C}$                            | 12 <sup>1a</sup>  | 22 <sup>1b</sup>  |                  |
|                | -Pulsed                                                         | 40                | 60                |                  |
| $P_D$          | Power Dissipation for Single Operation $T_A = 25^\circ\text{C}$ | 2.2 <sup>1a</sup> | 2.5 <sup>1b</sup> | W                |
|                | $T_A = 25^\circ\text{C}$                                        | 1.0 <sup>1c</sup> | 1.0 <sup>1d</sup> |                  |
| $T_J, T_{STG}$ | Operating and Storage Junction Temperature Range                | -55 to +150       |                   | $^\circ\text{C}$ |

### Thermal Characteristics

|                 |                                         |                   |                   |                    |
|-----------------|-----------------------------------------|-------------------|-------------------|--------------------|
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | 57 <sup>1a</sup>  | 50 <sup>1b</sup>  | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | 125 <sup>1c</sup> | 120 <sup>1d</sup> |                    |
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case    | 3.5               | 2                 |                    |

### Package Marking and Ordering Information

| Device Marking | Device     | Package  | Reel Size | Tape Width | Quantity   |
|----------------|------------|----------|-----------|------------|------------|
| FDMS7600AS     | FDMS7600AS | Power 56 | 13 "      | 12 mm      | 3000 units |

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

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

**Off Characteristics**

|                                      |                                           |                                                                                                                                                 |          |          |          |            |                                |
|--------------------------------------|-------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|----------|------------|--------------------------------|
| $BV_{DSS}$                           | Drain to Source Breakdown Voltage         | $I_D = 250\text{ }\mu\text{A}$ , $V_{GS} = 0\text{ V}$<br>$I_D = 1\text{ mA}$ , $V_{GS} = 0\text{ V}$                                           | Q1<br>Q2 | 30<br>30 |          |            | V                              |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\text{ }\mu\text{A}$ , referenced to $25\text{ }^{\circ}\text{C}$<br>$I_D = 1\text{ mA}$ , referenced to $25\text{ }^{\circ}\text{C}$ | Q1<br>Q2 |          | 15<br>18 |            | mV/ $^{\circ}\text{C}$         |
| $I_{DSS}$                            | Zero Gate Voltage Drain Current           | $V_{DS} = 24\text{ V}$ , $V_{GS} = 0\text{ V}$                                                                                                  | Q1<br>Q2 |          |          | 1<br>500   | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$                            | Gate to Source Leakage Current            | $V_{GS} = 20\text{ V}$ , $V_{DS} = 0\text{ V}$                                                                                                  | Q1<br>Q2 |          |          | 100<br>100 | nA<br>nA                       |

**On Characteristics**

|                                        |                                                          |                                                                                                                                                 |          |        |            |        |                        |
|----------------------------------------|----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|----------|--------|------------|--------|------------------------|
| $V_{GS(th)}$                           | Gate to Source Threshold Voltage                         | $V_{GS} = V_{DS}$ , $I_D = 250\text{ }\mu\text{A}$<br>$V_{GS} = V_{DS}$ , $I_D = 1\text{ mA}$                                                   | Q1<br>Q2 | 1<br>1 | 1.8<br>1.5 | 3<br>3 | V                      |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate to Source Threshold Voltage Temperature Coefficient | $I_D = 250\text{ }\mu\text{A}$ , referenced to $25\text{ }^{\circ}\text{C}$<br>$I_D = 1\text{ mA}$ , referenced to $25\text{ }^{\circ}\text{C}$ | Q1<br>Q2 |        | -6<br>-5   |        | mV/ $^{\circ}\text{C}$ |
| $r_{DS(on)}$                           | Drain to Source On Resistance                            | $V_{GS} = 10\text{ V}$ , $I_D = 12\text{ A}$                                                                                                    | Q1       |        | 6.0        | 7.5    | m $\Omega$             |
|                                        |                                                          | $V_{GS} = 4.5\text{ V}$ , $I_D = 10\text{ A}$                                                                                                   |          |        | 8.5        | 12     |                        |
|                                        |                                                          | $V_{GS} = 10\text{ V}$ , $I_D = 12\text{ A}$ , $T_J = 125\text{ }^{\circ}\text{C}$                                                              | Q2       |        | 8.3        | 12     |                        |
|                                        |                                                          | $V_{GS} = 10\text{ V}$ , $I_D = 20\text{ A}$                                                                                                    |          |        | 2.2        | 2.8    |                        |
| $g_{FS}$                               | Forward Transconductance                                 | $V_{GS} = 4.5\text{ V}$ , $I_D = 18\text{ A}$                                                                                                   | Q1<br>Q2 |        | 2.6        | 3.3    | S                      |
|                                        |                                                          | $V_{GS} = 10\text{ V}$ , $I_D = 20\text{ A}$ , $T_J = 125\text{ }^{\circ}\text{C}$                                                              |          |        | 2.6        | 3.8    |                        |

**Dynamic Characteristics**

|           |                              |                                                                            |          |  |              |              |          |
|-----------|------------------------------|----------------------------------------------------------------------------|----------|--|--------------|--------------|----------|
| $C_{iss}$ | Input Capacitance            | Q1:<br>$V_{DS} = 15\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1\text{ MHz}$ | Q1<br>Q2 |  | 1315<br>5265 | 1750<br>7005 | pF       |
| $C_{oss}$ | Output Capacitance           | Q2:<br>$V_{DS} = 15\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1\text{ MHz}$ | Q1<br>Q2 |  | 445<br>2150  | 600<br>2860  | pF       |
| $C_{rss}$ | Reverse Transfer Capacitance |                                                                            | Q1<br>Q2 |  | 45<br>200    | 70<br>300    | pF       |
| $R_g$     | Gate Resistance              |                                                                            | Q1<br>Q2 |  | 0.9<br>0.3   |              | $\Omega$ |

**Switching Characteristics**

|              |                               |                                                                                                                                                                                                                                    |          |  |            |           |    |
|--------------|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|--|------------|-----------|----|
| $t_{d(on)}$  | Turn-On Delay Time            | Q1:<br>$V_{DD} = 15\text{ V}$ , $I_D = 12\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$ , $R_{GEN} = 6\text{ }\Omega$<br><br>Q2:<br>$V_{DD} = 15\text{ V}$ , $I_D = 20\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$ , $R_{GEN} = 6\text{ }\Omega$ | Q1<br>Q2 |  | 8.6<br>18  | 18<br>32  | ns |
| $t_r$        | Rise Time                     |                                                                                                                                                                                                                                    | Q1<br>Q2 |  | 2.5<br>7.6 | 10<br>16  | ns |
| $t_{d(off)}$ | Turn-Off Delay Time           |                                                                                                                                                                                                                                    | Q1<br>Q2 |  | 20<br>45   | 32<br>72  | ns |
| $t_f$        | Fall Time                     |                                                                                                                                                                                                                                    | Q1<br>Q2 |  | 2.3<br>5.2 | 10<br>10  | ns |
| $Q_g$        | Total Gate Charge             | $V_{GS} = 0\text{ V}$ to $10\text{ V}$                                                                                                                                                                                             | Q1<br>Q2 |  | 20<br>81   | 28<br>113 | nC |
| $Q_g$        | Total Gate Charge             | $V_{GS} = 0\text{ V}$ to $4.5\text{ V}$                                                                                                                                                                                            | Q1<br>Q2 |  | 9.3<br>37  | 13<br>52  | nC |
| $Q_{gs}$     | Gate to Source Gate Charge    | Q2<br>$V_{DD} = 15\text{ V}$ ,<br>$I_D = 20\text{ A}$                                                                                                                                                                              | Q1<br>Q2 |  | 4.3<br>13  |           | nC |
| $Q_{gd}$     | Gate to Drain "Miller" Charge |                                                                                                                                                                                                                                    | Q1<br>Q2 |  | 2.2<br>9.6 |           | nC |

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

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

**Drain-Source Diode Characteristics**

|          |                                       |                                                                |    |  |     |     |    |
|----------|---------------------------------------|----------------------------------------------------------------|----|--|-----|-----|----|
| $V_{SD}$ | Source to Drain Diode Forward Voltage | $V_{GS} = 0\text{ V}$ , $I_S = 12\text{ A}$ (Note 2)           | Q1 |  | 0.8 | 1.2 | V  |
|          |                                       | $V_{GS} = 0\text{ V}$ , $I_S = 20\text{ A}$ (Note 2)           | Q2 |  | 0.7 | 1.2 |    |
| $t_{rr}$ | Reverse Recovery Time                 | Q1<br>$I_F = 12\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ | Q1 |  | 27  | 43  | ns |
|          |                                       |                                                                | Q2 |  | 47  | 75  |    |
| $Q_{rr}$ | Reverse Recovery Charge               | Q2<br>$I_F = 20\text{ A}$ , $di/dt = 300\text{ A}/\mu\text{s}$ | Q1 |  | 10  | 18  | nC |
|          |                                       |                                                                | Q2 |  | 80  | 128 |    |

**Notes:**

1:  $R_{\theta JA}$  is determined with the device mounted on a 1 in<sup>2</sup> pad 2 oz copper pad on a 1.5 x 1.5 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.



a. 57  $^{\circ}\text{C}/\text{W}$  when mounted on a 1 in<sup>2</sup> pad of 2 oz copper



b. 50  $^{\circ}\text{C}/\text{W}$  when mounted on a 1 in<sup>2</sup> pad of 2 oz copper



c. 125  $^{\circ}\text{C}/\text{W}$  when mounted on a minimum pad of 2 oz copper



d. 120  $^{\circ}\text{C}/\text{W}$  when mounted on a minimum pad of 2 oz copper

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

3: As an N-ch device, the negative  $V_{GS}$  rating is for low duty cycle pulse occurrence only. No continuous rating is implied.

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

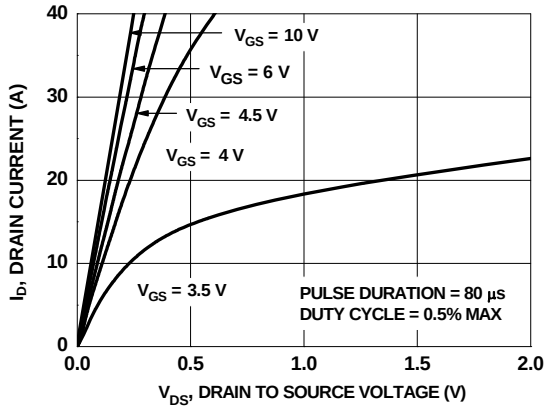


Figure 1. On Region Characteristics

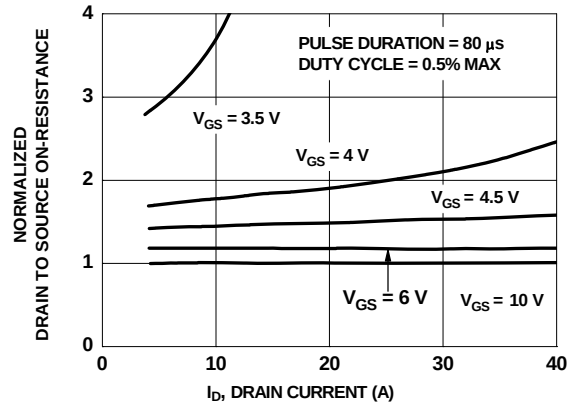


Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage

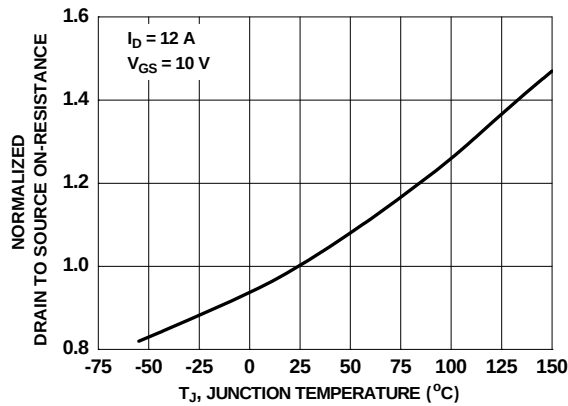


Figure 3. Normalized On Resistance vs Junction Temperature

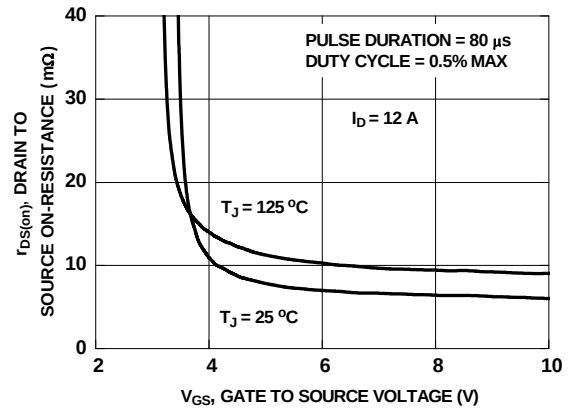


Figure 4. On-Resistance vs Gate to Source Voltage

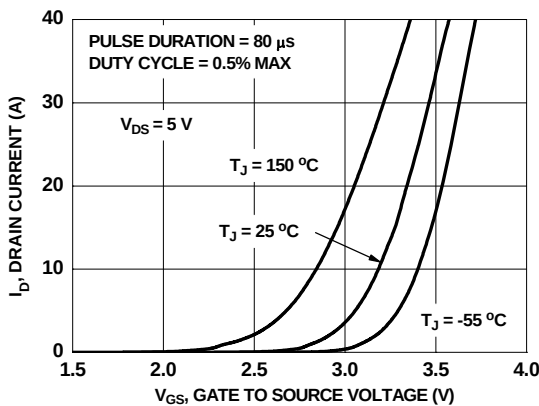


Figure 5. Transfer Characteristics

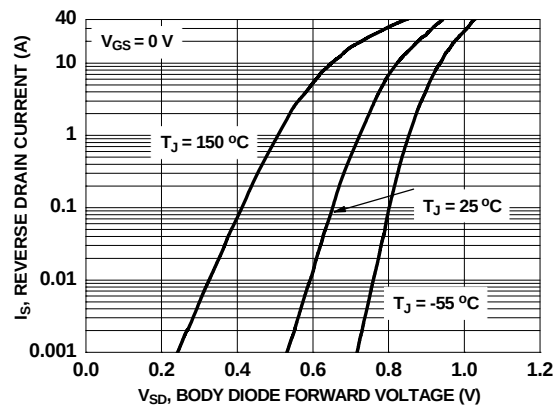


Figure 6. Source to Drain Diode Forward Voltage vs Source Current

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

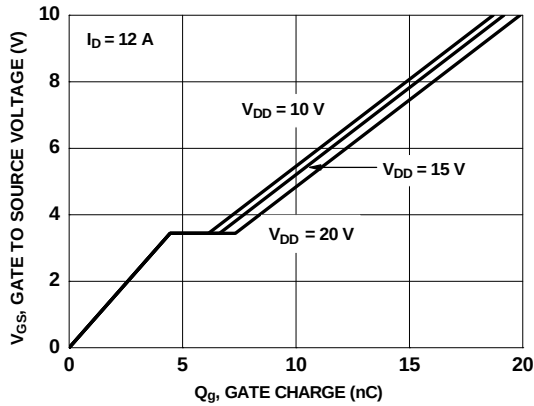


Figure 7. Gate Charge Characteristics

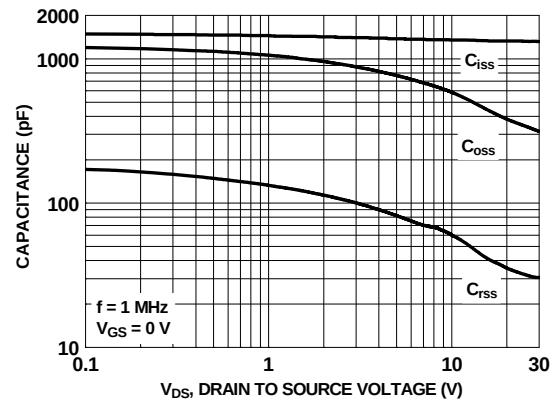


Figure 8. Capacitance vs Drain to Source Voltage

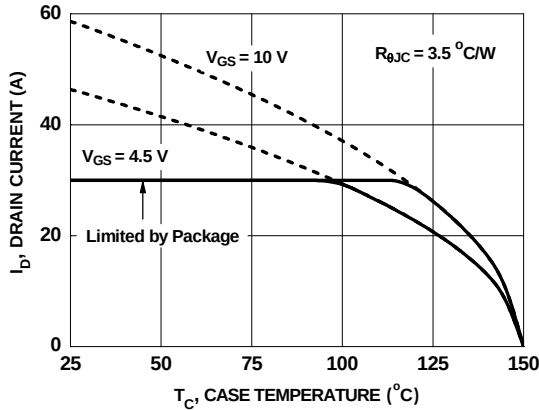


Figure 9. Maximum Continuous Drain Current vs Case Temperature

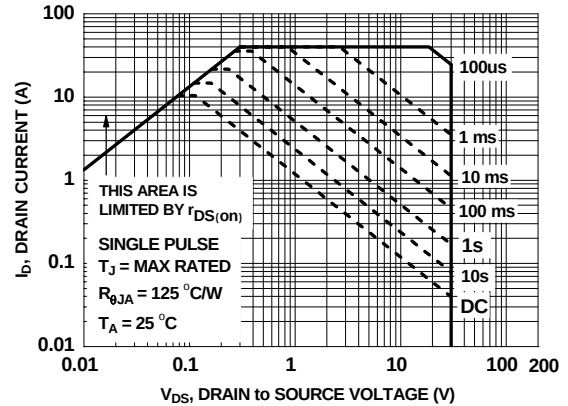


Figure 10. Forward Bias Safe Operating Area

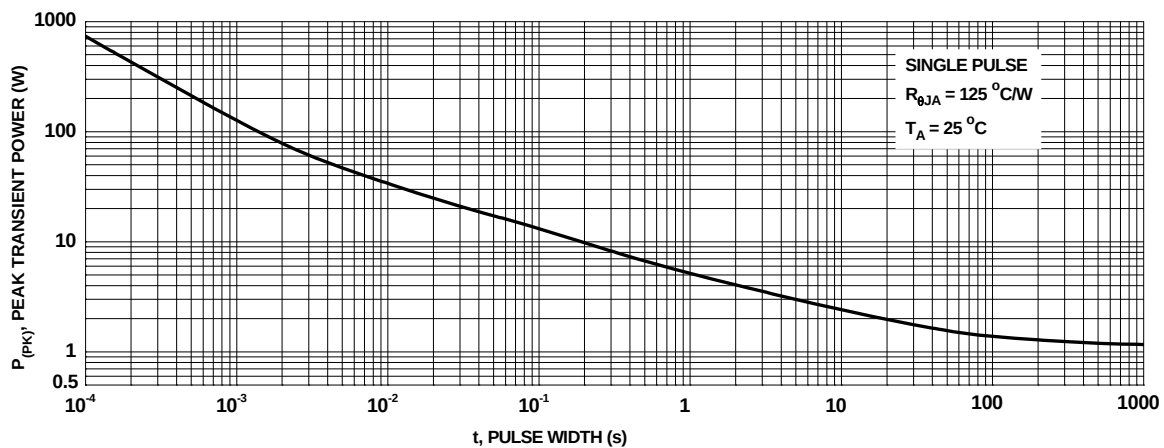


Figure 11. Single Pulse Maximum Power Dissipation

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

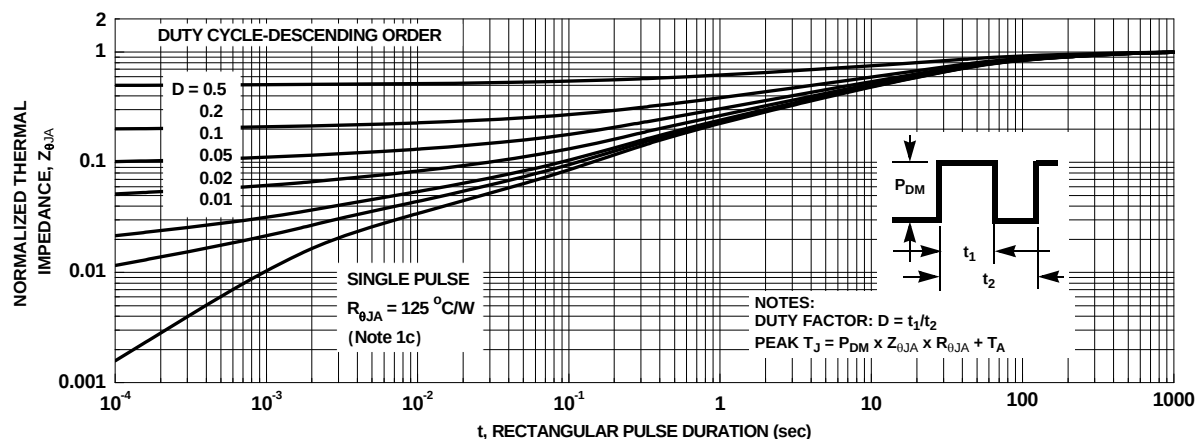


Figure 12. Junction-to-Ambient Transient Thermal Response Curve

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

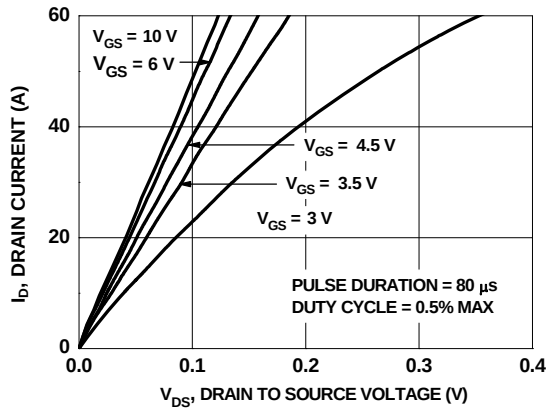


Figure 13. On-Region Characteristics

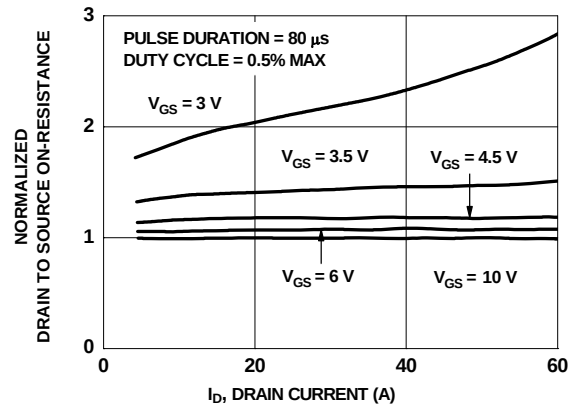


Figure 14. Normalized on-Resistance vs Drain Current and Gate Voltage

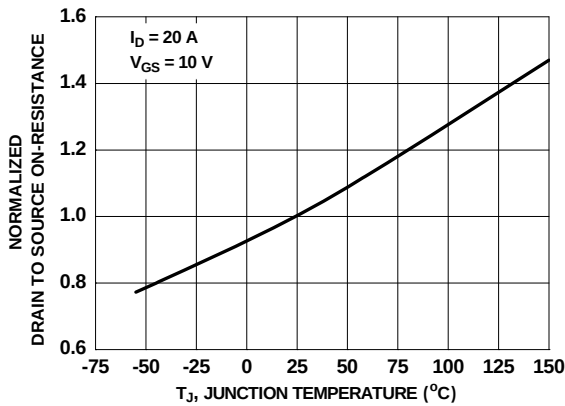


Figure 15. Normalized On-Resistance vs Junction Temperature

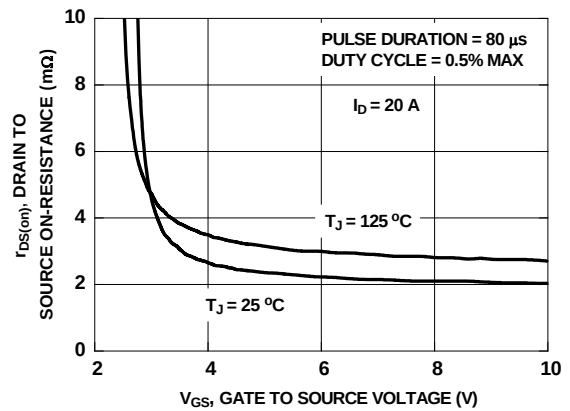


Figure 16. On-Resistance vs Gate to Source Voltage

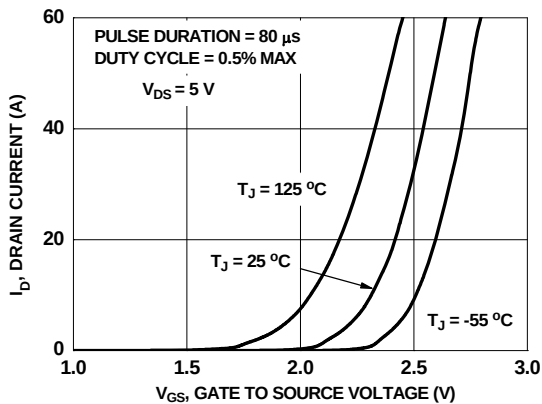


Figure 17. Transfer Characteristics

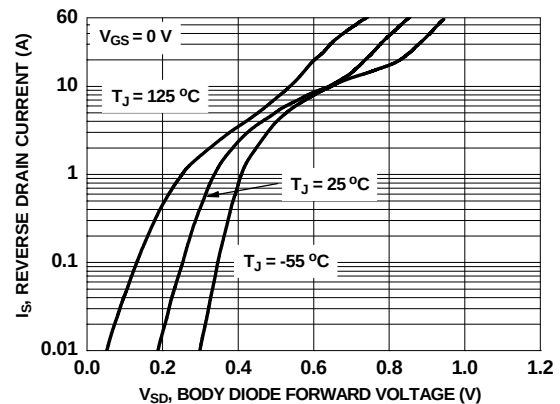


Figure 18. Source to Drain Diode Forward Voltage vs Source Current



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

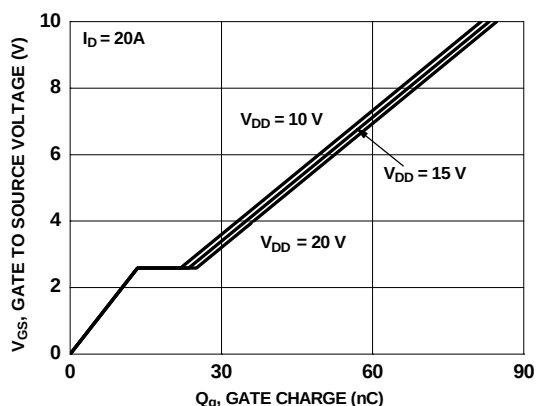


Figure 19. Gate Charge Characteristics

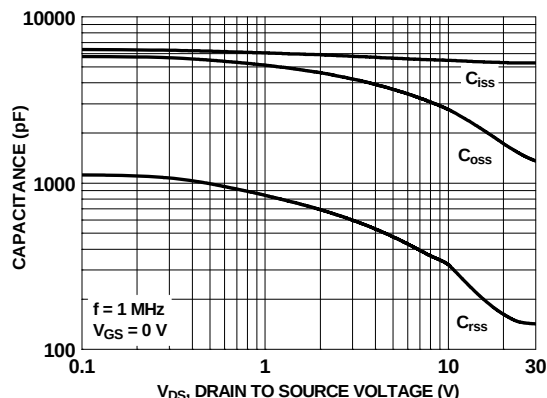


Figure 20. Capacitance vs Drain to Source Voltage

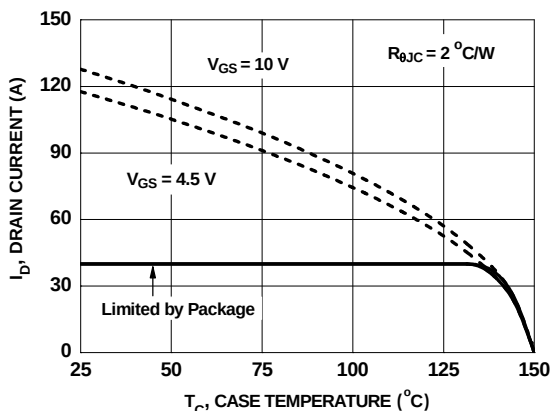


Figure 21. Maximum Continuous Drain Current vs Case Temperature

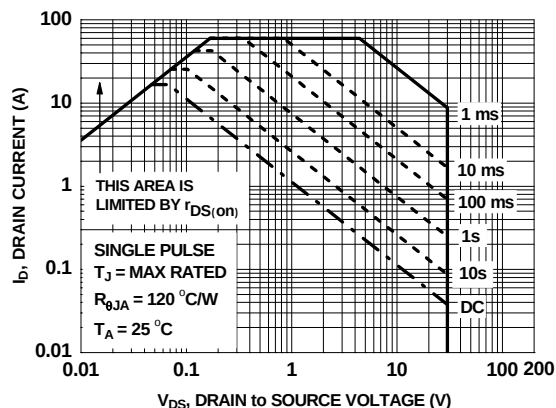


Figure 22. Forward Bias Safe Operating Area

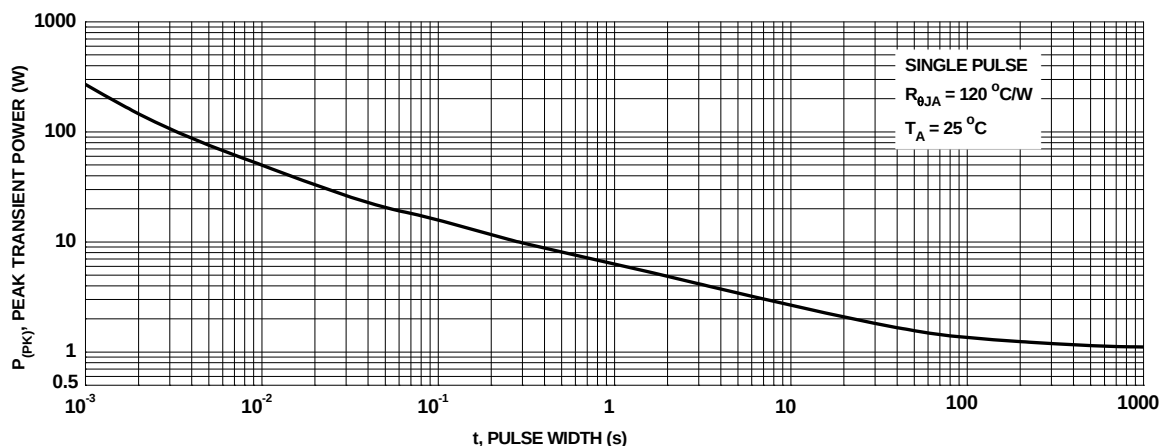


Figure 23. Single Pulse Maximum Power Dissipation

Typical Characteristics (Q2 N\_Channel)  $T_J = 25^\circ\text{C}$  unless otherwise noted

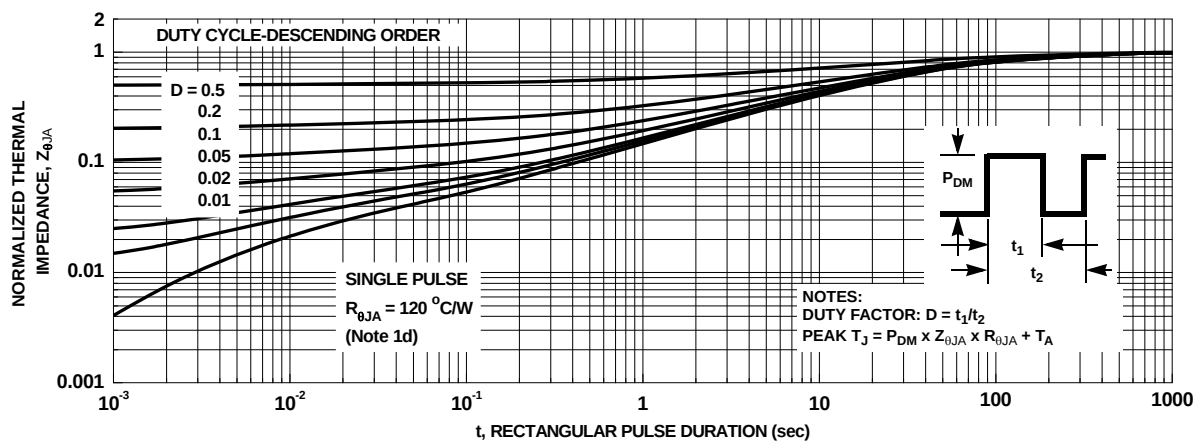


Figure24. Junction-to-Ambient Transient Thermal Response Curve

## Typical Characteristics (continued)

### SyncFET<sup>™</sup> Schottky body diode Characteristics

Fairchild's SyncFET<sup>™</sup> process embeds a Schottky diode in parallel with PowerTrench<sup>®</sup> MOSFET. This diode exhibits similar characteristics to a discrete external Schottky diode in parallel with a MOSFET. Figure 25 shows the reverse recovery characteristic of the FDMS7600AS.

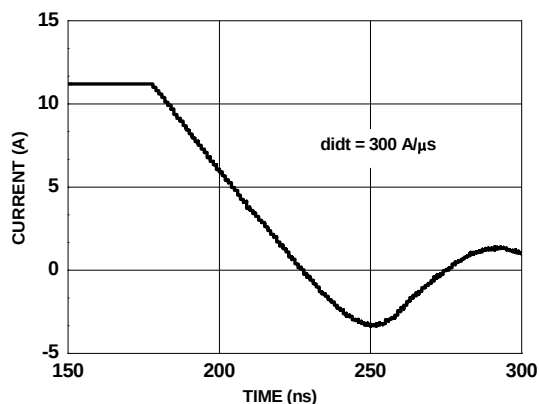


Figure 25. FDMS7600AS SyncFET<sup>™</sup> Body Diode Reverse Recovery Characteristic

Schottky barrier diodes exhibit significant leakage at high temperature and high reverse voltage. This will increase the power in the device.

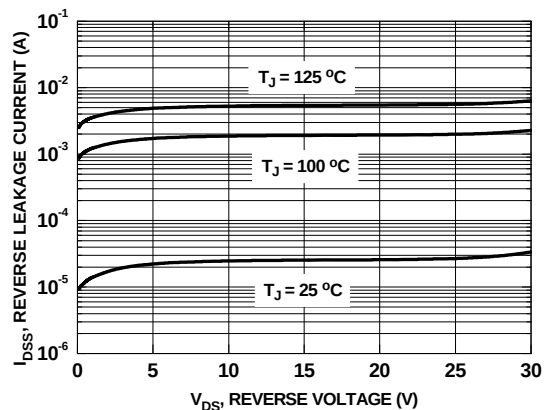


Figure 26. SyncFET<sup>™</sup> Body Diode Reverse Leakage vs. Drain-Source Voltage



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