

FDQ7236AS

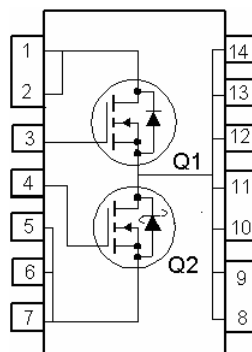
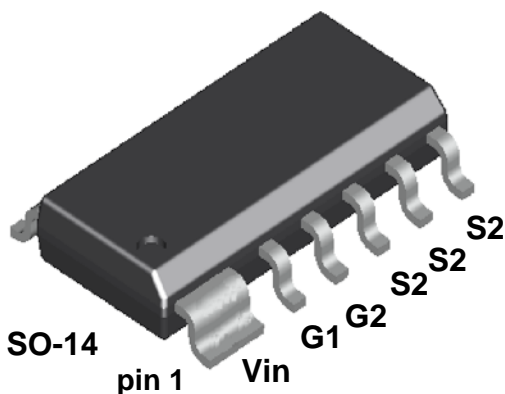
Dual Notebook Power Supply N-Channel PowerTrench® in SO-14 Package

General Description

The FDQ7236AS is designed to replace two single SO-8 MOSFETs in DC to DC power supplies. The high-side switch (Q1) is designed with specific emphasis on reducing switching losses while the low-side switch (Q2) is optimized to reduce conduction losses using Fairchild's SyncFET™ technology. The FDQ7236AS includes a patented combination of a MOSFET monolithically integrated with a Schottky diode.

Features

- **Q2:** 14 A, 30V. $R_{DS(on)} = 8.7\text{ m}\Omega @ V_{GS} = 10\text{V}$
 $R_{DS(on)} = 10.5\text{ m}\Omega @ V_{GS} = 4.5\text{V}$
- **Q1:** 11 A, 30V. $R_{DS(on)} = 13.2\text{ m}\Omega @ V_{GS} = 10\text{V}$
 $R_{DS(on)} = 16\text{ m}\Omega @ V_{GS} = 4.5\text{V}$



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

| Symbol | Parameter | Q2 | Q1 | Units |
|----------------|---|-------------|----------|------------------|
| V_{DSS} | Drain-Source Voltage | 30 | 30 | V |
| V_{GSS} | Gate-Source Voltage | ± 20 | ± 20 | V |
| I_D | Drain Current - Continuous (Note 1a) - Pulsed | 14 | 11 | A |
| | | 50 | 50 | |
| P_D | Power Dissipation for Single Operation (Note 1a & 1b) (Note 1c & 1d) | 2.4 | 1.8 | W |
| | | 1.3 | 1.1 | |
| 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 (Note 1a & 1b) (Note 1c & 1d) | Q2 | Q1 | $^\circ\text{C/W}$ |
|-----------------|--|----|-----|--------------------|
| | | 52 | 68 | |
| | | 94 | 118 | |

Package Marking and Ordering Information

| Device Marking | Device | Reel Size | Tape width | Quantity |
|----------------|-----------|-----------|------------|------------|
| FDQ7236AS | FDQ7236AS | 13" | 16mm | 2500 units |

Electrical Characteristics

 $T_A = 25^\circ\text{C}$ unless otherwise noted

| Symbol | Parameter | Test Conditions | Type | Min | Typ | Max | Units |
|--|--|--|----------|----------|-----------|-----------|----------------------|
| Off Characteristics | | | | | | | |
| BV_{DSS} | Drain-Source Breakdown Voltage | $V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$ $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$ | Q2 Q1 | 30 30 | | | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D = 10\text{ mA}$, Referenced to 25°C $I_D = 250\text{ }\mu\text{A}$, Referenced to 25°C | Q2 Q1 | | 25 24 | | mV/ $^\circ\text{C}$ |
| I_{DSS} | Zero Gate Voltage Drain Current | $V_{DS} = 24\text{ V}, V_{GS} = 0\text{ V}$ | Q2 Q1 | | | 500 1 | μA |
| | | $V_{DS} = 24\text{ V}, V_{GS} = 0\text{ V}, T_J = 125^\circ\text{C}$ | Q2 Q1 | | 5.6 40 | | mA μA |
| I_{GSS} | Gate-Body Leakage | $V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$ | ALL | | | ± 100 | nA |
| On Characteristics (Note 2) | | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS} = V_{GS}, I_D = 1\text{ mA}$ | Q2 | 1 | 1.8 | 3 | V |
| | | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$ | Q1 | 1 | 1.7 | 3 | |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate Threshold Voltage Temperature Coefficient | $I_D = 10\text{ mA}$, Referenced to 25°C $I_D = 250\text{ }\mu\text{A}$, Referenced to 25°C | Q2 Q1 | | -3 -4 | | mV/ $^\circ\text{C}$ |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance | $V_{GS} = 10\text{ V}, I_D = 14\text{ A}$ | Q2 | | 7.2 | 8.7 | m Ω |
| | | $V_{GS} = 4.5\text{ V}, I_D = 13\text{ A}$ | | | 8.7 | 10.5 | |
| | | $V_{GS} = 10\text{ V}, I_D = 14\text{ A}, T_J = 125^\circ\text{C}$ | | | 10 | 12.5 | |
| | | $V_{GS} = 10\text{ V}, I_D = 11\text{ A}$ | Q1 | | 11 | 13.2 | |
| $I_{D(on)}$ | On-State Drain Current | $V_{GS} = 10\text{ V}, V_{DS} = 5\text{ V}$ | Q2 | 50 | | | A |
| | | $V_{GS} = 10\text{ V}, V_{DS} = 5\text{ V}$ | Q1 | 50 | | | |
| | | $V_{GS} = 10\text{ V}, I_D = 11\text{ A}, T_J = 125^\circ\text{C}$ | | | 15 | 19 | |
| g_{FS} | Forward Transconductance | $V_{DS} = 10\text{ V}, I_D = 14\text{ A}$ | Q2 | | 58 | | S |
| | | $V_{DS} = 10\text{ V}, I_D = 11\text{ A}$ | Q1 | | 43 | | |
| Dynamic Characteristics | | | | | | | |
| C_{iss} | Input Capacitance | $V_{DS} = 15\text{ V}, V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}$ | Q2 | | 1530 | | pF |
| | | | Q1 | | 920 | | |
| C_{oss} | Output Capacitance | | Q2 | | 440 | | pF |
| | | | Q1 | | 190 | | |
| C_{riss} | Reverse Transfer Capacitance | | Q2 | | 160 | | pF |
| | | Q1 | | 120 | | | |
| R_g | Gate Resistance | $V_{GS} = 15\text{ mV}, f = 1.0\text{ MHz}$ | Q2 | | 1.9 | | Ω |
| | | | Q1 | | 1.9 | | |

Electrical Characteristics

$T_A = 25^\circ\text{C}$ unless otherwise noted

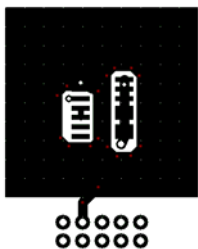
| Symbol | Parameter | Test Conditions | Type | Min | Typ | Max | Units |
|---|---|---|------|-----|-----|-----|-------|
| Switching Characteristics (Note 2) | | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD} = 15\text{ V}, I_D = 1\text{ A},$ $V_{GS} = 10\text{ V}, R_{GEN} = 6\ \Omega$ | Q2 | | 12 | 21 | ns |
| | | | Q1 | | 9 | 18 | |
| t_r | Turn-On Rise Time | | Q2 | | 13 | 23 | ns |
| | | | Q1 | | 5 | 10 | |
| $t_{d(off)}$ | Turn-Off Delay Time | $V_{DD} = 15\text{ V}, I_D = 1\text{ A},$ $V_{GS} = 4.5\text{ V}, R_{GEN} = 6\ \Omega$ | Q2 | | 30 | 49 | ns |
| | | | Q1 | | 27 | 43 | |
| t_f | Turn-Off Fall Time | | Q2 | | 19 | 35 | ns |
| | | | Q1 | | 4 | 8 | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD} = 15\text{ V}, I_D = 1\text{ A},$ $V_{GS} = 4.5\text{ V}, R_{GEN} = 6\ \Omega$ | Q2 | | 17 | 30 | ns |
| | | | Q1 | | 11 | 20 | |
| t_r | Turn-On Rise Time | | Q2 | | 18 | 32 | ns |
| | | | Q1 | | 15 | 26 | |
| $t_{d(off)}$ | Turn-Off Delay Time | $V_{DS} = 15\text{ V}, I_D = 14\text{ A}$ | Q2 | | 28 | 44 | ns |
| | | | Q1 | | 16 | 29 | |
| t_f | Turn-Off Fall Time | | Q2 | | 13 | 23 | ns |
| | | | Q1 | | 9 | 18 | |
| $Q_{g(TOT)}$ | Total Gate Charge, $V_{GS} = 10\text{ V}$ | $V_{DS} = 15\text{ V}, I_D = 14\text{ A}$ | Q2 | | 28 | 39 | nC |
| | | | Q1 | | 17 | 24 | |
| $Q_{g(TOT)}$ | Total Gate Charge, $V_{GS} = 5\text{ V}$ | $V_{DS} = 15\text{ V}, I_D = 11\text{ A}$ | Q2 | | 15 | 21 | nC |
| | | | Q1 | | 9 | 19 | |
| Q_{gs} | Gate-Source Charge | $V_{DS} = 15\text{ V}, I_D = 11\text{ A}$ | Q2 | | 4.1 | | nC |
| | | | Q1 | | 2.7 | | |
| Q_{gd} | Gate-Drain Charge | $V_{DS} = 15\text{ V}, I_D = 11\text{ A}$ | Q2 | | 4.9 | | nC |
| | | | Q1 | | 3.3 | | |

Drain-Source Diode Characteristics and Maximum Ratings

| | | | | | | | |
|----------|---|--|----|--|-----|-----|----|
| I_S | Maximum Continuous Drain-Source Diode Forward Current | | Q2 | | | 3.4 | A |
| | | | Q1 | | | 2.1 | |
| V_{SD} | Drain-Source Diode Forward Voltage | $V_{GS} = 0\text{ V}, I_S = 3.4\text{ A}$ (Note 2) | Q2 | | 0.5 | 0.7 | V |
| | | $V_{GS} = 0\text{ V}, I_S = 1.9\text{ A}$ (Note 2) | | | 0.4 | | |
| | | $V_{GS} = 0\text{ V}, I_S = 2.1\text{ A}$ (Note 2) | Q1 | | 0.7 | 1.2 | |
| t_{rr} | Diode Reverse Recovery Time | $I_F = 14\text{ A}$ | Q2 | | 22 | | ns |
| Q_{rr} | Diode Reverse Recovery Charge | $dI_F/dt = 300\text{ A}/\mu\text{s}$ | | | 15 | | nC |
| t_{rr} | Diode Reverse Recovery Time | $I_F = 11\text{ A}$ | Q1 | | 16 | | ns |
| Q_{rr} | Diode Reverse Recovery Charge | $dI_F/dt = 100\text{ A}/\mu\text{s}$ | | | 5 | | nC |

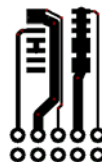
NOTE :

- $R_{\theta JA}$ 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 $R_{\theta CA}$ is determined by the user's board design.



a) $68^\circ\text{C}/\text{W}$ when mounted on a 1 in^2 pad of 2 oz copper (Q1).

b) $52^\circ\text{C}/\text{W}$ when mounted on a 1 in^2 pad of 2 oz copper (Q2).



c) $118^\circ\text{C}/\text{W}$ when mounted on a minimum pad of 2 oz copper (Q1).

d) $94^\circ\text{C}/\text{W}$ when mounted on a minimum pad of 2 oz copper (Q2).

Scale 1 : 1 on letter size paper

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

Typical Characteristics: Q2

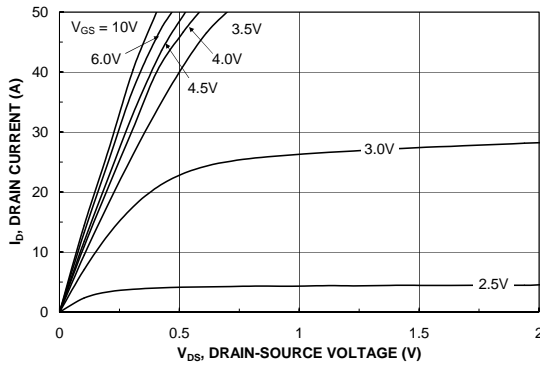


Figure 1. On-Region Characteristics.

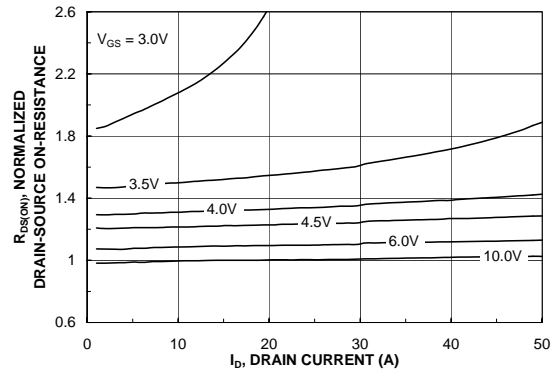


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

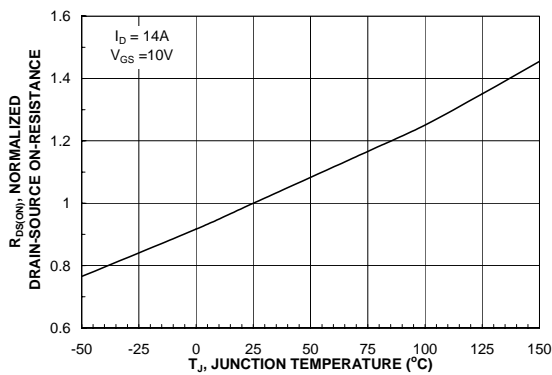


Figure 3. On-Resistance Variation with Temperature.

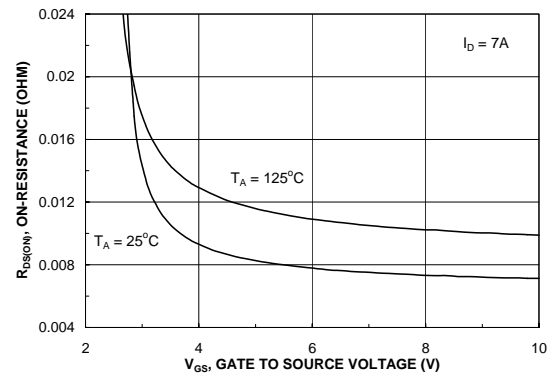


Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

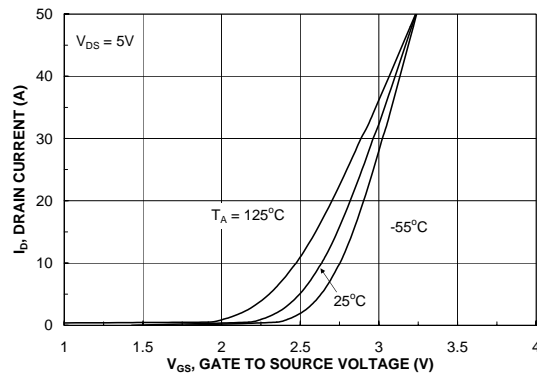


Figure 5. Transfer Characteristics.

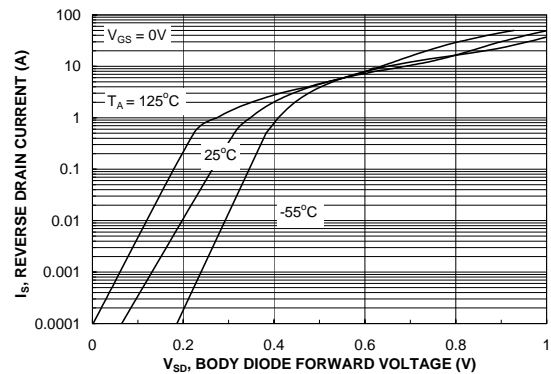


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

Typical Characteristics : Q2

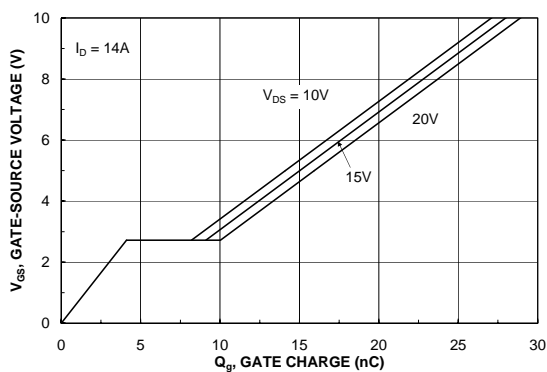


Figure 7. Gate Charge Characteristics.

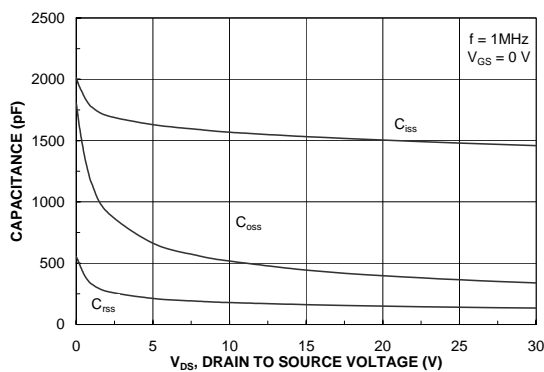


Figure 8. Capacitance Characteristics.

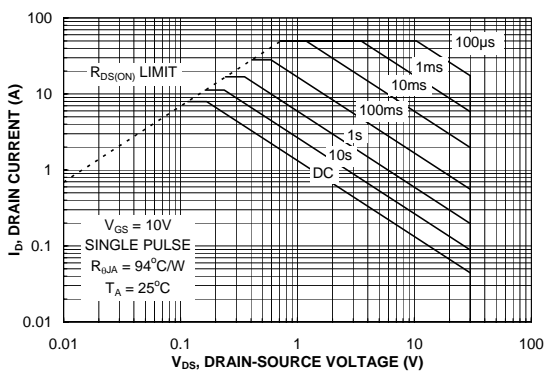


Figure 9. Maximum Safe Operating Area.

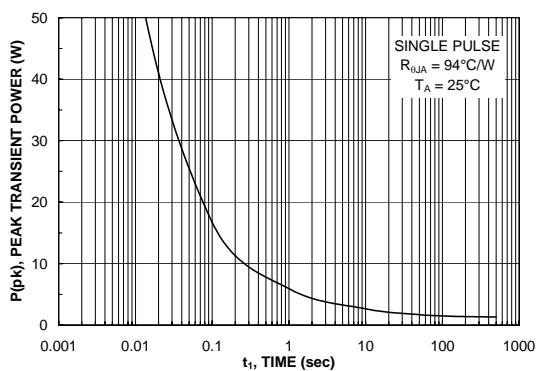


Figure 10. Single Pulse Maximum Power Dissipation.

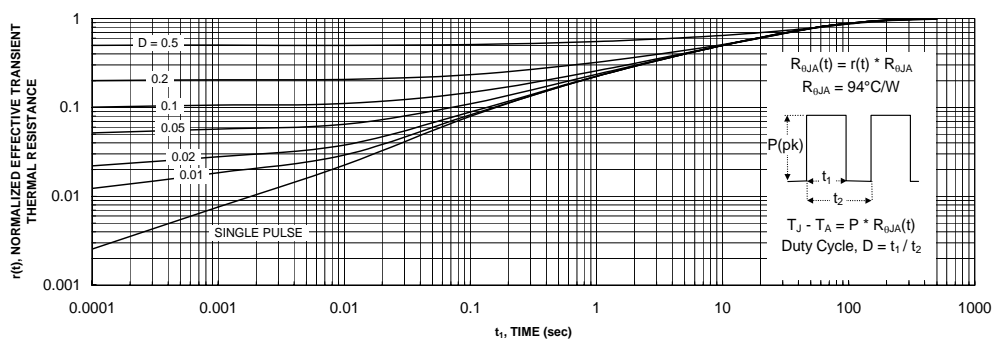


Figure 11. Transient Thermal Response Curve.

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

Typical Characteristics : Q2

SyncFET Schottky Body Diode Characteristics

Fairchild's SyncFET process embeds a Schottky diode in parallel with PowerTrench MOSFET. This diode exhibits similar characteristics to a discrete external Schottky diode in parallel with a MOSFET. Figure 12 shows the reverse recovery characteristic of the FDQ7236AS Q2.

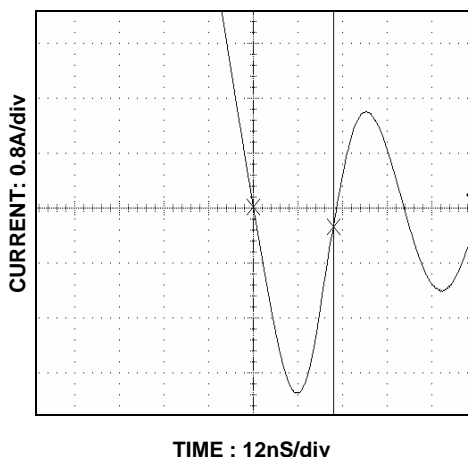


Figure 12. FDQ7236AS SyncFET body diode reverse recovery characteristic.

For comparison purposes, Figure 13 shows the reverse recovery characteristics of the body diode of an equivalent size MOSFET produced without SyncFET (FDS6670A).

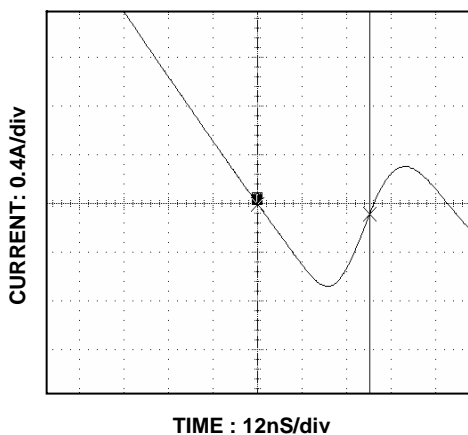


Figure 13. Non-SyncFET (FDS6670A) body diode reverse recovery characteristic.

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

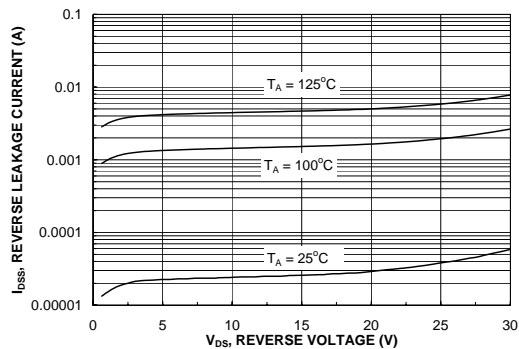


Figure 14. SyncFET body diode reverse leakage versus drain-source voltage and temperature.

Typical Characteristics: Q1

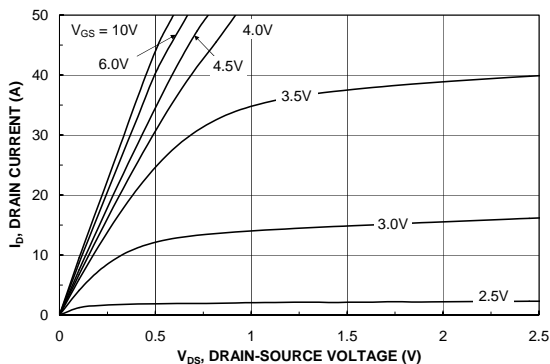


Figure 15. On-Region Characteristics.

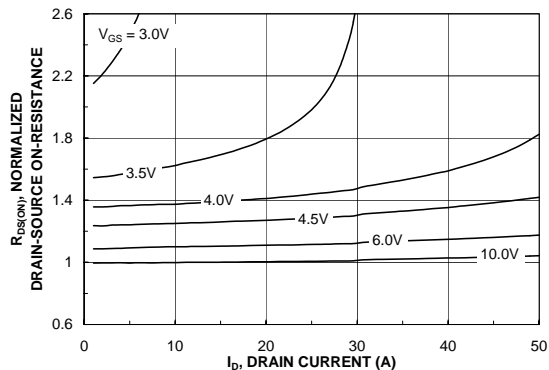


Figure 16. On-Resistance Variation with Drain Current and Gate Voltage.

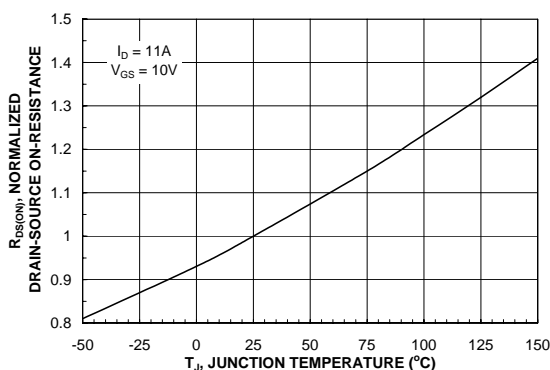


Figure 17. On-Resistance Variation with Temperature.

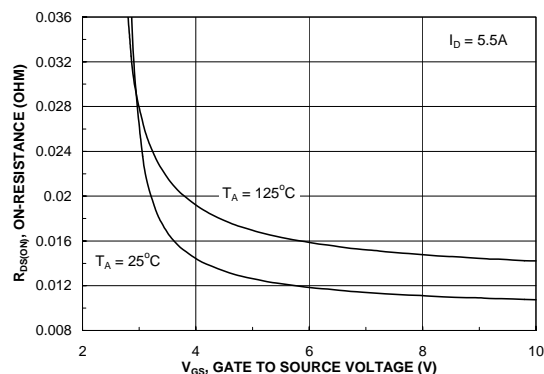


Figure 18. On-Resistance Variation with Gate-to-Source Voltage.

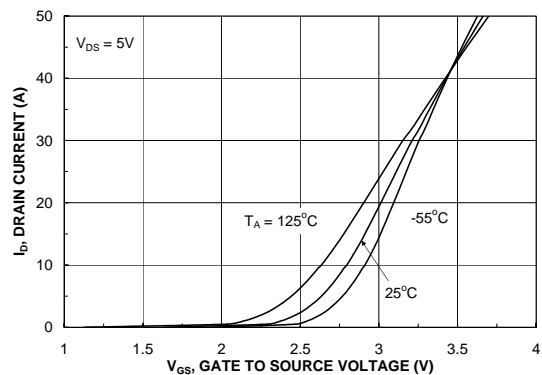


Figure 19. Transfer Characteristics.

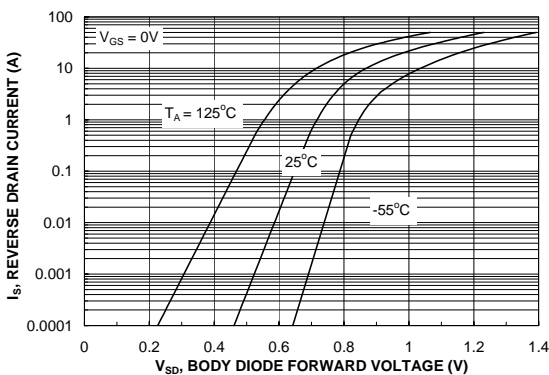


Figure 20. Body Diode Forward Voltage Variation with Source Current and Temperature.

Typical Characteristics: Q1

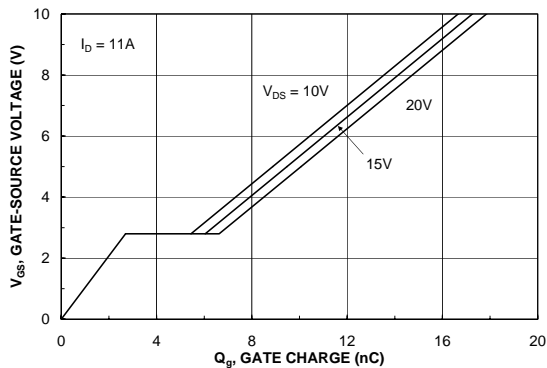


Figure 21. Gate Charge Characteristics.

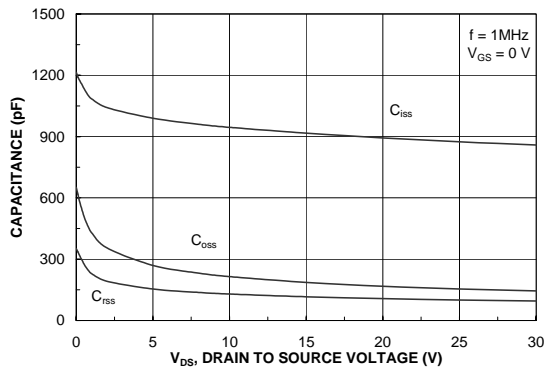


Figure 22. Capacitance Characteristics.

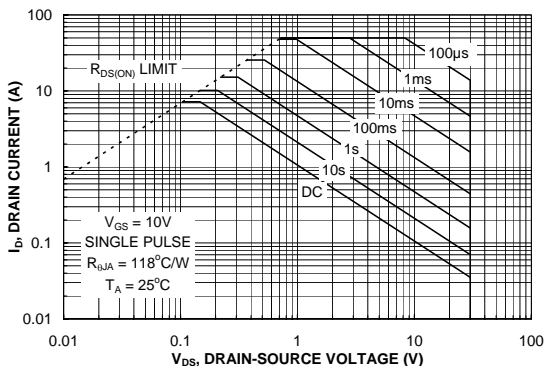


Figure 23. Maximum Safe Operating Area.

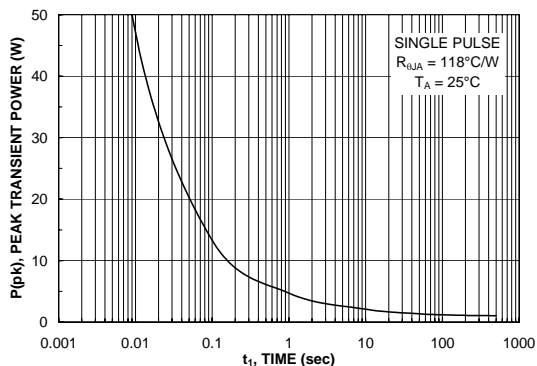


Figure 24. Single Pulse Maximum Power Dissipation.

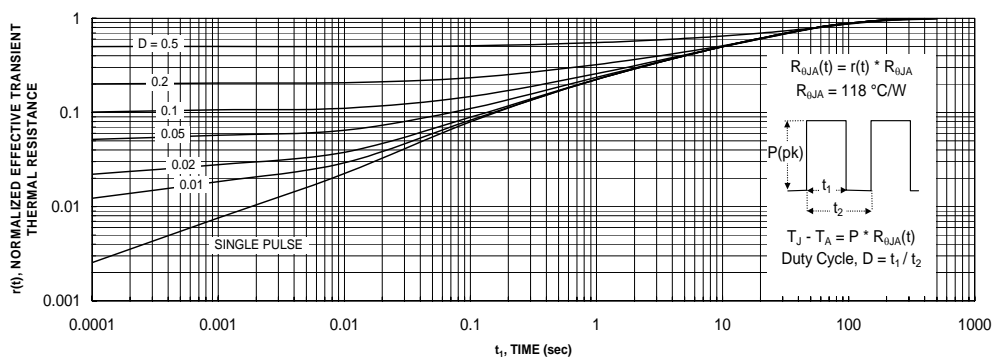







Figure 25. Transient Thermal Response Curve.

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



TRADEMARKS

The following includes registered and unregistered trademarks and service marks, owned by Fairchild Semiconductor and/or its global subsidiaries, and is not intended to be an exhaustive list of all such trademarks.

- | | | | |
|---|---|---|---|
| AccuPower™ | FPST™ | Power-SPM™ | The Power Franchise® |
| Auto-SPM™ | F-PFST™ | PowerTrench® | The Right Technology for Your Success™ |
| AX-CAP™* | FRFET® | PowerXS™ | |
| BitSiC® | Global Power Resource SM | Programmable Active Droop™ | power |
| Build it Now™ | Green FPS™ | QFET® | franchise |
| CorePLUS™ | Green FPS™ e-Series™ | QS™ | TinyBoost™ |
| CorePOWER™ | Gmax™ | Quiet Series™ | TinyBuck™ |
| CROSSVOLT™ | GTO™ | RapidConfigure™ | TinyCalc™ |
| CTL™ | IntelliMAX™ |  | TinyLogic® |
| Current Transfer Logic™ | ISOPLANAR™ | Saving our world, 1mW/W/kW at a time™ | TINYOPTO™ |
| DEUXPEED® | MegaBuck™ | SignalWise™ | TinyPower™ |
| Dual Cool™ | MICROCOUPLER™ | SmartMax™ | TinyPWM™ |
| EcoSPARK® | MicroFET™ | SMART START™ | TinyWire™ |
| EfficientMax™ | MicroPak™ | SPM® | TranSiC® |
| ESBC™ | MicroPak2™ | STEALTH™ | TriFault Detect™ |
|  | MillerDrive™ | SuperFET® | TRUECURRENT®* |
| Fairchild® | MotionMax™ | SuperSOT™-3 | µSerDes™ |
| Fairchild Semiconductor® | mWSaver™ | SuperSOT™-6 |  |
| FACT Quiet Series™ | OptiHIT™ | SuperSOT™-8 | UHC® |
| FACT® | OPTOLOGIC® | SupreMOS® | Ultra FRFET™ |
| FAST® | OPTOPLANAR® | SyncFET™ | UniFET™ |
| FastvCore™ |  | Sync-Lock™ | VCX™ |
| FETBench™ | PDP SPM™ |  | VisualMax™ |
| FlashWriter®* | | | XS™ |

*Trademarks of System General Corporation, used under license by Fairchild Semiconductor.

DISCLAIMER

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION, OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS. THESE SPECIFICATIONS DO NOT EXPAND THE TERMS OF FAIRCHILD'S WORLDWIDE TERMS AND CONDITIONS, SPECIFICALLY THE WARRANTY THEREIN, WHICH COVERS THESE PRODUCTS.

LIFE SUPPORT POLICY

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION.

As used here in:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.
2. A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

ANTI-COUNTERFEITING POLICY

Fairchild Semiconductor Corporation's Anti-Counterfeiting Policy. Fairchild's Anti-Counterfeiting Policy is also stated on our external website, www.Fairchildsemi.com, under Sales Support. Counterfeiting of semiconductor parts is a growing problem in the industry. All manufactures of semiconductor products are experiencing counterfeiting of their parts. Customers who inadvertently purchase counterfeit parts experience many problems such as loss of brand reputation, substandard performance, failed application, and increased cost of production and manufacturing delays. Fairchild is taking strong measures to protect ourselves and our customers from the proliferation of counterfeit parts. Fairchild strongly encourages customers to purchase Fairchild parts either directly from Fairchild or from Authorized Fairchild Distributors who are listed by country on our web page cited above. Products customers buy either from Fairchild directly or from Authorized Fairchild Distributors are genuine parts, have full traceability, meet Fairchild's quality standards for handling and storage and provide access to Fairchild's full range of up-to-date technical and product information. Fairchild and our Authorized Distributors will stand behind all warranties and will appropriately address and warranty issues that may arise. Fairchild will not provide any warranty coverage or other assistance for parts bought from Unauthorized Sources. Fairchild is committed to combat this global problem and encourage our customers to do their part in stopping this practice by buying direct or from authorized distributors.

PRODUCT STATUS DEFINITIONS

Definition of Terms

| Datasheet Identification | Product Status | Definition |
|--------------------------|-----------------------|---|
| Advance Information | Formative / In Design | Datasheet contains the design specifications for product development. Specifications may change in any manner without notice. |
| Preliminary | First Production | Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design. |
| No Identification Needed | Full Production | Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design. |
| Obsolete | Not In Production | Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only. |