



Is Now Part of



ON Semiconductor®

To learn more about ON Semiconductor, please visit our website at
www.onsemi.com

Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor's system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (_), the underscore (_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at www.onsemi.com. Please email any questions regarding the system integration to Fairchild_questions@onsemi.com.

ON Semiconductor and the ON Semiconductor logo are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

FDS8958A_F085

Dual N & P-Channel PowerTrench® MOSFET

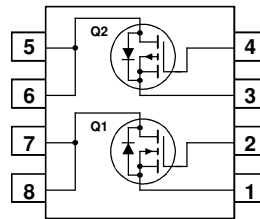
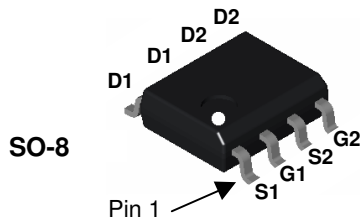
General Description

These dual N- and P-Channel enhancement mode power field effect transistors 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.

These devices are well suited for low voltage and battery powered applications where low in-line power loss and fast switching are required.

Features

- **Q1:** N-Channel
7.0A, 30V $R_{DS(on)} = 0.028\Omega @ V_{GS} = 10V$
 $R_{DS(on)} = 0.040\Omega @ V_{GS} = 4.5V$
- **Q2:** P-Channel
-5A, -30V $R_{DS(on)} = 0.052\Omega @ V_{GS} = -10V$
 $R_{DS(on)} = 0.080\Omega @ V_{GS} = -4.5V$
- Fast switching speed
- High power and handling capability in a widely used surface mount package
- Qualified to AEC Q101
- RoHS Compliant



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

| Symbol | Parameter | Q1 | Q2 | Units |
|----------------|--|-------------|----------|------------------|
| V_{DS} | Drain-Source Voltage | 30 | 30 | V |
| V_{GS} | Gate-Source Voltage | ± 20 | ± 20 | V |
| I_D | Drain Current - Continuous (Note 1a) | 7 | -5 | A |
| | - Pulsed | 20 | -20 | |
| P_D | Power Dissipation for Dual Operation | 2 | 2 | W |
| | Power Dissipation for Single Operation (Note 1a) | 1.6 | 1.6 | |
| | (Note 1c) | 0.9 | 0.9 | |
| E_{AS} | Single Pulse Avalanche Energy (Note 3) | 54 | 13 | mJ |
| 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) | 78 | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case (Note 1) | 40 | $^\circ\text{C}/\text{W}$ |

Package Marking and Ordering Information

| Device Marking | Device | Reel Size | Tape width | Quantity |
|----------------|---------------|-----------|------------|------------|
| FDS8958A | FDS8958A_F085 | 13" | 12mm | 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 | $V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$ $V_{GS} = 0\text{ V}, I_D = -250\ \mu\text{A}$ | Q1 Q2 | 30 -30 | | | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | 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 | | 25 -23 | | mV/ $^\circ\text{C}$ |
| I_{DSS} | Zero Gate Voltage Drain Current | $V_{DS} = 24\text{ V}, V_{GS} = 0\text{ V}$ $V_{DS} = -24\text{ V}, V_{GS} = 0\text{ V}$ | Q1 Q2 | | | 1 -1 | μA |
| I_{GSSF} | Gate-Body Leakage, Forward | $V_{GS} = 20\text{ V}, V_{DS} = 0\text{ V}$ | All | | | 100 | nA |
| I_{GSSR} | Gate-Body Leakage, Reverse | $V_{GS} = -20\text{ V}, V_{DS} = 0\text{ V}$ | All | | | -100 | nA |
| On Characteristics (Note 2) | | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$ $V_{DS} = V_{GS}, I_D = -250\ \mu\text{A}$ | Q1 Q2 | 1 -1 | 1.9 -1.7 | 3 -3 | V |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate 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 | | -4.5 4.5 | | mV/ $^\circ\text{C}$ |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance | $V_{GS} = 10\text{ V}, I_D = 7\text{ A}$ $V_{GS} = 10\text{ V}, I_D = 7\text{ A}, T_J = 125^\circ\text{C}$ $V_{GS} = 4.5\text{ V}, I_D = 6\text{ A}$ $V_{GS} = -10\text{ V}, I_D = -5\text{ A}$ $V_{GS} = -10\text{ V}, I_D = -5\text{ A}, T_J = 125^\circ\text{C}$ $V_{GS} = -4.5\text{ V}, I_D = -4\text{ A}$ | Q1 Q2 | | 19 27 24 42 57 65 | 28 42 40 52 78 80 | m Ω |
| $I_{D(on)}$ | On-State Drain Current | $V_{GS} = 10\text{ V}, V_{DS} = 5\text{ V}$ $V_{GS} = -10\text{ V}, V_{DS} = -5\text{ V}$ | Q1 Q2 | 20 -20 | | | A |
| g_{FS} | Forward Transconductance | $V_{DS} = 5\text{ V}, I_D = 7\text{ A}$ $V_{DS} = -5\text{ V}, I_D = -5\text{ A}$ | Q1 Q2 | | 25 10 | | S |
| Dynamic Characteristics | | | | | | | |
| C_{iss} | Input Capacitance | $V_{DS} = 15\text{ V}, V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}$ | Q1 Q2 | | 575 528 | | pF |
| C_{oss} | Output Capacitance | | Q1 Q2 | | 145 132 | | pF |
| C_{riss} | Reverse Transfer Capacitance | $V_{DS} = -15\text{ V}, V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}$ | Q1 Q2 | | 65 70 | | pF |
| R_G | Gate Resistance | | $V_{GS} = 15\text{ mV}, f = 1.0\text{ MHz}$ | Q1 Q2 | | 2.1 6.0 | |

Electrical Characteristics (continued) $T_A = 25^\circ\text{C}$ unless otherwise noted

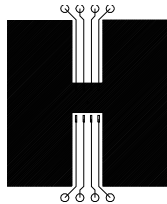
| Symbol | Parameter | Test Conditions | Type | Min | Typ | Max | Units |
|---|---------------------|---|----------|-----|-------------|----------|-------|
| Switching Characteristics (Note 2) | | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | Q1 $V_{DD} = 15\text{ V}, I_D = 1\text{ A},$ $V_{GS} = 10\text{ V}, R_{GEN} = 6\ \Omega$ | Q1 Q2 | | 8 7 | 16 14 | ns |
| t_r | Turn-On Rise Time | | Q1 Q2 | | 5 13 | 10 24 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | Q2 $V_{DD} = -15\text{ V}, I_D = -1\text{ A},$ $V_{GS} = -10\text{ V}, R_{GEN} = 6\ \Omega$ | Q1 Q2 | | 23 14 | 37 25 | ns |
| t_f | Turn-Off Fall Time | | Q1 Q2 | | 3 9 | 6 17 | ns |
| Q_g | Total Gate Charge | Q1 $V_{DS} = 15\text{ V}, I_D = 7\text{ A}, V_{GS} = 10\text{ V}$ | Q1 Q2 | | 11.4 9.6 | 16 13 | nC |
| Q_{gs} | Gate-Source Charge | Q2 | Q1 Q2 | | 1.7 2.2 | | nC |
| Q_{gd} | Gate-Drain Charge | $V_{DS} = -15\text{ V}, I_D = -5\text{ A}, V_{GS} = -10\text{ V}$ | Q1 Q2 | | 2.1 1.7 | | nC |

Drain-Source Diode Characteristics and Maximum Ratings

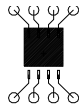
| | | | | | | | |
|----------|--|---|----------|--|---------------|-------------|----|
| I_S | Maximum Continuous Drain-Source Diode Forward Current | | Q1 Q2 | | | 1.3 -1.3 | A |
| I_{SM} | Maximum Pulsed Drain-Source Diode Forward Current (Note 2) | | Q1 Q2 | | | 20 -20 | A |
| V_{SD} | Drain-Source Diode Forward Voltage | $V_{GS} = 0\text{ V}, I_S = 1.3\text{ A}$ (Note 2) $V_{GS} = 0\text{ V}, I_S = -1.3\text{ A}$ (Note 2) | Q1 Q2 | | 0.75 -0.88 | 1.2 -1.2 | V |
| t_{rr} | Diode Reverse Recovery Time | Q1 $I_F = 7\text{ A}, dI_F/dt = 100\text{ A}/\mu\text{s}$ | Q1 Q2 | | 19 19 | | nS |
| Q_{rr} | Diode Reverse Recovery Charge | Q2 $I_F = -5\text{ A}, dI_F/dt = 100\text{ A}/\mu\text{s}$ | Q1 Q2 | | 9 6 | | nC |

Notes:

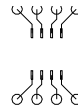
- $R_{\theta JA}$ is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins. $R_{\theta JC}$ is guaranteed by design while $R_{\theta CA}$ is determined by the user's board design.



a) 78°/W when mounted on a 0.5 in² pad of 2 oz copper



b) 125°/W when mounted on a .02 in² pad of 2 oz copper



c) 135°/W when mounted on a minimum pad.

Scale 1 : 1 on letter size paper

- Pulse Test: Pulse Width < 300 μs , Duty Cycle < 2.0%
- Starting $T_J = 25^\circ\text{C}$, $L = 3\text{ mH}$, $I_{AS} = 6\text{ A}$, $V_{DD} = 30\text{ V}$, $V_{GS} = 10\text{ V}$ (Q1).
Starting $T_J = 25^\circ\text{C}$, $L = 3\text{ mH}$, $I_{AS} = 3\text{ A}$, $V_{DD} = 30\text{ V}$, $V_{GS} = 10\text{ V}$ (Q2).

Typical Characteristics: Q1 (N-Channel)

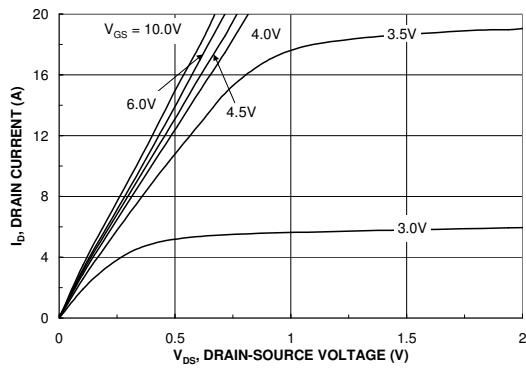


Figure 1. On-Region Characteristics.

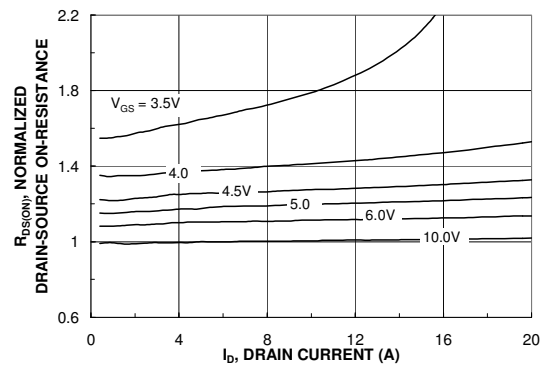


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

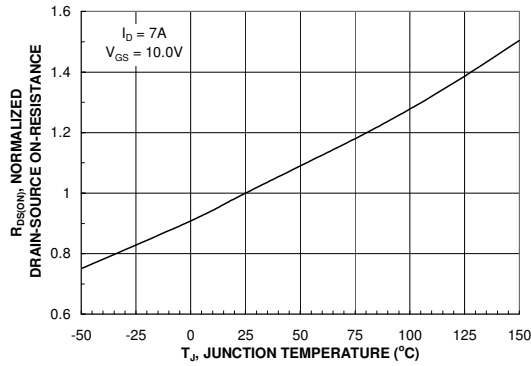


Figure 3. On-Resistance Variation with Temperature.

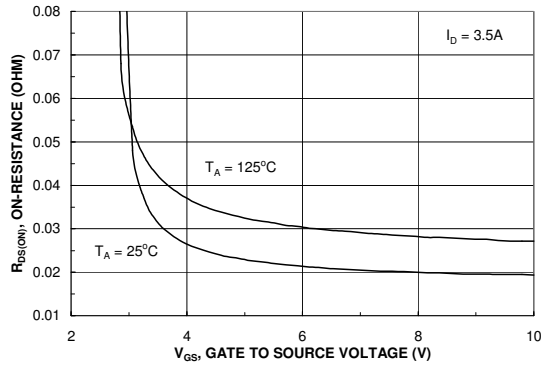


Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

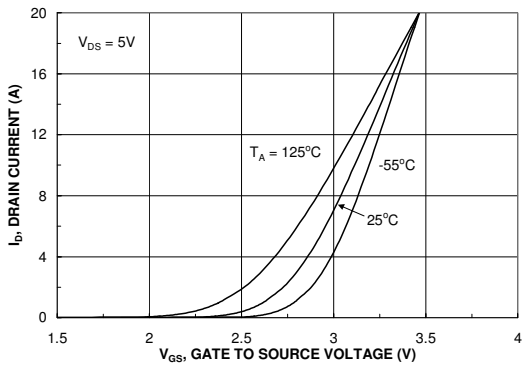


Figure 5. Transfer Characteristics.

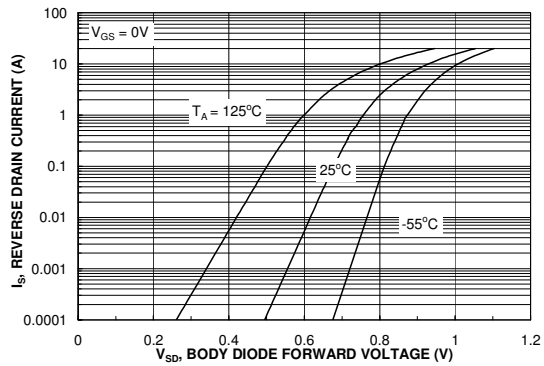


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

Typical Characteristics: Q1 (N-Channel)

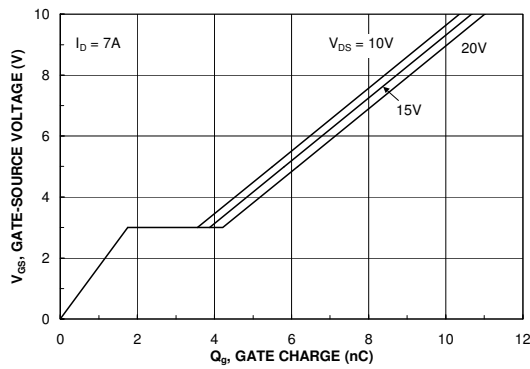


Figure 7. Gate Charge Characteristics.

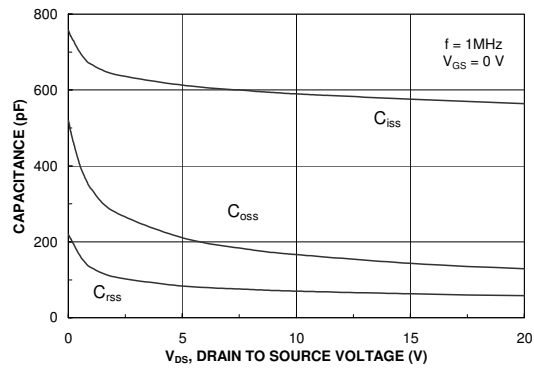


Figure 8. Capacitance Characteristics.

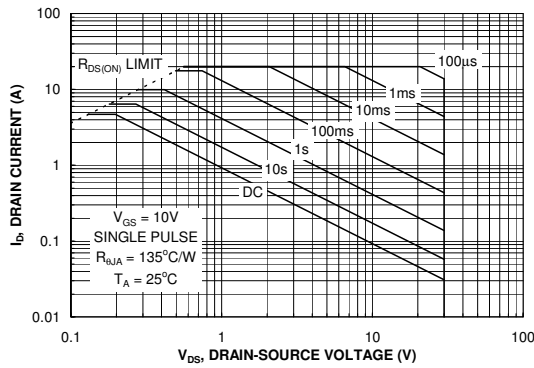


Figure 9. Maximum Safe Operating Area.

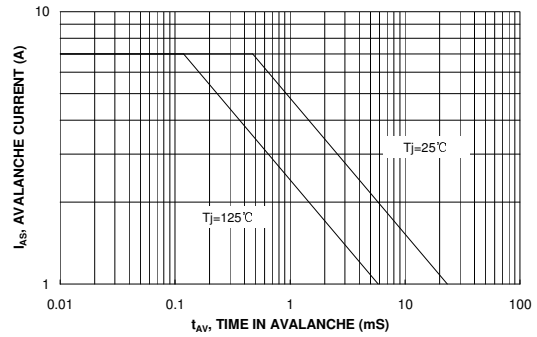


Figure 10. Unclamped Inductive Switching Capability Figure

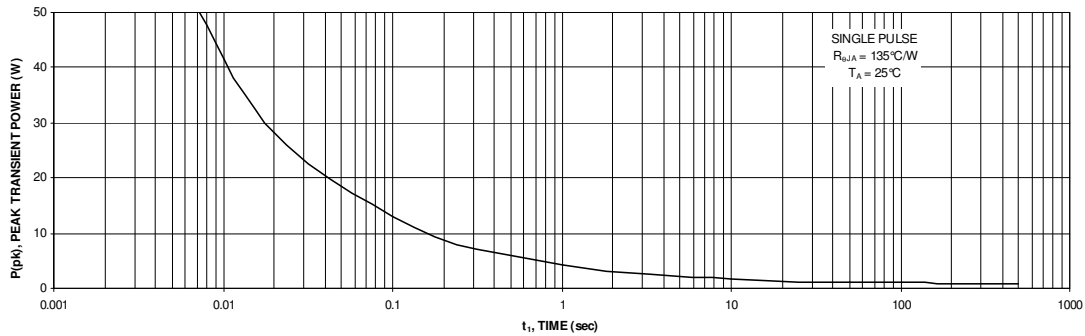


Figure 11. Single Pulse Maximum Power Dissipation.

Typical Characteristics: Q2 (P-Channel)

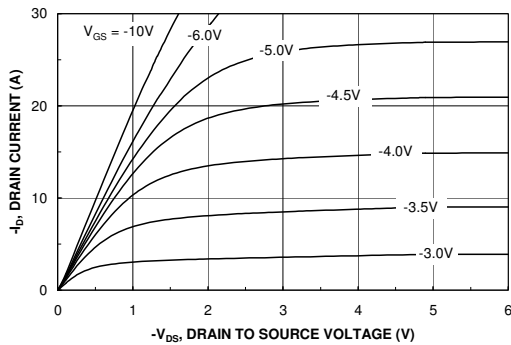


Figure 12. On-Region Characteristics.

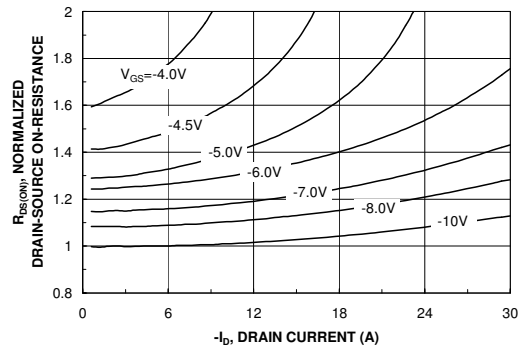


Figure 13. On-Resistance Variation with Drain Current and Gate Voltage.

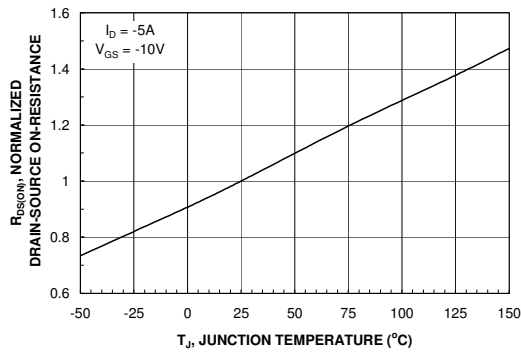


Figure 14. On-Resistance Variation with Temperature.

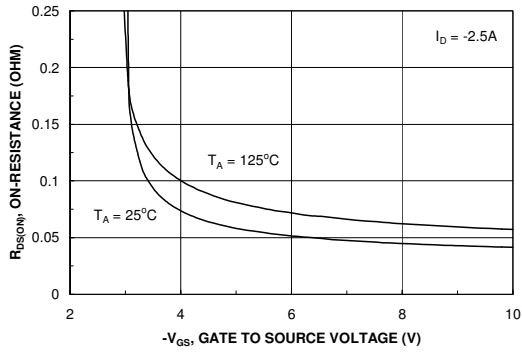


Figure 15. On-Resistance Variation with Gate-to-Source Voltage.

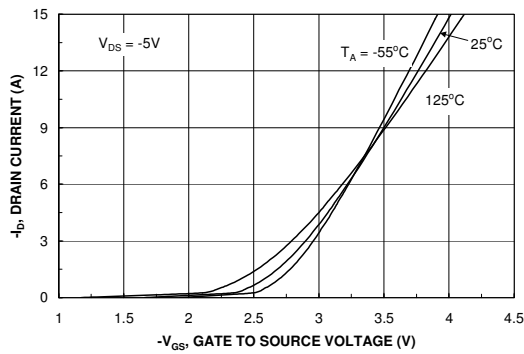


Figure 16. Transfer Characteristics.

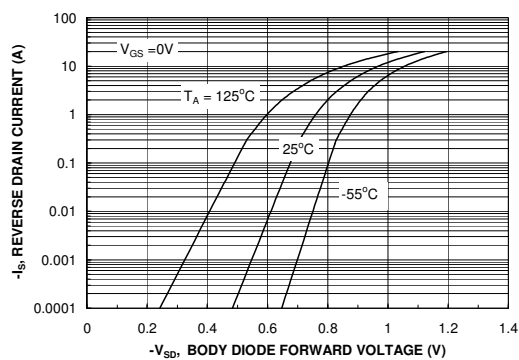


Figure 17. Body Diode Forward Voltage Variation with Source Current and Temperature.

Typical Characteristics: Q2 (P-Channel)

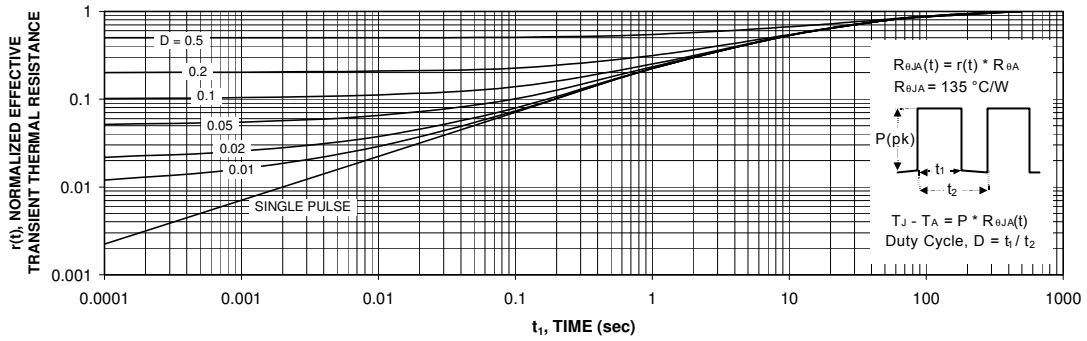







Figure 23. Transient Thermal Response Curve.

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

*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 herein:

- 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.
- 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. |

Rev. I47

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free
USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81-3-5817-1050

ON Semiconductor Website: www.onsemi.com
Order Literature: <http://www.onsemi.com/orderlit>
For additional information, please contact your local
Sales Representative