chanhvinh.com




**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.

chanhvinh.com



FAIRCHILD SEMICONDUCTOR®

April 2008

# FDS8958A

## Dual N & P-Channel PowerTrench® MOSFET

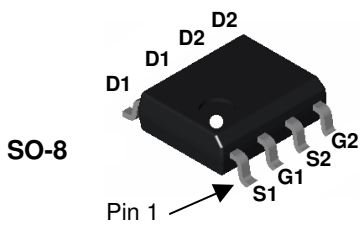
### General Description

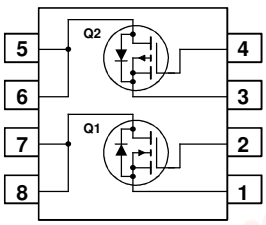
These dual N- and P-Channel enhancement mode power field effect transistors are produced using Fairchild Semiconductor's advanced PowerTrench process that has been especially tailored to minimize on-state ressitance and yet maintain superior switching performance.

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 $R_{DS(on)}$ = 0.028Ω @ $V_{GS}$ = 10V
  $R_{DS(on)}$ = 0.040Ω @ $V_{GS}$ = 4.5V
- **Q2**: P-Channel
  -5A, -30V $R_{DS(on)}$ = 0.052Ω @ $V_{GS}$ = -10V
  $R_{DS(on)}$ = 0.080Ω @ $V_{GS}$ = -4.5V
- Fast switching speed
- High power and handling capability in a widely used surface mount package




## Absolute Maximum Ratings $T_A$ = 25°C unless otherwise noted

| Symbol | Parameter | | Q1 | Q2 | Units |
|---|---|---|---|---|---|
| $V_{DSS}$ | Drain-Source Voltage | | 30 | 30 | V |
| $V_{GSS}$ | 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 | | °C |

## Thermal Characteristics

| | | | | |
|---|---|---|---|---|
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | (Note 1a) | 78 | °C/W |
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case | (Note 1) | 40 | °C/W |

## Package Marking and Ordering Information

| Device Marking | Device | Reel Size | Tape width | Quantity |
|---|---|---|---|---|
| FDS8958A | FDS8958A | 13" | 12mm | 2500 units |

©2008 Fairchild Semiconductor Corporation

chanhvinh.com



## Electrical Characteristics

$T_A$ = 25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | Type | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | | |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = 250 µA<br>$V_{GS}$ = 0 V, $I_D$ = -250 µA | Q1<br>Q2 | 30<br>-30 | | | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250 µA, Referenced to 25°C<br>$I_D$ = -250 µA, Referenced to 25°C | Q1<br>Q2 | | 25<br>-23 | | mV/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 24 V, $V_{GS}$ = 0 V<br>$V_{DS}$ = -24 V, $V_{GS}$ = 0 V | Q1<br>Q2 | | | 1<br>-1 | µA |
| $I_{GSSF}$ | Gate-Body Leakage, Forward | $V_{GS}$ = 20 V, $V_{DS}$ = 0 V | All | | | 100 | nA |
| $I_{GSSR}$ | Gate-Body Leakage, Reverse | $V_{GS}$ = -20 V, $V_{DS}$ = 0 V | All | | | -100 | nA |
| **On Characteristics** (Note 2) | | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA<br>$V_{DS}$ = $V_{GS}$, $I_D$ = -250 µA | Q1<br>Q2 | 1<br>-1 | 1.9<br>-1.7 | 3<br>-3 | V |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate Threshold Voltage Temperature Coefficient | $I_D$ = 250 µA, Referenced to 25°C<br>$I_D$ = -250 µA, Referenced to 25°C | Q1<br>Q2 | | -4.5<br>4.5 | | mV/°C |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance | $V_{GS}$ = 10 V, $I_D$ = 7 A<br>$V_{GS}$ = 10 V, $I_D$ = 7 A, $T_J$ = 125°C<br>$V_{GS}$ = 4.5 V, $I_D$ = 6 A | Q1 | | 19<br>27<br>24 | 28<br>42<br>40 | mΩ |
| | | $V_{GS}$ = -10 V, $I_D$ = -5 A<br>$V_{GS}$ = -10 V, $I_D$ = -5 A, $T_J$ = 125°C<br>$V_{GS}$ = -4.5 V, $I_D$ = -4 A | Q2 | | 42<br>57<br>65 | 52<br>78<br>80 | |
| $I_{D(on)}$ | On-State Drain Current | $V_{GS}$ = 10 V, $V_{DS}$ = 5 V<br>$V_{GS}$ = -10 V, $V_{DS}$ = -5 V | Q1<br>Q2 | 20<br>-20 | | | A |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 5 V, $I_D$ = 7 A<br>$V_{DS}$ = -5 V, $I_D$ =-5 A | Q1<br>Q2 | | 25<br>10 | | S |
| **Dynamic Characteristics** | | | | | | | |
| $C_{iss}$ | Input Capacitance | Q1<br>$V_{DS}$ = 15 V, $V_{GS}$ = 0 V, f = 1.0 MHz | Q1<br>Q2 | | 575<br>528 | | pF |
| $C_{oss}$ | Output Capacitance | Q2<br>$V_{DS}$ = -15 V, $V_{GS}$ = 0 V, f = 1.0 MHz | Q1<br>Q2 | | 145<br>132 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | Q1<br>Q2 | | 65<br>70 | | pF |
| $R_G$ | Gate Resistance | $V_{GS}$ = 15 mV, f = 1.0 MHz | Q1<br>Q2 | | 2.1<br>6.0 | | Ω |

chanhvinh.com



## Electrical Characteristics (continued)

$T_A$ = 25°C unless otherwise noted

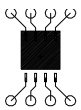
| Symbol | Parameter | Test Conditions | Type | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| **Switching Characteristics** (Note 2) | | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | Q1<br>$V_{DD}$ = 15 V, $I_D$ = 1 A,<br>$V_{GS}$ = 10V, $R_{GEN}$ = 6 Ω | Q1<br>Q2 | | 8<br>7 | 16<br>14 | ns |
| $t_r$ | Turn-On Rise Time | | Q1<br>Q2 | | 5<br>13 | 10<br>24 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | Q2<br>$V_{DD}$ = -15 V, $I_D$ = -1 A,<br>$V_{GS}$ = -10V, $R_{GEN}$ = 6 Ω | Q1<br>Q2 | | 23<br>14 | 37<br>25 | ns |
| $t_f$ | Turn-Off Fall Time | | Q1<br>Q2 | | 3<br>9 | 6<br>17 | ns |
| $Q_g$ | Total Gate Charge | Q1<br>$V_{DS}$ = 15 V, $I_D$ = 7 A, $V_{GS}$ = 10 V | Q1<br>Q2 | | 11.4<br>9.6 | 16<br>13 | nC |
| $Q_{gs}$ | Gate-Source Charge | Q2<br>$V_{DS}$ = -15 V, $I_D$ = -5 A, $V_{GS}$ = -10 V | Q1<br>Q2 | | 1.7<br>2.2 | | nC |
| $Q_{gd}$ | Gate-Drain Charge | | Q1<br>Q2 | | 2.1<br>1.7 | | nC |
| **Drain–Source Diode Characteristics and Maximum Ratings** | | | | | | | |
| $I_S$ | Maximum Continuous Drain-Source Diode Forward Current | | Q1<br>Q2 | | | 1.3<br>-1.3 | A |
| $I_{SM}$ | Maximum Plused Drain-Source Diode Forward Current (Note 2) | | Q1<br>Q2 | | | 20<br>-20 | A |
| $V_{SD}$ | Drain-Source Diode Forward Voltage | $V_{GS}$ = 0 V, $I_S$ = 1.3 A (Note 2)<br>$V_{GS}$ = 0 V, $I_S$ = -1.3 A (Note 2) | Q1<br>Q2 | | 0.75<br>-0.88 | 1.2<br>-1.2 | V |
| $t_{rr}$ | Diode Reverse Recovery Time | Q1<br>$I_F$ = 7 A, $d_{iF}/d_t$ = 100 A/µs | Q1<br>Q2 | | 19<br>19 | | nS |
| $Q_{rr}$ | Diode Reverse Recovery Charge | Q2<br>$I_F$ = -5 A, $d_{iF}/d_t$ = 100 A/µs | Q1<br>Q2 | | 9<br>6 | | nC |

**Notes:**

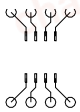
**1.** $R_{\theta JA}$ is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins. $R_{\theta JC}$ is guaranteed by design while $R_{\theta CA}$ is determined by the user's board design.



a) 78°/W when mounted on a 0.5 $in^2$ pad of 2 oz copper



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



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

Scale 1 : 1 on letter size paper

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

3. Starting TJ = 25°C, L = 3mH, $I_{AS}$ = 6A, $V_{DD}$ = 30V, $V_{GS}$ = 10V (Q1).

Starting TJ = 25°C, L = 3mH, $I_{AS}$ = 3A, $V_{DD}$ = 30V, $V_{GS}$ = 10V (Q2).

chanhvinh.com



## Typical Characteristics: Q1 (N-Channel)

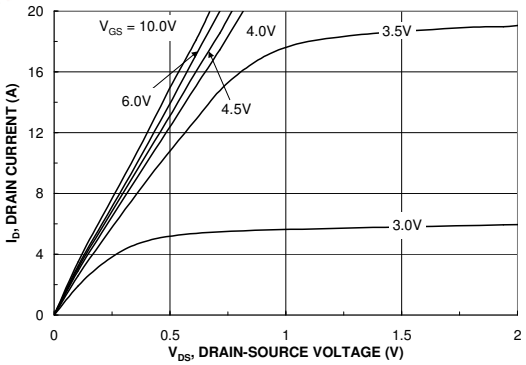



Figure 1. On-Region Characteristics.

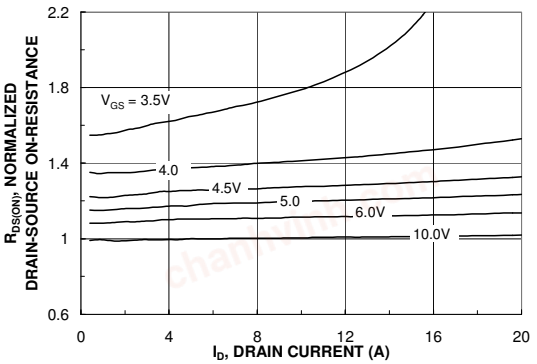



Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

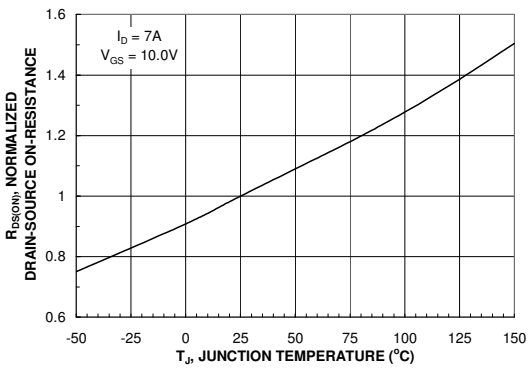



Figure 3. On-Resistance Variation with Temperature.

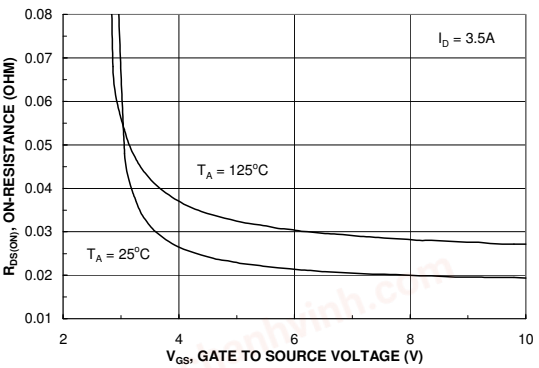



Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

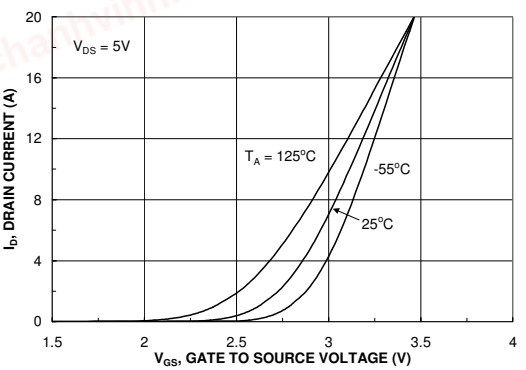



Figure 5. Transfer Characteristics.

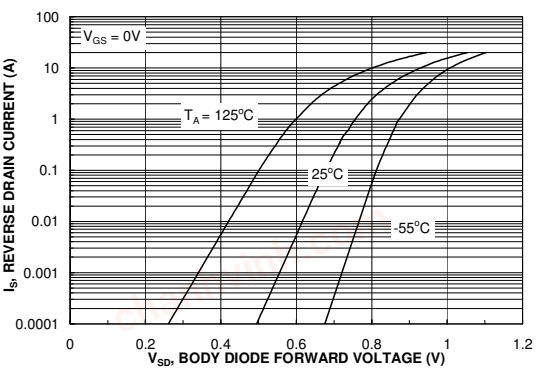



Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

chanhvinh.com



## Typical Characteristics: Q1 (N-Channel)

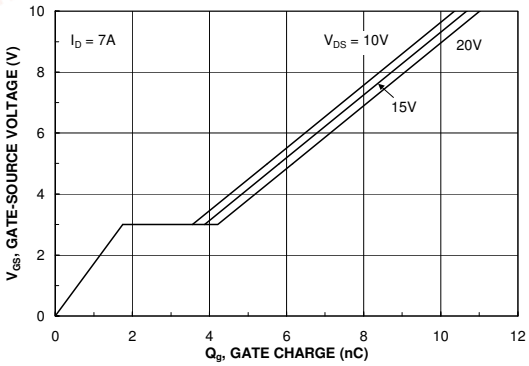



Figure 7. Gate Charge Characteristics.

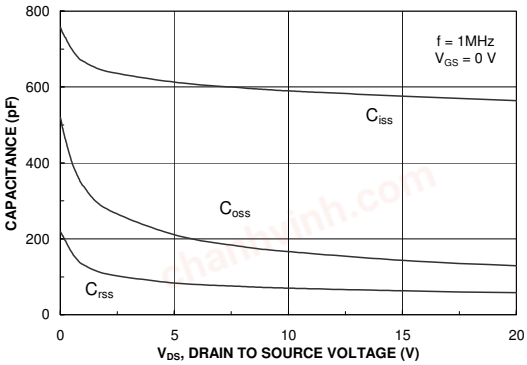



Figure 8. Capacitance Characteristics.

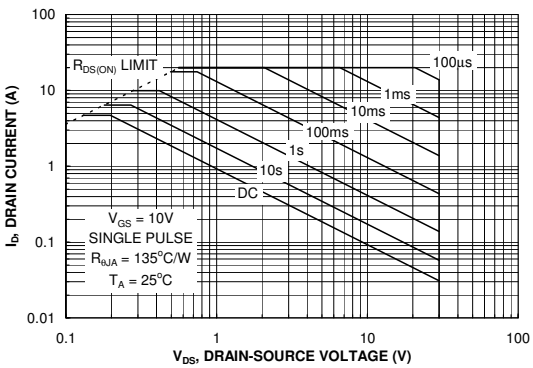



Figure 9. Maximum Safe Operating Area.

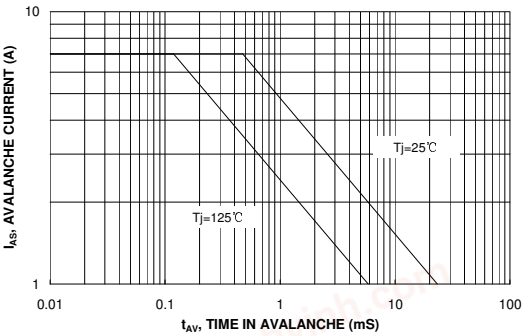



Figure 10. Unclamped Inductive Switching Capability Figure

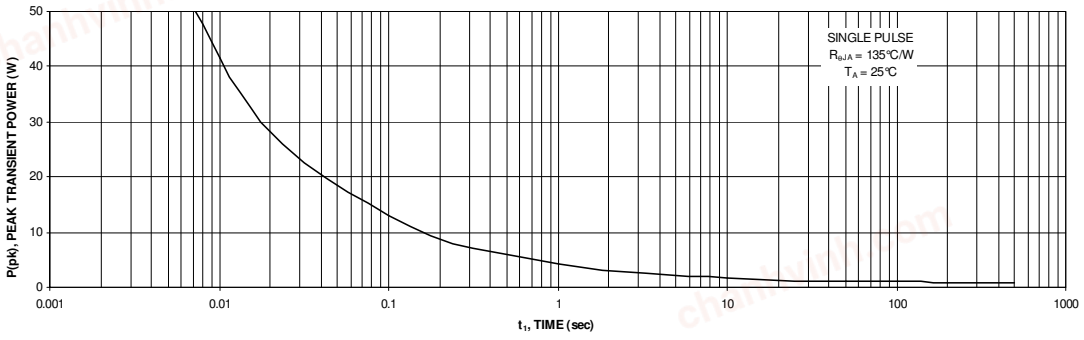



Figure 11. Single Pulse Maximum Power Dissipation.

chanhvinh.com



## Typical Characteristics: Q2 (P-Channel)

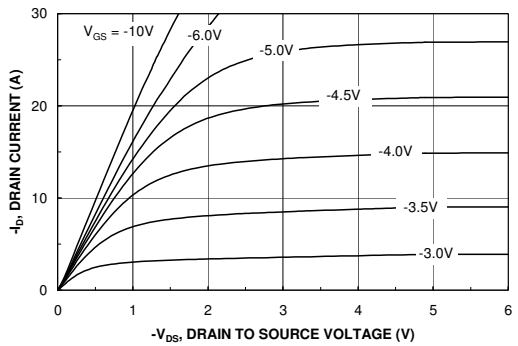



Figure 12. On-Region Characteristics.

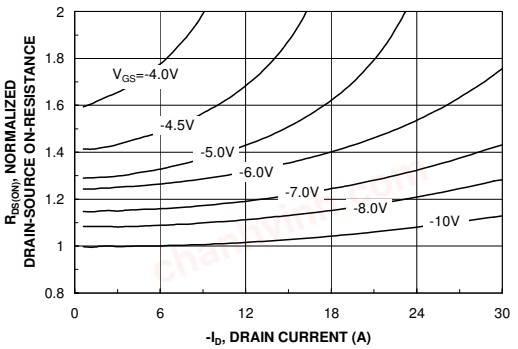



Figure 13. On-Resistance Variation with Drain Current and Gate Voltage.

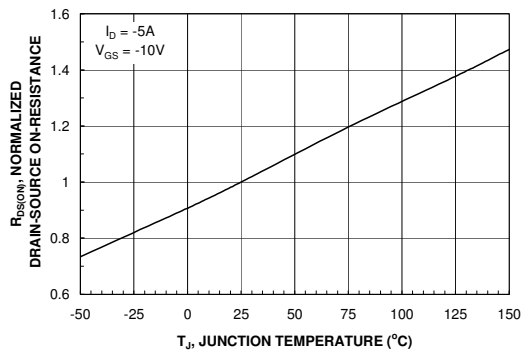



Figure 14. On-Resistance Variation with Temperature.

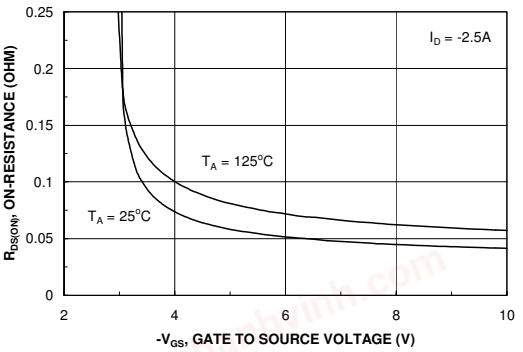



Figure 15. On-Resistance Variation with Gate-to-Source Voltage.

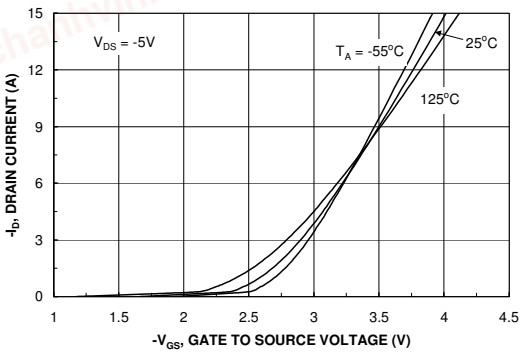



Figure 16. Transfer Characteristics.

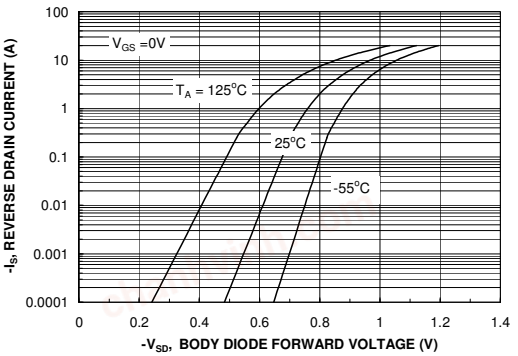



Figure 17. Body Diode Forward Voltage Variation with Source Current and Temperature.

chanhvinh.com



## Typical Characteristics: Q2 (P-Channel)

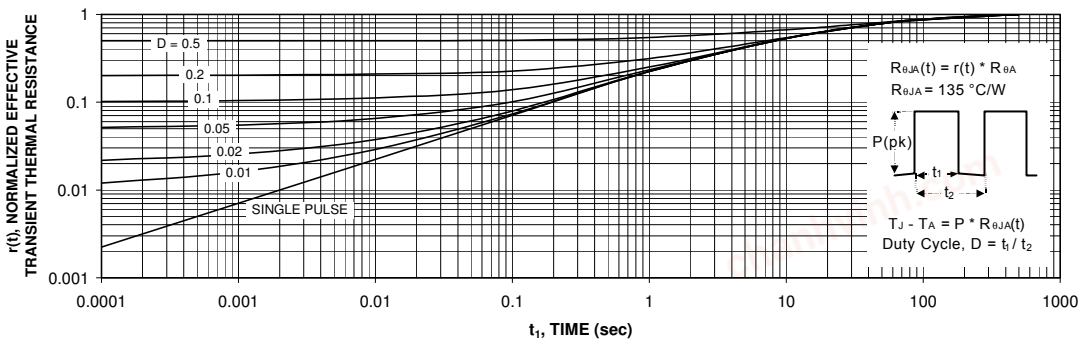



**Figure 23. Transient Thermal Response Curve.**

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

chanhvinh.com



FAIRCHILD SEMICONDUCTOR®

## TRADEMARKS

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

ACEx®
Build it Now™
CorePLUS™
CorePOWER™
*CROSSVOLT*™
CTL™
Current Transfer Logic™
EcoSPARK®
EfficentMax™
EZSWITCH™ *
™
®
Fairchild®
Fairchild Semiconductor®
FACT Quiet Series™
FACT®
FAST®
FastvCore™
FlashWriter® *
FPS™
F-PFS™
FRFET®
Global Power Resource℠
Green FPS™
Green FPS™ e-Series™
GTO™
IntelliMAX™
ISOPLANAR™
MegaBuck™
MICROCOUPLER™
MicroFET™
MicroPak™
MillerDrive™
MotionMax™
Motion-SPM™
OPTOLOGIC®
OPTOPLANAR®
®
PDP-SPM™
Power-SPM™
PowerTrench®
Programmable Active Droop™
QFET®
QS™
Quiet Series™
RapidConfigure™
Saving our world 1mW at a time™
SmartMax™
SMART START™
SPM®
STEALTH™
SuperFET™
SuperSOT™-3
SuperSOT™-6
SuperSOT™-8
SuperMOS™
SYSTEM GENERAL ®
The Power Franchise®
the power franchise
TinyBoost™
TinyBuck™
TinyLogic®
TINYOPTO™
TinyPower™
TinyPWM™
TinyWire™
µSerDes™
µ SerDes™
UHC®
Ultra FRFET™
UniFET™
VCX™
VisualMax™

* EZSWITCH™ and FlashWriter® are 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:

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.

## PRODUCT STATUS DEFINITIONS

**Definition of Terms**

| Datasheet Identification | Product Status | Definition |
|---|---|---|
| Advance Information | Formative or In Design | This datasheet contains the design specifications for product development. Specifications may change in any manner without notice. |
| Preliminary | First Production | This 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 | This 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 | This datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only. |

Rev. I34

chanhvinh.com

ON Semiconductor and ON 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

© Semiconductor Components Industries, LLC