FAIRCHILD SEMICONDUCTOR®

QFET™

FQG4904

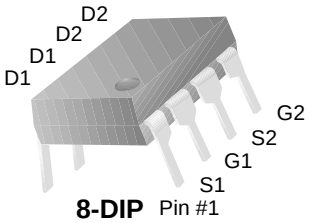
400V Dual N & P-Channel MOSFET

General Description

These dual N and P-channel enhancement mode power field effect transistors are produced using Fairchild's proprietary, planar stripe, DMOS technology.
This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for electronic lamp ballast based on half bridge.

Features

- N-Channel 0.46A, 400V, $R_{DS(on)}$ = 3.0 Ω @ V_{GS} = 10 V
  P-Channel -0.46A, -400V, $R_{DS(on)}$ = 3.0 Ω @ V_{GS} = -10 V
- Low gate charge (typical N-Channel 7.6 nC)
  (typical P-Channel 20.0 nC)
- Fast switching
- Improved dv/dt capability



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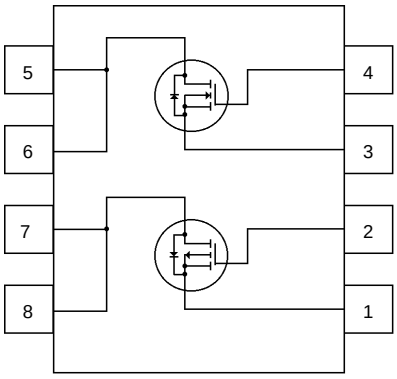


Absolute Maximum Ratings

T_A = 25°C unless otherwise noted

Symbol	Parameter		N-Channel	P-Channel	Units
V_{DSS}	Drain-Source Voltage		400	-400	V
I_D	Drain Current - Continuous (T_A = 25°C)		0.46	-0.46	A
	- Continuous (T_A = 100°C)		0.29	-0.29	A
I_{DM}	Drain Curent - Pulsed	(Note 1)	3.68	-3.68	A
V_{GSS}	Gate-Source Voltage		± 30		V
dv/dt	Peak Diode Recovery dv/dt	(Note 2)	4.5	-4.5	V/ns
P_D	Power Dissipation (T_A = 25°C)		1.6		W
	- Derate above 25°C		0.013		W/°C
T_J, T_{STG}	Operating and Storage Temperature Range		-55 to +150		°C

Thermal Characteristics

Symbol	Parameter		Typ	Max	Units
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	(Note 5a)	--	78	°C/W

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	N-Ch	400	--	--	V
		V_{GS} = 0 V, I_D = -250 µA	P-Ch	-400	--	--	V
ΔBV_{DSS} / ΔT_J	Breakdown Voltage Temperature Coefficient	I_D = 250 µA, Referenced to 25°C	N-Ch	--	0.47	--	V/°C
		I_D = -250 µA, Referenced to 25°C	P-Ch	--	-0.3	--	V/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 400 V, V_{GS} = 0 V	N-Ch	--	--	10	µA
		V_{DS} = 320 V, T_A = 125°C	N-Ch	--	--	100	µA
		V_{DS} = -400 V, V_{GS} = 0 V	P-Ch	--	--	-10	µA
		V_{DS} = -320 V, T_A = 125°C	P-Ch	--	--	-100	µA
I_{GSSF}	Gate-Body Leakage Current, Forward	V_{GS} = 30 V, V_{DS} = 0 V	All	--	--	100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	V_{GS} = -30 V, V_{DS} = 0 V	All	--	--	-100	nA
On Characteristics							
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 250 µA	N-Ch	2.0	--	4.0	V
		V_{DS} = V_{GS}, I_D = -250 µA	P-Ch	-2.0	--	-4.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	V_{GS} = 10 V, I_D = 0.23 A	N-Ch	--	2.0	3.0	Ω
		V_{GS} = -10 V, I_D = -0.23 A	P-Ch	--	2.2	3.0	Ω
g_{FS}	Forward Transconductance	V_{DS} = 40 V, I_D = 0.23 A	N-Ch	--	0.8	--	S
		V_{DS} = -40 V, I_D = -0.23 A	P-Ch	--	1.1	--	S
Dynamic Characteristics							
C_{iss}	Input Capacitance	N-Channel V_{DS} = 25 V, V_{GS} = 0 V, f = 1.0 MHz	N-Ch	--	235	300	pF
			P-Ch	--	500	645	pF
C_{oss}	Output Capacitance		N-Ch	--	40	55	pF
		P-Channel V_{DS} = -25 V, V_{GS} = 0 V, f = 1.0 MHz	P-Ch	--	85	110	pF
C_{rss}	Reverse Transfer Capacitance		N-Ch	--	6.5	8.5	pF
			P-Ch	--	14	18.5	pF
Switching Characteristics							
$t_{d(on)}$	Turn-On Delay Time	N-Channel V_{DD} = 200 V, I_D = 0.46 A, R_G = 25 Ω	N-Ch	--	6.5	25	ns
			P-Ch	--	10	30	ns
t_r	Turn-On Rise Time		N-Ch	--	16	40	ns
			P-Ch	--	21	52	ns
$t_{d(off)}$	Turn-Off Delay Time	P-Channel V_{DD} = -200 V, I_D = -0.46 A, R_G = 25 Ω (Note 3,4)	N-Ch	--	28	65	ns
			P-Ch	--	85	180	ns
t_f	Turn-Off Fall Time		N-Ch	--	34	80	ns
			P-Ch	--	56	120	ns
Q_g	Total Gate Charge	N-Channel V_{DS} = 320 V, I_D = 0.46 A, V_{GS} = 10 V	N-Ch	--	7.6	10	nC
			P-Ch	--	20	26	nC
Q_{gs}	Gate-Source Charge		N-Ch	--	1.2	--	nC
		P-Channel V_{DS} = -320 V, I_D = -0.46 A, V_{GS} = -10 V (Note 3,4)	P-Ch	--	2.7	--	nC
Q_{gd}	Gate-Drain Charge		N-Ch	--	3.3	--	nC
			P-Ch	--	9.9	--	nC

Electrical Characteristics (Continued)

Symbol	Parameter	Test Conditions	Type	Min	Typ	Max	Units
Drain-Source Diode Characteristics and Maximum Ratings							
I_S	Maximum Continuous Drain-Source Diode Forward Current		N-Ch	--	--	0.46	A
			P-Ch	--	--	-0.46	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		N-Ch	--	--	3.68	A
			P-Ch	--	--	-3.68	A
V_{SD}	Drain-Source Diode Forward Voltage	V_{GS} = 0 V, I_S = 0.46 A	N-Ch	--	--	1.4	V
		V_{GS} = 0 V, I_S = -0.46 A	P-Ch	--	--	-5.0	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0 V, I_S = 0.46 A, dI_F / dt = 100 A/µs (Note 3)	N-Ch	--	104	--	ns
Q_{rr}	Reverse Recovery Charge			--	248	--	nC
t_{rr}	Reverse Recovery Time	V_{GS} = 0 V, I_S = -0.46 A, dI_F / dt = 100 A/µs (Note 3)	P-Ch	--	117	--	ns
Q_{rr}	Reverse Recovery Charge			--	497	--	nC

Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. $I_{SD} \leq$ 0.46A, di/dt $\leq$ 200A/µs, $V_{DD} \leq BV_{DSS,}$ Starting T_J = 25°C
3. Pulse Test : Pulse width $\leq$ 300µs, Duty cycle $\leq$ 2%
4. Essentially independent of operating temperature
5. $R_{\theta JA}$ is the sum of the junction-to-case and case-to-ambient thermal resistance. $R_{\theta CA}$ is determined by the user's board design
   Maximum $R_{\theta JA}$ using the different board layouts on 3"x4.5" FR-4 PCB in a still air environment :
   a. 78°C/W when mounted without any pad copper
   b. 60°C/W when mounted on a 4.5 in^2 pad of 2oz copper. In such an environment, the power dissipation can be enhanced up to 2.1W

Typical Characteristics : N-Channel

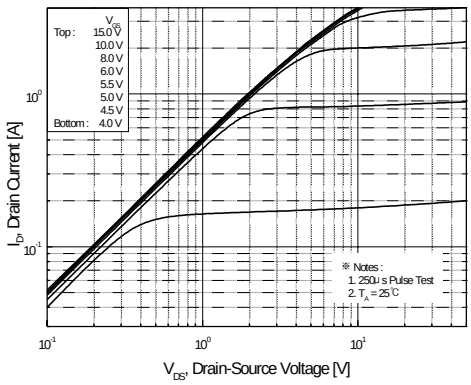


Figure 1. On-Region Characteristics

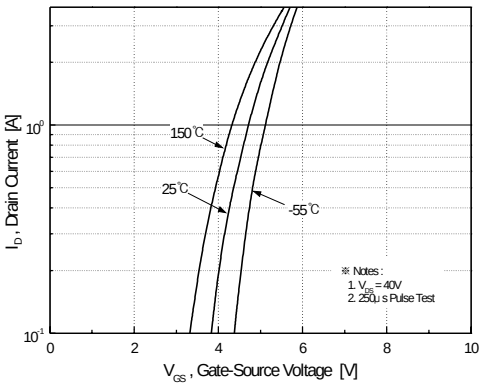


Figure 2. Transfer Characteristics

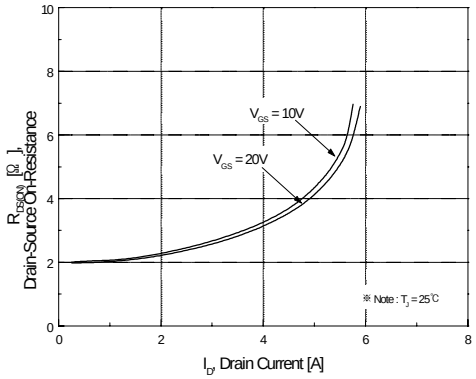


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

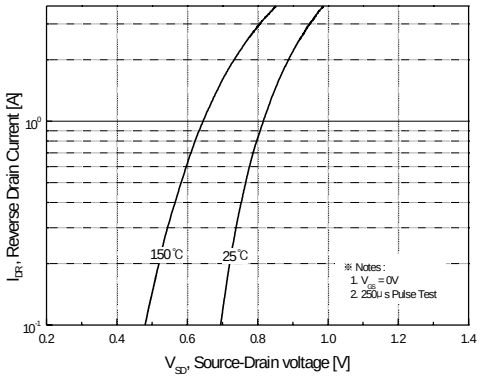


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

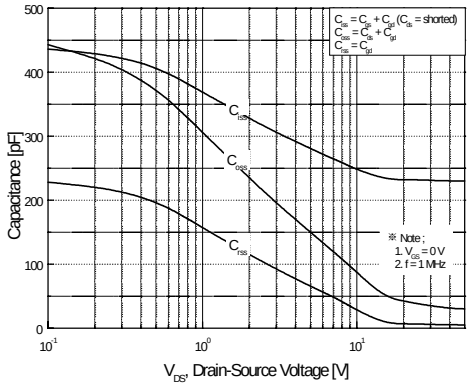


Figure 5. Capacitance Characteristics

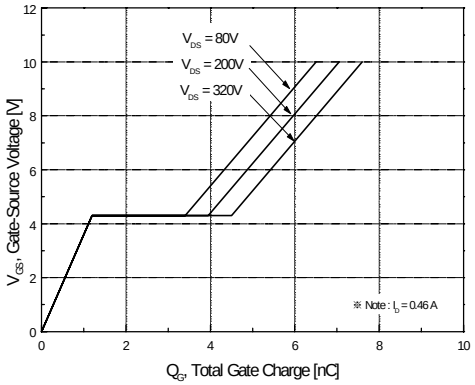


Figure 6. Gate Charge Characteristics

Typical Characteristics : N-Channel (Continued)

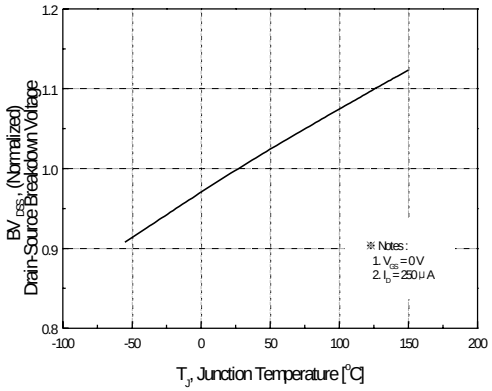


Figure 7. Breakdown Voltage Variation vs. Temperature

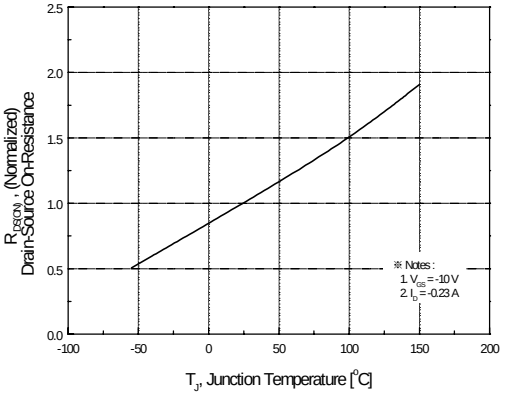


Figure 8. On-Resistance Variation vs. Temperature

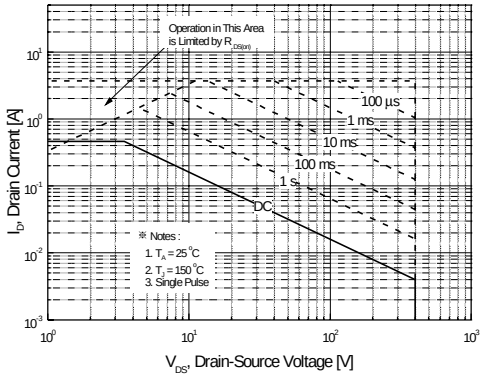


Figure 9. Maximum Safe Operating Area

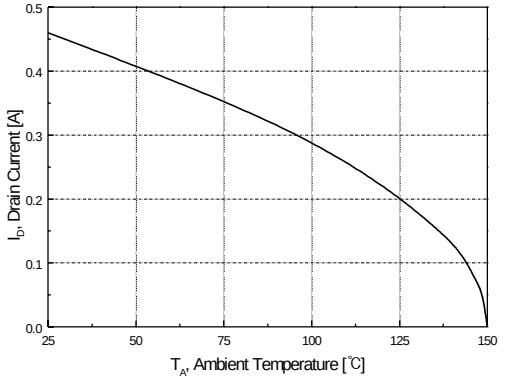


Figure 10. Maximum Drain Current vs. Ambient Temperature

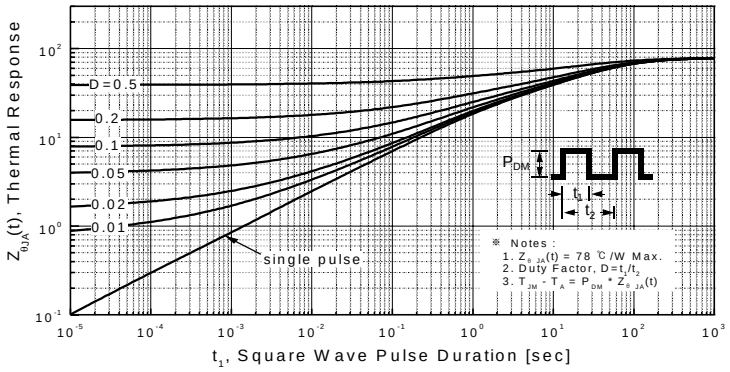


Figure 11. Transient Thermal Response Curve

Typical Characteristics : P-Channel

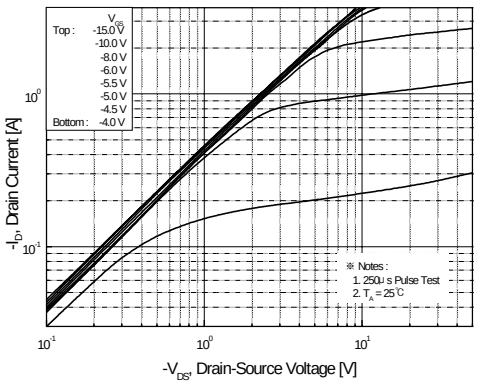


Figure 1. On-Region Characteristics

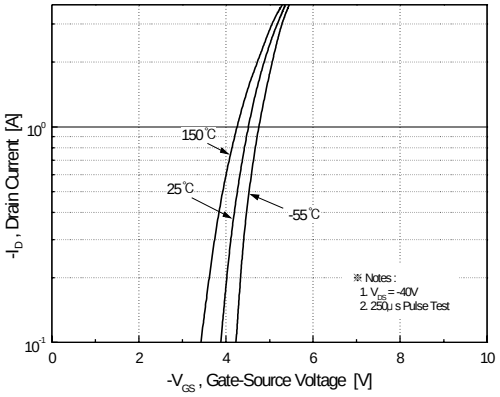


Figure 2. Transfer Characteristics

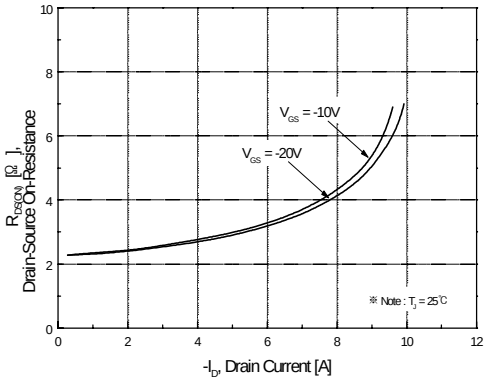


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

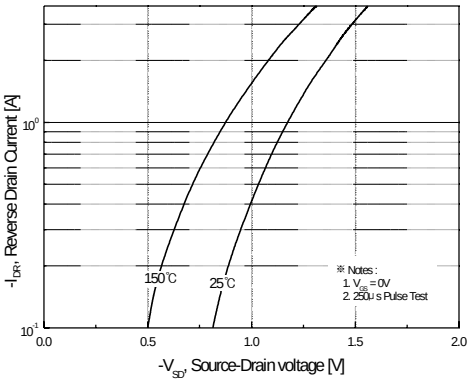


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

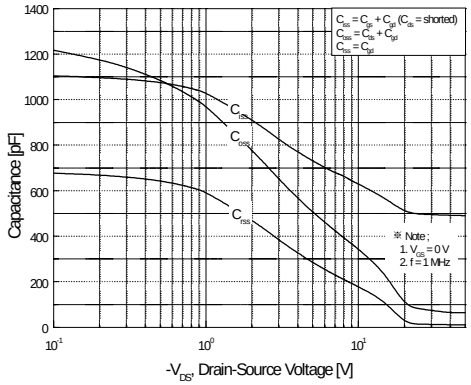


Figure 5. Capacitance Characteristics

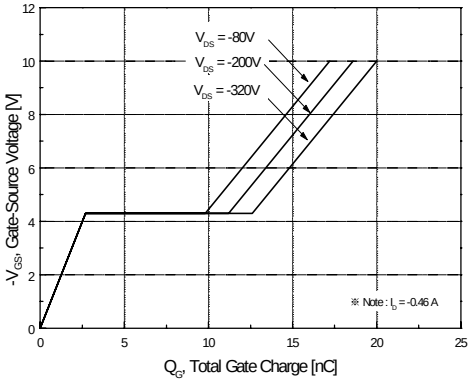


Figure 6. Gate Charge Characteristics

Typical Characteristics : P-Channel (Continued)

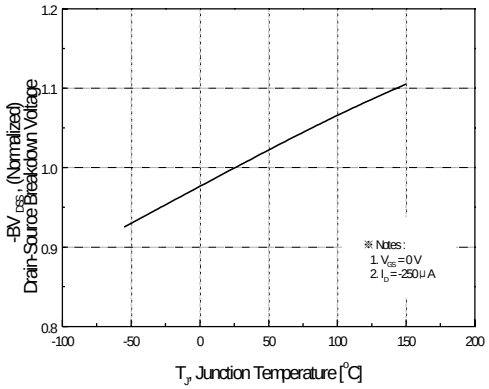


Figure 7. Breakdown Voltage Variation vs. Temperature

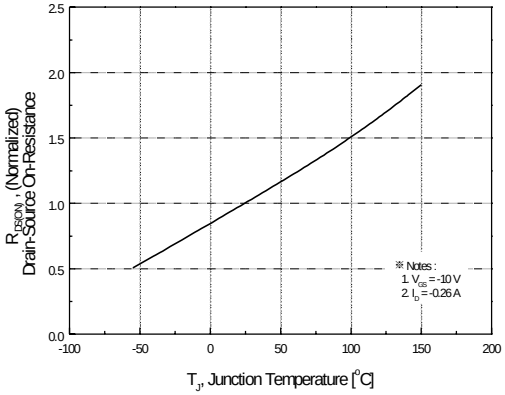


Figure 8. On-Resistance Variation vs. Temperature

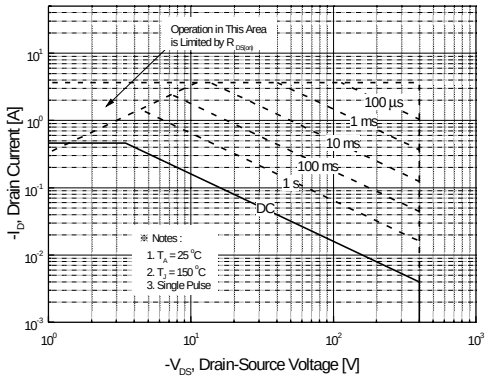


Figure 9. Maximum Safe Operating Area

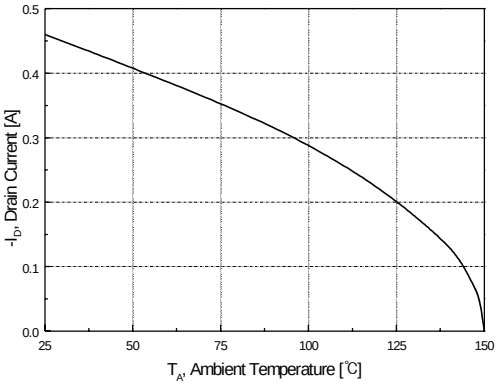


Figure 10. Maximum Drain Current vs. Ambient Temperature

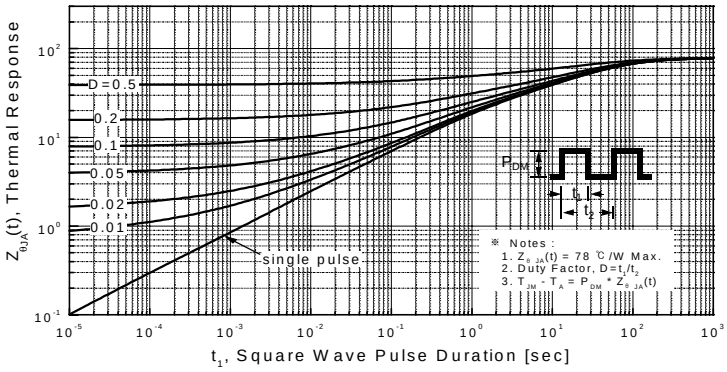
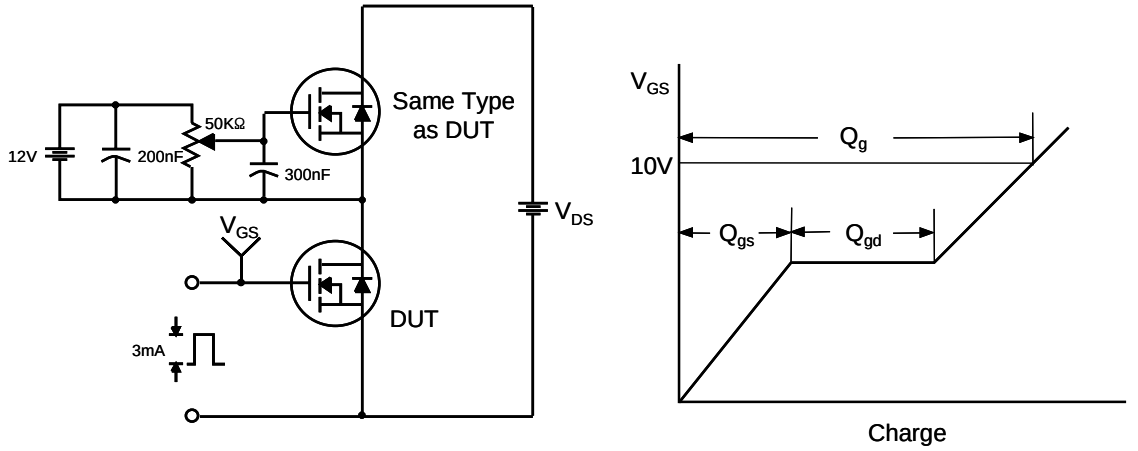
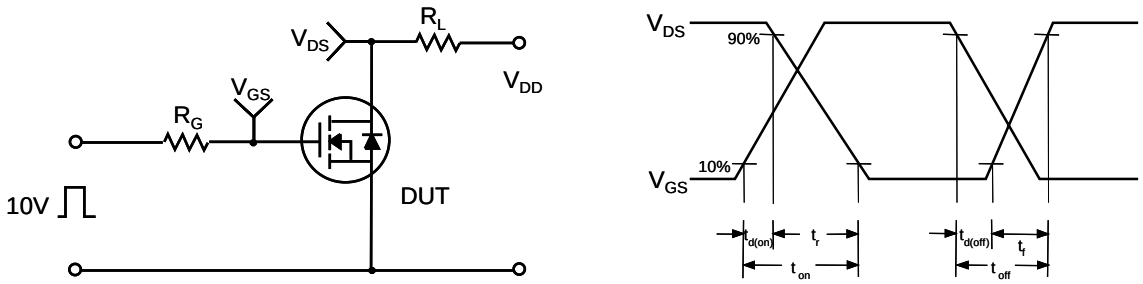


Figure 11. Transient Thermal Response Curve

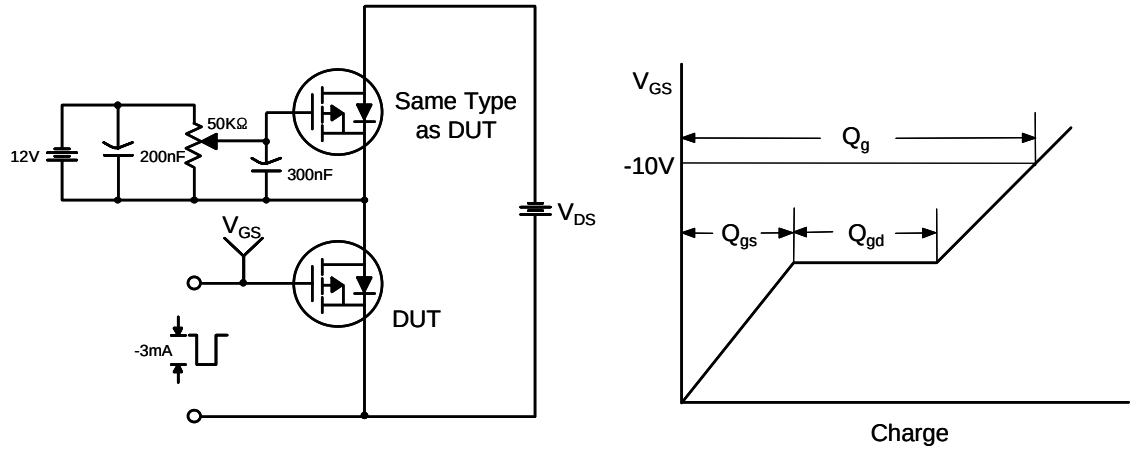
Gate Charge Test Circuit & Waveform (N-Channel)



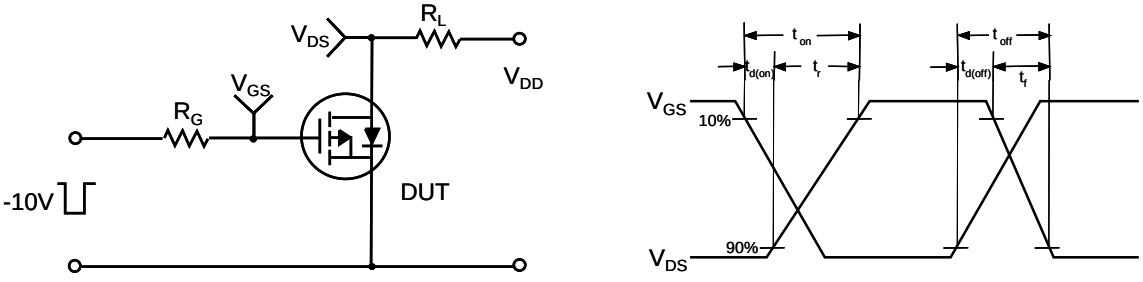
Resistive Switching Test Circuit & Waveforms (N-Channel)



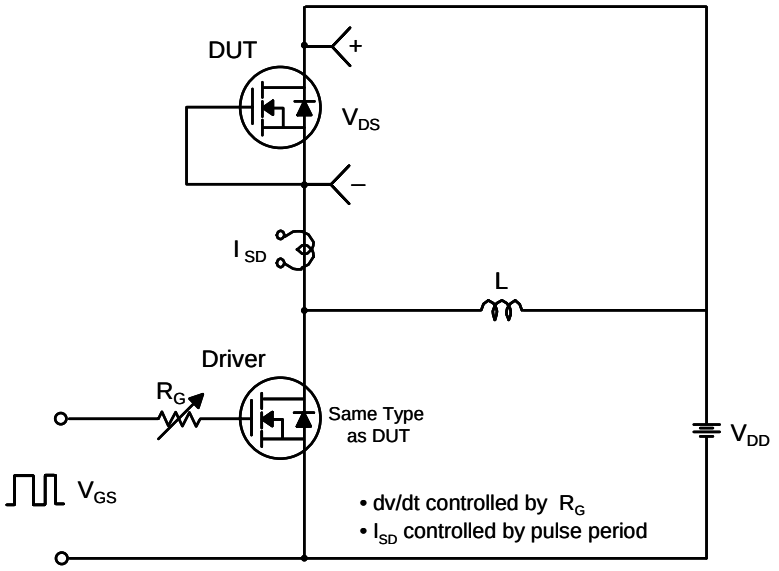
Gate Charge Test Circuit & Waveform (P-Channel)

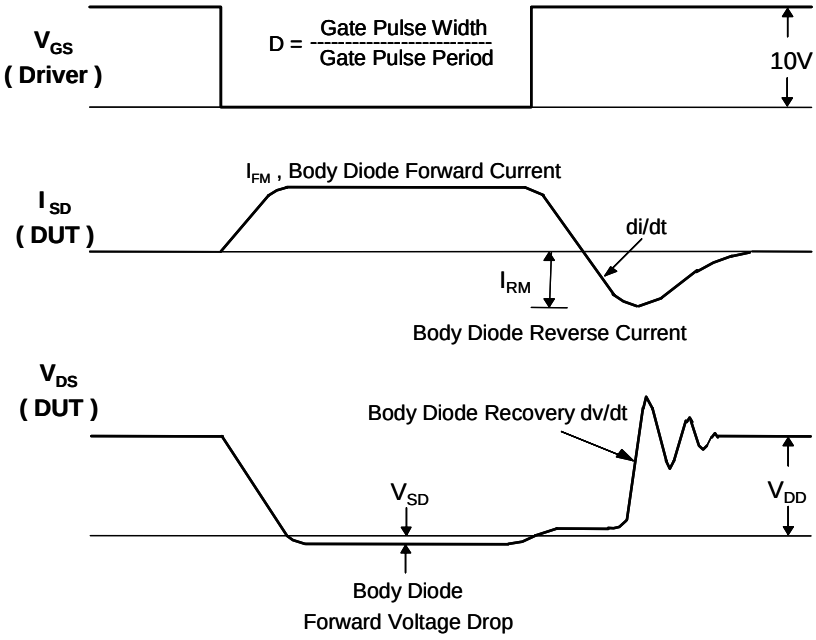


Resistive Switching Test Circuit & Waveforms (P-Channel)

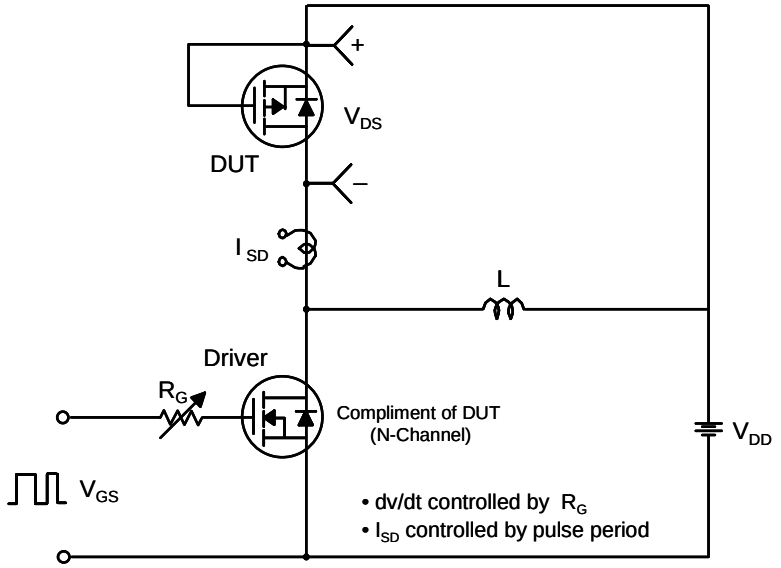


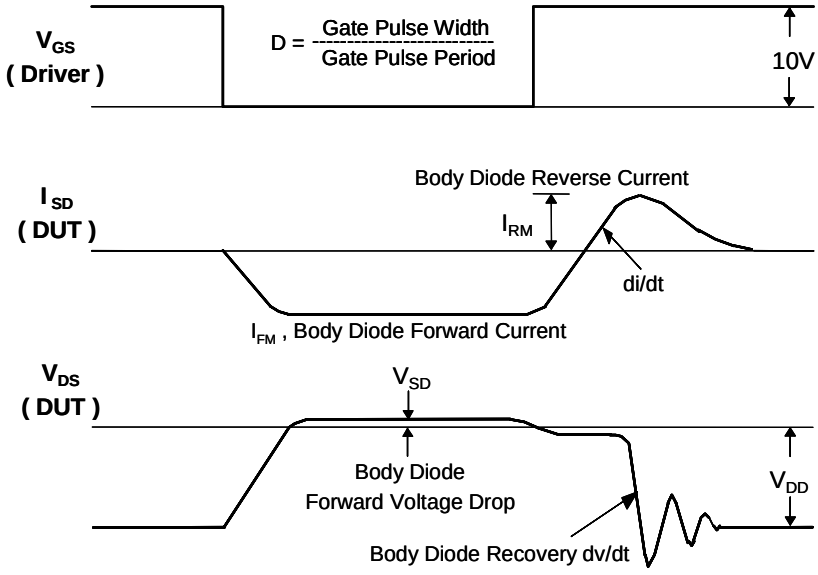
Peak Diode Recovery dv/dt Test Circuit & Waveforms (N-Channel)





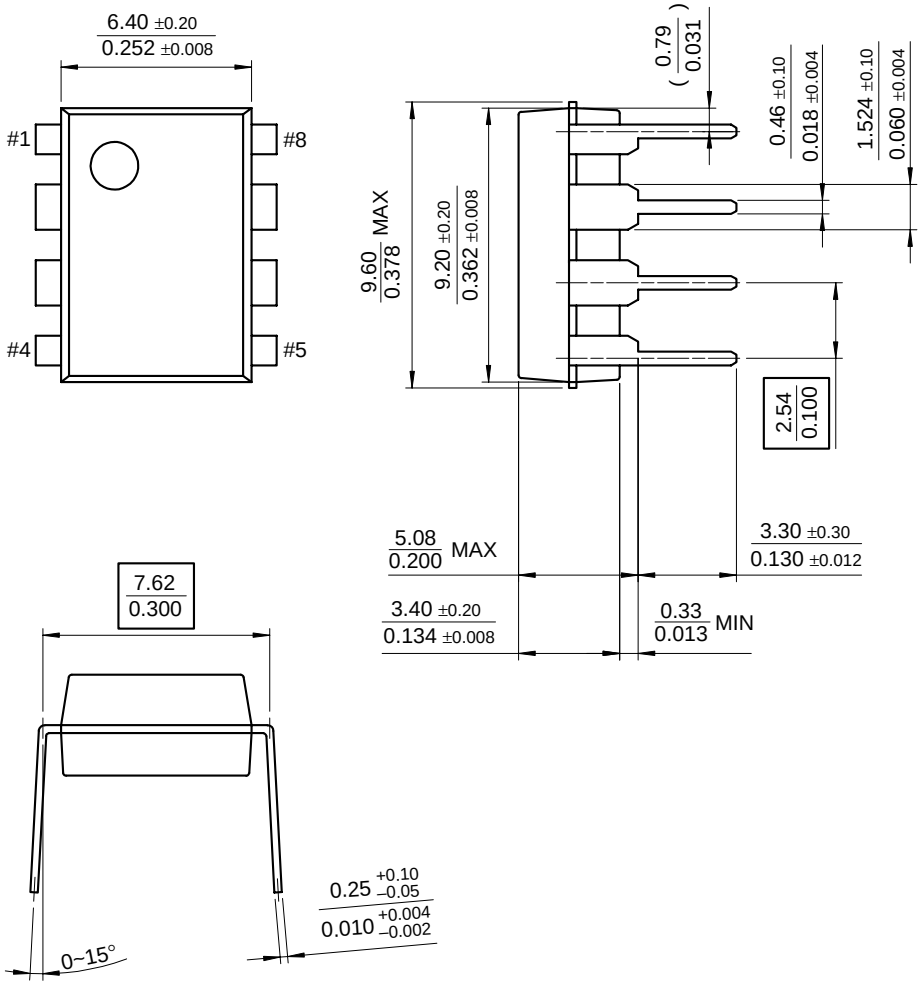
Peak Diode Recovery dv/dt Test Circuit & Waveforms (P-Channel)





Package Dimensions

8-DIP



Dimensions in Millimeters

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DOME™	HiSeC™	Power247™	SuperSOT™-3	
EcoSPARK™	I^2C™	PowerTrench®	SuperSOT™-6	
E^2CMOS™	ISOPLANAR™	QFET™	SuperSOT™-8	
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FACT Quiet Series™	MicroPak™	Quiet Series™	TruTranslation™	

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2. A critical component is 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, and supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice in order 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 in order to improve design.
Obsolete	Not In Production	This datasheet contains specifications on a product that has been discontinued by Fairchild semiconductor. The datasheet is printed for reference information only.