FAIRCHILD

SEMICONDUCTOR ™

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FDS6685

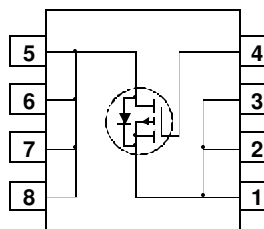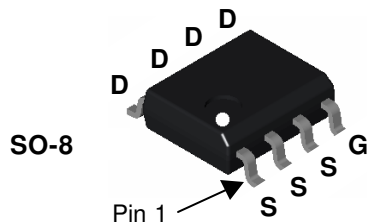## 30V P-Channel PowerTrench® MOSFET

General Description

This P-Channel MOSFET is a rugged gate version of Fairchild Semiconductor's advanced PowerTrench process. It has been optimized for power management applications requiring a wide range of gate drive voltage ratings (4.5V – 25V).

Applications

- Power management
- Load switch
- Battery protection

Features

- −8.8 A, −30 V $R_{DS(ON)}$ = 20 mΩ @ V_{GS} = −10 V
                      $R_{DS(ON)}$ = 35 mΩ @ V_{GS} = −4.5 V

- Low gate charge (17nC typical)

- Fast switching speed

- High performance trench technology for extremely low $R_{DS(ON)}$

- High power and current handling capability

SO-8

Pin 1

Absolute Maximum Ratings T_A=25°C unless otherwise noted

Symbol	Parameter		Ratings	Units
V_{DSS}	Drain-Source Voltage		−30	V
V_{GSS}	Gate-Source Voltage		±25	V
I_D	Drain Current – Continuous	(Note 1a)	−8.8	A
	– Pulsed		−50	
P_D	Power Dissipation for Single Operation	(Note 1a)	2.5	W
		(Note 1b)	1.2	
		(Note 1c)	1	
T_J, T_{STG}	Operating and Storage Junction Temperature Range		−55 to +175	°C

Thermal Characteristics

$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	(Note 1a)	50	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	(Note 1c)	125	°C/W
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	(Note 1)	25	°C/W

Package Marking and Ordering Information

Device Marking	Device	Reel Size	Tape width	Quantity
FDS6685	FDS6685	13"	12mm	2500 units

FDS6685 Rev D(W)

Electrical Characteristics

T_A = 25°C unless otherwise noted

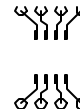| Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Off Characteristics						
BV_{DSS}	Drain–Source Breakdown Voltage	V_{GS} = 0 V, I_D = –250 µA	–30			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	I_D = –250 µA, Referenced to 25°C		–21		mV/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = –24 V, V_{GS} = 0 V			–1	µA
I_{GSSF}	Gate–Body Leakage, Forward	V_{GS} = 25 V, V_{DS} = 0 V			100	nA
I_{GSSR}	Gate–Body Leakage, Reverse	V_{GS} = –25 V, V_{DS} = 0 V			–100	nA
On Characteristics **(Note 2)**						
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = –250 µA	–1	–1.7	–3	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	I_D = –250 µA, Referenced to 25°C		5		mV/°C
$R_{DS(on)}$	Static Drain–Source On–Resistance	V_{GS} = –10 V, I_D = –8.8 A V_{GS} = –4.5 V, I_D = –6.7 A V_{GS} = –10 V, I_D = –8.8A, T_J=125°C		15 22 19	20 35 32	mΩ
$I_{D(on)}$	On–State Drain Current	V_{GS} = –10 V, V_{DS} = –5 V	–25			A
g_{FS}	Forward Transconductance	V_{DS} = –5 V, I_D = –8.8 A		24		S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = –15 V, V_{GS} = 0 V,		1604		pF
C_{oss}	Output Capacitance	f = 1.0 MHz		408		pF
C_{rss}	Reverse Transfer Capacitance			202		pF
Switching Characteristics **(Note 2)**						
$t_{d(on)}$	Turn–On Delay Time	V_{DD} = –15 V, I_D = –1 A,		13	23	ns
t_r	Turn–On Rise Time	V_{GS} = –10 V, R_{GEN} = 6 Ω		13.5	24	ns
$t_{d(off)}$	Turn–Off Delay Time			42	68	ns
t_f	Turn–Off Fall Time			25	40	ns
Q_g	Total Gate Charge	V_{DS} = –15 V, I_D = –8.8 A,		17	24	nC
Q_{gs}	Gate–Source Charge	V_{GS} = –5 V		5		nC
Q_{gd}	Gate–Drain Charge			6		nC
Drain–Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain–Source Diode Forward Current				–2.1	A
V_{SD}	Drain–Source Diode Forward Voltage	V_{GS} = 0 V, I_S = –2.1 A (Note 2)		–0.73	–1.2	V

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) 50°C/W when mounted on a 1in² pad of 2 oz copper

b) 105°C/W when mounted on a .04 in² pad of 2 oz copper

c) 125°C/W when mounted on a minimum pad.

Scale 1 : 1 on letter size paper

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

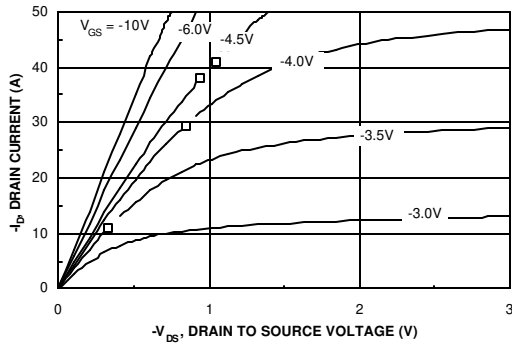## Typical Characteristics

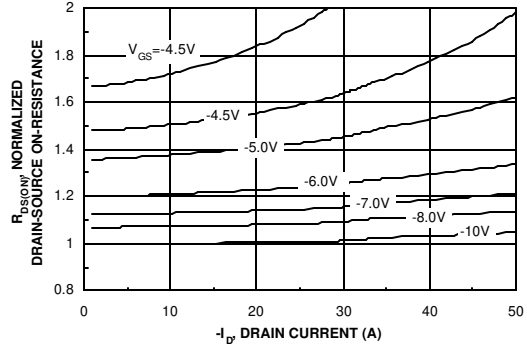Figure 1. On-Region Characteristics.

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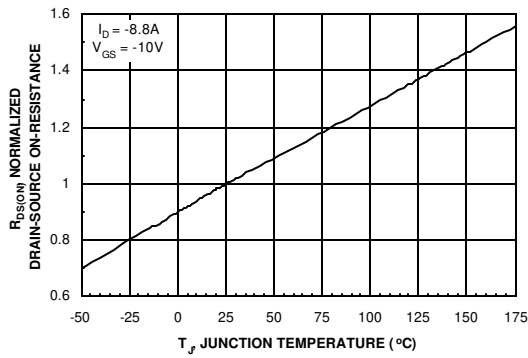

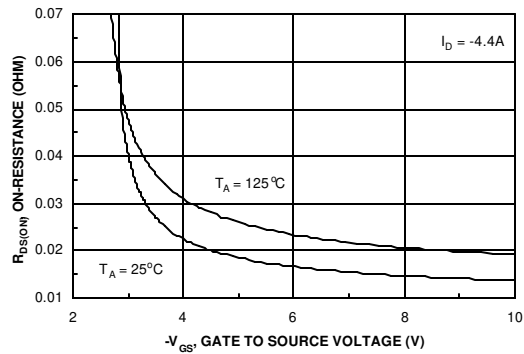Figure 3. On-Resistance Variation with Temperature.

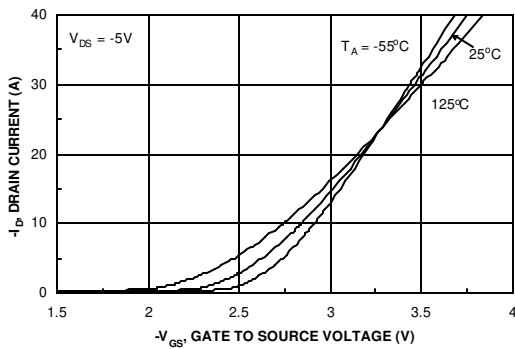Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

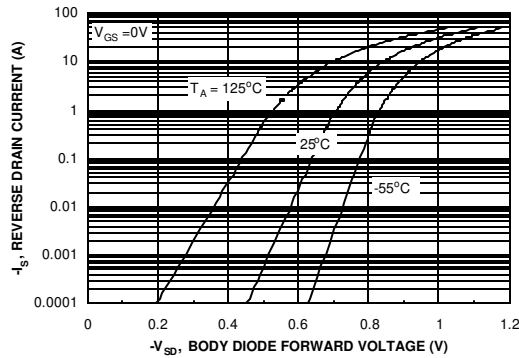Figure 5. Transfer Characteristics.

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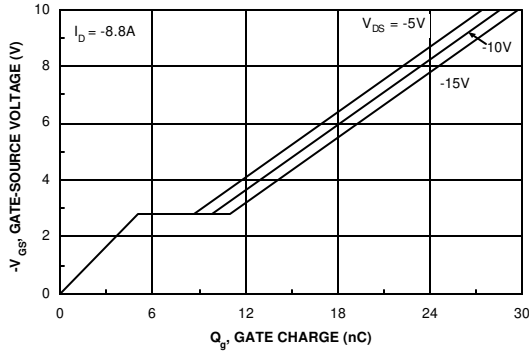
Typical Characteristics
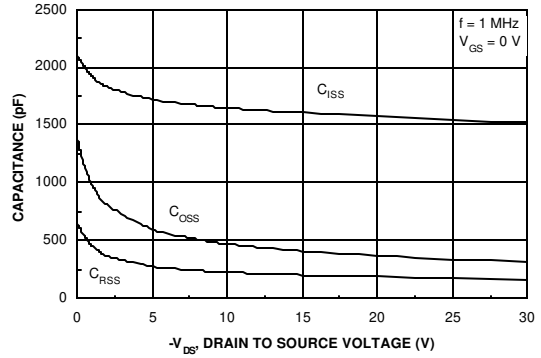

Figure 7. Gate Charge Characteristics.
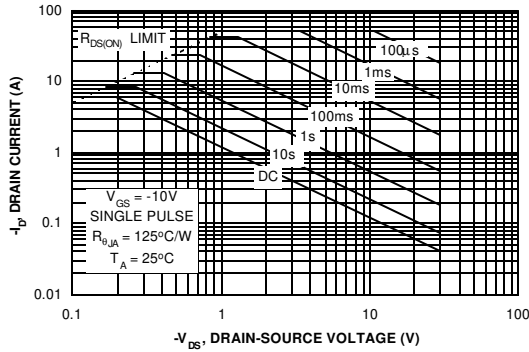

Figure 8. Capacitance Characteristics.

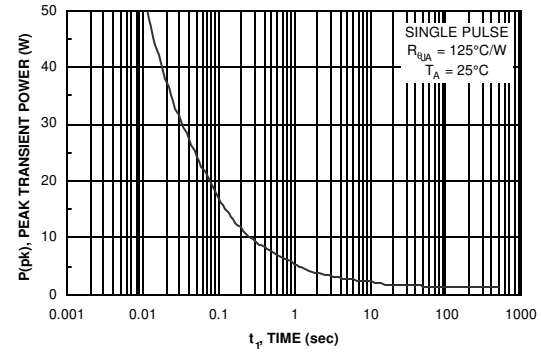**Figure 9. Maximum Safe Operating Area.**

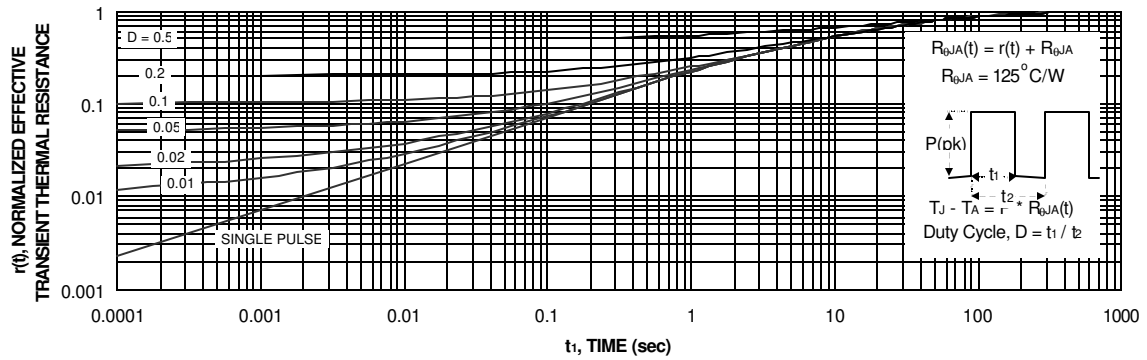**Figure 10. Single Pulse Maximum Power Dissipation.**

Figure 11. Transient Thermal Response Curve.

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